# Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the document.

In the present document, modal verbs have the following meanings:

**shall** indicates a mandatory requirement to do something

**shall not** indicates an interdiction (prohibition) to do something

The constructions "shall" and "shall not" are confined to the context of normative provisions, and do not appear in Technical Reports.

The constructions "must" and "must not" are not used as substitutes for "shall" and "shall not". Their use is avoided insofar as possible, and they are not used in a normative context except in a direct citation from an external, referenced, non-3GPP document, or so as to maintain continuity of style when extending or modifying the provisions of such a referenced document.

**should** indicates a recommendation to do something

**should not** indicates a recommendation not to do something

**may** indicates permission to do something

**need not** indicates permission not to do something

The construction "may not" is ambiguous and is not used in normative elements. The unambiguous constructions "might not" or "shall not" are used instead, depending upon the meaning intended.

**can** indicates that something is possible

**cannot** indicates that something is impossible

The constructions "can" and "cannot" are not substitutes for "may" and "need not".

**will** indicates that something is certain or expected to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

**will not** indicates that something is certain or expected not to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

**might** indicates a likelihood that something will happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

**might not** indicates a likelihood that something will not happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

In addition:

**is** (or any other verb in the indicative mood) indicates a statement of fact

**is not** (or any other negative verb in the indicative mood) indicates a statement of fact

The constructions "is" and "is not" do not indicate requirements.

# 1 Scope

The present document specifies requirements for support of Radio Resource Management for the FDD and TDD modes of New Radio (NR). These requirements include requirements on measurements in NR and the UE as well as requirements on node dynamical behaviour and interaction, in terms of delay and response characteristics.

# 2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non‑specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TS 38.304: "NR; User Equipment (UE) procedures in idle mode".

[2] 3GPP TS 38.331: "NR; Radio Resource Control (RRC); Protocol specification".

[3] 3GPP TS 38.213: "NR; Physical layer procedures for control".

[4] 3GPP TS 38.215: "NR; Physical layer measurements".

[5] 3GPP TS 38.533: "NR; User Equipment (UE) conformance specification; Radio Resource Management (RRM)".

[6] 3GPP TS 38.211: "NR; Physical channels and modulation”.

[7] 3GPP TS 38.321: "NR; Medium Access Control (MAC) protocol specification".

[8] 3GPP TS 38.212 "NR; Multiplexing and channel coding".

[9] 3GPP TS 38.202: "NR; Physical layer services provided by the physical layer".

[10] 3GPP TS 38.300: "NR; Overall description; Stage-2".

[11] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[12] 3GPP TS 38.423: "NG-RAN; Xn Application Protocol (XnAP)".

[13] 3GPP TS 38.104: "NR; Base Station (BS) radio transmission and reception".

[14] 3GPP TS 38.306: "NR; User Equipment (UE) radio access capabilities".

[15] 3GPP TS 36.133: "Evolved Universal Terrestrial Radio Access (E-UTRA); Requirements for support of radio resource management".

[16] 3GPP TS 36.331: "Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC) protocol specification".

[17] 3GPP TS 37.340: "Evolved Universal Terrestrial Radio Access (E-UTRA) and NR; Multi-connectivity", Stage 2.

[18] 3GPP TS 38.101-1: "NR; User Equipment (UE) radio transmission and reception; Part 1: Range 1 Standalone".

[19] 3GPP TS 38.101-2: "NR; User Equipment (UE) radio transmission and reception; Part 2: Range 2 Standalone".

[20] 3GPP TS 38.101-3: "NR; User Equipment (UE) radio transmission and reception; Part 3: Range 1 and Range 2 Interworking operation with other radios".

[21] 3GPP TS 38.101-4: "NR; User Equipment (UE) radio transmission and reception; Part 4: Performance requirements".

[22] 3GPP TS 38.305: "NG Radio Access Network (NG-RAN); Stage 2 functional specification of User Equipment (UE) positioning in NG-RAN".

[23] 3GPP TS 36.211: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Channels and Modulation".

[24] 3GPP TS 36.300: "Evolved Universal Terrestrial Radio Access (E-UTRA); Overall description".

[25] 3GPP TS 36.101: "Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception".

[26] 3GPP TS 38.214: "NR; Physical layer procedures for data".

[27] 3GPP TS 36.355: "Evolved Universal Terrestrial Radio Access (E-UTRA); LTE Positioning Protocol (LPP)".

[28] Void.

[29] 3GPP TS 25.133: "Requirements for Support of Radio Resource Management (FDD)".

[30] 3GPP TS 25.302: "Services provided by the Physical Layer".

[31] 3GPP TS 37.320: "Universal Terrestrial Radio Access (UTRA), Evolved Universal Terrestrial Radio Access (E-UTRA) and Next Generation Radio Access; Radio measurement collection for Minimization of Drive Tests (MDT); Overall description; Stage 2".

[32] 3GPP TS 25.214: "Physical layer procedures (FDD)".

[33] 3GPP TS 37.213: "Physical layer procedures for shared spectrum channel access"

[34] 3GPP TS 37.355: "LTE Positioning Protocol (LPP) ".

[35] 3GPP TS 38.455 : "NG-RAN; NR Positioning Protocol A (NRPPa) ".

[36] 3GPP TS 37.106: “User Equipment (UE) requirements for shared spectrum channel access”.

# 3 Definitions, symbols and abbreviations

## 3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [11] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [11].

**1 Rx RedCap**: RedCap UE for which requirements are derived assuming 1 Rx branch.

**2 Rx RedCap**: RedCap UE for which requirements are derived assuming 2 Rx branches.

**Active DL BWP**: Active DL bandwidth part as defined in TS 38.213 [3].

**Blackbox Approach:** Testing methodology, in which the UE internal implementation of certain specific UE functionality involved in the test, is unknown.

**CD-SSB:** Cell defining SSB as defined in TS 38.300 [10].

**Control Resource Set:** As defined in TS 38.213 [3].

**DL BWP**: DL bandwidth part as defined in TS 38.213 [3].

**EN-DC**: E-UTRA-NR Dual Connectivity as defined in clause 4.1.2 of TS 37.340 [17].

**en-gNB**: As defined in TS 37.340 [17].

**FR1**: Frequency range 1 as defined in clause 5.1 of TS 38.104 [13].

**FR2**: Frequency range 2 as defined in clause 5.1 of TS 38.104 [13].

**gNB**: as defined in TS 38.300 [10].

**IBM (Independent Beam Management):** As defined in TS 38.101-2 [19].

**LMF**: as defined in TS 38.305 [22].

**Master Cell Group:** As defined in TS 38.331 [2].

**Multi-Radio Dual Connectivity:** Dual Connectivity between E-UTRA and NR nodes, or between two NR nodes, as defined in TS 37.340 [17].

**NCD-SSB:** Non cell defining SSB as defined in TS 38.300 [10].

**ng-eNB**: As defined in TS 38.300 [10].

**NE-DC**: NR-E-UTRA Dual Connectivity as defined in clause 4.1.3.2 of TS 37.340 [17].

**NGEN-DC**: NG-RAN E-UTRA-NR Dual Connectivity as defined in clause 4.1.3.1 of TS 37.340 [17].

**NR-DC**: NR-NR Dual Connectivity as defined in clause 4.1.3.3 of TS 37.340 [17].

**Primary Cell**: As defined in TS 38.331 [2].

**PRS resource instance:** An instance in time of a configured PRS resource as defined in TS 38.331 [2], which may or not overlap with a measurement gap occasion.

**Quasi Co-Location:** As defined in TS 38.214 [26].

**RedCap UE:** A UE with reduced capabilities as defined in clause 4.2 in TS 38.306 [14].

**RLM-RS resource:** A resource out of the set of resources configured for RLM by higher layer parameter RLM-RS-List [2] as defined in TS 38.213 [3].

**SA operation mode**: Operation mode when the UE is configured with at least PCell and not any MR-DC.

**Secondary Cell**: As defined in TS 38.331 [2].

**Secondary Cell Group:** As defined in TS 38.331 [2].

**Serving Cell**: As defined in TS 38.331 [2].

**SMTC**: An SSB-based measurement timing configuration configured by *SSB-MeasurementTimingConfiguration* as specified in TS 38.331 [2].

**Special Cell:** As defined in TS 38.331 [2].

**SSB:** SS/PBCH block as defined in clause 7.8.3 of TS 38.211 [6].

**Timing Advance Group**: As defined in TS 38.331 [2].

## 3.2 Symbols

For the purposes of the present document, the following symbols apply:

BWChannel Channel bandwidth, defined in TS 38.101-1, 38.101-2 and 38.101-3 subclause 3.2

Ês Received energy per RE (power normalized to the subcarrier spacing) during the useful part of the symbol, i.e. excluding the cyclic prefix, at the UE antenna connector or radiated interface boundary

FC *RF reference frequency* on the channel raster, given in table 5.4.2.2-1 in TS 38.101-1 and 38.101-2

FC,low The Fc of the lowest carrier, expressed in MHz

Io The total received power density, including signal and interference, as measured at the UE antenna connector or radiated interface boundary.

Ioc The power spectral density (integrated in a noise bandwidth equal to the chip rate and normalized to the chip rate) of a band limited noise source (simulating interference from cells, which are not defined in a test procedure) as measured at the UE antenna connector or radiated interface boundary.

Iot The received power spectral density of the total noise and interference for a certain RE (power integrated over the RE and normalized to the subcarrier spacing) as measured at the UE antenna connector or radiated interface boundary

 The power spectral density of a white noise source (average power per RE normalised to the subcarrier spacing), simulating interference from cells that are not defined in a test procedure, as measured at the UE antenna connector or radiated interface boundary

 Physical Resource Block number as defined in clause 3.2 in TS 38.211.

 Timing offset between uplink and downlink radio frames at the UE, as defined in clause 4.2 in TS 38.213.

 Fixed timing advance offset, as defined in clause 7.1.2 in TS 38.133.

   Configured UE transmitted power as defined in clause 6.2.4 in TS 38.101-1, 38-101-2 and 38.101-3.

PCMAX,c Configured UE transmitted power on a serving cell *c* as defined in clause 6.2.4 in TS 38.101-1, 38-101-2 and 38.101-3

S Cell Selection Criterion defined in TS 38.304, subclause 5.2.3.2 for NR

SSB\_RP Received (linear) average power of the resource elements that carry NR synchronisation burst, measured at the UE antenna connector or radiated interface boundary

Srxlev Cell selection RX level, defined in TS 38.304, subclause 5.2.3.2

Squal Cell selection quality, defined in TS 38.304, subclause 5.2.3.2

Sintrasearch Defined in TS 38.304 , subclause 5.2.4.7 for E-UTRAN amd 38.304 subclause 5.2.4.7 for NR

Snonintrasearch Defined in TS 38.304 , subclause 5.2.4.7

Threshx, high Defined in TS 38.304 , subclause 5.2.4.7

Threshx, low Defined in TS 38.304 , subclause 5.2.4.7

Threshserving, low Defined in TS 38.304 , subclause 5.2.4.7

TRE-ESTABLISH-REQ The RRC Re-establishment delay requirement, the time between the moment when erroneous CRCs are applied, to when the UE starts to send preambles on the PRACH.

Tc Basic time unit, defined in clause 4.1 of TS 38.211 [6].

Ts Reference time unit, defined in clause 4.1 of TS 38.211 [6].

Treselection Defined in TS 25.304, subclause 5.2.6.1.5

TreselectionRAT Defined in TS 36.304 , subclause 5.2.4.7

TreselectionEUTRA Defined in TS 36.304 , subclause 5.2.4.7

TreselectionUTRA Defined in TS 36.304 , subclause 5.2.4.7

TreselectionGERANDefined in TS 36.304 , subclause 5.2.4.

Threshx, high Defined in TS 38.304 , subclause 5.2.4.7

Threshx, low Defined in TS 38.304 , subclause 5.2.4.7

Threshserving, low Defined in TS 38.304 , subclause 5.2.4.7

TUE\_re-establish\_delay Time between the moments when any of the conditions requiring RRC re-establishment as defined in clause 5.3.7 in TS 38.331 [2] is detected by the UE and when the UE sends PRACH to the target PCell.

## 3.3 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [11] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [11].

AoA Angle of Arrival

AoD Angle of Departure

BFD Beam Failure Detection

BFD-RS BFD Reference Signal

BLER Block Error Rate

BM-RS Beam Management Reference Signal

BWP Bandwidth Part

CA Carrier Aggregation

CBD Candidate Beam Detection

CBW Channel Bandwidth

CC Component Carrier

CCA Clear Channel Assessment

CG-SDT Configured Grant Small Data Transmisison

CLI Cross Link Interference

CMR Channel Measurement Resource

CORESET Control Resource Set

CP Cyclic Prefix

CSI Channel-State Information

CSI-RS CSI Reference Signal

CSI-RSRP CSI Reference Signal based Reference Signal Received Power

CSI-RSRQ CSI Reference Signal based Reference Signal Received Quality

CSI-SINR CSI Reference Signal based Signal to Noise and Interference Ratio

CSI\_RP Received (linear) average power of the resource elements that carry NR CSI-RS signals and channels, measured at the UE antenna connector

DBT Discovery Burst Transmission

DC Dual Connectivity

DCI Downlink Control Information

DL Downlink

DL-AoD Downlink Angle-of-Departure

DL-TDOA Downlink Time Difference Of Arrival

DMRS Demodulation Reference Signal

DRX Discontinuous Reception

E-CID Enhanced Cell ID

E-UTRA Evolved UTRA

E-UTRAN Evolved UTRAN

EN-DC E-UTRA-NR Dual Connectivity

FDD Frequency Division Duplex

FR Frequency Range

GEO Geostationary Earth Orbit

HARQ Hybrid Automatic Repeat Request

HO Handover

GAP Refers to any of Measurement Gap, activated Pre-MG and NCSG

IMR Interference Measurement Resource

L1-RSRP Layer 1 RSRP

L1 SL-RSRP Layer 1 Sidelink RSRP which corresponds to PSCCH-RSRP and/or PSSCH-RSRP

LEO Low Earth Orbit

LMF Location Management Function

LPP LTE Positioning Protocol

MAC Medium Access Control

MCG Master Cell Group

MDT Minimization of Drive Tests

MG Measurement Gap

MGL Measurement Gap Length

MGRP Measurement Gap Repetition Period

MIB Master Information Block

ML Measurement Length

MN Master Node

MR-DC Multi-Radio Dual Connectivity

MUSIM Multi-Universal Subscriber Identity Module

NCSG Network Controlled Small Gap

NE-DC NR-E-UTRA Dual Connectivity

NGEN-DC NG-RAN E-UTRA-NR Dual Connectivity

NR New Radio

NR-DC NR-NR Dual Connectivity

NTN Non-Terrestrial Network

OFDM Orthogonal Frequency Division Multiplexing

OFDMA Orthogonal Frequency Division Multiple Access

OTDOA Observed Time Difference Of Arrival

PBCH Physical Broadcast Channel

PCC Primary Component Carrier

PCell Primary Cell

PDCCH Physical Downlink Control Channel

PDSCH Physical Downlink Shared Channel

PLMN Public Land Mobile Network

PRACH Physical RACH

Pre-MG Pre-configured Measurement Gap

PRP PRS Received Power

PRS Positioning Reference Signal

PRS-RSRP Positioning Reference Signal based Reference Signal Received Power

PPW PRS Processing Window

PSBCH Physical Sidelink Broadcast Channel

PSBCH-RSRP Physical Sidelink Broadcast Channel DMRS based Reference Signal Received Power

PSCCH Physical Sidelink Control Channel

PSCCH-RSRP Physical Sidelink Control Channel DMRS based Reference Signal Received Power

PSCell Primary SCell

PSS Primary Synchronization Signal

PSSCH Physical Sidelink Shared Channel

PSSCH-RSRP Physical Sidelink Shared Channel DMRS based Reference Signal Received Power

pTAG Primary Timing Advance Group

PUCCH Physical Uplink Control Channel

PUSCH Physical Uplink Shared Channel

QCL Quasi Co-Location

RACH Random Access Channel

RAT Radio Access Technology

RLM Radio Link Monitoring

RLM-RS Reference Signal for RLM

RMSI Remaining Minimum System Information

RRC Radio Resource Control

RRH Remote Radio Head

RRM Radio Resource Management

RSSI Received Signal Strength Indicator

RSRP Reference Signal Received Power

RSRQ Reference Signal Received Quality

RSTD Reference Signal Time Difference

RTT Round Trip Time

S-SSB Sidelink Synchronization Signal Block

SSB\_RP Received (linear) average power of the resource elements that carry NR SSB signals and channels, measured at the UE antenna connector or radiated interface boundary.

SA Standalone operation mode

SAB Satellite access band

SAN Satellite Access Node

SCC Secondary Component Carrier

SCell Secondary Cell

SCG Secondary Cell Group

SCS Subcarrier Spacing

SCSSSB SSB subcarrier spacing

SDL Supplementary Downlink

SDT Small Data Transmission

SFN System Frame Number

SFTD SFN and Frame Timing DifferenceSI System Information

SIB System Information Block

SL-RSSI Sidelink Received Signal Strength Indicator

SLSS Sidelink Synchronization Signal

SMTC SSB-based Measurement Timing configuration

SpCell Special Cell

SRS Sounding Reference Signal

SRS-RSRP Sounding Reference Signal based Reference Signal Received Power

SS-RSRP Synchronization Signal based Reference Signal Received Power

SS-RSRQ Synchronization Signal based Reference Signal Received Quality

SS-SINR Synchronization Signal based Signal to Noise and Interference Ratio

SSB Synchronization Signal Block

SSB\_RP Received (linear) average power of the resource elements that carry NR SSB signals and channels, measured at the UE antenna connector.

SSS Secondary Synchronization Signal

sTAG Secondary Timing Advance Group

SUL Supplementary Uplink

TA Timing Advance

TAG Timing Advance Group

TCI Transmission Configuration Indicator

TDD Time Division Duplex

TDOA Time Difference Of Arrival

TN Terrestrial Network

TRP Transmission-Reception Point

TTI Transmission Time Interval

UE User Equipment

UL Uplink

VIL Visible Interruption Length

VIRP Visible Interruption Repetition Period

VSAT Very Small Aperture Terminal

## 3.4 Test tolerances

The requirements given in the present document make no allowance for measurement uncertainty. The test specification 38.533 [5] defines the test tolerances.

## 3.5 Frequency bands grouping

### 3.5.1 Introduction

The intention with the frequency band grouping below is to increase the readability of the specification.

The frequency bands grouping is derived based on UE REFSENS requirements specified in [18, 19, 20] and assuming 0.5 dB step between the neighbour groups. The groups are defined in the order of increasing REFSENS, i.e., the group A has the smallest REFSENS among the groups. For the same SCS and a given bandwidth, the bands within the same group have the same Io conditions in a corresponding requirement in this specification, provided the bands support this SCS. For different SCSs supported by a frequency band and the same bandwidth, different Io conditions may apply for the frequency band in the requirements, while the band group is the same, based on the lowest REFSENS requirement normalized by the number of subcarriers among its supported SCSs for this bandwidth. For the same SCS but different supported bandwidths, the group for a band is determined based on the lowest REFSENS requirement normalized by the number of subcarriers among its supported bandwidths.

### 3.5.2 NR operating bands in FR1

NR frequency bands grouping for FR1 is specified in Table 3.5.2-1.

Table 3.5.2-1: NR frequency band groups for FR1

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Group | NR FDD | | NR TDD | | NR SDL | | NR CCA10 | |
|  | Band group notation | Operating bands | Band group notation | Operating bands | Band group notation | Operating bands | Band group notation | Operating bands |
| A | NR\_FDD\_FR1\_A | n1, n18, n24, n70, n744, n91, n92, n93, n94, n100 | NR\_TDD\_FR1\_A | n34, n389, n39, n40, n50, n51, n53, n101 | NR\_SDL\_FR1\_A | n67, n75, n76 | NR\_CCA\_FR1\_A | - |
| B | NR\_FDD\_FR1\_B | n65, n66, n743 | NR\_TDD\_FR1\_B | n387 | NR\_SDL\_FR1\_B | - | NR\_CCA\_FR1\_B | - |
| C | NR\_FDD\_FR1\_C | n30 | NR\_TDD\_FR1\_C | n48, n771, n78, n79 | NR\_SDL\_FR1\_C | - | NR\_CCA\_FR1\_C | - |
| D | NR\_FDD\_FR1\_D | n28 | NR\_TDD\_FR1\_D | n772 | NR\_SDL\_FR1\_D | - | NR\_CCA\_FR1\_D | - |
| E | NR\_FDD\_FR1\_E | n2, n5, n7 | NR\_TDD\_FR1\_E | n41, n90 | NR\_SDL\_FR1\_E | - | NR\_CCA\_FR1\_E | - |
| F | NR\_FDD\_FR1\_F | n266 | NR\_TDD\_FR1\_F | - | NR\_SDL\_FR1\_F | - | NR\_CCA\_FR1\_F | - |
| G | NR\_FDD\_FR1\_G | n3, n8, n12, n13, n14, n20, n71, n85 | NR\_TDD\_FR1\_G | n104 | NR\_SDL\_FR1\_G | n29 | NR\_CCA\_FR1\_G | - |
| H | NR\_FDD\_FR1\_H | n25 | NR\_TDD\_FR1\_H | - | NR\_SDL\_FR1\_H | - | NR\_CCA\_FR1\_H | - |
| I | NR\_FDD\_FR1\_I | - | NR\_TDD\_FR1\_I |  | NR\_SDL\_FR1\_I | - | NR\_CCA\_FR1\_I | n46 |
| J | NR\_FDD\_FR1\_J | - | NR\_TDD\_FR1\_J | n478, n96 | NR\_SDL\_FR1\_J | - | NR\_CCA\_FR1\_J | n96 |
| NOTE 1: Except 3.8 GHz to 4.2 GHz.  NOTE 2: Only 3.8 GHz to 4.2 GHz.  NOTE 3: Except 1475.9 MHz to 1510.9 MHz.  NOTE 4: Only when the band is confined in 1475.9 MHz to 1510.9 MHz.  NOTE 5: These bands are used only in NR carrier aggregation with other NR bands according to NR CA band combinations specified in TS 38.101-1 [18] and TS 38.101-3 [20].  NOTE 6: The minimum Io condition is reduced by 0.5 dB when the carrier frequency of the assigned NR channel bandwidth is within 865-894 MHz.  NOTE 7: When this band is only used for V2X SL service, the band is exclusively used for NR V2X in particular regions.  NOTE 8: This band is unlicensed band used for V2X service. There is no expected network deployment in this band.  NOTE 9: When this band is only used for WAN service.  NOTE 10: Operating bands where operation on carrier frequencies with CCA is supported. | | | | | | | | |

### 3.5.2A NR operating bands for satellite access in FR1

NR frequency bands grouping for satellite access in FR1 is specified in Table 3.5.2A-1.

Table 3.5.2A-1: NR frequency band groups for satellite access in FR1

|  |  |  |
| --- | --- | --- |
| Group | NR FDD | |
|  | Band group notation | Operating bands |
| A | NR\_FDD\_SAB\_FR1\_A | n255, n256 |
| B | NR\_FDD\_SAB\_FR1\_B |  |
| C | NR\_FDD\_SAB\_FR1\_C |  |
| D | NR\_FDD\_SAB\_FR1\_D |  |
| E | NR\_FDD\_SAB\_FR1\_E |  |
| F | NR\_FDD\_SAB\_FR1\_F |  |
| G | NR\_FDD\_SAB\_FR1\_G |  |
| H | NR\_FDD\_SAB\_FR1\_H |  |
| I | NR\_FDD\_SAB\_FR1\_I |  |
| J | NR\_FDD\_SAB\_FR1\_J |  |

### 3.5.3 NR operating bands in FR2

NR frequency bands grouping for FR2 is specified in Table 3.5.3-1.

Table 3.5.3-1: NR frequency band groups for FR2

|  |  |  |
| --- | --- | --- |
| Group | Band group notation | Operating bands |
| A | NR\_TDD\_FR2\_A | n2571, n2581, n2611 |
| B | NR\_TDD\_FR2\_B | n2574, n2584, n2614 |
| C | NR\_TDD\_FR2\_C |  |
| D | NR\_TDD\_FR2\_D |  |
| E | NR\_TDD\_FR2\_E |  |
| F | NR\_TDD\_FR2\_F | n2604 |
| G | NR\_TDD\_FR2\_G | n2601 |
| H | NR\_TDD\_FR2\_H |  |
| I | NR\_TDD\_FR2\_I |  |
| J | NR\_TDD\_FR2\_J |  |
| K | NR\_TDD\_FR2\_K | n2575,6, n2585,6, n2621, n2616 |
| L | NR\_TDD\_FR2\_L | n2572, n2582, n2612 |
| M | NR\_TDD\_FR2\_M |  |
| N | NR\_TDD\_FR2\_N | n2624 |
| O | NR\_TDD\_FR2\_O |  |
| P | NR\_TDD\_FR2\_P |  |
| Q | NR\_TDD\_FR2\_Q | n2595 |
| R | NR\_TDD\_FR2\_R |  |
| S | NR\_TDD\_FR2\_S |  |
| T | NR\_TDD\_FR2\_T | n2573, n2583, n2613 |
| U | NR\_TDD\_FR2\_U |  |
| V | NR\_TDD\_FR2\_V |  |
| W | NR\_TDD\_FR2\_W | n2622 |
| X | NR\_TDD\_FR2\_X |  |
| Y | NR\_TDD\_FR2\_Y | n2603 |
| Z | NR\_TDD\_FR2\_Z | n2577, n2587, n2617 |
| AA | NR\_TDD\_FR2\_AA | n2593 |
| AB | NR\_TDD\_FR2\_AB |  |
| AC | NR\_TDD\_FR2\_AC |  |
| AD | NR\_TDD\_FR2\_AD |  |
| AE | NR\_TDD\_FR2\_AE | n2623 |
| NOTE 1: UE power class 1.  NOTE 2: UE power class 2.  NOTE 3: UE power class 3.  NOTE 4: UE power class 4.  NOTE 5: UE power class 5.  NOTE 6: UE power class 6.  NOTE 7: UE power class 7. | | |

## 3.6 Applicability of requirements in this specification version

In this specification,

- ‘cell’, ‘PCell’, ‘PSCell’ and ‘SCell’ refer to NR cell, NR PCell, NR PSCell, and NR SCell,

- E-UTRA cells are referred to as ‘E-UTRA cell’, ‘E-UTRA PCell’, ‘E-UTRA PSCell’, and ‘E-UTRA SCell’,

- E-UTRA-NR dual connectivity where E-UTRA is the master is referred to as ‘E-UTRA-NR dual connectivity’ or ‘EN-DC’.

- NR-NR dual connectivity which involves two gNB acting as Master gNB and Secondary gNB is referred to as “NR-NR dual connectivity” or “NR-DC”. NR-DC in Rel-15 only includes the scenarios where all serving cells in MCG in FR1 and all serving cells in SCG in FR2.

- ‘active serving cell’ refers to PCell, PSCell and activated SCells

For UE configured with supplementary UL, the requirements in clause 7.1 and 7.3 shall also apply to uplink transmissions on supplementary UL.

Unless explictly stated, requirements do not apply when CCA is used on serving or neighbour cells.

### 3.6.1 RRC connected state requirements in DRX

For the requirements in RRC connected state specified in this version of the specification, the UE shall assume that no DRX is used provided the following conditions are met:

- DRX parameters are not configured or

- DRX parameters are configured and

- *drx-InactivityTimer* is running or

- *drx-RetransmissionTimerDL* is running or

- *drx-RetransmissionTimerUL* is running or

- *ra-ContentionResolutionTimer* is running or

- a Scheduling Request sent on PUCCH is pending or

- a PDCCH indicating a new transmission addressed to the C-RNTI of the MAC entity has not been received after successful reception of a Random Access Response for the preamble not selected by the MAC entity

Otherwise the UE shall assume that DRX is used.

### 3.6.2 Number of serving carriers

#### 3.6.2.1 Number of serving carriers for SA

Requirements for standalone NR with NR PCell are applicable for the UE configured with the following number of serving NR CCs:

- up to 16 NR DL CCs in total, with 1 UL (or 2 UL if SUL is configured) in PCell and up to 8 UL (or 9 UL if SUL is configured) in total for SCells.

- SUL may be configured together with one of the UL

#### 3.6.2.2 Number of serving carriers for EN-DC

Requirements for EN-DC operation of E-UTRA and NR with E-UTRA PCell and NR PSCell are applicable for the UE configured with the following number of serving NR CCs:

- up to 9 NR DL CCs in total, with 1 UL (or 2 UL if SUL is configured) in PSCell, up to 7 UL (or 8 UL if SUL is configured) in total for SCells in the FR of PSCell and up to 1 UL (or 2 UL if SUL is configured) in SCell in different FR with PSCell.

- SUL may be configured together with one of the UL

The applicable number of E-UTRA CC for EN-DC in the MCG for both UL and DL is specified in TS 36.133 [15].

#### 3.6.2.3 Number of serving carriers for NE-DC

Requirements for NE-DC operation of NR and E-UTRA with NR PCell and E-UTRA PSCell are applicable for the UE configured with the following number of serving NR CCs:

- up to 7 NR DL CCs in total, with 1 UL (or 2 UL if SUL is configured) in PCell and up to 1 UL (or 2 UL if SUL is configured) in SCell.

- SUL may be configured together with one of the UL

The applicable number of E-UTRA CC for NE-DC in the SCG for both UL and DL is specified in TS 36.133 [15].

#### 3.6.2.4 Number of serving carriers for NR-DC

Requirements for NR-DC are applicable for the UE configured with the following number of serving NR CCs:

- up to 2 NR DL CCs in total in FR1, up to 8 NR DL CCs in total in FR2, with 1 UL in PCell, 1 UL in PSCell, and up to 1 UL in each SCell.

### 3.6.3 Applicability for intra-band FR2

For the requirements in RRC connected state specified in this version of the specification, UE shall assume that the transmitted signals from the serving cells should have the same downlink spatial domain transmission filter on one OFDM symbol in the same band in FR2. Otherwise, the UE is not supposed to satisfy any requirements for SCell.

### 3.6.4 Applicability for FR2 UE power classes

For the requirements of each FR2 power class specified in this version of the specification, certain UE types with specific device architectures are assumed. The UE types can be found in TS 38.101-2 [19].

### 3.6.5 Applicability for SDL bands

The measurements accuracy requirements for SDL bands in this version of specification in clause 10.1 shall apply for NR intra-frequency measurements on SCC (SS-RSRP, SS-RSRQ, SS-SINR, and L1-RSRP) and inter-frequency measurements (SS-RSRP, SS-RSRQ, and SS-SINR).

### 3.6.6 Applicability of requirements for NGEN-DC operation

All the requirements in this specification applicable for EN-DC are also applicable for NGEN-DC.

### 3.6.7 Applicability of QCL

For the requirements specified in this version of the specification for TCI state switching, DL TCI state switching for unified TCI or UL TCI state switching for unified TCI, a reference signal is considered to be QCLed to another reference signal if it is in the same TCI chain as the other reference signal, provided that the number of Reference Signals in the chain is no more than 4. It is assumed there is single QCL type per TCI chain.

A DL TCI chain consists of an SSB, and one or more CSI-RS resources, and the TCI state of each Reference Signal includes another Reference Signal in the same TCI chain, where the SSB can be associated with serving cell PCID or associated with a PCID different from serving cell PCID.

DMRS of PDCCH or PDSCH is QCLed with the reference signal in its active TCI state and any other reference signal that is QCLed, based on the criteria for DL TCI chain, with the reference signal in the active TCI state.

A UL TCI chain consists of an SSB, and one or more CSI-RS resources, and the TCI state of each Reference Signal includes another Reference Signal in the same TCI chain, where the SSB can be associated with serving cell PCID or associated with a PCID different from serving cell PCID.

DMRS of PUCCH or PUSCH is QCLed with the reference signal in its active TCI state and any other reference signal that is QCLed, based on the criteria for UL TCI chain, with the reference signal in the active TCI state.

3.6.8 Applicability of 2-step RA and 4-step RA in RRM requirements

Unless explicitly stated otherwise the requirements under the following clauses, where the UE transmits random acess (with requirements in clause 6.2.2) to NR serving cell or NR target cell, are applicable for both 2-step RA and 4-step RA procedures [3]:

- Handover requirements in clause 6.1, except for clauses 6.1.2 and 6.1B,

- RRC connection re-establishment requirements in clause 6.2.1,

- RRC connection release with redirection to NR requirements in clause 6.2.3.2.1,

- UE transmit timing requirements in clause 7.1,

- PSCell addition delay requirements in clause 8.9.2,

- PSCell change requirements in clause 8.11 and

- Conditional PSCell change requirements in clause 8.11B.

Unless explicitly stated otherwise the requirements under the following clauses, where the UE transmits random acess (with requirements in clause 6.2.2A) to NR serving cell or NR target cell subject to uplink CCA, are applicable for both 2-step RA and 4-step RA procedures [3]:

- Handover requirements with CCA in clause 6.1B,

- RRC connection re-establishment requirements with CCA in clause 6.2.1A,

- RRC connection release with redirection to NR requirements with CCA in clause 6.2.3.2.3, and

- UE transmit timing requirements with CCA in clause 7.1.

### 3.6.9 Applicability of requirements for scheduling availability

The scheduling availability requirements in clause 8.1.7.3, 8.5.7.3, 8.5.8.3, 9.5.6.3 and 9.10.2.6.2 assumes that:

- The UE is not configured with simultaneous UL/DL between two FR2 bands if the UE does not have the capability of supporting *simultaneousRxTxInterBandCA*, and

- The UE is not configured with mixed numerology on two FR2 CCs if the UE does not have the capability of supporting simultaneous reception with two different numerologies between FR2 CCs in DL.

The scheduling availability requirements in clause 8.1.7.1, 8.1.7.2, 8.5.7.1, 8.5.7.2, 8.5.8.1, 8.5.8.2, 9.5.6.1, 9.5.6.2, 9.8.6.1, and 9.8.6.2 assumes that the UE is not configured with simultaneous UL/DL between two FR1 bands if the UE does not have the capability of supporting *simultaneousRxTxInterBandCA*.

The scheduling availability requirements in clause 8.1.7.4, 8.5.7.4, 8.5.8.4, 9.5.6.4 and 9.8.6.4 assumes that the UE is not configured with simultaneous UL/DL between FR1 and FR2 bands if the UE does not have the capability of supporting *simultaneousRxTxInterBandCA* on this band combination.

### 3.6.10 Applicability of requirements for measurement restrictions

The requirements for measurement restrictions in clause 8.1.2.3, 8.1.3.3, 8.5.2.3, 8.5.3.3, 8.5.5.3, 8.5.6.3, 9.5.5 and 9.8.5 are not applicable if the following condition is met:

- The network configures mixed numerology on two CCs if the UE does not have the capability of supporting simultaneous reception with different numerologies between the two CCs in DL.

### 3.6.11 Applicability of requirements for Redcap UEs

#### 3.6.11.1 RRC connected state requirements in DRX

The requirements in clause 3.6.1 shall apply.

#### 3.6.11.2 Applicability for FR2 Redcap UE power classes

The requirements in clause 3.6.4 shall apply.

#### 3.6.11.3 Applicability of QCL

The requirements in clause 3.6.7 shall apply.

### 3.6.12 Applicability of requirements for Satellite Access

The requirements for Satellite Access defined in clauses with suffix ‘C’ apply provided that UE indicates *nonTerrestrialNetwork* and is accessing a cell served by a Satellite Access Node (SAN). The requirements apply provided that serving and all neighbour satellites on the same layer are of same satellite type (LEO or GEO).

### 3.6.13 Applicability of requirements for FR2

Unless stated otherwise, the requirements for FR2 are applicable to both FR2-1 and FR2-2, except for the following cases:

SFTD measurement requirements in clause 9.2.5.4, 9.3.8, 10.1.21 for FR2 are only applicable for FR2-1,

CGI identification requirements in clause 9.11 for FR2 are only applicable for FR2-1,

Inter-band CA requirements in all corresponding clauses for FR2 are only applicable for FR2-1.

L1-RSRP measurements for a cell with different PCI from serving cell in clause 9.13 for FR2 are only applicable for FR2-1.

### 3.6.14 Applicability of requirements for FR2 Power Class 6

For Rel-17 FR2 power class 6 for the UE type of high speed train roof-mounted UE, UE shall only be in NR SA operation.

Measurement and evaluation period requirements with *highSpeedMeasFlagFR2-r17* configured in clause 4.2.2.3, 8.1.2.2, 8.5.2.2, 9.2.5, 9.2.6, 9.5.4, [9.8.4], delay requirements in clause 6.2.1.2.1, 8.10.3A, and UL timing adjustment in clause 7.1.2.3, are only applicable when any two SSBs from adjacent [RRHs] are not on the same or consecutive symbols.

*Editor note: The definition of RRH shall be added in clause 3.1.*

# 4 SA: RRC\_IDLE state mobility

## 4.1 Cell Selection

After a UE has switched on and a PLMN has been selected, the Cell selection process takes place, as described in TS 38.304 [1]. This process allows the UE to select a suitable cell where to camp on in order to access available services. In this process, the UE can use stored information (*Stored information cell selection*) or not (*Initial cell selection*).

The 1 Rx RedCap UE for the cell selection procedure [1] applies:

*- Qrxlevmin* as the signaled value of *Qrxlevmin* [2] -1 dB.

*- Qqualmin* as the signaled value of *Qqualmin* [2] -1 dB.

## 4.2 Cell Re-selection

### 4.2.1 Introduction

The cell reselection procedure allows the UE to select a more suitable cell and camp on it.

When the UE is in either *Camped* *Normally* state or *Camped on Any Cell* state on a cell, the UE shall attempt to detect, synchronise, and monitor intra-frequency, inter-frequency and inter-RAT cells indicated by the serving cell. For intra-frequency and inter-frequency cells the serving cell may not provide explicit neighbour list but carrier frequency information and bandwidth information only. UE measurement activity is also controlled by measurement rules defined in TS 38.304 [1], allowing the UE to limit its measurement activity

In the requirements of clause 4.2, the exceptions for side conditions apply as follows:

- for the UE capable of CA, the applicable exceptions for side conditions are specified in Annex B, clause B.3.2.1, B.3.2.3, or B.3.2.5 for UE supporting CA in FR1, CA in FR2 and CA between FR1 and FR2, respectively;

- for the UE capable of SUL, the applicable exceptions for side conditions are specified in Annex B, clause B.3.4.1 for UE supporting SUL in FR1.

### 4.2.2 Requirements

#### 4.2.2.1 UE measurement capability

For idle mode cell re-selection purposes, and for UE supporting *IdleInactiveMeasurements-r16* or *idleInactiveEUTRA-MeasReport-r16*, for NR CA and MR-DC measurement purpose, the UE shall be capable of monitoring at least:

- Intra-frequency carrier, and

- Depending on UE capability, 7 NR inter-frequency carriers, and

- Depending on UE capability, 7 FDD E-UTRA inter-RAT carriers, and

- Depending on UE capability, 7 TDD E-UTRA inter-RAT carriers.

In addition to the requirements defined above, a UE supporting E-UTRA measurements in RRC\_IDLE state shall be capable of monitoring a total of at least 14 carrier frequency layers, which includes serving layer, comprising of any above defined combination of E-UTRA FDD, E-UTRA TDD and NR layers.

#### 4.2.2.2 Measurement and evaluation of serving cell

The UE shall measure the SS-RSRP and SS-RSRQ level of the serving cell and evaluate the cell selection criterion S defined in TS 38.304 [1] for the serving cell at least once every M1\*N1 DRX cycle; where:

M1=2 if SMTC periodicity (TSMTC) > 20 ms and DRX cycle ≤ 0.64 second,

otherwise M1=1.

The UE shall filter the SS-RSRP and SS-RSRQ measurements of the serving cell using at least 2 measurements. Within the set of measurements used for the filtering, at least two measurements shall be spaced by, at least DRX cycle/2.

If the UE has evaluated according to Table 4.2.2.2-1 in Nserv consecutive DRX cycles that the serving cell does not fulfil the cell selection criterion S, the UE shall initiate the measurements of all neighbour cells indicated by the serving cell, regardless of the measurement rules currently limiting UE measurement activities.

If the UE in RRC\_IDLE has not found any new suitable cell based on searches and measurements using the intra-frequency, inter-frequency and inter-RAT information indicated in the system information for 10 s, the UE shall initiate cell selection procedures for the selected PLMN as defined in TS 38.304 [1].

Table 4.2.2.2-1: Nserv

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| DRX cycle length [s] | Scaling Factor (N1) | | | Nserv [number of DRX cycles] |
|  | FR1 | FR2-1Note1 | FR2-2 Note2 |  |
| 0.32 | 1 | 8 | 12 | M1\*N1\*4 |
| 0.64 |  | 5 | 8 | M1\*N1\*4 |
| 1.28 |  | 4 | 6 | N1\*2 |
| 2.56 |  | 3 | 5 | N1\*2 |
| Note 1: Applies for UE supporting FR2-1 power class 2&3&4. For UE supporting FR2-1 power class 1 or 5, N1 = 8 for all DRX cycle length.  Note 2: Applies for UE supporting FR2-2 power class 2&3. For UE supporting FR2-2 power class 1, N1 = 12 for all DRX cycle length. | | | | |

#### 4.2.2.3 Measurements of intra-frequency NR cells

The UE shall be able to identify new intra-frequency cells and perform SS-RSRP and SS-RSRQ measurements of the identified intra-frequency cells without an explicit intra-frequency neighbour list containing physical layer cell identities.

The UE shall be able to evaluate whether a newly detectable intra-frequency cell meets the reselection criteria defined in TS38.304 [1] within Tdetect,NR\_Intrawhen that Treselection= 0. An intra frequency cell is considered to be detectable according to the conditions defined in Annex B.1.2 for a corresponding Band.

The UE shall measure SS-RSRP and SS-RSRQ at least every Tmeasure,NR\_Intra (see table 4.2.2.3-1, table 4.2.2.3-2 or table 4.2.2.3-3) for intra-frequency cells that are identified and measured according to the measurement rules.

The UE shall filter SS-RSRP and SS-RSRQ measurements of each measured intra-frequency cell using at least 2 measurements. Within the set of measurements used for the filtering, at least two measurements shall be spaced by at least Tmeasure,NR\_Intra/2.

The UE shall not consider a NR neighbour cell in cell reselection, if it is indicated as not allowed in the measurement control system information of the serving cell.

For an intra-frequency cell that has been already detected, but that has not been reselected to, the filtering shall be such that the UE shall be capable of evaluating that the intra-frequency cell has met reselection criterion defined in TS38.304 [1] within Tevaluate,NR\_Intra when Treselection = 0as specified in table 4.2.2.3-1, table 4.2.2.3-2 or table 4.2.2.3-3 provided that:

when *rangeToBestCell* is not configured:

- the cell is at least 3dB better ranked in FR1 or 4.5dB better ranked in FR2.

when *rangeToBestCell* is configured:

- the cell has the highest number of beams above the threshold *absThreshSS-BlocksConsolidation* among all detected cells whose cell-ranking criterion R value in TS38.304 [1] is within *rangeToBestCell* of the cell-ranking criterion R value of the highest ranked cell.

- if there are multiple such cells, the cell has the highest rank among them.

- the cell is at least 3dB better ranked in FR1 or 4.5dB better ranked in FR2 if the current serving cell is among them.

When evaluating cells for reselection, the SSB side conditions apply to both serving and non-serving intra-frequency cells.

If Treselection timer has a non zero value and the intra-frequency cell is satisfied with the reselection criteria which are defined in TS38.304 [1], the UE shall evaluate this intra-frequency cell for the Treselection time. If this cell remains satisfied with the reselection criteria within this duration, then the UE shall reselect that cell.

For UE neither configured with *highSpeedMeasFlag-r16* nor *highSpeedMeasFlagFR2-r17*, Tdetect,NR\_Intra, Tmeasure,NR\_Intra and Tevaluate, NR\_intra are specified in Table 4.2.2.3-1. For UE configured with *highSpeedMeasFlag-r16*, Tdetect,NR\_Intra, Tmeasure,NR\_Intra and Tevaluate, NR\_intra are specified in Table 4.2.2.3-2. For FR2 power class 6 UE configured with *highSpeedMeasFlagFR2-r17*, Tdetect,NR\_Intra, Tmeasure,NR\_Intra and Tevaluate, NR\_intra are specified in Table 4.2.2.3-3.

The requirements in Table 4.2.2.3-2 apply only when the UE supports *measurementEnhancement-r16* or *intraNR-MeasurementEnhancement-r16*. For UE neither supporting either *measurementEnhancement-r16* nor *intraNR-MeasurementEnhancement-r16*, the UE is not required to meet the requirements specified in Table 4.2.2.3-2.

Table 4.2.2.3-1: Tdetect,NR\_Intra, Tmeasure,NR\_Intra and Tevaluate,NR\_Intra

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| DRX cycle length [s] | Scaling Factor (N1) | | | Tdetect,NR\_Intra [s] (number of DRX cycles) | Tmeasure,NR\_Intra [s] (number of DRX cycles) | Tevaluate,NR\_Intra  [s] (number of DRX cycles) |
|  | FR1 | FR2-1Note1 | FR2-2 Note2 |  |  |  |
| 0.32 | 1 | 8 | 12 | 11.52 x N1 x M2 (36 x N1 x M2) | 1.28 x N1 x M2 (4 x N1 x M2) | 5.12 x N1 x M2 (16 x N1 x M2) |
| 0.64 |  | 5 | 8 | 17.92 x N1 (28 x N1) | 1.28 x N1 (2 x N1) | 5.12 x N1 (8 x N1) |
| 1.28 |  | 4 | 6 | 32 x N1 (25 x N1) | 1.28 x N1 (1 x N1) | 6.4 x N1 (5 x N1) |
| 2.56 |  | 3 | 5 | 58.88 x N1 (23 x N1) | 2.56 x N1 (1 x N1) | 7.68 x N1 (3 x N1) |
| Note 1: Applies for UE supporting FR2-1 power class 2&3&4. For UE supporting FR2-1 power class 1 or 5, N1 = 8 for all DRX cycle length.  Note 2: Applies for UE supporting FR2-2 power class 2&3. For UE supporting FR2-2 power class 1, N1 = 12 for all DRX cycle length.  Note 3: M2 = 1.5 if SMTC periodicity of measured intra-frequency cell > 20 ms; otherwise M2=1. If different SMTC periodicities are configured for different cells, the SMTC periodicity in this note is the one used by the cell being identified. During PSS/SSS detection, the periodicity of the SMTC configured for the intra-frequency carrier is assumed, and if the actual SSB transmission periodicity is greater than the SMTC configured for the intra-frequency carrier, longer Tdetect, NR\_intra is expected. | | | | | | |

Table 4.2.2.3-2: Tdetect,NR\_Intra, Tmeasure,NR\_Intra and Tevaluate,NR\_Intra for UE configured with *highSpeedMeasFlag-r16* (Frequency range FR1)

|  |  |  |  |
| --- | --- | --- | --- |
| DRX cycle length [s] | Tdetect,NR\_Intra [s] (number of DRX cycles) | Tmeasure,NR\_Intra [s] (number of DRX cycles) | Tevaluate,NR\_Intra  [s] (number of DRX cycles) |
|
| 0.32 | 2.56 x M2 (8 x M2) | 0.32 x M3 (1 x M3) | 0.96 x M4 (3 x M4) |
| 0.64 | 5.12 (8) | 0.64 (1) | 1.92 (3) |
| 1.28 | 8.96 (7) | 1.28 (1) | 3.84 (3) |
| 2.56 | 58.88 (23) | 2.56 (1) | 7.68 (3) |
| Note 1: when SMTC < = 40 ms, M2 = M3 = M4 = 1; and when SMTC > 40 ms, M2 = 1.5, M3 = M4 = 2  Note 2: When *highSpeedMeasFlag-r16* is configured, the requirements apply only to UE supporting either *measurementEnhancement-r16* or *intraNR-MeasurementEnhancement-r16.* | | | |

Table 4.2.2.3-3: Tdetect,NR\_Intra, Tmeasure,NR\_Intra and Tevaluate,NR\_Intra for UE configured with *highSpeedMeasFlagFR2-r17* (Frequency range FR2)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| DRX cycle length [s] | Scaling Factor (N1) | Tdetect,NR\_Intra [s] (number of DRX cycles) | Tmeasure,NR\_Intra [s] (number of DRX cycles) | Tevaluate,NR\_Intra  [s] (number of DRX cycles) |
| 0.32 | N2Note2 | 2.56 x N1 x M2 (8 x N1 x M2) | 0.32 x N1 x M3 (1 x N1 x M3) | 0.96 x N1 x M4 (3 x N1 x M4) |
| 0.64 | 5 | 17.92 x N1 (28 x N1) | 1.28 x N1 (2 x N1) | 5.12 x N1 (8 x N1) |
| 1.28 | 4 | 32 x N1 (25 x N1) | 1.28 x N1 (1 x N1) | 6.4 x N1 (5 x N1) |
| 2.56 | 3 | 58.88 x N1 (23 x N1) | 2.56 x N1 (1 x N1) | 7.68 x N1 (3 x N1) |
| Note 1: When SMTC < = 40 ms, M2 = M3 = M4 = 1; and when SMTC > 40 ms, M2 = 1.5, M3 = M4 = 2  Note 2: N2 = 2 when [*highSpeedMeasFlagFR2-r17*] = [set1]; N2 = 6 when [*highSpeedMeasFlagFR2-r17*] = [set2]. | | | | |

#### 4.2.2.4 Measurements of inter-frequency NR cells

The UE shall be able to identify new inter-frequency cells and perform SS-RSRP or SS-RSRQ measurements of identified inter-frequency cells if carrier frequency information is provided by the serving cell, even if no explicit neighbour list with physical layer cell identities is provided.

If Srxlev > SnonIntraSearchP and Squal > SnonIntraSearchQ then the UE shall search for inter-frequency layers of higher priority at least every Thigher\_priority\_search where Thigher\_priority\_search is described in clause 4.2.2.7.

If Srxlev ≤ SnonIntraSearchP or Squal ≤ SnonIntraSearchQ then the UE shall search for and measure inter-frequency layers of higher, equal or lower priority in preparation for possible reselection. In this scenario, the minimum rate at which the UE is required to search for and measure higher priority layers shall be the same as that defined below in this clause.

The UE shall be able to evaluate whether a newly detectable inter-frequency cell meets the reselection criteria defined in TS38.304 [1] within Kcarrier \* Tdetect,NR\_Inter + Kcarrier\_HST \* Tdetect,NR\_Inter\_HST if at least carrier frequency information is provided for inter-frequency neighbour cells by the serving cells when Treselection = 0 provided that the reselection criteria is met by a margin of at least 5 dB in FR1 or 6.5dB in FR2 for reselections based on ranking or 6dB in FR1 or 7.5dB in FR2 for SS-RSRP reselections based on absolute priorities or 4dB in FR1 and 4dB in FR2 for SS-RSRQ reselections based on absolute priorities.

The parameter Kcarrier is the number of NR inter-frequency carriers which are not configured with *highSpeedMeasInterFreq-r17* for FR1 indicated by the serving cell. The parameter Kcarrier\_HST is the number of NR inter-frequency carriers which are configured with *highSpeedMeasInterFreq-r17* for FR1 indicated by the serving cell. The parameter Kcarrier for a UE configured with idle mode CA measurements (while T331 is running), is the combined number of NR inter-frequency carriers indicated by the serving cell and the number of NR inter-frequency carriers configured for idle mode CA measurements which are not configured with *highSpeedMeasInterFreq-r17* for FR1. The parameter Kcarrier\_HST for a UE configured with idle mode CA measurements (while T331 is running), is the combined number of NR inter-frequency carriers indicated by the serving cell and the number of NR inter-frequency carriers configured for idle mode CA measurements which are configured with *highSpeedMeasInterFreq-r17* for FR1.

Note: combined total number means that if a carrier is an inter-frequency carrier indicated by the serving cell for mobility and additionally a carrier configured for idle mode CA measurements, it only counts as one carrier.

An inter-frequency cell is considered to be detectable according to the conditions defined in Annex B.1.3 for a corresponding Band.

When higher priority cells are found by the higher priority search, they shall be measured at least every Tmeasure,NR\_Inter. If, after detecting a cell in a higher priority search, it is determined that reselection has not occurred then the UE is not required to continuously measure the detected cell to evaluate the ongoing possibility of reselection. However, the minimum measurement filtering requirements specified later in this clause shall still be met by the UE before it makes any determination that it may stop measuring the cell. If the UE detects on a NR carrier a cell whose physical identity is indicated as not allowed for that carrier in the measurement control system information of the serving cell, the UE is not required to perform measurements on that cell.

The UE shall measure SS-RSRP or SS-RSRQ at least every Kcarrier \* Tmeasure,NR\_Inter + Kcarrier\_HST \* Tmeasure,NR\_Inter\_HST (see table 4.2.2.4-1 and table 4.2.2.4-2 if UE declares support of idle mode inter-frequency measurement enhancement when configured with *highSpeedMeasInterFreq-r17* for FR1, otherwise see table 4.2.2.4-1 only) for identified lower or equal priority inter-frequency cells. If the UE detects on a NR carrier a cell whose physical identity is indicated as not allowed for that carrier in the measurement control system information of the serving cell, the UE is not required to perform measurements on that cell.

The UE shall filter SS-RSRP or SS-RSRQ measurements of each measured higher, lower and equal priority inter-frequency cell using at least 2 measurements. Within the set of measurements used for the filtering, at least two measurements shall be spaced by at least Tmeasure,NR\_Inter/2 for carriers which are not configured with *highSpeedMeasInterFreq-r17* for FR1or Tmeasure,NR\_Inter\_HST /2 for carriers which are configured with *highSpeedMeasInterFreq-r17* forFR1.

The UE shall not consider a NR neighbour cell in cell reselection, if it is indicated as not allowed in the measurement control system information of the serving cell.

For an inter-frequency cell that has been already detected, but that has not been reselected to, the filtering shall be such that the UE shall be capable of evaluating that the inter-frequency cell has met reselection criterion defined TS 38.304 [1] within Kcarrier \* Tevaluate,NR\_Inter + Kcarrier\_HST \* Tevaluate,NR\_Inter\_HST when Treselection = 0as specified in table 4.2.2.4-1 and table 4.2.2.4-2 if UE declares support of idle mode inter-frequency measurement enhancement when configured with *highSpeedMeasInterFreq-r17* for FR1, otherwise see table 4.2.2.4-1 only, provided that the reselection criteria is met by

- the condition when performing equal priority reselection and

- when *rangeToBestCell* is not configured:

- the cell is at least 5dB better ranked in FR1 or 6.5dB better ranked in FR2 or.

when *rangeToBestCell* is configured:

- the cell has the highest number of beams above the threshold *absThreshSS-BlocksConsolidation* among all detected cells whose cell-ranking criterion R value in TS38.304 [1] is within *rangeToBestCell* of the cell-ranking criterion R value of the highest ranked cell.

- if there are multiple such cells, the cell has the highest rank among them

- the cell is at least 5dB better ranked in FR1 or 6.5dB better ranked in FR2 if the current serving cell is among them. or

- 6dB in FR1 or 7.5dB in FR2 for SS-RSRP reselections based on absolute priorities or

- 4dB in FR1 or 4dB in FR2 for SS-RSRQ reselections based on absolute priorities.

When evaluating cells for reselection, the SSB side conditions apply to both serving and inter-frequency cells.

If Treselection timer has a non zero value and the inter-frequency cell is satisfied with the reselection criteria, the UE shall evaluate this inter-frequency cell for the Treselection time. If this cell remains satisfied with the reselection criteria within this duration, then the UE shall reselect that cell.

The UE is not expected to meet the measurement requirements for an inter-frequency carrier under DRX cycle=320 ms defined in Table 4.2.2.4-1 and Table 4.2.2.4-2 under the following conditions:

- TSMTC\_intra = TSMTC\_inter = 160 ms; where

- TSMTC\_intra is the periodicity of the SMTC configured for the intra-frequency carrier if no identified intra-frequency cell is in the PCI list of smtc2-LP on this intra-frequency carrier; TSMTC\_intra is the periodicity of the smtc2-LP configured for the intra-frequency carrier if at least one identified intra-frequency cell is in the PCI list of smtc2-LP on this intra-frequency carrier. During PSS/SSS detection, the periodicity of the SMTC configured for the intra-frequency carrier is assumed for TSMTC\_intra. If the actual SSB transmission periodicity is greater than the SMTC configured for the intra-frequency carrier, longer Tdetect, NR\_intra is expected.

- TSMTC\_inter is the actual SMTC periodicity used by the inter-frequency cell being identified. During PSS/SSS detection, the periodicity of the SMTC configured for the inter-frequency carrier is assumed for TSMTC\_inter. If the actual SSB transmission periodicity is greater than the SMTC configured for the inter-frequency carrier, longer Tdetect, NR\_inter is expected.

- SMTC occasions configured for the inter-frequency carrier occur up to 1 ms before the start or up to 1 ms after the end of the SMTC occasions configured for the intra-frequency carrier, and

- SMTC occasions configured for the intra-frequency carrier and for the inter-frequency carrier occur up to 1 ms before the start or up to 1 ms after the end of the paging occasion in TS38.304 [1].

**Table 4.2.2.4-1: Tdetect,NR\_Inter, Tmeasure,NR\_Inter and Tevaluate,NR\_Inter**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **DRX cycle length [s]** | **Scaling Factor (N1)** | | | **Tdetect,NR\_Inter [s] (number of DRX cycles)** | **Tmeasure,NR\_Inter [s] (number of DRX cycles)** | **Tevaluate,NR\_Inter [s] (number of DRX cycles)** |
| **FR1** | **FR2-1Note1** | **FR2-2** Note2 |
| 0.32 | 1 | 8 | 12 | 11.52 x N1 x 1.5 (36 x N1 x 1.5) | 1.28 x N1 x 1.5 (4 x N1 x 1.5) | 5.12 x N1 x 1.5 (16 x N1 x 1.5) |
| 0.64 |  | 5 | 8 | 17.92x N1 (28 x N1) | 1.28 x N1 (2 x N1) | 5.12 x N1 (8 x N1) |
| 1.28 |  | 4 | 6 | 32 x N1 (25 x N1) | 1.28 x N1 (1 x N1) | 6.4 x N1 (5 x N1) |
| 2.56 |  | 3 | 5 | 58.88 x N1 (23 x N1) | 2.56 x N1 (1 x N1) | 7.68 x N1 (3 x N1) |
| Note 1: Applies for UE supporting FR2-1 power class 2&3&4. For UE supporting FR2-1 power class 1 or 5, N1 = 8 for all DRX cycle length.  Note 2: Applies for UE supporting FR2-2 power class 2&3. For UE supporting FR2-2 power class 1, N1 = 12 for all DRX cycle length. | | | | | | |

Table 4.2.2.4-2: Tdetect,NR\_Inter\_HST, Tmeasure,NR\_Inter\_HST and Tevaluate,NR\_Inter\_HST for FR1 configured with *highSpeedMeasInterFreq-r17* note2

|  |  |  |  |
| --- | --- | --- | --- |
| DRX cycle length [s] | Tdetect,NR\_Inter\_HST [s] (number of DRX cycles) | Tmeasure,NR\_Inter\_HST [s] (number of DRX cycles) | Tevaluate,NR\_Inter\_HST [s] (number of DRX cycles) |
|
| 0.32 | [3.2 x M2 (10 x M2)] Note 1 | [0.32 x M3 ([1] x M3)] Note 1 | 0.96 x M4 (3 x M4) Note 1 |
| 0.64 | [6.4 (10)] | [0.64 (1)] | 1.92 (3) |
| 1.28 | [10.24 (8)] | 1.28 (1) | 3.84 (3) |
| 2.56 | 58.88 (23) | 2.56 (1) | 7.68 (3) |
| Note 1: When SMTC < = 40 ms, M2 = M3 = M4 = 1; and when SMTC > 40 ms, M2 = 1.5, M3 = M4 = 2  Note 2: The support of HST Idle mode inter-frequency measurement enhancement is optional without capability signalling. Apply for UE declarating supports idle mode inter-frequency measurement enhancement for HST, otherwise Table 4.2.2.4-1 shall be used. | | | |

#### 4.2.2.5 Measurements of inter-RAT E-UTRAN cells

If Srxlev > SnonIntraSearchP and Squal > SnonIntraSearchQ then the UE shall search for inter-RAT E-UTRAN layers of higher priority at least every Thigher\_priority\_search where Thigher\_priority\_search is described in clause 4.2.2.

If Srxlev ≤ SnonIntraSearchP or Squal ≤ SnonIntraSearchQ then the UE shall search for and measure inter-RAT E-UTRAN layers of higher, lower priority in preparation for possible reselection. In this scenario, the minimum rate at which the UE is required to search for and measure higher priority inter-RAT E-UTRAN layers shall be the same as that defined below for lower priority RATs.

The requirements in this clause apply for inter-RAT E-UTRAN FDD measurements and E-UTRA TDD measurements. When the measurement rules indicate that inter-RAT E-UTRAN cells are to be measured, the UE shall measure RSRP and RSRQ of detected E-UTRA cells in the neighbour frequency list at the minimum measurement rate specified in this clause.

Theparameter NEUTRA\_carrier is the total number of configured E-UTRA carriers indicated to meet non high speed requirements in the neighbour frequency list. The parameter NEUTRA\_carrier\_HST is the total number of configured E-UTRA carriers indicated to meet high speed requirements in the neighbour frequency list. If Srxlev ≤ SnonIntraSearchP or Squal ≤ SnonIntraSearchQ, an inter-RAT E-UTRAN layer is indicated to meet high speed requirements if highSpeedMeasFlag-r16 is configured and the carrier to be measured is configured with highSpeedEUTRACarrier-r16 and UE supports the enhanced inter-RAT E-UTRAN measurement requirements. If Srxlev > SnonIntraSearchP and Squal > SnonIntraSearchQ, UE is required to meet non high speed requirements no matter whether highSpeedMeasFlag-r16 or highSpeedEUTRACarrier-r16 is configured or not.

The parameter NEUTRA\_carrier for a UE configured with idle mode DC measurements (while T331 is running), is the combined number of configured E-UTRA carriers in the neighbour frequency list and E-UTRA carriers configured for idle mode DC measurements, excluding the configured E-UTRA carriers indicated to meet high speed requirements in the neighbour frequency list.

Note: combined total number means that if a carrier is an E-UTRA carrier indicated by the serving cell for mobility and additionally a carrier configured for idle mode CA/DC measurements, it only counts as one carrier.

The UE shall filter RSRP and RSRQ measurements of each measured E-UTRA cell using at least 2 measurements. Within the set of measurements used for the filtering, at least two measurements shall be spaced by at least half the minimum specified measurement period.

An inter-RAT E-UTRA cell is considered to be detectable provided the following conditions are fulfilled:

- the same conditions as for inter-frequency RSRP measurements specified in TS 36.133 [15, Annex B.1.2] are fulfilled for a corresponding Band, and

- the same conditions as for inter-frequency RSRQ measurements specified in TS 36.133 [15, Annex B.1.2] are fulfilled for a corresponding Band.

- SCH conditions specified in TS 36.133 [15, Annex B.1.2] are fulfilled for a corresponding Band

The UE shall be able to evaluate whether a newly detectable inter-RAT E-UTRAN cell meets the reselection criteria defined in TS38.304 [1] within NEUTRA\_carrier\_HST \* Tdetect,EUTRAN\_HST + NEUTRA\_carrier \* Tdetect,EUTRAN when Srxlev ≤ SnonIntraSearchP or Squal ≤ SnonIntraSearchQ when Treselection = 0 provided that the reselection criteria is met by a margin of at least 6dB for RSRP reselections based on absolute priorities or 4dB for RSRQ reselections based on absolute priorities.

Cells which have been detected shall be measured at least every NEUTRA\_carrier\_HST \* Tmeasure,EUTRAN\_HST + NEUTRA\_carrier \* Tmeasure,EUTRAN when Srxlev ≤ SnonIntraSearchP or Squal ≤ SnonIntraSearchQ.

When higher priority cells are found by the higher priority search, they shall be measured at least every Tmeasure,EUTRAN. If, after detecting a cell in a higher priority search, it is determined that reselection has not occurred then the UE is not required to continuously measure the detected cell to evaluate the ongoing possibility of reselection. However, the minimum measurement filtering requirements specified later in this clause shall still be met by the UE before it makes any determination that it may stop measuring the cell.

If the UE detects on an inter-RAT E-UTRAN carrier a cell whose physical identity is indicated as not allowed for that carrier in the measurement control system information of the serving cell, the UE is not required to perform measurements on that cell.

The UE shall not consider an inter-RAT E-UTRA cell in cell reselection, if it is indicated as not allowed in the measurement control system information of the serving cell.

For a cell that has been already detected, but that has not been reselected to, the filtering shall be such that the UE shall be capable of evaluating that an already identified inter-RAT E-UTRA cell has met reselection criterion defined in TS 38.304 [1] within NEUTRA\_carrier\_HST \* Tevaluate,EUTRAN\_HST + NEUTRA\_carrier \* T evaluate,EUTRAN when Treselection = 0as speficied in table 4.2.2.5-1 and 4.2.2.5-2 provided that the reselection criteria is met by a margin of at least 6dB for RSRP reselections based on absolute priorities or 4dB for RSRQ reselections based on absolute priorities.

If Treselection timer has a non zero value and the inter-RAT E-UTRA cell is satisfied with the reselection criteria which are defined in TS 38.304 [1], the UE shall evaluate this E-UTRA cell for the Treselection time. If this cell remains satisfied with the reselection criteria within this duration, then the UE shall reselect that cell.

Table 4.2.2.5-1: Tdetect,EUTRAN, Tmeasure,EUTRAN, and Tevaluate,EUTRAN

|  |  |  |  |
| --- | --- | --- | --- |
| DRX cycle length [s] | Tdetect,EUTRAN [s] (number of DRX cycles) | Tmeasure,EUTRAN [s] (number of DRX cycles) | Tevaluate,EUTRAN  [s] (number of DRX cycles) |
| 0.32 | 11.52 (36) | 1.28 (4) | 5.12 (16) |
| 0.64 | 17.92 (28) | 1.28 (2) | 5.12 (8) |
| 1.28 | 32(25) | 1.28 (1) | 6.4 (5) |
| 2.56 | 58.88 (23) | 2.56 (1) | 7.68 (3) |

Table 4.2.2.5-2: Tdetect,EUTRAN\_HST, Tmeasure,EUTRAN\_HST, and Tevaluate,EUTRAN\_HST for UE configured with highSpeedMeasFlag-r16

|  |  |  |  |
| --- | --- | --- | --- |
| DRX cycle length [s] | Tdetect,EURAN\_HST [s] (number of DRX cycles) | Tmeasure,EUTRAN\_HST [s] (number of DRX cycles) | Tevaluate,EUTRAN\_HST  [s] (number of DRX cycles) |
|  |
| 0.32 | 4.16 (13) | 0.64 (2) | 0.96 (3) |
| 0.64 | 7.68 (12) | 1.28 (2) | 1.92 (3) |
| 1.28 | 8.96 (7) | 1.28 (1) | 3.84 (3) |
| 2.56 | 58.88 (23) | 2.56 (1) | 7.68 (3) |
| Note 1: When highSpeedMeasFlag-r16 is configured, the requirements apply only to UE supporting either *measurementEnhancement-r16* or *[interRAT-MeasurementEnhancement-r16]*. | | | |

The requirements in Table 4.2.2.5-2 apply only when the UE supports *measurementEnhancement-r16* or *interRAT-MeasurementEnhancement-r16*. For UE not supporting either *measurementEnhancement-r16* or *interRAT-MeasurementEnhancement-r16*, the UE is not required to meet the requirements specified in Table 4.2.2.5-2.

#### 4.2.2.6 Maximum interruption in paging reception

UE shall perform the cell re-selection with minimum interruption in monitoring downlink channels for paging reception.

At intra-frequency and inter-frequency cell re-selection, the UE shall monitor the downlink of serving cell for paging reception until the UE is capable to start monitoring downlink channels of the target intra-frequency and inter-frequency cell for paging reception. The interruption time shall not exceed TSI-NR + 2\*Ttarget\_cell\_SMTC\_period ms. Ttarget\_cell\_SMTC\_period is the periodicity of the SMTC occasions configured for the target NR cell. If the target cell is in the PCI list of *smtc2-LP*, the SMTC periodicityfollows *smtc2-LP*; otherwise, the SMTC periodicity follows *smtc*.

At inter-RAT cell re-selection, the UE shall monitor the downlink of serving cell for paging reception until the UE is capable to start monitoring downlink channels for paging reception of the target inter-RAT cell. For NR to E-UTRAN cell re-selection the interruption time must not exceed TSI-EUTRA + 55 ms.

TSI-NR is the time required for receiving all the relevant system information data according to the reception procedure and the RRC procedure delay of system information blocks defined in TS 38.331 [2] for an NR cell.

TSI-EUTRA is the time required for receiving all the relevant system information data according to the reception procedure and the RRC procedure delay of system information blocks defined in TS 36.331 [16] for an E-UTRAN cell.

These requirements assume sufficient radio conditions, so that decoding of system information can be made without errors and does not take into account cell re-selection failure.

#### 4.2.2.7 General requirements

The UE shall search every layer of higher priority at least every Thigher\_priority\_search = (60 \* Nlayers) seconds, where Nlayers is the total number of higher priority NR and E-UTRA carrier frequencies broadcasted in system information.

For a UE configured with early measurement reporting, while T331 is running, Nlayers is the combined total number of higher priority NR and E-UTRA carrier frequencies broadcasted in system information and carriers configured for idle mode CA measurements.

Note: combined total number means that if a carrier is a high priority carrier and additionally a carrier configured for idle mode CA measurements, it only counts as one carrier.

#### 4.2.2.8 Minimum requirement at transitions

When switching from low mobility scenario or not-at-cell-edge scenario to low mobility and not-at-cell-edge scenario during cell-reselection period, the UE shall fulfill the requirements corresponding to low mobility scenario or not-at-cell-edge scenario over measurement period (Trelaxed) and thereafter switch to requirements corresponding to low mobility and not-at-cell-edge scenario. The measurement period, Trelaxed, is any of:

- Tmeasure,NR\_Intra and Tevaluate,NR\_Intra, defined in section 4.2.2.9 for intra-frequency measurements on NR cells,

- Tmeasure,NR\_Inter and Tevaluate,NR\_Inter defined in section 4.2.2.10 for inter-frequency measurements on NR cells and

- Tmeasure,EUTRAN and Tevaluate,EUTRAN defined in sections 4.2.2.11 for inter-RAT E-UTRAN measurements.

When switching from low mobility and not-at-cell-edge scenario to low mobility scenario or not-at-cell-edge scenario during cell-reselection period, the UE shall fulfill the requirements corresponding to low mobility scenario or not-at-cell-edge scenario upon fulfilling the switching criteria.

When switching from normal mode to low mobility scenario or not-at-cell-edge scenario or low mobility and not-at-cell-edge scenario during cell-reselection period, the UE shall fulfill the requirements corresponding to normal mode over measurement period (Tnormal) and thereafter switch to requirements corresponding to low mobility scenario or not-at-cell-edge scenario or low mobility and not-at-cell-edge scenario. The measurement period, Tnormal, is any of:

- Tmeasure,NR\_Intra and Tevaluate,NR\_Intra, defined in section 4.2.2.3 for intra-frequency measurements on NR cells,

- Tmeasure,NR\_Inter and Tevaluate,NR\_Inter defined in section 4.2.2.4 for inter-frequency measurements on NR cells and

- Tmeasure,EUTRAN and Tevaluate,EUTRAN defined in sections 4.2.2.5 for inter-RAT E-UTRAN measurements.

When switching from low mobility scenario or not-at-cell-edge scenario or low mobility and not-at-cell-edge scenario to normal mode during cell-reselection period, the UE shall fulfill the requirements corresponding to normal mode upon fulfilling the switching criteria.

No requirement is defined for multiple transitions of scenarios within one measurement period.

#### 4.2.2.9 Measurements of intra-frequency NR cells for UE configured with relaxed measurement criterion

##### 4.2.2.9.1 Introduction

This clause contains the requirements for measurements on intra-frequency NR cells when Srxlev ≤ SIntraSearchP or Squal ≤ SIntraSearchQ and when the UE is configured any of the following relaxed measurement critera:

- Relaxed measurement criterion for UE with low mobility defined in clause 5.2.4.9.1 in [1],

- Relaxed measurement criterion for UE not-at-cell edge defined in clause 5.2.4.9.2 in [1],

- Both low mobility criterion and not-at-cell edge criterion as defined in clauses 5.2.4.9.1 and 5.2.4.9.2 in [1] respectively.

##### 4.2.2.9.2 Measurements for UE fulfilling low mobility criterion

This clause contains requirements for measurements on intra-frequency NR cells provided that:

- UE is configured with *lowMobilityEvaluation* [2] criterion and UE has fulfilled, or

- UE is configured with both *lowMobilityEvaluation* [2] criterion and *cellEdgeEvaluation* [2] criterion and *combineRelaxedMeasCondition* [2] not configured, and UE has fulfilled only the *lowMobilityEvaluation* [2] criterion.

The requirements defined in clause 4.2.2.3 apply for this clause except that:

- Tdetect,NR\_Intraas specified in Table 4.2.2.9. 2-1.

- Tmeasure,NR\_Intra as specified in Table 4.2.2.9. 2-1.

- Tevaluate,NR\_Intra as specified in Table 4.2.2.9. 2-1.

Table 4.2.2.9.2-1: Tdetect,NR\_Intra, Tmeasure,NR\_Intra and Tevaluate,NR\_Intra

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| DRX cycle length [s] | Scaling Factor (N1) | | | Tdetect,NR\_Intra [s] (number of DRX cycles) | Tmeasure,NR\_Intra [s] (number of DRX cycles) | Tevaluate,NR\_Intra  [s] (number of DRX cycles) |
|  | FR1 | FR2-1Note1 | FR2-2 Note2 |
| 0.32 | 1 | 8 | 12 | 11.52 x N1 x M2 x K1 (36 x N1 x M2 x K1) | 1.28 x N1 x M2 x K1 (4 x N1 x M2 x K1) | 5.12 x N1 x M2 x K1 (16 x N1 x M2 x K1) |
| 0.64 |  | 5 | 8 | 17.92 x N1 x K1 (28 x N1 x K1) | 1.28 x N1 x K1 (2 x N1 x K1) | 5.12 x N1 x K1 (8 x N1 x K1) |
| 1.28 |  | 4 | 6 | 32 x N1 x K1 (25 x N1 x K1) | 1.28 x N1 x K1 (1 x N1 x K1) | 6.4 x N1 x K1 (5 x N1 x K1) |
| 2.56 |  | 3 | 5 | 58.88 x N1 x K1 (23 x N1 x K1) | 2.56 x N1 x K1 (1 x N1 x K1) | 7.68 x N1 x K1 (3 x N1 x K1) |
| Note 1: Applies for UE supporting FR2-1 power class 2&3&4. For UE supporting FR2-1 power class 1 or 5, N1 = 8 for all DRX cycle length.  Note 2: Applies for UE supporting FR2-2 power class 2&3. For UE supporting FR2-2 power class 1, N1 = 12 for all DRX cycle length.  Note 3: M2 = 1.5 if SMTC periodicity of measured intra-frequency cell > 20 ms; otherwise M2=1. If high layer signalling *smtc2-LP-r16* is configured, for cells indicated in the *pci-List* parameter in *smtc2-LP-r16*, the SMTC periodicity corresponds to the value of higher layer parameter *smtc2-LP-r16*; for the other cells, the SMTC periodicity corresponds to the value of higher layer parameter *smtc*.  Note 4: K1 = 3 is the measurement relaxation factor applicable for UE fulfilling the *lowMobilityEvaluation* [2] criterion. | | | | | | |

##### 4.2.2.9.3 Measurements for UE fulfilling not-at-cell edge criterion

This clause contains requirements for measurements on intra-frequency NR cells provided that:

- UE is configured with *cellEdgeEvaluation* [2] criterion and UE has fulfilled, or

- UE is configured with both *lowMobilityEvaluation* [2] criterion and *cellEdgeEvaluation* [2] criteria and *combineRelaxedMeasCondition* [2] not configured, and UE has fulfilled only the *cellEdgeEvaluation* [2] criterion.

The requirements defined in clause 4.2.2.3 apply for this clause except that:

- Tdetect,NR\_Intraas specified in Table 4.2.2.9.3-1.

- Tmeasure,NR\_Intra as specified in Table 4.2.2.9.3-1.

- Tevaluate,NR\_Intra as specified in Table 4.2.2.9.3-1.

Table 4.2.2.9.3-1: Tdetect,NR\_Intra, Tmeasure,NR\_Intra and Tevaluate,NR\_Intra

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| DRX cycle length [s] | Scaling Factor (N1) | | | Tdetect,NR\_Intra [s] (number of DRX cycles) | Tmeasure,NR\_Intra [s] (number of DRX cycles) | Tevaluate,NR\_Intra  [s] (number of DRX cycles) |
|  | FR1 | FR2-1Note1 | FR2-2 Note2 |
| 0.32 | 1 | 8 | 12 | 11.52 x N1 x M2 x K1 (36 x N1 x M2 x K1) | 1.28 x N1 x M2 x K1 (4 x N1 x M2 x K1) | 5.12 x N1 x M2 x K1 (16 x N1 x M2 x K1) |
| 0.64 |  | 5 | 8 | 17.92 x N1 x K1 (28 x N1 x K1) | 1.28 x N1 x K1 (2 x N1 x K1) | 5.12 x N1 x K1 (8 x N1 x K1) |
| 1.28 |  | 4 | 6 | 32 x N1 x K1 (25 x N1 x K1) | 1.28 x N1 x K1 (1 x N1 x K1) | 6.4 x N1 x K1 (5 x N1 x K1) |
| 2.56 |  | 3 | 5 | 58.88 x N1 x K1 (23 x N1 x K1) | 2.56 x N1 x K1 (1 x N1 x K1) | 7.68 x N1 x K1 (3 x N1 x K1) |
| Note 1: Applies for UE supporting FR2-1 power class 2&3&4. For UE supporting FR2-1 power class 1 or 5, N1 = 8 for all DRX cycle length.  Note 2: Applies for UE supporting FR2-2 power class 2&3. For UE supporting FR2-2 power class 1, N1 = 12 for all DRX cycle length.  Note 3: M2 = 1.5 if SMTC periodicity of measured intra-frequency cell > 20 ms; otherwise M2=1. If high layer signalling *smtc2-LP-r16* is configured, for cells indicated in the *pci-List* parameter in *smtc2-LP-r16*, the SMTC periodicity corresponds to the value of higher layer parameter *smtc2-LP-r16*; for the other cells, the SMTC periodicity corresponds to the value of higher layer parameter *smtc*.  Note 4: K1 = 3 is the measurement relaxation factor applicable for UE fulfilling the *cellEdgeEvaluation* [2] criterion. | | | | | | |

##### 4.2.2.9.4 Measurements for UE fulfilling low mobility and not-at-cell edge criteria

This clause contains requirements for measurements on intra-frequency NR cells provided that:

- UE is configured with both *lowMobilityEvaluation* [2] criterion and *cellEdgeEvaluation* [2] criterion, and

- has also fulfilled both criteria, and

- less than 1 hour have passed since measurements for cell reselection were last performed

In this case the UE is not required to meet Tdetect,NR\_Intra, Tmeasure,NR\_Intra and Tevaluate,NR\_Intra as defined in Table 4.2.2.3-1.

#### 4.2.2.10 Measurements of inter-frequency NR cells for UE configured with relaxed measurement criterion

##### 4.2.2.10.1 Introduction

This clause contains the requirements for measurements on inter-frequency NR cells when the UE is configured with any of following relaxed measurement criteria:

- Relaxed measurement criterion for UE with low mobility defined in clause 5.2.4.9.1 in [1],

- Relaxed measurement criterion for UE not-at-cell edge defined in clause 5.2.4. 9.2 in [1],

- Both low mobility criterion and not-at-cell edge criterion as defined in clauses 5.2.4. 9.1 and 5.2.4.9.2 in [1] respectively.

##### 4.2.2.10.2 Measurements for UE fulfilling low mobility criterion

This clause contains requirements for measurements on inter-frequency NR cells provided that:

- UE is configured with *lowMobilityEvaluation* [2] criterion and UE has fulfilled, or

- UE is configured with both *lowMobilityEvaluation* [2] and *cellEdgeEvaluation* [2] criterion and *combineRelaxedMeasCondition* [2] not configured, and

- UE has fulfilled only the *lowMobilityEvaluation* [2] criterion.

The UE shall not relax measurements on NR inter-frequency carriers configured for idle mode CA/DC measurements (defined in clause 4.4) while T331 is running.

When Srxlev ≤ SnonIntraSearchP or Squal ≤ SnonIntraSearchQ then the requirements are defined as follows:

- Tdetect,NR\_Inter\_Relaxas specified in Table 4.2.2.10.2-1.

- Tmeasure,NR\_Inter\_Relax as specified in Table 4.2.2.10.2-1.

- Tevaluate,NR\_Inter\_Relax as specified in Table 4.2.2.10.2-1.

- The UE shall be able to evaluate whether a newly detectable inter-frequency NR cell meets the reselection criteria defined in TS38.304 [1] within Ncarrier\_Relax \* Tdetect,NR\_Inter\_Relax + Ncarrier\_Non\_relax \* Tdetect,NR\_Inter. Cells which have been detected shall be measured at least every Ncarrier\_Relax \* Tmeasure,NR\_Inter\_Relax + Ncarrier\_Non\_relax \* Tmeasure,NR\_Inter. The UE shall be able to evaluate that an already identified inter-frequency NR cell has met reselection criterion defined in TS 38.304 [1] within Ncarrier\_Relax \*Tevaluate,NR\_Inter\_Relax + Ncarrier\_Non\_relax \* Tevaluate,NR\_Inter.

- When T331 is running,

- The parameter Ncarrier\_Relax is the total number of NR inter-frequency carriers not configured for idle mode CA/DC measurements.

- The parameter Ncarrier\_Non\_relax is the total number of NR inter-frequency carriers configured for idle mode CA/DC measurements.

- When T331 is not running,

- The parameter Ncarrier\_Relax is the total number of inter-frequency carriers configured for mobility measurements only and the number of inter-frequency carriers configured for both mobility measurement and idle mode CA/DC measurements.

- The parameter Ncarrier\_Non\_relax =0.When Srxlev > SnonIntraSearchP and Squal > SnonIntraSearchQ and the UE is configured with *highPriorityMeasRelax* [2] then the UE shall search for inter-frequency layers of higher priority at least every K2\*Thigher\_priority\_search where Thigher\_priority\_search is described in clause 4.2.2.7 and, K2 = 60. Otherwise if the UE is not configured with *highPriorityMeasRelax* [2] then the UE shall search for inter-frequency layers of higher priority at least every Thigher\_priority\_search where Thigher\_priority\_search is described in clause 4.2.2.7.

Table 4.2.2.10.2-1: Tdetect,NR\_Inter\_Relax, Tmeasure,NR\_Inter\_Relax and Tevaluate,NR\_Inter\_Relax

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **DRX cycle length [s]** | **Scaling Factor (N1)** | | | **Tdetect,NR\_Inter [s] (number of DRX cycles)** | **Tmeasure,NR\_Inter [s] (number of DRX cycles)** | **Tevaluate,NR\_Inter [s] (number of DRX cycles)** |
| **FR1** | **FR2-1Note1** | FR2-2 Note2 |
| 0.32 | 1 | 8 | 12 | 11.52 x N1 x 1.5 (36 x N1 x 1.5) | 1.28 x N1 x 1.5 (4 x N1 x 1.5) | 5.12 x N1 x 1.5 (16 x N1 x 1.5) |
| 0.64 |  | 5 | 8 | 17.92x N1 (28 x N1) | 1.28 x N1 (2 x N1) | 5.12 x N1 (8 x N1) |
| 1.28 |  | 4 | 6 | 32 x N1 (25 x N1) | 1.28 x N1 (1 x N1) | 6.4 x N1 (5 x N1) |
| 2.56 |  | 3 | 5 | 58.88 x N1 (23 x N1) | 2.56 x N1 (1 x N1) | 7.68 x N1 (3 x N1) |
| Note 1: Applies for UE supporting FR2-1 power class 2&3&4. For UE supporting FR2-1 power class 1 or 5, N1 = 8 for all DRX cycle length.  Note 2: Applies for UE supporting FR2-2 power class 2&3. For UE supporting FR2-2 power class 1, N1 = 12 for all DRX cycle length.  Note 3: K1 = 3 is the measurement relaxation factor applicable for UE fulfilling the low mobility. | | | | | | |

##### 4.2.2.10.3 Measurements for UE fulfilling not-at-cell edge criterion

This clause contains requirements for measurements on inter-frequency NR cells provided that:

- UE is configured with *cellEdgeEvaluation* [2] criterion, and UE has fulfilled or

- UE is configured with both *lowMobilityEvaluation* [2] criterion and *cellEdgeEvaluation* [2] criterion and *combineRelaxedMeasCondition* [2] not configured, and

- UE has fulfilled only the *cellEdgeEvaluation* [2] criterion.

The UE shall not relax measurements on NR inter-frequency carriers configured for idle mode CA/DC measurements (defined in clause 4.4) while T331 is running.

When Srxlev ≤ SnonIntraSearchP or Squal ≤ SnonIntraSearchQ then the requirements defined in clause 4.2.2.4 apply for this clause except that:

- Tdetect,NR\_Inter\_Relaxas specified in Table 4.2.2.10.3-1.

- Tmeasure,NR\_Inter\_Relax as specified in Table 4.2.2.10.3-1.

- Tevaluate,NR\_Inter\_Relax as specified in Table 4.2.2.10.3-1.

- The UE shall be able to evaluate whether a newly detectable inter-frequency NR cell meets the reselection criteria defined in TS38.304 [1] within Ncarrier\_Relax \* Tdetect,NR\_Inter\_Relax + Ncarrier\_Non\_relax \* Tdetect,NR\_Inter. Cells which have been detected shall be measured at least every Ncarrier\_Relax \* Tmeasure,NR\_Inter\_Relax + Ncarrier\_Non\_relax \* Tmeasure,NR\_Inter. The UE shall be able to evaluate that an already identified inter-frequency NR cell has met reselection criterion defined in TS 38.304 [1] within Ncarrier\_Relax \* Tevaluate,NR\_Inter\_Relax + Ncarrier\_Non\_relax \* Tevaluate,NR\_Inter.

- When T331 is running,

- The parameter Ncarrier\_Relax is the total number of NR inter-frequency carriers not configured for idle mode CA/DC measurements.

- The parameter Ncarrier\_Non\_relax is the total number of NR inter-frequency carriers configured for idle mode CA/DC measurements.

- When T331 is not running,

- The parameter Ncarrier\_Relax is the total number of inter-frequency carriers configured for mobility measurements only and the number of inter-frequency carriers configured for both mobility measurement and idle mode CA/DC measurements. - The parameter Ncarrier\_Non\_relax =0.

When Srxlev > SnonIntraSearchP and Squal > SnonIntraSearchQ and regardless of whether the UE is configured with *highPriorityMeasRelax* [2] or not, the UE shall search for inter-frequency layers of higher priority at least every Thigher\_priority\_search where Thigher\_priority\_search is described in clause 4.2.2.7

Table 4.2.2.10.3-1: Tdetect,NR\_Inter\_Relax, Tmeasure,NR\_Inter\_Relax and Tevaluate,NR\_Inter\_Relax

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **DRX cycle length [s]** | **Scaling Factor (N1)** | | | **Tdetect,NR\_Inter [s] (number of DRX cycles)** | **Tmeasure,NR\_Inter [s] (number of DRX cycles)** | **Tevaluate,NR\_Inter [s] (number of DRX cycles)** |
| **FR1** | **FR2-1Note1** | FR2-2 Note2 |
| 0.32 | 1 | 8 | 12 | 11.52 x N1 x 1.5 (36 x N1 x 1.5) | 1.28 x N1 x 1.5 (4 x N1 x 1.5) | 5.12 x N1 x 1.5 (16 x N1 x 1.5) |
| 0.64 |  | 5 | 8 | 17.92x N1 (28 x N1) | 1.28 x N1 (2 x N1) | 5.12 x N1 (8 x N1) |
| 1.28 |  | 4 | 6 | 32 x N1 (25 x N1) | 1.28 x N1 (1 x N1) | 6.4 x N1 (5 x N1) |
| 2.56 |  | 3 | 5 | 58.88 x N1 (23 x N1) | 2.56 x N1 (1 x N1) | 7.68 x N1 (3 x N1) |
| Note 1: Applies for UE supporting FR2-1 power class 2&3&4. For UE supporting FR2-1 power class 1 or 5, N1 = 8 for all DRX cycle length.  Note 2: Applies for UE supporting FR2-2 power class 2&3. For UE supporting FR2-2 power class 1, N1 = 12 for all DRX cycle length.  Note 3: K1 = 3 is the measurement relaxation factor applicable for UE fulfilling the *cellEdgeEvaluation* [2] criterion. | | | | | | |

##### 4.2.2.10.4 Measurements for UE fulfilling low mobility and not-at-cell edge criterion

This clause contains requirements for measurements on inter-frequency NR cells provided that:

- T331 timer is not running for EMR measurements on inter-frequency NR carrier, and

- UE is configured with both *lowMobilityEvaluation* [2] criterion and *cellEdgeEvaluation* [2] criterion, and

- Has also fulfilled both criteria

In this case the UE is not required to meet Tdetect,NR\_Inter, Tmeasure,NR\_Inter and Tevaluate,NR\_Inter as defined in Table 4.2.2.4-1.

When Srxlev ≤ SnonIntraSearchP or Squal ≤ SnonIntraSearchQ, the UE shall search for, measure and evaluate inter-frequency layers of higher, equal or lower priority at least every 1 hour.

When Srxlev > SnonIntraSearchP and Squal > SnonIntraSearchQ, the UE shall search for inter-frequency layers of higher priority at least every K2\*Thigher\_priority\_search where Thigher\_priority\_search is described in clause 4.2.2.7 and K2=60.

#### 4.2.2.11 Measurements of inter-RAT E-UTRAN cells for UE configured with relaxed measurement criterion

##### 4.2.2.11.1 Introduction

This clause contains the requirements for measurements on inter-RAT E-UTRAN cells when the UE is configured with any of following relaxed measurement critera:

- Relaxed measurement criterion for UE with low mobility defined in clause 5.2.4.9.1 in [1],

- Relaxed measurement criterion for UE not-at-cell edge defined in clause 5.2.4.9.2 in [1],

- Both low mobility criterion and not-at-cell edge criterion as defined in clauses 5.2.4.9.1 and 5.2.4.9.2 in [1] respectively.

##### 4.2.2.11.2 Measurements for UE fulfilling low mobility criterion

This clause contains requirements for measurements on inter-RAT E-UTRAN cells provided that:

- T331 timer is not running for EMR measurements on inter-RAT E-UTRAN, and

- UE is configured with *lowMobilityEvaluation* [2] criterion and UE has fulfilled, or

- UE is configured with both *lowMobilityEvaluation* [2] criterion and *cellEdgeEvaluation* [2] criterion and *combineRelaxedMeasCondition* [2] not configured, and

- UE has fulfilled only the *lowMobilityEvaluation* [2] criterion.

The UE shall not relax measurements on inter-RAT E-UTRAN carriers configured for idle mode CA/DC measurements (defined in clause 4.4) while T331 is running.

When Srxlev ≤ SnonIntraSearchP or Squal ≤ SnonIntraSearchQ then the requirements defined in clause 4.2.2.5 apply for this clause except that:

- Tdetect,EUTRAN\_Relaxas specified in Table 4.2.2.11.2-1.

- Tmeasure,EUTRAN\_Relax as specified in Table 4.2.2.11.2-1.

- Tevaluate,EUTRAN\_Relax as specified in Table 4.2.2.11.2-1.

- The UE shall be able to evaluate whether a newly detectable inter-RAT E-UTRAN cell meets the reselection criteria defined in TS38.304 [1] within Ncarrier\_Relax \* Tdetect,EUTRAN\_Relax + Ncarrier\_Non\_relax \* Tdetect,EUTRAN. Cells which have been detected shall be measured at least every Ncarrier\_Relax \* Tmeasure,EUTRAN\_Relax + Ncarrier\_Non\_relax \* Tmeasure,EUTRAN. The UE shall be able to evaluate that an already identified inter-RAT E-UTRAN cell has met reselection criterion defined in TS 38.304 [1] within NEUTRAN carrier\_Relax \* Tevaluate,EUTRAN\_Relax + NEUTRAN carrier\_Non\_relax \* Tevaluate,EUTRAN.

- When T331 is running,

- The parameter Ncarrier\_Relax is the total number of inter-RAT E-UTRAN carriers not configured for idle mode CA/DC measurements.

- The parameter Ncarrier\_Non\_relax is the total number of inter-RAT E-UTRAN carriers configured for idle mode CA/DC measurements.

- When T331 is not running,

- The parameter Ncarrier\_Relax is the total number of inter-RAT E-UTRAN carriers configured for mobility measurements only and the number of inter-RAT E-UTRAN carriers configured for both mobility measurement and idle mode CA/DC measurements.

- The parameter Ncarrier\_Non\_relax =0.

When Srxlev > SnonIntraSearchP and Squal > SnonIntraSearchQ and the UE is configured with *highPriorityMeasRelax* [2] then the UE shall search for E-UTRA inter-RAT frequency layers of higher priority at least every K2\*Thigher\_priority\_search seconds where Thigher\_priority\_search is described in clause 4.2.2.7 and, K2 = 60. Otherwise if the UE is not configured with *highPriorityMeasRelax* [2] then the UE shall search for E-UTRA inter-RAT frequency layers of higher priority at least every Thigher\_priority\_search where Thigher\_priority\_search is described in clause 4.2.2.7.

Table 4.2.2.11.2-1: Tdetect,EUTRAN\_Relax, Tmeasure,EUTRAN\_Relax, and Tevaluate,EUTRAN\_Relax

|  |  |  |  |
| --- | --- | --- | --- |
| DRX cycle length [s] | Tdetect,EUTRAN\_Relax [s] (number of DRX cycles) | Tmeasure,EUTRAN\_Relax [s] (number of DRX cycles) | Tevaluate,EUTRAN\_Relax  [s] (number of DRX cycles) |
| 0.32 | 11.52 x K1 (36 x K1) | 1.28 x K1 (4 x K1) | 5.12 x K1 (16 x K1) |
| 0.64 | 17.92 x K1 (28 x K1) | 1.28 x K1 (2 x K1) | 5.12 x K1 (8 x K1) |
| 1.28 | 32 x K1 (25 x K1) | 1.28 x K1 (1 x K1) | 6.4 x K1 (5 x K1) |
| 2.56 | 58.88 x K1 (23 x K1) | 2.56 x K1 (1 x K1) | 7.68 x K1 (3 x K1) |
| Note 1: K1 = 3 is the measurement relaxation factor applicable for UE fulfilling the *lowMobilityEvaluation* [2] criterion. | | | |

##### 4.2.2.11.3 Measurements for UE fulfilling with not-at-cell edge criterion

This clause contains requirements for measurements on inter-RAT E-UTRAN cells provided that:

- T331 timer is not running for EMR measurements on inter-RAT E-UTRAN, and

- UE is configured with *cellEdgeEvaluation* [2] criterion and UE has fulfilled, or

- UE is configured with both *lowMobilityEvaluation* [2] criterion and *cellEdgeEvaluation* [2] criterion and *combineRelaxedMeasCondition* [2] not configured, and

- UE has fulfilled only the *cellEdgeEvaluation* [2] criterion.

The UE shall not relax measurements on inter-RAT E-UTRAN carriers configured for idle mode CA/DC measurements (defined in clause 4.4) while T331 is running.

When Srxlev ≤ SnonIntraSearchP or Squal ≤ SnonIntraSearchQ then the requirements defined in clause 4.2.2.5 apply for this clause except that:

- Tdetect,EUTRAN\_Relaxas specified in Table 4.2.2.11.3-1.

- Tmeasure,EUTRAN\_Relax as specified in Table 4.2.2.11.3-1.

- Tevaluate,EUTRAN\_Relax as specified in Table 4.2.2.11.3-1.

- The UE shall be able to evaluate whether a newly detectable inter-RAT E-UTRAN cell meets the reselection criteria defined in TS38.304 [1] within Ncarrier\_Relax \* Tdetect,EUTRAN\_Relax + Ncarrier\_Non\_relax \* Tdetect,EUTRAN. Cells which have been detected shall be measured at least every Ncarrier\_Relax \* Tmeasure,EUTRAN\_Relax + Ncarrier\_Non\_relax \* Tmeasure,EUTRAN. The UE shall be able to evaluate that an already identified inter-RAT E-UTRAN cell has met reselection criterion defined in TS 38.304 [1] within NEUTRAN carrier\_Relax \* Tevaluate,EUTRAN\_Relax + NEUTRAN carrier\_Non\_relax \* Tevaluate,EUTRAN.

- When T331 is running,

- The parameter Ncarrier\_Relax is the total number of inter-RAT E-UTRAN carriers not configured for idle mode CA/DC measurements.

- The parameter Ncarrier\_Non\_relax is the total number of inter-RAT E-UTRAN carriers configured for idle mode CA/DC measurements.

- When T331 is not running,

- The parameter Ncarrier\_Relax is the total number of inter-RAT E-UTRAN carriers configured for mobility measurements only and the number of inter-RAT E-UTRAN carriers configured for both mobility measurement and idle mode CA/DC measurements.

- The parameter Ncarrier\_Non\_relax =0.

When Srxlev > SnonIntraSearchP and Squal > SnonIntraSearchQ and regardless of whether the UE is configured with *highPriorityMeasRelax* [2] or not, the UE shall search for inter-RAT E-UTRAN frequency layers of higher priority at least every Thigher\_priority\_search where Thigher\_priority\_search is described in clause 4.2.2.7.

Table 4.2.2.11.3-1: Tdetect,EUTRAN\_Relax, Tmeasure,EUTRAN\_Relax, and Tevaluate,EUTRAN\_Relax

|  |  |  |  |
| --- | --- | --- | --- |
| DRX cycle length [s] | Tdetect,EUTRAN [s] (number of DRX cycles) | Tmeasure,EUTRAN [s] (number of DRX cycles) | Tevaluate,EUTRAN  [s] (number of DRX cycles) |
| 0.32 | 11.52 x K1 (36 x K1) | 1.28 x K1 (4 x K1) | 5.12 x K1 (16 x K1) |
| 0.64 | 17.92 x K1 (28 x K1) | 1.28 x K1 (2 x K1) | 5.12 x K1 (8 x K1) |
| 1.28 | 32 x K1 (25 x K1) | 1.28 x K1 (1 x K1) | 6.4 x K1 (5 x K1) |
| 2.56 | 58.88 x K1 (23 x K1) | 2.56 x K1 (1 x K1) | 7.68 x K1 (3 x K1) |
| Note 1: K1 = 3 is the measurement relaxation factor applicable for UE fulfilling the *cellEdgeEvaluation* [2] criterion. | | | |

##### 4.2.2.11.4 Measurements for UE fulfilling low mobility and not-at-cell edge criterion

This clause contains requirements for measurements on inter-RAT E-UTRAN cells provided that:

- T331 timer is not running for EMR measurements on inter-RAT E-UTRAN, and

- UE is configured with both *lowMobilityEvaluation* [2] criterion and *cellEdgeEvaluation* [2] criterion, and

- has also fulfilled both criteria

In this case the UE is not required to meet Tdetect,EUTRAN , Tmeasure,EUTRAN and Tevaluate,EUTRAN as defined in Table 4.2.2.5-1.

When Srxlev ≤ SnonIntraSearchP or Squal ≤ SnonIntraSearchQ, the UE shall search for, measure and evaluate inter-RAT E-UTRAN layers of higher or lower priority at least every 1 hour.

When Srxlev > SnonIntraSearchP and Squal > SnonIntraSearchQ, the UE shall search for inter-RAT E-UTRAN of higher priority at least every K2\*Thigher\_priority\_search where Thigher\_priority\_search is described in clause 4.2.2.7 and K2=60.

## 4.2A Cell Re-selection when subject to CCA

### 4.2A.1 Introduction

The cell reselection procedure allows the UE to select a more suitable cell and camp on it. The requirements in clauses 4.2A.2.3, 4.2A.2.4, and 4.2A.2.6, apply when at least the target cell is on a carrier frequency subject to CCA, and the requirements in clauses 4.2A.2.2, and 4.2A.2.5 apply when at least the camping cell is on a carrier frequency subject to CCA.

When the UE is in either *Camped* *Normally* state or *Camped on Any Cell* state on a cell, the UE shall attempt to detect, synchronise, and monitor intra-frequency, inter-frequency and inter-RAT cells indicated by the serving cell. For intra-frequency and inter-frequency cells the serving cell may not provide explicit neighbour list but carrier frequency information and bandwidth information only. UE measurement activity is also controlled by measurement rules defined in TS 38.304, allowing the UE to limit its measurement activity.

In the requirements of clause 4.2A, the exceptions for side conditions apply as follows:

- for the UE capable of CA, the applicable exceptions for side conditions are specified in Annex B, clause B.x.y for UE supporting CA in FR1.

In the requirements of clause 4.2A.2, the term SMTC occasion not available at the UE refers to when the SMTC contains SSBs configured by gNB in a cell on a carrier frequency subject to CCA, but *N* candidate SSB positions for the same SS/PBCH block index within the discovery burst transmission window are not available at the UE due to DL CCA failures at gNB during the corresponding detection, measurement, or evaluation period, where:

- For the cell detection procedure: *N* is at least one candidate SSB position (NOTE: the one candidate SSB position for the cell detection shall not be impacted by the set of candidate SSB positions which are already being measured by the UE within the current measurement period of the on-going measurements), and

- For other procedures in clause 4.2A.2: *N* are the first two successive candidate SSB positions when two or more candidate SSB positions are configured for this SSB index in one discovery burst transmission window, otherwise N is one candidate SSB position;

otherwise the SMTC occasion is considered as available at the UE.

### 4.2A.2 Requirements

#### 4.2A.2.1 UE measurement capability

For idle mode cell re-selection purposes, the UE shall be capable of monitoring at least:

- Intra-frequency carrier, and

- Depending on UE capability, 7 NR inter-frequency carriers, and

- Depending on UE capability, 7 FDD E-UTRA inter-RAT carriers, and

- Depending on UE capability, 7 TDD E-UTRA inter-RAT carriers.

In addition to the requirements defined above, a UE supporting E-UTRA measurements in RRC\_IDLE state shall be capable of monitoring a total of at least 14 carrier frequency layers, which includes serving layer, comprising of any above defined combination of E-UTRA FDD, E-UTRA TDD and NR layers. The inter-frequency carriers include carriers on unlicensed band and/or licensed band.

#### 4.2A.2.2 Measurement and evaluation when subject to CCA on the serving cell

The UE shall measure the SS-RSRP and SS-RSRQ level of the serving cell and evaluate the cell selection criterion S defined in TS 38.304 [1] for the serving cell at least once every (1+Mn)\*M1\*N1 DRX cycles in Nserv\_CCA consecutive DRX cycles; where:

- M1=2 if SMTC periodicity (TSMTC) > 20 ms and DRX cycle ≤ 0.64 second,

- otherwise M1=1.

- N1\*Mn is the maximum separation in DRX cycles between two measurements that are used for filtering.

The UE shall filter the SS-RSRP and SS-RSRQ measurements of the serving cell using at least 2 measurements. Within the set of measurements used for the filtering, at least two measurements shall be spaced by, at least DRX cycle/2 but not separated in time by more than N1\*Mn, where Mn=2.

If the UE has evaluated according to Table 4.2A.2.2-1 in Nserv\_CCA consecutive DRX cycles that the serving cell does not fulfil the cell selection criterion S, the UE shall initiate the measurements of all neighbour cells indicated by the serving cell, regardless of the measurement rules currently limiting UE measurement activities.

UE shall initiate measurements on neighbour cells indicated by the serving cell if it is unable to measure on the serving cell for at least N1\*Mp consecutive number of DRX cycles each with at least one SMTC occasion not available at the UE, where Mp=4 when DRX cycle length <1.28 s, Mp=2 when DRX cycle length ≥1.28 s.

UE shall initiate the measurements on neighbour cells of any intra-frequency or inter-frequency if it is unable to measure on serving cell during at least consecutive N1\*Mq number of DRX cycles each with at least one SMTC occasion not available at the UE, regardless of any condition of SnonIntraSearchP and SnonIntraSearchQ, where Mq=8 when DRX cycle length <1.28 s, Mq=4 when DRX cycle length ≥1.28 s.

If the UE in RRC\_IDLE has not found any new suitable cell based on searches and measurements using the intra-frequency, inter-frequency and inter-RAT information indicated in the system information for 10 s, the UE shall initiate cell selection procedures for the selected PLMN as defined in TS 38.304 [1].

Table 4.2A.2.2-1: Nserv\_CCA

|  |  |  |  |
| --- | --- | --- | --- |
| DRX cycle length [s] | Scaling Factor (N1) | | **Nserv\_CCA [number of DRX cycles]** |
| FR1 | FR2-2 Note 3 |
| 0.32 | 1 | 12 | N1\*M1\*(4+ Ms) |
| 0.64 |  | 8 | N1\*M1\*(4+ Ms) |
| 1.28 |  | 6 | N1\*(2+Ms) |
| 2.56 |  | 5 | N1\*(2+Ms) |
| Note 1: Ms is the number of groups of consecutive N1 DRX cycles each group with at least one SMTC occasion not available at the UE during Nserv\_CCA, and Ms< Ms,max  Note 2: Ms,max=8 for DRX cycle length < 1.28 s, Ms,max= 4 for DRX cycle length ≥ 1.28 s.  Note 3: Applies for UE supporting FR2-2 power class 2&3. For UE supporting FR2-2 power class 1, N1 = 12 for all DRX cycle length. | | | |

The UE shall restart the measurements used for serving cell evaluation if Ms exceeds Ms,max.

#### 4.2A.2.3 Measurements of intra-frequency NR cells when subject to CCA on the serving cell and target cell

The UE shall be able to identify new intra-frequency cells with CCA and perform SS-RSRP and SS-RSRQ measurements of the identified intra-frequency cells without an explicit intra-frequency neighbour list containing physical layer cell identities.

When the intra-frequency measurement is performed on a neighbour cell in FR2-2 with shared spectrum channel access, UE shall determine the CCA mode of the neighbour cell according to *channelAccessMode2-r17*of the cell configured in *SIB3*. If *channelAccessMode2-r17* of the cell is enabled, UE shall assume that CCA applies to the cell and perform measurement accordingly, and the requirements in clause 4.2A.2.3 shall apply; otherwise, UE shall assume that CCA does not apply to the cell and perform measurement accordingly, and requirements in 4.2.2.3 shall apply.

The UE shall be able to evaluate whether a newly detectable intra-frequency cell meets the reselection criteria defined in TS38.304 within Tdetect,NR\_Intra\_CCAwhen that Treselection= 0. An intra frequency cell is considered to be detectable according to the conditions defined in Annex B. 2. 8 for a corresponding Band.

The UE shall measure SS-RSRP and SS-RSRQ at least every Tmeasure,NR\_Intra\_CCA (see table 4.2A.2.3-1) for intra-frequency cells that are identified and measured according to the measurement rules. For a cell that is already identified, after 2 unsuccessful measurement attempts due to exceeding the maximum number of SMTC occasions not available at the UE, the UE shall detect cells on any of the configured serving- and/or non-serving carriers.

The UE shall filter SS-RSRP and SS-RSRQ measurements of each measured intra-frequency cell using at least 2 measurements. Within the set of measurements used for the filtering, at least two measurements shall be spaced by at least Tmeasure,NR\_Intra\_CCA/2.

The UE shall not consider a NR neighbour cell in cell reselection, if it is indicated as not allowed in the measurement control system information of the serving cell.

For an intra-frequency cell that has been already detected, but that has not been reselected to, the filtering shall be such that the UE shall be capable of evaluating that the intra-frequency cell has met reselection criterion defined [1] within Tevaluate,NR\_Intra\_CCA when Treselection = 0as specified in table 4.2A.2.3-1 provided that:

when *rangeToBestCell* is not configured:

- the cell is at least 3dB better ranked in FR1 or [4.5]dB better ranked in FR2-2.

when *rangeToBestCell* is configured:

- the cell has the highest number of beams above the threshold *absThreshSS-BlocksConsolidation* among all detected cells whose cell-ranking criterion R value [1] is within *rangeToBestCell* of the cell-ranking criterion R value of the highest ranked cell.

- if there are multiple such cells, the cell has the highest rank among them.

- the cell is at least 3dB better ranked in FR1 or [4.5]dB better ranked in FR2-2 if the current serving cell is among them.

When evaluating cells for reselection, the SSB side conditions apply to both serving and non-serving intra-frequency cells.

If Treselection timer has a non-zero value and the intra-frequency cell is satisfied with the reselection criteria, which are defined in TS38.304 [1], the UE shall evaluate this intra-frequency cell for the Treselection time. If this cell remains satisfied with the reselection criteria within this duration, then the UE shall reselect that cell.

Table 4.2A.2.3-1: Tdetect,NR\_Intra\_CCA, Tmeasure,NR\_Intra\_CCA and Tevaluate,NR\_Intra\_CCA

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| DRX cycle length [s] | Scaling Factor (N1) | | Tdetect,NR\_Intra\_CCA [s] (number of DRX cycles) | Tmeasure,NR\_Intra\_CCA [s] (number of DRX cycles) | Tevaluate,NR\_Intra\_CCA  [s] (number of DRX cycles) |
| **FR1** | **FR2-2 Note 5** |
| 0.32 | 1 | 12 | 0.32xN1x(36+Md)xM2  {(36+Md)xN1xM2} | 0.32xN1x(4+Mm)xM2  {(4+Mm)xN1 xM2 | 0.32xN1x(16+Me) x M2  {(16+Me)xN1xM2} |
| 0.64 |  | 8 | 0.64xN1x(28+Md)  {(28+Md)xN1 } | 0.64xN1x(2+Mm)  {(2+Mm)xN1 } | 0.64xN1x(8+Me)  {(8+Me)xN1 } |
| 1.28 |  | 6 | 1.28xN1x(25+Md)  {(25+Md)xN1 } | 1.28xN1x(1+Mm)  {(1+Mm)xN1 } | 1.28xN1x(5+Me)  {(5+Me)xN1 } |
| 2.56 |  | 5 | 2.56xN1x(23+Md)  {(23+Md)xN1 } | 2.56xN1x(1+Mm)  {(1+Mm)xN1 } | 2.56xN1x(3+Me)  {(3+Me)xN1 } |
| Note 1: M2 = 1.5 if SMTC periodicity of measured intra-frequency cell > 20 ms; otherwise M2=1.  Note 2: Md, Mm, Me are the number of groups of consecutive N1 DRX cycles each group with at least one SMTC occasion not available during the Tdetect,NR\_Intra\_CCA, Tmeasure,NR\_Intra\_CCA and Tevaluate,NR\_Intra\_CCA, and Mm ≤ Mm,max, Md ≤ Md,max and Me ≤  Me,max  Note 3: Mm,max = 16 for DRX cycle length = 0.32s; Mm,max = 8 for DRX cycle length = 0.64s; Mm,max = 4 for DRX cycle length = 1.28s; Mm,max = 4 for DRX cycle length = 2.56s.  Note 4: Md,max = 4\*Mm,max, Me,max = 2\*Mm,max.  Note 5: Applies for UE supporting FR2-2 power class 2&3. For UE supporting FR2-2 power class 1, N1 = 12 for all DRX cycle length. | | | | | |

The UE shall restart the measurements upon exceeding Mm,max, Md,max, or Me,max.

#### 4.2A.2.4 Measurements of inter-frequency NR cells when subject to CCA on the target cell

The UE shall be able to identify new inter-frequency cells and perform SS-RSRP or SS-RSRQ measurements of identified inter-frequency cells if carrier frequency information is provided by the serving cell, even if no explicit neighbour list with physical layer cell identities is provided.

When the inter-frequency measurement is performed on a neighbour cell in FR2-2 with shared spectrum channel access, UE shall determine the CCA mode of the neighbour cell according to *channelAccessMode2-r17*of the cell configured in *SIB4*. If *channelAccessMode2-r17* of the cell is enabled, UE shall assume that CCA applies to the cell and perform measurement accordingly, and the requirements in clause 4.2A.2.4 shall apply; otherwise, UE shall assume that CCA does not apply to the cell and perform measurement accordingly, and requirements in 4.2.2.4 shall apply.

If Srxlev > SnonIntraSearchP  and Squal > SnonIntraSearchQ then the UE shall search for inter-frequency layers of higher priority at least every Thigher\_priority\_search where Thigher\_priority\_search is described in clause 4.2A.2.7.

If Srxlev ≤ SnonIntraSearchP or Squal ≤ SnonIntraSearchQ then the UE shall search for and measure inter-frequency layers of higher, equal or lower priority in preparation for possible reselection. In this scenario, the minimum rate at which the UE is required to search for and measure higher priority layers shall be the same as that defined below in this clause.

The UE shall be able to evaluate whether a newly detectable inter-frequency cell meets the reselection criteria defined in TS38.304 within Kcarrier \* Tdetect,NR\_Inter + Kcarrier\_CCA \* Tdetect,NR\_Inter\_CCA if at least carrier frequency information is provided for inter-frequency neighbour cells by the serving cells when Treselection = 0 provided that the reselection criteria is met by a margin of at least 5 dB in FR1 or [6.5]dB in FR2-2 for reselections based on ranking or 6dB in FR1 or [7.5]dB in FR2-2 for SS-RSRP reselections based on absolute priorities or 4dB in FR1 and [4]dB in FR2-2 for SS-RSRQ reselections based on absolute priorities. The parameter Kcarrier is the number of NR inter-frequency carriers on licensed band and Kcarrier\_CCA is the number of NR inter-frequency carriers on unlicensed band indicated by the serving cell. An inter-frequency cell is considered to be detectable according to the conditions defined in Annex B. 2. 9 for a corresponding Band.

When higher priority cells are found by the higher priority search, they shall be measured at least every Tmeasure,NR\_Inter\_CCA. If after detecting a cell in a higher priority search, it is determined that reselection has not occurred then the UE is not required to continuously measure the detected cell to evaluate the ongoing possibility of reselection. However, the minimum measurement filtering requirements specified later in this clause shall still be met by the UE before it makes any determination that it may stop measuring the cell. If the UE detects on a NR carrier a cell whose physical identity is indicated as not allowed for that carrier in the measurement control system information of the serving cell, the UE is not required to perform measurements on that cell.

The UE shall measure SS-RSRP or SS-RSRQ at least every Kcarrier \* Tmeasure,NR\_Inter + Kcarrier\_CCA \* Tmeasure,NR\_Inter\_CCA for identified lower or equal priority inter-frequency cells. If the UE detects on a NR carrier a cell whose physical identity is indicated as not allowed for that carrier in the measurement control system information of the serving cell, the UE is not required to perform measurements on that cell.

For a cell that is already identified, after 2 unsuccessful measurement attempts due to exceeding the maximum number of SMTC occasions not available at the UE, the UE shall detect cells on any of the configured serving- and/or non-serving carriers.

The UE shall filter SS-RSRP or SS-RSRQ measurements of each measured higher, lower and equal priority inter-frequency cell using at least 2 measurements. Within the set of measurements used for the filtering, at least two measurements shall be spaced by at least Tmeasure,NR\_Inter\_CCA/2.

The UE shall not consider a NR neighbour cell in cell reselection, if it is indicated as not allowed in the measurement control system information of the serving cell.

For an inter-frequency cell that has been already detected, but that has not been reselected to, the filtering shall be such that the UE shall be capable of evaluating that the inter-frequency cell has met reselection criterion defined TS 38.304 within Kcarrier \* Tevaluate,NR\_Inter + Kcarrier\_CCA \* Tevaluate,NR\_Inter\_CCA when Treselection = 0as specified in table 4.2A.2.4-1 provided that the reselection criteria is met by

- the condition when performing equal priority reselection and

when *rangeToBestCell* is not configured:

- the cell is at least 5dB better ranked in FR1 or [6.5]dB better ranked in FR2-2 or.

when *rangeToBestCell* is configured:

- the cell has the highest number of beams above the threshold *absThreshSS-BlocksConsolidation* among all detected cells whose cell-ranking criterion R value [1] is within *rangeToBestCell* of the cell-ranking criterion R value of the highest ranked cell.

- if there are multiple such cells, the cell has the highest rank among them

- the cell is at least 5dB better ranked in FR1 or [6.5]dB better ranked in FR2-2 if the current serving cell is among them. or

- 6dB in FR1 or [7.5]dB in FR2-2 for SS-RSRP reselections based on absolute priorities or

- 4dB in FR1 or [4]dB in FR2-2 for SS-RSRQ reselections based on absolute priorities.

When evaluating cells for reselection, the SSB side conditions apply to both serving and inter-frequency cells.

If Treselection timer has a non zero value and the inter-frequency cell is satisfied with the reselection criteria, the UE shall evaluate this inter-frequency cell for the Treselection time. If this cell remains satisfied with the reselection criteria within this duration, then the UE shall reselect that cell.

The UE is not expected to meet the measurement requirements for an inter-frequency carrier under DRX cycle=320 ms defined in Table 4.2A.2.4-1 under the following conditions:

- TSMTC\_intra = TSMTC\_inter = 160 ms; where TSMTC\_intra and TSMTC\_inter are periodicities of the SMTC occasions configured for the intra-frequency carrier and the inter-frequency carrier respectively, and

- SMTC occasions configured for the inter-frequency carrier occur up to 1 ms before the start or up to 1 ms after the end of the SMTC occasions configured for the intra-frequency carrier, and

- SMTC occasions configured for the intra-frequency carrier and for the inter-frequency carrier occur up to 1 ms before the start or up to 1 ms after the end of the paging occasion [1].

Table 4.2A.2.4-1: Tdetect,NR\_Inter\_CCA, Tmeasure,NR\_Inter\_CCA and Tevaluate,NR\_Inter\_CCA

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| DRX cycle length [s] | Scaling Factor (N1) | | Tdetect,NR\_Inter\_CCA [s] (number of DRX cycles) | Tmeasure,NR\_Inter\_CCA [s] (number of DRX cycles) | Tevaluate,NR\_Inter\_CCA  [s] (number of DRX cycles) |
| **FR1** | **FR2-2Note 5** |
| 0.32 | 1 | 12 | 0.32xN1x(36+Md)xM2  {(36+Md)xN1xM2} | 0.32xN1x(4+Mm) xM2  {(4+Mm)xN1xM2} | 0.32xN1x(16+Me) x M2  {(16+Me)xN1 xM2} |
| 0.64 |  | 8 | 0.64xN1x(28+Md)  {(28+Md)xN1 } | 0.64xN1x(2+Mm)  {(2+Mm)xN1 } | 0.64xN1x(8+Me)  {(8+Me)xN1 } |
| 1.28 |  | 6 | 1.28xN1x(25+Md)  {(25+Md)xN1 } | 1.28xN1x(1+Mm)  {(1+Mm)xN1 } | 1.28xN1x(5+Me)  {(5+Me)xN1} |
| 2.56 |  | 5 | 2.56xN1x(23+Md)  {(23+Md)xN1 } | 2.56xN1x(1+Mm)  {(1+Mm)xN1 } | 2.56xN1x(3+Me)  {(3+Me)xN1} |
| Note 1: M2 = 1.5 if SMTC periodicity of measured intra-frequency cell > 20 ms; otherwise M2=1.  Note 2: Md, Mm, Me are the number of groups of consecutive N1 DRX cycles each group with at least one SMTC occasion not available at the UE during Tdetect,NR\_Inter\_CCA, Tmeasure,NR\_Inter\_CCA and Tevaluate,NR\_Inter\_CCA, and M m ≤ Mm,max, Md ≤ Md,max and Me ≤  Me,max  Note 3: Mm,max = 16 for DRX cycle length = 0.32s;  Mm,max = 8 for DRX cycle length = 0.64s;  Mm,max = 4 for DRX cycle length = 1.28s;  Mm,max = 4 for DRX cycle length = 2.56s  Note 4: Md,max = 4\*Mm,max, Me,max = 2\*Mm,max.  Note 5: Applies for UE supporting FR2-2 power class 2&3. For UE supporting FR2-2 power class 1, N1 = 12 for all DRX cycle length. | | | | | |

The UE shall restart the measurements upon exceeding Mm,max, Md.max, or Me,max.

#### 4.2A.2.5 Measurements of inter-RAT E-UTRAN cells when subject to CCA on the serving cell

The requirements in clause 4.2.2.5 shall apply.

#### 4.2A.2.6 Maximum interruption in paging reception when subject to CCA on the target cell

UE shall perform the cell re-selection with minimum interruption in monitoring downlink channels for paging reception.

At intra-frequency and inter-frequency cell re-selection, the UE shall monitor the downlink of serving cell for paging reception until the UE is capable to start monitoring downlink channels of the target intra-frequency and inter-frequency cell for paging reception. The interruption time shall not exceed TSI,CCA + 2\*Ttarget\_cell\_SMTC\_period.

At inter-RAT cell re-selection, the UE shall monitor the downlink of serving cell for paging reception until the UE is capable to start monitoring downlink channels for paging reception of the target inter-RAT cell. For NR to E-UTRAN cell re-selection the interruption time shall not exceed TSI-EUTRA + 55 ms.

TSI\_CCA is the time required for receiving all the relevant system information data according to the reception procedure and the RRC procedure delay of system information blocks defined in TS 38.331 [2] for an NR cell.

TSI-EUTRA is the time required for receiving all the relevant system information data according to the reception procedure and the RRC procedure delay of system information blocks defined in TS 36.331 [16] for an E-UTRAN cell.

These requirements assume sufficient radio conditions, so that decoding of system information can be made without errors and does not take into account cell re-selection failure.

#### 4.2A.2.7 General requirements

The requirements in clause 4.2.2.7 shall apply.

## 4.2B Cell Re-selection for RedCap

### 4.2B.1 Introduction

The terms SSB and SMTC in this clause apply to CD-SSB only if not specified otherwise.

The 1 Rx RedCap UE for performing the cell reselection procedure [1] applies:

*- Qrxlevmin* as the signaled value of *Qrxlevmin* [2] -1 dB.

*- Qqualmin* as the signaled value of *Qqualmin* [2] -1 dB.

### 4.2B.2 Requirements

#### 4.2B.2.1 UE measurement capability for RedCap

##### 4.2B.2.1.1 UE measurement capability for 1 Rx RedCap

For idle mode cell re-selection purposes, and for UE supporting *IdleInactiveMeasurements-r16* or *idleInactiveEUTRA-MeasReport-r16*, the UE shall be capable of monitoring at least:

- Intra-frequency carrier, and

- Depending on UE capability, 6 NR inter-frequency carriers, and

- Depending on UE capability, 6 FDD E-UTRA inter-RAT carriers, and

- Depending on UE capability, 6 TDD E-UTRA inter-RAT carriers.

In addition to the requirements defined above, a UE supporting E-UTRA measurements in RRC\_IDLE state shall be capable of monitoring a total of at least 11 carrier frequency layers, which includes serving layer, comprising of any above defined combination of E-UTRA FDD, E-UTRA TDD and NR layers.

##### 4.2B.2.1.2 UE measurement capability for 2 Rx RedCap

The capability defined in section 4.2.2.1 apply for this section.

#### 4.2B.2.2 Measurement and evaluation of serving cell for RedCap UE

The UE shall measure the SS-RSRP and SS-RSRQ level of the serving cell and evaluate the cell selection criterion S defined in TS 38.304 [1] for the serving cell at least once every M1\*N1 DRX cycle; where:

- M1=2 if SMTC periodicity (TSMTC) > 20 ms and DRX cycle ≤ 0.64 second,

- otherwise M1=1.

The UE shall filter the SS-RSRP and SS-RSRQ measurements of the serving cell using at least 2 measurements. Within the set of measurements used for the filtering, at least two measurements shall be spaced by, at least DRX cycle/2.

If the UE is not configured with eDRX\_IDLE cycle and the UE has evaluated according to Table 4.2B.2.2-1 for both 1Rx RedCap and 2Rx RedCap in Nserv\_RedCap consecutive DRX cycles that the serving cell does not fulfil the cell selection criterion S, the UE shall initiate the measurements of all neighbour cells indicated by the serving cell, regardless of the measurement rules currently limiting UE measurement activities. . In this case the UE shall not relax measurements on any of the neighbour cells even if UE has fulfilled the criteria for meeting the relaxed measurement requirements defined clauses 4.2B.2.9.3, 4.2B.2.9.5, 4.2B.2.9.6, 4.2B.2.9.7, 4.2B.2.10.3, 4.2B.2.10.5, 4.2B.2.10.6, 4.2B.2.10.7, 4.2B.2.11.3, 4.2B.2.11.5, 4.2B.2.11.6, and 4.2B.2.11.7.

If the UE is configured with eDRX\_IDLE cycle and has evaluated according Nserv\_RedCap consecutive DRX cycles within a single PTW that the serving cell does not fulfil the cell selection criterion S, the UE shall initiate the measurements of all neighbour cells indicated by the serving cell, regardless of the measurement rules currently limiting UE measurement activities. In this case the UE shall not relax measurements on any of the neighbour cells even if UE has fulfilled the criteria for meeting the relaxed measurement requirements defined clauses 4.2B.2.9.3, 4.2B.2.9.5, 4.2B.2.9.6, 4.2B.2.9.7, 4.2B.2.10.3, 4.2B.2.10.5, 4.2B.2.10.6, 4.2B.2.10.7, 4.2B.2.11.3, 4.2B.2.11.5, 4.2B.2.11.6, and 4.2B.2.11.7.

For the UE configured with eDRX\_IDLE cycle, Nserv\_RedCap is specified in Table 4.2B.2.2-2 for 1 Rx RedCap and 2 Rx RedCap in FR1 and in Table 4.2B.2.2-3 for FR2 for 2 Rx RedCap.

If the UE in RRC\_IDLE has not found any new suitable cell based on searches and measurements using the intra-frequency, inter-frequency and inter-RAT information indicated in the system information during the time T, the UE shall initiate cell selection procedures for the selected PLMN as defined in TS 38.304 [1], where

- T= 10 s if the UE is not configured with eDRX\_IDLE cycle, or

- T= MAX (10 s, one eDRX\_IDLE cycle) if the UE is configured with eDRX\_IDLE cycle in FR1, or

- T= MAX (10 s, N1\* eDRX\_IDLE cycle) if the UE is configured with eDRX\_IDLE cycle less than 20.48s in FR2,

- Otherwise, T= MAX (10 s, one eDRX\_IDLE cycle) if the UE is configured with eDRX\_IDLE cycle no less than 20.48 s in FR2

Table 4.2B.2.2-1: Nserv\_RedCap

|  |  |  |  |
| --- | --- | --- | --- |
| DRX cycle length [s] | Scaling Factor (N1) | | Nserv\_RedCap [number of DRX cycles] |
|  | FR1 | FR2Note1 |  |
| 0.32 | 1 | 8 | M1\*N1\*4 |
| 0.64 |  | 5 | M1\*N1\*4 |
| 1.28 |  | 4 | N1\*2 |
| 2.56 |  | 3 | N1\*2 |
| Note 1: Applies for RedCap UE of all FR2 power class. | | | |

Table 4.2B.2.2-2: Nserv\_RedCap for UE configured with eDRX\_IDLE cycle (Frequency range FR1)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| eDRX\_IDLE cycle length [s] | DRX cycle length [s] | PTW length [s] (number of 1.28s periods) | Scaling Factor (N1) | Nserv\_RedCap [number of DRX or eDRX cycles Note 3] |
| 2.56 | N/A | N/A | 1 | N1\*2 |
| 5.12 | N/A | N/A | N1\*2 |
| 10.24 | N/A | N/A | N1\*2 |
| 20.48 ≤ eDRX\_IDLE cycle length ≤10485.76 | 0.32 | ≥[1.28] (1) | N1\*M1\*2 |
| 0.64 | ≥ 1.28 (1) (M1=1) or ≥ 2.56 (2) (M1=2) | N1\*M1\*2 |
| 1.28 | ≥2.56 (2) | N1\*2 |
| 2.56 | ≥5.12 (4) | N1\*2 |
| NOTE 1: The number of DRX cycles in this table is given for the DRX cycles within PTWs.  NOTE 2: The eDRX\_IDLE cycle lengths are as specified in Section 10.5.5.32 of TS 24.008 [34].  NOTE 3: Number of eDRX cycles when eDRX\_IDLE cycle length equals 2.56s, 5.12s and 10.24s. Otherwise, number of DRX cycles.  NOTE 4: The lower bound of PTW length is derived based on . | | | | |

Table 4.2B.2.2-3: Nserv\_RedCap for UE configured with eDRX\_IDLE cycle (Frequency range FR2)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| eDRX\_IDLE cycle length [s] | DRX cycle length [s] | PTW length [s] (number of 1.28s periods) | Scaling Factor (N1) Note1 | Nserv\_RedCap [number of DRX or eDRX cycles Note 4] |
| 2.56 | N/A | N/A | 3 | N1\*2 |
| 5.12 | N/A | N/A | 3 | N1\*2 |
| 10.24 | N/A | N/A | 3 | N1\*2 |
| 20.48 ≤ eDRX\_IDLE cycle length ≤10485.76 | 0.32 | ≥5.12 (4) | 8 | N1\*2 |
| 0.64 | ≥6.4 (5) | 5 | N1\*2 |
| 1.28 | ≥10.24 (8) | 4 | N1\*2 |
| 2.56 | ≥15.36 (12) | 3 | N1\*2 |
| NOTE 1: Applies for RedCap UE of all FR2 power class.  NOTE 2: The number of DRX cycles in this table is given for the DRX cycles within PTWs.  NOTE 3: The eDRX\_IDLE cycle lengths are as specified in Section 10.5.5.32 of TS 24.008 [34].  NOTE 4: Number of eDRX cycles when eDRX\_IDLE cycle length equals 2.56s, 5.12s and 10.24s. Otherwise, number of DRX cycles.  NOTE 5: The lower bound of PTW length is derived based on .  NOTE 6: When eDRX=20.48s and DRX=0.32s, UE is allowed to perform cell evaluation within PTW in every 2 eDRX cycles. | | | | |

For any requirement in this section, when the UE transitions between any two states when being configured with eDRX\_IDLE, being configured with eDRX\_IDLE cycle, changing eDRX\_IDLE cycle length, or changing PTW configuration, the UE shall meet the transition requirement, which is the less stringent requirement of the two requirements corresponding to the first state and the second state, during the transition time interval which is the time corresponding to the transition requirement. After the transition time interval, the UE shall meet the requirement corresponding to the second state.

#### 4.2B.2.3 Measurements of intra-frequency NR cells for RedCap UE

The UE shall be able to identify new intra-frequency cells and perform SS-RSRP and SS-RSRQ measurements of the identified intra-frequency cells without an explicit intra-frequency neighbour list containing physical layer cell identities.

The UE shall be able to evaluate whether a newly detectable intra-frequency cell meets the reselection criteria defined in TS 38.304 [1] within Tdetect,NR\_Intra\_RedCapwhen that Treselection= 0. An intra frequency cell is considered to be detectable according to the conditions defined in Annex B.1.4 for a corresponding Band.

The UE shall measure SS-RSRP and SS-RSRQ at least every Tmeasure,NR\_Intra\_RedCap for intra-frequency cells that are identified and measured according to the measurement rules.

The UE shall filter SS-RSRP and SS-RSRQ measurements of each measured intra-frequency cell using at least 2 measurements. Within the set of measurements used for the filtering, at least two measurements shall be spaced by at least Tmeasure,NR\_Intra\_RedCap/2.

The UE shall not consider a NR neighbour cell in cell reselection, if it is indicated as not allowed in the measurement control system information of the serving cell.

For an intra-frequency cell that has been already detected, but that has not been reselected to, the filtering shall be such that the UE shall be capable of evaluating that the intra-frequency cell has met reselection criterion defined in TS 38.304 [1] within Tevaluate,NR\_Intra\_RedCap when Treselection = 0 provided that:

when *rangeToBestCell* is not configured:

- the cell is at least 3dB better ranked in FR1 or 4.5dB better ranked in FR2 for 2 Rx RedCap.

- the cell is at least 4dB better ranked in FR1 for 1 Rx RedCap.

when *rangeToBestCell* is configured:

- the cell has the highest number of beams above the threshold *absThreshSS-BlocksConsolidation* among all detected cells whose cell-ranking criterion R value in TS 38.304 [1] is within *rangeToBestCell* of the cell-ranking criterion R value of the highest ranked cell.

- if there are multiple such cells, the cell has the highest rank among them.

- the cell is at least 3dB better ranked in FR1 or 4.5dB better ranked in FR2 if the current serving cell is among them for 2 Rx RedCap.

- the cell is at least 4dB better ranked in FR1 if the current serving cell is among them for 1 Rx RedCap.

The 1 Rx RedCap UE applies *absThreshSS-BlocksConsolidation* as the signaled value of *absThreshSS-BlocksConsolidation* [2] + 1 dB.

When evaluating cells for reselection, the SSB side conditions apply to both serving and non-serving intra-frequency cells.

If Treselection timer has a non-zero value and the intra-frequency cell is satisfied with the reselection criteria which are defined in TS 38.304 [1], the UE shall evaluate this intra-frequency cell for the Treselection time. If this cell remains satisfied with the reselection criteria within this duration, then the UE shall reselect that cell.

For both 1Rx RedCap and 2Rx RedCap not configured with eDRX\_IDLE cycle, Tdetect,NR\_Intra\_RedCap, Tmeasure,NR\_Intra\_RedCap and Tevaluate,NR\_Intra\_RedCap are specified in Table 4.2B.2.3-1

For 1 Rx RedCap and 2 Rx RedCap configured with eDRX\_IDLE cycle, Tdetect,NR\_Intra\_RedCap, Tmeasure,NR\_Intra\_RedCap and Tevaluate,NR\_Intra\_RedCap are specified in Table 4.2B.2.3-2 and Table 4.2B.2.3-3 for FR1 and FR2 respectively, where the requirements apply provided that the serving cell is configured with eDRX\_IDLE and is the same in all PTWs during any of Tdetect,NR\_Intra\_RedCap, Tmeasure,NR\_Intra\_RedCap and Tevaluate,NR\_Intra\_RedCap when multiple PTWs are used.

Table 4.2B.2.3-1: Tdetect,NR\_Intra\_RedCap, Tmeasure,NR\_Intra\_RedCap and Tevaluate,NR\_Intra\_RedCap

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| DRX cycle length [s] | Scaling Factor (N1) | | Tdetect,NR\_Intra\_RedCap [s] (number of DRX cycles) | Tmeasure,NR\_Intra\_RedCap [s] (number of DRX cycles) | Tevaluate,NR\_Intra\_RedCap  [s] (number of DRX cycles) |
|  | FR1 | FR2Note1 |  |  |  |
| 0.32 | 1 | 8 | 11.52 x N1 x M2 (36 x N1 x M2) | 1.28 x N1 x M2 (4 x N1 x M2) | 5.12 x N1 x M2 (16 x N1 x M2) |
| 0.64 |  | 5 | 17.92 x N1 (28 x N1) | 1.28 x N1 (2 x N1) | 5.12 x N1 (8 x N1) |
| 1.28 |  | 4 | 32 x N1 (25 x N1) | 1.28 x N1 (1 x N1) | 6.4 x N1 (5 x N1) |
| 2.56 |  | 3 | 58.88 x N1 (23 x N1) | 2.56 x N1 (1 x N1) | 7.68 x N1 (3 x N1) |
| Note 1: Applies for RedCap UE of all FR2 power class.  Note 2: M2 = 1.5 if SMTC periodicity of measured intra-frequency cell > 20 ms; otherwise M2=1. If different SMTC periodicities are configured for different cells, the SMTC periodicity in this note is the one used by the cell being identified. During PSS/SSS detection, the periodicity of the SMTC configured for the intra-frequency carrier is assumed, and if the actual SSB transmission periodicity is greater than the SMTC configured for the intra-frequency carrier, longer Tdetect, NR\_intra\_RedCap is expected. | | | | | |

Table 4.2B.2.3-2: Tdetect,NR\_Intra\_RedCap, Tmeasure,NR\_Intra\_RedCap and Tevaluate,NR\_Intra\_RedCap for UE configured with eDRX\_IDLE cycle (Frequency range FR1)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **eDRX\_IDLE cycle length [s]** | **DRX cycle length [s]** | **PTW length [s] (number of 1.28s periods)** | **Tdetect,NR\_Intra\_RedCap [s] (number of DRX cycles or eDRX cycles Note 3)** | **Tmeasure,NR\_Intra\_RedCap [s] (number of DRX cycles or eDRX cycles Note 3)** | **Tevaluate,NR\_Intra\_RedCap [s] (number of DRX cycles or eDRX cycles Note 3)** |
| 2.56 | - | - | 58.88 (23) | 2.56 (1) | 7.68 (3) |
| 5.12 | - | - | 117.76 (23) | 5.12 (1) | 10.24 (2) |
| 10.24 | - | - | 235.52 (23) | 10.24 (1) | 20.48 (2) |
| 20.48 ≤ eDRX\_IDLE cycle length ≤10485.76 | 0.32 | ≥[1.28] ([1]) | (23) | 0.32 x M2 (1 x M2) | 0.64 x M2 (2 x M2) |
| 0.64 | ≥[1.28] ([1]) | 0.64 (1) | 1.28 (2) |
| 1.28 | ≥[2.56] ([2]) | 1.28 (1) | 2.56 (2) |
| 2.56 | ≥[5.12] ([4]) | 2.56 (1) | 5.12 (2) |
| Note 1: The number of DRX cycles in this table is given for the DRX cycles within PTWs.  Note 2: The eDRX\_IDLE cycle lengths are as specified in Section 10.5.5.32 of TS 24.008 [34].  Note 3: Number of eDRX cycles when eDRX\_IDLE cycle length equals 2.56s, 5.12s and 10.24s. Otherwise, number of DRX cycles.  Note 4: The lower bound of PTW length is derived based on .  Note 5: M2 = 1.5 if SMTC periodicity of measured intra-frequency cell > 20 ms; otherwise M2=1. | | | | | |

Table 4.2B.2.3-3: Tdetect,NR\_Intra\_RedCap, Tmeasure,NR\_Intra\_RedCap and Tevaluate,NR\_Intra\_RedCap for UE configured with eDRX\_IDLE cycle (Frequency range FR2)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **eDRX\_IDLE cycle length [s]** | **DRX cycle length [s]** | **PTW length [s] (number of 1.28s periods)** | **Scaling Factor (N1)** Note1 | **Tdetect,NR\_Intra\_RedCap [s] (number of DRX cycles or eDRX cycles Note 4)** | **Tmeasure,NR\_Intra\_RedCap [s] (number of DRX cycles or eDRX cycles Note 4)** | **Tevaluate,NR\_Intra\_RedCap [s] (number of DRX cycles or eDRX cycles Note 4)** |
| 2.56 | - | - | 3 | 58.88 x N1 (23 x N1) | 2.56 x N1 (1 x N1) | 7.68 x N1 (3 x N1) |
| 5.12 | - | - | 3 | 117.76 x N1 (23 x N1) | 5.12 x N1 (1 x N1) | 10.24 x N1 (2 x N1) |
| 10.24 | - | - | 3 | 235.52 x N1 (23 x N1) | 10.24 x N1 (1 x N1) | 20.48 x N1 (2 x N1) |
| 20.48 ≤ eDRX\_IDLE cycle length ≤10485.76 | 0.32 | ≥5.12 (4) | 8 | (23 x N1) | 0.32 x N1 (1 x N1) | 0.64 x N1 (2 x N1) |
| 0.64 | ≥6.4 (5) | 5 | 0.64 x N1 (1 x N1) | 1.28 x N1 (2 x N1) |
| 1.28 | ≥10.24 (8) | 4 | 1.28 x N1 (1 x N1) | 2.56 x N1 (2 x N1) |
| 2.56 | ≥15.36 (12) | 3 | 2.56 x N1 (1 x N1) | 5.12 x N1 (2 x N1) |
| NOTE 1: Applies for RedCap UE of all power class.  NOTE 2: The number of DRX cycles in this table is given for the DRX cycles within PTWs.  NOTE 3: The eDRX\_IDLE cycle lengths are as specified in Section 10.5.5.32 of TS 24.008 [34].  NOTE 4: Number of eDRX cycles when eDRX\_IDLE cycle length equals 2.56s, 5.12s and 10.24s. Otherwise, number of DRX cycles.  NOTE 5: The lower bound of PTW length is derived based on .  NOTE 6: When eDRX=20.48s and DRX=0.32s, UE is allowed to perform cell evaluation within PTW in every 2 eDRX cycles. | | | | | | |

For any requirement in this section, when the UE transitions between any two states when being configured with eDRX\_IDLE, being configured with eDRX\_IDLE cycle, changing eDRX\_IDLE cycle length, or changing PTW configuration, the UE shall meet the transition requirement, which is the less stringent requirement of the two requirements corresponding to the first state and the second state, during the transition time interval which is the time corresponding to the transition requirement. After the transition time interval, the UE shall meet the requirement corresponding to the second state.

#### 4.2B.2.4 Measurements of inter-frequency NR cells for RedCap UE

The UE shall be able to identify new inter-frequency cells and perform SS-RSRP or SS-RSRQ measurements of identified inter-frequency cells if carrier frequency information is provided by the serving cell, even if no explicit neighbour list with physical layer cell identities is provided.

If Srxlev > SnonIntraSearchP and Squal > SnonIntraSearchQ then the UE shall search for inter-frequency layers of higher priority at least every Thigher\_priority\_search where Thigher\_priority\_search is described in clause 4.2.2.7.

If Srxlev ≤ SnonIntraSearchP or Squal ≤ SnonIntraSearchQ then the UE shall search for and measure inter-frequency layers of higher, equal or lower priority in preparation for possible reselection. In this scenario, the minimum rate at which the UE is required to search for and measure higher priority layers shall be the same as that defined below in this clause.

The UE shall be able to evaluate whether a newly detectable inter-frequency cell meets the reselection criteria defined in TS 38.304 [1] within Kcarrier\_RedCap \* Tdetect,NR\_Inter\_RedCap if at least carrier frequency information is provided for inter-frequency neighbour cells by the serving cells when Treselection = 0 provided that the reselection criteria is met

For 2 Rx RedCap by a margin of at least

5 dB in FR1 or 6.5 dB in FR2 for reselections based on ranking or

6 dB in FR1 or 7.5 dB in FR2 for SS-RSRP reselections based on absolute priorities or

4 dB in FR1 and 4 dB in FR2 for SS-RSRQ reselections based on absolute priorities

For 1 Rx RedCap by a margin of at least

[5 dB] in FR1 or for reselections based on ranking or

[6 dB] in FR1 for SS-RSRP reselections based on absolute priorities or

[4 dB] in FR1 for SS-RSRQ reselections based on absolute priorities.

The parameter Kcarrier\_RedCap is the number of NR inter-frequency carriers indicated by the serving cell. An inter-frequency cell is considered to be detectable according to the conditions defined in Annex B.1.5 for a corresponding Band. When higher priority cells are found by the higher priority search, they shall be measured at least every Tmeasure,NR\_Inter\_RedCap. If, after detecting a cell in a higher priority search, it is determined that reselection has not occurred then the UE is not required to continuously measure the detected cell to evaluate the ongoing possibility of reselection. However, the minimum measurement filtering requirements specified later in this clause shall still be met by the UE before it makes any determination that it may stop measuring the cell. If the UE detects on a NR carrier a cell whose physical identity is indicated as not allowed for that carrier in the measurement control system information of the serving cell, the UE is not required to perform measurements on that cell.

The UE shall measure SS-RSRP or SS-RSRQ at least every Kcarrier\_RedCap \* Tmeasure,NR\_Inter\_RedCap for identified lower or equal priority inter-frequency cells. If the UE detects on a NR carrier a cell whose physical identity is indicated as not allowed for that carrier in the measurement control system information of the serving cell, the UE is not required to perform measurements on that cell.

The UE shall filter SS-RSRP or SS-RSRQ measurements of each measured higher, lower and equal priority inter-frequency cell using at least 2 measurements. Within the set of measurements used for the filtering, at least two measurements shall be spaced by at least Tmeasure,NR\_Inter/2.

The UE shall not consider a NR neighbour cell in cell reselection, if it is indicated as not allowed in the measurement control system information of the serving cell.

For an inter-frequency cell that has been already detected, but that has not been reselected to, the filtering shall be such that the UE shall be capable of evaluating that the inter-frequency cell has met reselection criterion defined TS 38.304 [1] within Kcarrier \* Tevaluate,NR\_Inter\_RedCap when Treselection = 0provided that the reselection criteria is met by

- the condition when performing equal priority reselection and

- when *rangeToBestCell* is not configured:

- the cell is at least 5dB better ranked in FR1 or 6.5dB better ranked in FR2 for 2 Rx RedCap.

- the cell is at least [5dB] better ranked in FR1 for 1 Rx RedCap.

- when *rangeToBestCell* is configured:

- the cell has the highest number of beams above the threshold *absThreshSS-BlocksConsolidation* among all detected cells whose cell-ranking criterion R value defined in TS38.304 [1] is within *rangeToBestCell* of the cell-ranking criterion R value of the highest ranked cell.

- if there are multiple such cells, the cell has the highest rank among them

- the cell is at least 5dB better ranked in FR1 or 6.5dB better ranked in FR2 if the current serving cell is among them, or 6dB in FR1 or 7.5dB in FR2 for SS-RSRP reselections based on absolute priorities for 2 Rx RedCap or 4dB in FR1 or 4dB in FR2 for SS-RSRQ reselections based on absolute priorities for 2 Rx RedCap.

- the cell is at least [5dB] better ranked in FR1 if the current serving cell is among them, or [6dB] in FR1 for SS-RSRP reselections based on absolute priorities or [4dB] in FR1 for SS-RSRQ reselections based on absolute priorities for 1 Rx RedCap.

The 1 Rx RedCap UE applies *absThreshSS-BlocksConsolidation* as the signaled value of *absThreshSS-BlocksConsolidation* [2] + 1 dB.

When evaluating cells for reselection, the SSB side conditions apply to both serving and inter-frequency cells.

If Treselection timer has a non-zero value and the inter-frequency cell is satisfied with the reselection criteria, the UE shall evaluate this inter-frequency cell for the Treselection time. If this cell remains satisfied with the reselection criteria within this duration, then the UE shall reselect that cell.

The UE is not expected to meet the measurement requirements for an inter-frequency carrier under DRX cycle=320 ms defined in Table 4.2B.2.4-1 for both 1Rx RedCap and 2Rx RedCap under the following conditions:

- TSMTC\_intra = TSMTC\_inter = 160 ms; where TSMTC\_intra and TSMTC\_inter are periodicities of the SMTC occasions configured for the intra-frequency carrier and the inter-frequency carrier respectively, and

- SMTC occasions configured for the inter-frequency carrier occur up to 1 ms before the start or up to 1 ms after the end of the SMTC occasions configured for the intra-frequency carrier, and

- SMTC occasions configured for the intra-frequency carrier and for the inter-frequency carrier occur up to 1 ms before the start or up to 1 ms after the end of the paging occasion defined in TS38.304 [1].

For UE not configured with eDRX\_IDLE cycle, Tdetect,NR\_Inter\_RedCap, Tmeasure,NR\_ Inter \_RedCap and Tevaluate,NR\_ Inter \_RedCap are specified in Table 4.2B.2.4.1-1.

For 1 Rx RedCap configured with eDRX\_IDLE cycle, Tdetect,NR\_ Inter \_RedCap, Tmeasure,NR\_ Inter \_RedCap and Tevaluate,NR\_ Inter \_RedCap are specified in Table 4.2B.2.4-2 for FR1. For 1 Rx RedCap and 2 Rx RedCap configured with eDRX\_IDLE cycle, Tdetect,NR\_ Inter \_RedCap, Tmeasure,NR\_ Inter \_RedCap and Tevaluate,NR\_ Inter \_RedCap are specified in Table 4.2B.2.4-2 and Table 4.2B.2.4-3 for FR1 and FR2 respectively. The requirements apply provided that the serving cell is configured with eDRX\_IDLE and is the same in all PTWs during any of Tdetect,NR\_ Inter \_RedCap, Tmeasure,NR\_ Inter \_RedCap and Tevaluate,NR\_ Inter \_RedCap when multiple PTWs are used.

Table 4.2B.2.4-1: Tdetect,NR\_Inter\_RedCap, Tmeasure,NR\_Inter\_RedCap and Tevaluate,NR\_Inter\_RedCap

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| DRX cycle length [s] | Scaling Factor (N1) | | Tdetect,NR\_Inter\_RedCap [s] (number of DRX cycles) | Tmeasure,NR\_Inter\_RedCap [s] (number of DRX cycles) | Tevaluate,NR\_Inter\_RedCap [s] (number of DRX cycles) |
| FR1 | FR2Note1 |
| 0.32 | 1 | 8 | 11.52 x N1 x 1.5 (36 x N1 x 1.5) | 1.28 x N1 x 1.5 (4 x N1 x 1.5) | 5.12 x N1 x 1.5 (16 x N1 x 1.5) |
| 0.64 | 5 | 17.92x N1 (28 x N1) | 1.28 x N1 (2 x N1) | 5.12 x N1 (8 x N1) |
| 1.28 | 4 | 32 x N1 (25 x N1) | 1.28 x N1 (1 x N1) | 6.4 x N1 (5 x N1) |
| 2.56 | 3 | 58.88 x N1 (23 x N1) | 2.56 x N1 (1 x N1) | 7.68 x N1 (3 x N1) |
| Note 1: Applies for RedCap UE of all FR2 power class. | | | | | |

Table 4.2B.2.4-2: Tdetect,NR\_Inter\_RedCap, Tmeasure,NR\_Inter\_RedCap and Tevaluate,NR\_Inter\_RedCap for UE configured with eDRX\_IDLE cycle (Frequency range FR1)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **eDRX\_IDLE cycle length [s]** | **DRX cycle length [s]** | **PTW length [s] (number of 1.28s periods)** | **Tdetect,NR\_Inter\_RedCap [s] (number of DRX cycles or eDRX cycles Note 3)** | **Tmeasure,NR\_Inter\_RedCap** **[s] (number of DRX cycles or eDRX cycles Note 3)** | **Tevaluate,NR\_Inter\_RedCap****[s] (number of DRX cycles or eDRX cycles Note 3)** |
|
| 2.56 | - | - | 58.88 (23) | 2.56 (1) | 7.68 (3) |
| 5.12 | - | - | 117.76 (23) | 5.12 (1) | 10.24 (2) |
| 10.24 | - | - | 235.52 (23) | 10.24 (1) | 20.48 (2) |
| 20.48 ≤ eDRX\_IDLE cycle length ≤10485.76 | 0.32 | ≥1.28 (1) | (23) | 0.32 x 1.5 (1 x 1.5) | 0.64 x 1.5 (2 x 1.5) |
| 0.64 | ≥1.28 (1) | 0.64 (1) | 1.28 (2) |
| 1.28 | ≥2.56 (2) | 1.28 (1) | 2.56 (2) |
| 2.56 | ≥5.12 (4) | 2.56 (1) | 5.12 (2) |
| NOTE 1: The number of DRX cycles in this table is given for the DRX cycles within PTWs.  NOTE 2: The eDRX\_IDLE cycle lengths are as specified in Section 10.5.5.32 of TS 24.008 [34].  NOTE 3: Number of eDRX cycles when eDRX\_IDLE cycle length equals 2.56s, 5.12s and 10.24s. Otherwise, number of DRX cycles.  NOTE 4: The lower bound of PTW length is derived based on . | | | | | |

Table 4.2B.2.4-3: Tdetect,NR\_Inter\_RedCap, Tmeasure,NR\_Inter\_RedCap and Tevaluate,NR\_Inter\_RedCap for UE configured with eDRX\_IDLE cycle (Frequency range FR2)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **eDRX\_IDLE cycle length [s]** | **DRX cycle length [s]** | **PTW length [s] (number of 1.28s periods)** | **Scaling Factor (N1)** Note1 | **Tdetect,NR\_Inter\_RedCap [s] (number of DRX cycles or eDRX cycles Note 3)** | **Tmeasure,NR\_Inter\_RedCap** **[s] (number of DRX cycles or eDRX cycles Note 3)** | | **Tevaluate,NR\_Inter\_RedCap****[s] (number of DRX cycles or eDRX cycles Note 3)** |
| 2.56 | - | - | 3 | 58.88 x N1 (23 x N1) | | 2.56 x N1 (1 x N1) | 7.68 x N1 (3 x N1) |
| 5.12 | - | - | 3 | 117.76 x N1 (23 x N1) | | 5.12 x N1 (1 x N1) | 10.24 x N1 (2 x N1) |
| 10.24 | - | - | 3 | 235.52 x N1 (23 x N1) | | 10.24 x N1 (1 x N1) | 20.48 x N1 (2 x N1) |
| 20.48 ≤ eDRX\_IDLE cycle length ≤10485.76 | 0.32 | ≥5.12 (4) | 8 | (23 x N1) | | 0.32 x N1 (1 x N1) | 0.64 x N1 (2 x N1) |
| 0.64 | ≥6.4 (5) | 5 | 0.64 x N1 (1 x N1) | 1.28 x N1 (2 x N1) |
| 1.28 | ≥10.24 (8) | 4 | 1.28 x N1 (1 x N1) | 2.56 x N1 (2 x N1) |
| 2.56 | ≥15.36 (12) | 3 | 2.56 x N1 (1 x N1) | 5.12 x N1 (2 x N1) |
| NOTE 1: Applies for RedCap UE of all power class.  NOTE 2: The number of DRX cycles in this table is given for the DRX cycles within PTWs.  NOTE 3: The eDRX\_IDLE cycle lengths are as specified in Section 10.5.5.32 of TS 24.008 [34].  NOTE 4: Number of eDRX cycles when eDRX\_IDLE cycle length equals 2.56s, 5.12s and 10.24s. Otherwise, number of DRX cycles.  NOTE 5: The lower bound of PTW length is derived based on .  NOTE 6: When eDRX=20.48s and DRX=0.32s, UE is allowed to perform cell evaluation within PTW in every 2 eDRX cycles. | | | | | | | |

For any requirement in this section, when the UE transitions between any two states when being configured with eDRX\_IDLE, being configured with eDRX\_IDLE cycle, changing eDRX\_IDLE cycle length, or changing PTW configuration, the UE shall meet the transition requirement, which is the less stringent requirement of the two requirements corresponding to the first state and the second state, during the transition time interval which is the time corresponding to the transition requirement. After the transition time interval, the UE shall meet the requirement corresponding to the second state.

#### 4.2B.2.5 Measurements of inter-RAT E-UTRAN cells for RedCap UE

If Srxlev > SnonIntraSearchP and Squal > SnonIntraSearchQ then the UE shall search for inter-RAT E-UTRAN layers of higher priority at least every Thigher\_priority\_search where Thigher\_priority\_search is described in clause 4.2B.2.7.

If Srxlev ≤ SnonIntraSearchP or Squal ≤ SnonIntraSearchQ then the UE shall search for and measure inter-RAT E-UTRAN layers of higher, lower priority in preparation for possible reselection. In this scenario, the minimum rate at which the UE is required to search for and measure higher priority inter-RAT E-UTRAN layers shall be the same as that defined below for lower priority RATs.

The requirements in this clause apply for inter-RAT E-UTRAN FDD measurements and E-UTRA TDD measurements. When the measurement rules indicate that inter-RAT E-UTRAN cells are to be measured, the UE shall measure RSRP and RSRQ of detected E-UTRA cells in the neighbour frequency list at the minimum measurement rate specified in this clause.

The parameter NEUTRA\_carrier\_RedCap is the total number of configured E-UTRA carriers in the neighbour frequency list. The UE shall filter RSRP and RSRQ measurements of each measured E-UTRA cell using at least 2 measurements. Within the set of measurements used for the filtering, at least two measurements shall be spaced by at least Tmeasure,EUTRAN\_RedCap/2.

An inter-RAT E-UTRA cell is considered to be detectable provided the following conditions are fulfilled:

- the same conditions as for inter-frequency RSRP measurements specified in TS 36.133 [15, Annex B.x.y] are fulfilled for a corresponding Band, and

- the same conditions as for inter-frequency RSRQ measurements specified in TS 36.133 [15, Annex B.x.y] are fulfilled for a corresponding Band.

- SCH conditions specified in TS 36.133 [15, Annex B.1.2] are fulfilled for a corresponding Band

The UE shall be able to evaluate whether a newly detectable inter-RAT E-UTRAN cell meets the reselection criteria defined in TS38.304 [1] within (NEUTRA\_carrier\_RedCap) \* Tdetect,EUTRAN\_RedCap when Srxlev ≤ SnonIntraSearchP or Squal ≤ SnonIntraSearchQ when Treselection = 0 provided that the reselection criteria are met by a margin of at least 6dB for RSRP reselections based on absolute priorities or 4dB for RSRQ reselections based on absolute priorities for 2 Rx RedCap and at least [6dB] for RSRP reselections based on absolute priorities or [4dB] for RSRQ reselections based on absolute priorities for 1 Rx RedCap.

Cells which have been detected shall be measured at least every (NEUTRA\_carrier\_RedCap) \* Tmeasure,EUTRAN\_RedCap when Srxlev ≤ SnonIntraSearchP or Squal ≤ SnonIntraSearchQ.

When higher priority cells are found by the higher priority search, they shall be measured at least every Tmeasure,EUTRAN\_RedCap. If, after detecting a cell in a higher priority search, it is determined that reselection has not occurred then the UE is not required to continuously measure the detected cell to evaluate the ongoing possibility of reselection. However, the minimum measurement filtering requirements specified later in this clause shall still be met by the UE before it makes any determination that it may stop measuring the cell.

If the UE detects on an inter-RAT E-UTRAN carrier a cell whose physical identity is indicated as not allowed for that carrier in the measurement control system information of the serving cell, the UE is not required to perform measurements on that cell.

The UE shall not consider an inter-RAT E-UTRA cell in cell reselection, if it is indicated as not allowed in the measurement control system information of the serving cell.

For a cell that has been already detected, but that has not been reselected to, the filtering shall be such that the UE shall be capable of evaluating that an already identified inter-RAT E-UTRA cell has met reselection criterion defined in TS 38.304 [1] within (NEUTRA\_carrier\_RedCap) \* Tevaluate,EUTRAN\_RedCap when Treselection = 0provided that the reselection criteria are met by a margin of at least 6dB for RSRP reselections based on absolute priorities or 4dB for RSRQ reselections based on absolute priorities for 2 Rx RedCap and at least [6dB] for RSRP reselections based on absolute priorities or [4dB] for RSRQ reselections based on absolute priorities for 1 Rx RedCap.

If Treselection timer has a non-zero value and the inter-RAT E-UTRA cell is satisfied with the reselection criteria which are defined in TS 38.304 [1], the UE shall evaluate this E-UTRA cell for the Treselection time. If this cell remains satisfied with the reselection criteria within this duration, then the UE shall reselect that cell.

For 1 Rx RedCap and 2 Rx RedCap not configured with eDRX\_IDLE cycle, Tdetect,EUTRAN\_RedCap, Tmeasure,EUTRAN\_RedCap and Tevaluate, E-UTRAN\_RedCap are specified in Table 4.2B.2.5-1 and Table 4.2.2.5-1 respectively.

For 1 Rx RedCap and 2 Rx RedCap configured with eDRX\_IDLE cycle, Tdetect,EUTRAN\_RedCap, Tmeasure,EUTRAN\_RedCap and Tevaluate, E-UTRAN\_RedCap are specified in Table 4.2B.2.5-2, where the requirements apply provided that the serving cell is configured with eDRX\_IDLE and is the same in all PTWs during any of Tdetect,EUTRAN\_RedCap, Tmeasure,EUTRAN\_RedCap and Tevaluate, E-UTRAN\_RedCap when multiple PTWs are used.

Table 4.2B.2.5-1: Tdetect,EUTRAN\_RedCap, Tmeasure,EUTRAN\_RedCap, and Tevaluate,EUTRAN\_RedCap for 1 Rx RedCap

|  |  |  |  |
| --- | --- | --- | --- |
| DRX cycle length [s] | Tdetect,EUTRAN [s] (number of DRX cycles) | Tmeasure,EUTRAN [s] (number of DRX cycles) | Tevaluate,EUTRAN  [s] (number of DRX cycles) |
| 0.32 | 11.52 (36) | 1.28 (4) | 5.12 (16) |
| 0.64 | 17.92 (28) | 1.28 (2) | 5.12 (8) |
| 1.28 | 32(25) | 1.28 (1) | 6.4 (5) |
| 2.56 | 58.88 (23) | 2.56 (1) | 7.68 (3) |

Table 4.2B.2.5-2: Tdetect,EUTRAN\_RedCap, Tmeasure,EUTRAN\_RedCap, and Tevaluate,EUTRAN\_RedCap for UE configured with eDRX\_IDLE cycle

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| eDRX\_IDLE cycle length [s] | DRX cycle length [s] | PTW length [s] (number of 1.28s periods) | Tdetect,EUTRAN\_RedCap [s] (number of DRX or eDRX cycles Note 3) | Tmeasure,EUTRAN\_RedCap [s] (number of DRX or eDRX cycles Note 3) | Tevaluate,E-UTRAN\_RedCap  [s] (number of DRX or eDRX cycles Note 3) |
| 2.56 | N/A | N/A | 58.88 (23) | 2.56 (1) | 7.68 (3) |
| 5.12 | N/A | N/A | 117.76 (23) | 5.12 (1) | 10.24 (2) |
| 20.48 ≤ eDRX\_IDLE cycle length ≤ 2621.444 | 0.32 | ≥1.28 (1) | (23) | 0.32 (1) | 0.64 (2) |
| 0.64 | ≥1.28 (1) | 0.64 (1) | 1.28 (2) |
| 1.28 | ≥2.56 (2) | 1.28 (1) | 2.56 (2) |
| 2.56 | ≥5.12 (4) | 2.56 (1) | 5.12 (2) |
| NOTE 1: The number of DRX cycles in this table is given for the DRX cycles within PTWs.  NOTE 2: The eDRX\_IDLE cycle lengths are as specified in Section 10.5.5.32 of TS 24.008 [34].  NOTE 3: Number of eDRX cycles when eDRX\_IDLE cycle length equals 5.12s, number of DRX cycles otherwise.  NOTE 4: The lower bound of PTW length is derived based on .  NOTE 5: When eDRX=20.48s and DRX=0.32s, UE is allowed to perform cell evaluation within PTW in every 2 eDRX cycles. | | | | | |

For any requirement in this section, when the UE transitions between any two states when being configured with eDRX\_IDLE, being configured with eDRX\_IDLE cycle, changing eDRX\_IDLE cycle length, or changing PTW configuration, the UE shall meet the transition requirement, which is the less stringent requirement of the two requirements corresponding to the first state and the second state, during the transition time interval which is the time corresponding to the transition requirement. After the transition time interval, the UE shall meet the requirement corresponding to the second state.

#### 4.2B.2.6 Maximum interruption in paging reception for RedCap

The FDD, HD-FDD and TDD RedCap UE shall meet all applicable requirements specified in clause 4.2.2.6. In addition, when the UE is configured with eDRX\_IDLE cycle, the UE shall not miss any paging in a PTW provided the paging is sent in at least 2 DRX cycles before the end of that PTW.

The 1 Rx RedCap in HD-FDD shall meet all applicable requirements specified in clause 4.2.2.6 under the following conditions

- at least 1 SSB is available at the UE in the serving cell during the last 160 ms duration.

#### 4.2B.2.7 General requirements for RedCap

The requirements defined in section 4.2.2.7 apply for this section.

#### 4.2B.2.8 Minimum requirement at transitions

When switching from:

low mobility scenario to stationary scenario, or

from low mobility scenario to stationary and not-at-cell-edge scenario,

the UE shall fulfill the requirements corresponding to low mobility scenario over measurement period (Trelaxed) and thereafter switch to requirements corresponding to stationary scenario, or stationary and not-at-cell-edge scenario. The measurement period, Trelaxed, is any of:

- Tmeasure,NR\_Intra\_RedCap\_Relax and Tevaluate,NR\_Intra\_RedCap\_Relax, defined in section 4.2B.2.9 for intra-frequency measurements on NR cells,

- Tmeasure,NR\_Inter\_RedCap\_Relax and Tevaluate,NR\_Inter\_RedCap\_Relax defined in section 4.2B.2.10 for inter-frequency measurements on NR cells and

- Tmeasure,EUTRAN\_RedCap\_Relax and Tevaluate,EUTRAN\_RedCap\_Relax defined in sections 4.2B.2.11 for inter-RAT E-UTRAN measurements.

When switching from:

stationary scenario to low mobility scenario, or

stationary and not-at-cell-edge scenario to low mobility scenario,

the UE shall fulfill the requirements corresponding to low mobility scenario upon fulfilling the switching criteria.

When switching from normal mode to low mobility scenario, stationary scenario or stationary and not-at-cell edge scenario during cell-reselection period, the UE shall fulfill the requirements corresponding to normal mode over measurement period (Tnormal) and thereafter switch to requirements corresponding to low mobility scenario, stationary scenario or stationary and not-at-cell edge scenario. The measurement period, Tnormal, is any of:

- Tmeasure,NR\_Intra\_RedCap and Tevaluate,NR\_Intra\_RedCap, defined in section 4.2B.2.3 for intra-frequency measurements on NR cells,

- Tmeasure,NR\_Inter\_RedCap and Tevaluate,NR\_Inter\_RedCap defined in section 4.2B.2.4 for inter-frequency measurements on NR cells and

- Tmeasure,EUTRAN\_RedCap and Tevaluate,EUTRAN\_RedCap defined in sections 4.2B.2.5 for inter-RAT E-UTRAN measurements.

When switching from:

low mobility scenario to normal mode, or

stationary scenario to normal mode, or

stationary and not-at-cell-edge scenario to normal mode

the UE shall fulfill the requirements corresponding to normal mode upon fulfilling the switching criteria.

No requirement is defined for multiple transitions of scenarios within one measurement period.

#### 4.2B.2.9 Measurements of intra-frequency NR cells for UE configured with relaxed measurement criterion for RedCap

##### 4.2B.2.9.1 Introduction

This clause contains the requirements for measurements on intra-frequency NR cells when Srxlev ≤ SIntraSearchP or Squal ≤ SIntraSearchQ and when the UE is configured any of the following relaxed measurement critera:

- Relaxed measurement criterion for a stationary UE defined in clause 5.2.4.9.3 in [1],

- Relaxed measurement criteria for a stationary UE and not-at-cell edge defined in clause 5.2.4.9.4 in [1],

- Both low mobility criterion and stationary criterion as defined in clause 5.2.4.9.1 and 5.2.4.9.3 or 5.2.4.9.4 in [1] respectively.

The 1 Rx RedCap UE for the evaluation of one or more relaxed measurement criteria defined in clause 5.2.4.9 [1] applies:

- *s-SearchDeltaP-r16* as the signaled value of *s-SearchDeltaP-r16* [2] - 1 dB.

- *s-SearchDeltaP-Stationary-r17* as the signaled value of *s-SearchDeltaP-Stationary-r17* [2] - 1 dB.

- *s-SearchThresholdP-r16* as the signaled value of *s-SearchThresholdP-r16* [2] + 1 dB.

- *s-SearchThresholdQ-r16* as the signaled value of *s-SearchThresholdQ-r16 [*2] + 1 dB.

- *s-SearchThresholdP2-r17* as the signaled value of *s-SearchThresholdP2-r17* [2] + 1 dB.

- *s-SearchThresholdQ2-r17* as the signaled value of *s-SearchThresholdQ2-r17* [2] + 1 dB.

##### 4.2B.2.9.2 Measurements for UE fulfilling stationary criterion

This clause contains requirements for measurements on intra-frequency NR cells provided that:

- UE is configured with *stationaryMobilityEvaluation* [2] criterion and UE has fulfilled that criterion, or

- UE is configured with both *stationaryMobilityEvaluation* [2] criterion and *cellEdgeEvaluationWhileStationary* [2] criterion and *combineRelaxedMeasCondition2* [2] not configured, and UE has fulfilled only the *stationaryMobilityEvaluation* [2] criterion

The requirements defined in clause 4.2B.2.3 apply for this clause except that:

- Tdetect,NR\_Intra\_RedCap\_Relaxas specified in Table 4.2B.2.9.2-1 and Table 4.2B.2.9.2-2 for 1 Rx RedCap and 2 Rx RedCap respectively.

- Tmeasure,NR\_Intra\_RedCap\_Relax as specified in Table 4.2B.2.9.2-1 and Table 4.2B.2.9.2-2 for 1 Rx RedCap and 2 Rx RedCap respectively.

- Tevaluate,NR\_Intra\_RedCap\_Relax as specified in Table 4.2B.2.9.2-1 and Table 4.2B.2.9.2-2 for 1 Rx RedCap and 2 Rx RedCap respectively.

If the UE is configured with eDRX\_IDLE cycle then the requirements in Table 4.2B.2.9.2-3 and Table 4.2B.2.9.2-4 are applicable for eDRX cycle up to 10.24 s in FR1 and FR2 respectively.

If the UE is configured with eDRX\_IDLE cycle greater than 10.24 s in FR1 and FR2, then the requirements in Table Table 4.2B.2.9.2-5 and Table 4.2B.2.9.2-6 respectively apply provided eDRX cycle is ≤ [163.84] sec and evaluation/measurement time with relaxation on one carrier is not greater than single PTW window length.

Table 4.2B.2.9.2-1: Tdetect,NR\_Intra\_RedCap\_Relax, Tmeasure,NR\_Intra\_RedCap\_Relax and Tevaluate,NR\_Intra\_RedCap\_Relax for UEs fulfilling stationary criterion for 1 Rx RedCap UE

|  |  |  |  |
| --- | --- | --- | --- |
| DRX cycle length [s] | Tdetect,NR\_Intra\_RedCap\_Relax [s] (number of DRX cycles) | Tmeasure,NR\_Intra\_RedCap\_Relax [s] (number of DRX cycles) | Tevaluate,NR\_Intra\_RedCap\_Relax  [s] (number of DRX cycles) |
|  |  |  |  |
| 0.32 | 11.52 x M2 x K3 (36 x M2 x K3) | 1.28 x M2 x K3 (4 x M2 x K3) | 5.12 x M2 x K3 (16 x M2 x K3) |
| 0.64 | 17.92 x K3 (28 x K3) | 1.28 x K3 (2 x K3) | 5.12 x K3 (8 x K3) |
| 1.28 | 32 x K3 (25 x K3) | 1.28x K3 (1 x K3) | 6.4 x K3 (5 x K3) |
| 2.56 | 58.88 x K3 (23 x K3) | 2.56 x K3 (1 x K3) | 7.68 x K3 (3 x K3) |
| Note 1: M2 = 1.5 if SMTC periodicity of measured intra-frequency cell > 20 ms; otherwise M2=1. If different SMTC periodicities are configured for different cells, the SMTC periodicity in this note is the one used by the cell being identified. During PSS/SSS detection, the periodicity of the SMTC configured for the intra-frequency carrier is assumed, and if the actual SSB transmission periodicity is greater than the SMTC configured for the intra-frequency carrier, longer Tdetect, NR\_intra is expected.  Note 2: K3 = 6 is the measurement relaxation factor applicable for UE fulfilling the *stationaryMobilityEvaluation* [2] criterion. | | | |

Table 4.2B.2.9.2-2: Tdetect,NR\_Intra\_RedCap\_Relax, Tmeasure,NR\_Intra\_RedCap\_Relax and Tevaluate,NR\_Intra\_RedCap\_Relax for UEs fulfilling stationary criterion for 2 Rx RedCap UE

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| DRX cycle length [s] | Scaling Factor (N1) | | Tdetect,NR\_Intra\_RedCap\_Relax [s] (number of DRX cycles) | Tmeasure,NR\_Intra\_RedCap\_Relax [s] (number of DRX cycles) | Tevaluate,NR\_Intra\_RedCap\_Relax  [s] (number of DRX cycles) |
|  | FR1 | FR2Note1 |  |  |  |
| 0.32 | 1 | 8 | 11.52 x N1 x M2 x K3 (36 x N1 x M2 x K3) | 1.28 x N1 x M2 x K3 (4 x N1 x M2 x K3) | 5.12 x N1 x M2 x K3 (16 x N1 x M2 x K3) |
| 0.64 |  | 5 | 17.92 x N1 x K3 (28 x N1 x K3) | 1.28 x N1 x K3 (2 x N1 x K3) | 5.12 x N1 x K3 (8 x N1 x K3) |
| 1.28 |  | 4 | 32 x N1 x K3 (25 x N1 x K3) | 1.28 x N1 x K3 (1 x N1 x K3) | 6.4 x N1 x K3 (5 x N1 x K3) |
| 2.56 |  | 3 | 58.88 x N1 x K3 (23 x N1 x K3) | 2.56 x N1 x K3 (1 x N1 x K3) | 7.68 x N1 x K3 (3 x N1 x K3) |
| Note 1: Applies for RedCap UE of all supporting FR2 power classes.  Note 2: M2 = 1.5 if SMTC periodicity of measured intra-frequency cell > 20 ms; otherwise M2=1. If different SMTC periodicities are configured for different cells, the SMTC periodicity in this note is the one used by the cell being identified. During PSS/SSS detection, the periodicity of the SMTC configured for the intra-frequency carrier is assumed, and if the actual SSB transmission periodicity is greater than the SMTC configured for the intra-frequency carrier, longer Tdetect, NR\_intra is expected.  Note 3: K3 = 6 is the measurement relaxation factor applicable for UE fulfilling the *stationaryMobilityEvaluation* [2] criterion. | | | | | |

Table 4.2B.2.9.2-3: Tdetect,NR\_Intra\_RedCap\_Relax, Tmeasure,NR\_Intra\_RedCap\_Relax and Tevaluate,NR\_Intra\_RedCap\_Relax for UE configured with eDRX\_IDLE cycle (Frequency range FR1) for eDRX\_IDLE cycle upto 10.24 s

|  |  |  |  |
| --- | --- | --- | --- |
| **eDRX\_IDLE cycle length [s]** | **Tdetect,NR\_Intra\_RedCap\_Relax [s] (number of eDRX IDLE cycles)** | **Tmeasure,NR\_Intra\_RedCap\_Relax [s] (number of eDRX IDLE cycles)** | **Tevaluate,NR\_Intra\_RedCap\_Relax [s] (number of eDRX IDLE cycles)** |
|
| 2.56 | 58.88 x K3 (23 x K3) | 2.56 x K3 (1 x K3) | 7.68 x K3 (3 x K3) |
| 5.12 | 117.76 x K3 (23 x K3) | 5.12 x K3 (1 x K3) | 10.24 x K3 (2 x K3) |
| 10.24 | 235.52 x K3 (23 x K3) | 10.24 x K3 (1 x K3) | 20.48 x K3 (2 x K3) |
| Note 1: K3 = 6 is the measurement relaxation factor applicable for UE fulfilling the *stationaryMobilityEvaluation* [2] criterion. | | | |

Table 4.2B.2.9.2-4: Tdetect,NR\_Intra\_RedCap\_Relax, Tmeasure,NR\_Intra\_RedCap\_Relax and Tevaluate,NR\_Intra\_RedCap\_Relax for UE configured with eDRX\_IDLE cycle (Frequency range FR2) for eDRX\_IDLE cycle upto 10.24 s

|  |  |  |  |
| --- | --- | --- | --- |
| **eDRX\_IDLE cycle length [s]** | **Tdetect,NR\_Intra\_RedCap\_Relax [s] (number of eDRX IDLE cycles)** | **Tmeasure,NR\_Intra\_RedCap\_Relax [s] (number of eDRX IDLE cycles)** | **Tevaluate,NR\_Intra\_RedCap\_Relax [s] (number of eDRX IDLE cycles)** |
|
| 2.56 | 58.88 x N1 x K3 (23 x N1 x K3) | 2.56 x N1 x K3 (1 x K3) | 7.68 x N1 x K3 (3 x N1 x K3) |
| 5.12 | 117.76 x N1 x K3 (23 x N1 x K3) | 5.12 x N1 x K3 (1 x N1 x K3) | 10.24 x N1 x K3 (2 x N1 x K3) |
| 10.24 | 235.52 x N1 x K3 (23 x N1 x K3) | 10.24 x N1 x K3 (1 x N1 x K3) | 20.48 x N1 x K3 (2 x N1 x K3) |
| Note 1: K3 = 6 is the measurement relaxation factor applicable for UE fulfilling the *stationaryMobilityEvaluation* [2] criterion. | | | |

Table 4.2B.2.9.2-5: Tdetect,NR\_Intra\_RedCap\_Relax, Tmeasure,NR\_Intra\_RedCap\_Relax and Tevaluate,NR\_Intra\_RedCap\_Relax for UE configured with eDRX\_IDLE cycle (Frequency range FR1)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **eDRX\_IDLE cycle length [s]** | **DRX cycle length [s]** | **PTW length [s] (number of 1.28s periods)** | **Tdetect,NR\_Intra\_RedCap\_Relax [s] (number of DRX cycles or eDRX cycles Note 3)** | **Tmeasure,NR\_Intra\_RedCap\_Relax [s] (number of DRX cycles or eDRX cycles Note 3)** | **Tevaluate,NR\_Intra\_RedCap\_Relax [s] (number of DRX cycles or eDRX cycles Note 3)** |
| 20.48 ≤ eDRX\_IDLE cycle length ≤[163.84] | 0.32 | ≥[6.4] ([5]) | (23 x K3) | 0.32 x M2 x K3 (1 x M2 x K3) | 0.64 x M2 x K3 (2 x M2 x K3) |
| 0.64 | ≥[12.8] ([10]) | 0.64 x K3 (1 x K3) | 1.28 x K3 (2 x K3) |
| 1.28 | ≥[15.36] ([12]) | 1.28 x K3 (1 x K3) | 2.56 x K3 (2 x K3) |
| 2.56 | ≥[30.72] ([24]) | 2.56 x K3 (1 x K3) | 5.12 x K3 (2 x K3) |
| Note 1: The number of DRX cycles in this table is given for the DRX cycles within PTWs.  Note 2: The eDRX\_IDLE cycle lengths are as specified in Section 10.5.5.32 of TS 24.008 [34].  Note 3: The lower bound of PTW length is derived based on .  Note 4: M2 = 1.5 if SMTC periodicity of measured intra-frequency cell > 20 ms; otherwise M2=1. If different SMTC periodicities are configured for different cells, the SMTC periodicity in this note is the one used by the cell being identified. During PSS/SSS detection, the periodicity of the SMTC configured for the intra-frequency carrier is assumed, and if the actual SSB transmission periodicity is greater than the SMTC configured for the intra-frequency carrier, longer Tdetect, NR\_intra\_RedCap is expected.  Note 5: K3 = 6 is the measurement relaxation factor applicable for UE fulfilling the stationaryMobilityEvaluation [2] criterion. | | | | | |

Table 4.2B.2.9.2-6: Tdetect,NR\_Intra\_RedCap\_Relax, Tmeasure,NR\_Intra\_RedCap\_Relax and Tevaluate,NR\_Intra\_RedCap\_Relax for UE configured with eDRX\_IDLE cycle (Frequency range FR2)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **eDRX\_IDLE cycle length [s]** | **DRX cycle length [s]** | **PTW length [s] (number of 1.28s periods)** | **Scaling Factor (N1)** Note1 | **Tdetect,NR\_Intra\_RedCap\_Relax [s] (number of DRX cycles or eDRX cycles Note 3)** | **Tmeasure,NR\_Intra\_RedCap\_Relax** **[s] (number of DRX cycles or eDRX cycles Note 3)** | | **Tevaluate,NR\_Intra\_RedCap\_Relax****[s] (number of DRX cycles or eDRX cycles Note 3)** |
| 20.48 ≤ eDRX\_IDLE cycle length ≤[163.84] | 0.32 | ≥30.72 (24) | 8 | K3 x  (23 x N1 x K3) | | 0.32 x N1 x K3 (1 x N1 x K3) | 0.64 x N1 x K3 (2 x N1 x K3) |
| 0.64 | ≥38.4 (30) | 5 | 0.64 x N1 x K3 (1 x N1 x K3) | 1.28 x N1 x K3 (2 x N1 x K3) |
| 1.28 | ≥61.44 (48) | 4 | 1.28 x N1 x K3 (1 x N1 x K3) | 2.56 x N1 x K3 (2 x N1 x K3) |
| 2.56 | ≥92.16 (72) | 3 | 2.56 x N1 x K3 (1 x N1 x K3) | 5.12 x N1 x K3 (2 x N1 x K3) |
| Note 1: Applies for RedCap UE of all supporting FR2 power classes.  Note 2: The number of DRX cycles in this table is given for the DRX cycles within PTWs.  Note 3: The eDRX\_IDLE cycle lengths are as specified in Section 10.5.5.32 of TS 24.008 [34].  Note 4: The lower bound of PTW length is derived based on .  Note 5: The measurement shall not be performed across PTW’s. In this case the measurement is performed in the next available PTW.  Note 6: The evaluation shall not be performed across PTW’s. In this case the evaluation is performed in the next available PTW.  Note 7: K3 = 6 is the measurement relaxation factor applicable for UE fulfilling the stationaryMobilityEvaluation [2] criterion. | | | | | | | |

##### 4.2B.2.9.3 Measurements for a UE fulfilling stationary and not-at-cell edge criteria

This clause contains requirements for measurements on intra-frequency NR cells provided that:

- UE is configured with both *stationaryMobilityEvaluation* [2] criterion and *cellEdgeEvaluationWhileStationary* [2] criterion, and

- has also fulfilled both criteria, and,

- less than 4 hours have passed since measurements for cell reselection were last performed

The requirments defined in this clause apply regardless of eDRX\_IDLE configurations.

In this case the UE is not required to meet Tdetect,NR\_Intra\_RedCap, Tmeasure,NR\_Intra\_RedCap and Tevaluate,NR\_Intra\_RedCap as defined in clause 4.2B.2.3.

##### 4.2B.2.9.3A Measurements for a UE fulfilling stationary and Rel-16 not at cell edge criteria

- UE is configured with both *stationaryMobilityEvaluation* [2] criterion and *cellEdgeEvaluation* [2] criterion, and has also fulfilled both criteria, or

- UE is configured with *cellEdgeEvaluation* [2] criterion and with both *stationaryMobilityEvaluation* [2] criterion and *cellEdgeEvaluationWhileStationary* [2] criterion and *combineRelaxedMeasCondition2* [2] not configured, and UE has fulfilled *cellEdgeEvaluation* and *stationaryMobilityEvaluation* [2] criteria

The requirements defined in clause 4.2B.2.3 apply for this clause except that:

- Tdetect,NR\_Intra\_RedCap\_Relaxas specified in Table 4.2B.2.9.2-1 and Table 4.2B.2.9.2-2 for 1 Rx RedCap and 2 Rx RedCap respectively.

- Tmeasure,NR\_Intra\_RedCap\_Relax as specified in Table 4.2B.2.9.2-1 and Table 4.2B.2.9.2-2 for 1 Rx RedCap and 2 Rx RedCap respectively.

- Tevaluate,NR\_Intra\_RedCap\_Relax as specified in Table 4.2B.2.9.2-1 and Table 4.2B.2.9.2-2 for 1 Rx RedCap and 2 Rx RedCap respectively.

If the UE is configured with eDRX\_IDLE cycle then the requirements in Table 4.2B.2.9.2-3 and Table 4.2B.2.9.2-4 are applicable for eDRX cycle up to 10.24 s in FR1 and FR2 respectively.

If the UE is configured with eDRX\_IDLE cycle greater than 10.24 s in FR1 and FR2, then the requirements in Table Table 4.2B.2.9.2-5 and Table 4.2B.2.9.2-6 respectively apply provided eDRX cycle is ≤ [163.84] sec and evaluation/measurement time with relaxation on one carrier is not greater than single PTW window length.

##### 4.2B.2.9.4 Measurements for a UE fulfilling low mobility and stationary criteria

This clause contains requirements for measurements on intra-frequency NR cells provided that:

- UE is configured with *lowMobilityEvaluation* [2] criterion and *stationaryMobilityEvaluation* [2] criterion, and has also fulfilled both criteria, or,

- UE is configured with *lowMobilityEvaluation* [2] criterion and with both *stationaryMobilityEvaluation* [2] criterion and *cellEdgeEvaluationWhileStationary* [2] criterion and *combineRelaxedMeasCondition2* [2] not configured, and UE has fulfilled *lowMobilityEvaluation* and *stationaryMobilityEvaluation* [2] criteria

The requirements defined in clause 4.2B.2.9.2 apply for this clause.

##### 4.2B.2.9.5 Measurements for a UE fulfilling low mobility criterion and stationary and not-at-cell edge criteria

This clause contains requirements for measurements on intra-frequency NR cells provided that:

- UE is configured with *lowMobilityEvaluation* [2] criterion and UE has fulfilled this criterion, and

- UE is configured with *stationaryMobilityEvaluation* [2] and *cellEdgeEvaluationWhileStationary* [2] criterion, and UE has also fulfilled both criteria

The requirements defined in clause 4.2B.2.9.3 apply for this clause.

##### 4.2B.2.9.6 Measurements for a UE fulfilling not-at-cell edge criterion and stationary and not-at-cell edge criteria

This clause contains requirements for measurements on intra-frequency NR cells provided that:

* UE is configured with cellEdgeEvaluation [2] criterion and UE has fulfilled that criterion, and
* UE is configured with *stationaryMobilityEvaluation* [2] criterion and *cellEdgeEvaluationWhileStationary* [2] criterion, and has also fulfilled both criteria

The requirements defined in clause 4.2B.2.9.3 apply for this clause.

##### 4.2B.2.9.7 Measurements for a UE fulfilling low mobility and not-at-cell edge criteria and stationary and notatcell edge criteria

This clause contains requirements for measurements on intra-frequency NR cells provided that:

* UE is configured with both *lowMobilityEvaluation* [2] criterion and *cellEdgeEvaluation* [2] criterion, and has fulfilled both criteria, and
* UE is configured with *stationaryMobilityEvaluation* [2] criterion and *cellEdgeEvaluationWhileStationary* [2] criterion, and has also fulfilled both criteria

The requirements defined in clause 4.2B.2.9.3 apply for this clause.

##### 4.2B.2.9.8 Measurements for a UE fulfilling low mobility and not-at-cell edge criteria and stationary criterion

This clause contains requirements for measurements on intra-frequency NR cells provided that:

- UE is configured with both *lowMobilityEvaluation* [2] criterion and *cellEdgeEvaluation* [2] criterion, and has fulfilled both criteria, and

- UE is configured with *stationaryMobilityEvaluation* [2] criterion and has also fulfilled that criterion, or UE is configured with both *stationaryMobilityEvaluation* [2] criterion and *cellEdgeEvaluationWhileStationary* [2] criterion and *combineRelaxedMeasCondition2* [2] not configured, and UE has fulfilled *stationaryMobilityEvaluation* [2] criteria

The requirements defined in clause 4.2.2.9.4 apply for this clause.

#### 4.2B.2.10 Measurements of inter-frequency NR cells for UE configured with relaxed measurement criterion

##### 4.2B.2.10.1 Introduction

This clause contains the requirements for measurements on inter-frequency NR cells when Srxlev ≤ SnonIntraSearchP or Squal ≤ SnonIntraSearchQ and when the UE is configured any of the following relaxed measurement critera:

- Relaxed measurement criterion for a stationary UE defined in clause 5.2.4.9.3 in [1],

- Relaxed measurement criterion for a stationary UE not at cell edge defined in clause 5.2.4.9.4 in [1],

- Both low mobility criterion and stationary criterion as defined in clause 5.2.4.9.1 and 5.2.4.9.3 or 5.2.4.9.4 in [1] respectively.

The 1 Rx RedCap UE for the evaluation of one or more relaxed measurement criteria defined in clause 5.2.4.9 [1] applies:

- *s-SearchDeltaP-r16* as the signaled value of *s-SearchDeltaP-r16* [2] - 1 dB.

- *s-SearchDeltaP-Stationary-r17* as the signaled value of *s-SearchDeltaP-Stationary-r17* [2] - 1 dB.

- *s-SearchThresholdP-r16* as the signaled value of *s-SearchThresholdP-r16* [2] + 1 dB.

- *s-SearchThresholdQ-r16* as the signaled value of *s-SearchThresholdQ-r16* [2] + 1 dB.

- *s-SearchThresholdP2-r17* as the signaled value of *s-SearchThresholdP2-r17* [2] + 1 dB.

- s-SearchThresholdQ2-r17 as the signaled value of s-SearchThresholdQ2-r17 [2] + 1 dB.

##### 4.2B.2.10.2 Measurements for UE fulfilling stationary criterion

This clause contains requirements for measurements on inter-frequency NR cells provided that:

- UE is configured with *stationaryMobilityEvaluation* [2] criterion and UE has fulfilled that criterion, or

- UE is configured with both *stationaryMobilityEvaluation* [2] criterion and *cellEdgeEvaluationWhileStationary* [2] criterion and *combineRelaxedMeasCondition2* [2] not configured, and UE has fulfilled only the *stationaryMobilityEvaluation* [2] criterion, and

The requirements defined in clause 4.2B.2.4 apply for this clause except that:

- Tdetect,NR\_Inter\_RedCap\_Relaxas specified in Table 4.2B.2.10.2-1 and Table 4.2B.2.10.2-2 for 1 Rx RedCap and 2 Rx RedCap respectively.

- Tmeasure,NR\_Inter\_RedCap\_Relax as specified in Table 4.2B.2.10.2-1 and Table 4.2B.2.10.2-2 for 1 Rx RedCap and 2 Rx RedCap respectively.

- Tevaluate,NR\_Inter\_RedCap\_Relax as specified in Table 4.2B.2.10.2-1 and Table 4.2B.2.10.2-2 for 1 Rx RedCap and 2 Rx RedCap respectively.

- When Srxlev > SnonIntraSearchP and Squal > SnonIntraSearchQ then the UE shall search for inter-frequency layers of higher priority at least every K2\*Thigher\_priority\_search where Thigher\_priority\_search is described in clause 4.2.2.7 and, K2 = 240.

If the UE is configured with eDRX\_IDLE cycle then the requirements in Table 4.2B.2.10.2-3 and Table 4.2B.2.10.2-4 are applicable for eDRX cycle up to 10.24 s in FR1 and FR2 respectively.

If the UE is configured with eDRX\_IDLE cycle greater than 10.24 s in FR1 and FR2, then the requirements in Table Table 4.2B.2.10.2-5 and Table 4.2B.2.10.2-6 respectively apply provided that eDRX cycle is ≤ [163.84] sec and evaluation/measurement time with relaxation on one carrier is not greater than single PTW window length.

Table 4.2B.2.10.2-1: Tdetect,NR\_Inter\_RedCap\_Relax, Tmeasure,NR\_Inter\_RedCap\_Relax and Tevaluate,NR\_Inter\_RedCap\_Relax for 1 Rx RedCap UE

|  |  |  |  |
| --- | --- | --- | --- |
| DRX cycle length [s] | Tdetect,NR\_Inter\_RedCap\_Relax [s] (number of DRX cycles) | Tmeasure,NR\_Inter\_RedCap\_Relax [s] (number of DRX cycles) | Tevaluate,NR\_Inter\_RedCap\_Relax [s] (number of DRX cycles) |
| 0.32 | 11.52 x 1.5 x K4(36 x 1.5 x K4) | 1.28 x 1.5 x K4 (4 x 1.5 x K4) | 5.12 x 1.5 x K4 (16 x 1.5 x K4) |
| 0.64 | 17.92 x K4 (28 x K4) | 1.28x K4 (2 x K4) | 5.12 x K4 (8 x K4) |
| 1.28 | 32 x K4 (25 x K4) | 1.28x K4 (1 x K4) | 6.4 x K4 (5 x K4) |
| 2.56 | 58.88 x K4 (23 x K4) | 2.56 x K4 (1 x K4) | 7.68 x K4 (3 x K4) |
| Note 1: K4 = 6 is the measurement relaxation factor applicable for UE fulfilling the *stationaryMobilityEvaluation* [2] criterion. | | | |

Table 4.2B.2.10.2-2: Tdetect,NR\_Inter\_RedCap\_Relax, Tmeasure,NR\_Inter\_RedCap\_Relax and Tevaluate,NR\_Inter\_RedCap\_Relax for 2 Rx RedCap UE

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| DRX cycle length [s] | Scaling Factor (N1) | | Tdetect,NR\_Inter\_Relax [s] (number of DRX cycles) | Tmeasure,NR\_Inter\_Relax [s] (number of DRX cycles) | Tevaluate,NR\_Inter\_Relax [s] (number of DRX cycles) |
| FR1 | FR2Note1 |
| 0.32 | 1 | 8 | 11.52 x N1 x 1.5 x K4 (36 x N1 x 1.5 x K4) | 1.28 x N1 x 1.5 x K4 (4 x N1 x 1.5 x K4) | 5.12 x N1 x 1.5 x K4 (16 x N1 x 1.5 x K4) |
| 0.64 |  | 5 | 17.92x N1 x K4 (28 x N1 x K4) | 1.28 x N1 x K4 (2 x N1 x K4) | 5.12 x N1 x K4 (8 x N1 x K4) |
| 1.28 |  | 4 | 32 x N1 x K4 (25 x N1 x K4) | 1.28 x N1 x K4 (1 x N1 x K4) | 6.4 x N1 x K4 (5 x N1 x K4) |
| 2.56 |  | 3 | 58.88 x N1 x K4 (23 x N1 x K4) | 2.56 x N1 x K4 (1 x N1 x K4) | 7.68 x N1 x K4 (3 x N1 x K4) |
| Note 1: Applies for RedCap UE of all supporting power class.  Note 2: K4 = 6 is the measurement relaxation factor applicable for UE fulfilling the *stationaryMobilityEvaluation* [2] criterion. | | | | | |

Table 4.2B.2.10.2-3: Tdetect,E-UTRAN \_RedCap\_Relax, Tmeasure,NR\_,E-UTRAN \_RedCap\_Relax and Tevaluate,NR\_,E-UTRAN \_RedCap\_Relax for UE configured with eDRX\_IDLE cycle

|  |  |  |  |
| --- | --- | --- | --- |
| **eDRX\_IDLE cycle length [s]** | **Tdetect,NR\_E-UTRAN\_RedCap\_Relax [s] (number of DRX cycles)** | **Tmeasure,NR\_E-UTRAN\_RedCap\_Relax [s] (number of DRX cycles)** | **Tevaluate,NR\_E-UTRAN\_RedCap\_Relax [s] (number of DRX cycles)** |
|
| 2.56 | 58.88 x K3 (23 x K3) | 2.56 x K3 (1 x K3) | 5.12 x K3 (2 x K3) |
| 5.12 | 117.76 x K3 (23 x K3) | 5.12 x K3 (1 x K3) | 10.24 x K3 (2 x K3) |
| Note 1: M2 = 1.5 if SMTC periodicity of measured intra-frequency cell > 20 ms; otherwise M2=1. If different SMTC periodicities are configured for different cells, the SMTC periodicity in this note is the one used by the cell being identified. During PSS/SSS detection, the periodicity of the SMTC configured for the intra-frequency carrier is assumed, and if the actual SSB transmission periodicity is greater than the SMTC configured for the intra-frequency carrier, longer Tdetect, NR\_intra is expected.  Note 2: K3 = 6 is the measurement relaxation factor applicable for UE fulfilling the *stationaryMobilityEvaluation* [2] criterion. | | | |

Table 4.2B.2.10.2-4: Tdetect,NR\_Inter\_RedCap\_Relax, Tmeasure,NR\_Inter\_RedCap\_Relax and Tevaluate,NR\_Inter\_RedCap\_Relax for UE configured with eDRX\_IDLE cycle (Frequency range FR2) for eDRX\_IDLE cycle upto 10.24 s

|  |  |  |  |
| --- | --- | --- | --- |
| **eDRX\_IDLE cycle length [s]** | **Tdetect,NR\_Inter\_RedCap\_Relax [s] (number of DRX cycles)** | **Tmeasure,NR\_Inter\_RedCap\_Relax [s] (number of DRX cycles)** | **Tevaluate,NR\_Inter\_RedCap\_Relax [s] (number of DRX cycles)** |
|
| 2.56 | 58.88 x N1 x K3 (23 x N1 x K3) | 2.56 x N1 x K3 (1 x K3) | 7.68 x N1 x K3 (3 x N1 x K3) |
| 5.12 | 117.76 x N1 x K3 (23 x N1 x K3) | 5.12 x N1 x K3 (1 x N1 x K3) | 10.24 x N1 x K3 (2 x N1 x K3) |
| 10.24 | 235.52 x N1 x K3 (23 x N1 x K3) | 10.24 x N1 x K3 (1 x N1 x K3) | 20.48 x N1 x K3 (2 x N1 x K3) |
| Note 1: K3 = 6 is the measurement relaxation factor applicable for UE fulfilling the *stationaryMobilityEvaluation* [2] criterion. | | | |

Table 4.2B.2.10.2-5: Tdetect,NR\_Inter\_RedCap\_Relax, Tmeasure,NR\_ Inter \_RedCap\_Relax and Tevaluate,NR\_ Inter \_RedCap\_Relax for UE configured with eDRX\_IDLE cycle (Frequency range FR1) for eDRX\_IDLE cycle larger than 10.24 s

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **eDRX\_IDLE cycle length [s]** | **DRX cycle length [s]** | **PTW length [s] (number of 1.28s periods)** | **Tdetect,NR\_Inter\_RedCap\_Relax [s] (number of DRX cycles or eDRX cycles Note 3)** | **Tmeasure,NR\_Inter\_RedCap\_Relax [s] (number of DRX cycles or eDRX cycles Note 3)** | **Tevaluate,NR\_Inter\_RedCap\_Relax [s] (number of DRX cycles or eDRX cycles Note 3)** |
| 20.48 ≤ eDRX\_IDLE cycle length ≤[163.84] | 0.32 | ≥[6.4] ([5]) | (23 x K3) | 0.32 x M2 x K3 (1 x M2 x K3) | 0.64 x M2 x K3 (2 x M2 x K3) |
| 0.64 | ≥[12.8] ([10]) | 0.64 x K3 (1 x K3) | 1.28 x K3 (2 x K3) |
| 1.28 | ≥[15.36] ([12]) | 1.28 x K3 (1 x K3) | 2.56 x K3 (2 x K3) |
| 2.56 | ≥[30.72] ([4]) | 2.56 x K3 (1 x K3) | 5.12 x K3 (2 x K3) |
| Note 1: The number of DRX cycles in this table is given for the DRX cycles within PTWs.  Note 2: The eDRX\_IDLE cycle lengths are as specified in Section 10.5.5.32 of TS 24.008 [34].  Note 3: The lower bound of PTW length is derived based on .  Note 4: K4 = 6 is the measurement relaxation factor applicable for UE fulfilling the stationaryMobilityEvaluation [2] criterion. | | | | | |

Table 4.2B.2.10.2-6: Tdetect,NR\_Inter\_RedCap\_Relax, Tmeasure,NR\_Inter\_RedCap\_Relax and Tevaluate,NR\_Inter\_RedCap\_Relax for UE configured with eDRX\_IDLE cycle (Frequency range FR2) for eDRX\_IDLE cycle larger than 10.24 s

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **eDRX\_IDLE cycle length [s]** | **DRX cycle length [s]** | **PTW length [s] (number of 1.28s periods)** | **Scaling Factor (N1)** Note1 | **Tdetect,NR\_Inter\_RedCap\_Relax [s] (number of DRX cycles or eDRX cycles Note 3)** | **Tmeasure,NR\_Inter\_RedCap\_Relax** **[s] (number of DRX cycles or eDRX cycles Note 3)** | | **Tevaluate,NR\_Inter\_RedCap\_Relax****[s] (number of DRX cycles or eDRX cycles Note 3)** |
| 20.48 ≤ eDRX\_IDLE cycle length ≤[163.84] | 0.32 | ≥30.72 (24) | 8 | K3 x  (23 x N1 x K3) | | 0.32 x N1 x K3 (1 x N1 x K3) | 0.64 x N1 x K3 (2 x N1 x K3) |
| 0.64 | ≥38.4 (30) | 5 | 0.64 x N1 x K3 (1 x N1 x K3) | 1.28 x N1 x K3 (2 x N1 x K3) |
| 1.28 | ≥61.44 (48) | 4 | 1.28 x N1 x K3 (1 x N1 x K3) | 2.56 x N1 x K3 (2 x N1 x K3) |
| 2.56 | ≥92.16 (72) | 3 | 2.56 x N1 x K3 (1 x N1 x K3) | 5.12 x N1 x K3 (2 x N1 x K3) |
| Note 1: Applies for RedCap UE of all supporting FR2 power classes.  Note 2: The number of DRX cycles in this table is given for the DRX cycles within PTWs.  Note 3: The eDRX\_IDLE cycle lengths are as specified in Section 10.5.5.32 of TS 24.008 [34].  Note 4: The lower bound of PTW length is derived based on .  Note 5: K4 = 6 is the measurement relaxation factor applicable for UE fulfilling the stationaryMobilityEvaluation [2] criterion. | | | | | | | |

##### 4.2B.2.10.3 Measurements for a UE fulfilling stationary not at cell edge criterion

This clause contains requirements for measurements on inter-frequency NR cells provided that:

- UE is configured with both *stationaryMobilityEvaluation* [2] criterion and *cellEdgeEvaluationWhileStationary* [2] criterion, and

- has also fulfilled both criteria, and

- less than 4 hours have passed since measurements for cell reselection were last performed, and

In this case the UE is not required to meet Tdetect,NR\_Inter\_RedCap, Tmeasure,NR\_Inter\_RedCap and Tevaluate,NR\_Inter\_RedCap as defined in clause 4.2B.2.4.

When Srxlev ≤ SnonIntraSearchP or Squal ≤ SnonIntraSearchQ, the UE shall search for, measure and evaluate inter-frequency layers of higher, equal or lower priority at least every 4 hours.

When Srxlev > SnonIntraSearchP and Squal > SnonIntraSearchQ, the UE shall search for inter-frequency layers of higher priority at least every K2\*Thigher\_priority\_search where Thigher\_priority\_search is described in clause 4.2.2.7 and K2=240.

The requirments defined in this clause apply regardless of eDRX\_IDLE configurations.

##### 4.2B.2.10.3A Measurements for a UE fulfilling stationary and Rel-16 not at cell edge criterion

This clause contains requirements for measurements on inter-frequency NR cells provided that:

- UE is configured with both *stationaryMobilityEvaluation* [2] criterion and *cellEdgeEvaluation* [2] criterion, and- has also fulfilled both criteria, or

- UE is configured with *cellEdgeEvaluation* [2] criterion and with both *stationaryMobilityEvaluation* [2] criterion and *cellEdgeEvaluationWhileStationary* [2] criterion and *combineRelaxedMeasCondition2* [2] not configured, and UE has fulfilled *cellEdgeEvaluation* and *stationaryMobilityEvaluation* [2] criteria

The requirements defined in clause 4.2B.2.4 apply for this clause except that:

- Tdetect,NR\_Inter\_RedCap\_Relaxas specified in Table 4.2B.2.10.2-1 and Table 4.2B.2.10.2-1 for 1 Rx RedCap and 2 Rx RedCap respectively.

- Tmeasure,NR\_Inter\_RedCap\_Relax as specified in Table 4.2B.2.10.2-1 and Table 4.2B.2.10.2-1 for 1 Rx RedCap and 2 Rx RedCap respectively.

- Tevaluate,NR\_Inter\_RedCap\_Relax as specified in Table 4.2B.2.10.2-1 and Table 4.2B.2.10.2-1 for 1 Rx RedCap and 2 Rx RedCap respectively.

If the UE is configured with eDRX\_IDLE cycle then the requirements in Table 4.2B.2.10.2-3 and Table 4.2B.2.10.2-4 are applicable for eDRX cycle up to 10.24 s in FR1 and FR2 respectively.

If the UE is configured with eDRX\_IDLE cycle greater than 10.24 s in FR1 and FR2, then the requirements in Table Table 4.2B.2.10.2-5 and Table 4.2B.2.10.2-6 respectively apply provided that eDRX cycle is ≤ [163.84] sec and evaluation/measurement time with relaxation on one carrier is not greater than single PTW window length.

##### 4.2B.2.10.4 Measurements for a UE fulfilling low mobility and stationary criteria

This clause contains requirements for measurements on inter-frequency NR cells provided that:

- UE is configured with *lowMobilityEvaluation* [2] criterion and *stationaryMobilityEvaluation* [2] criterion, and has also fulfilled both criteria, or,

- UE is configured with *lowMobilityEvaluation* [2] criterion and with both *stationaryMobilityEvaluation* [2] criterion and *cellEdgeEvaluationWhileStationary* [2] criterion and *combineRelaxedMeasCondition2* [2] not configured, and UE has fulfilled *lowMobilityEvaluation* and *stationaryMobilityEvaluation* [2] criteria

The requirements defined in clause 4.2B.2.10.2 apply for this clause.

##### 4.2B.2.10.5 Measurements for a UE fulfilling low mobility and stationary not at cell edge criteria

This clause contains requirements for measurements on intra-frequency NR cells provided that:

- UE is configured with *lowMobilityEvaluation* [2] criterion and UE has fulfilled this criterion, and

- UE is configured with *stationaryMobilityEvaluation* [2] and *cellEdgeEvaluationWhileStationary* [2] criterion, and UE has also fulfilled both criteria

The requirements defined in clause 4.2B.2.10.3 apply for this clause.

##### 4.2B.2.10.6 Measurements for a UE fulfilling not-at-cell edge criterion and stationary not at cell edge criteria

This clause contains requirements for measurements on inter-frequency NR cells provided that:

* UE is configured with cellEdgeEvaluation [2] criterion and UE has fulfilled that criterion, and
* UE is configured with *stationaryMobilityEvaluation* [2] criterion and *cellEdgeEvaluationWhileStationary* [2] criterion, and has also fulfilled both criteria

The requirements defined in clause 4.2B.2.10.3 apply for this clause.

##### 4.2B.2.10.7 Measurements for a UE fulfilling low mobility not-at-cell edge criterion and stationary not at cell edge criteria

This clause contains requirements for measurements on intra-frequency NR cells provided that:

* UE is configured with both *lowMobilityEvaluation* [2] criterion and *cellEdgeEvaluation* [2] criterion, and has fulfilled both criteria, and
* UE is configured with *stationaryMobilityEvaluation* [2] criterion and *cellEdgeEvaluationWhileStationary* [2] criterion, and has also fulfilled both criteria

The requirements defined in clause 4.2B.2.10.3 apply for this clause.

##### 4.2B.2.10.8 Measurements for a UE fulfilling low mobility not-at-cell edge criterion and stationary criteria

This clause contains requirements for measurements on inter-frequency NR cells provided that:

- UE is configured with both *lowMobilityEvaluation* [2] criterion and *cellEdgeEvaluation* [2] criterion, and has fulfilled both criteria, and

- UE is configured with *stationaryMobilityEvaluation* [2] criterion and has also fulfilled that criterion, or UE is configured with both *stationaryMobilityEvaluation* [2] criterion and *cellEdgeEvaluationWhileStationary* [2] criterion and *combineRelaxedMeasCondition2* [2] not configured, and UE has fulfilled *stationaryMobilityEvaluation* [2] criterion.

The requirements defined in clause 4.2.2.10.4 apply for this clause.

#### 4.2B.2.11 Measurements of inter-RAT E-UTRAN cells for UE configured with relaxed measurement criterion

##### 4.2B.2.11.1 Introduction

This clause contains the requirements for measurements on inter-RAT E-UTRAN cells when Srxlev ≤ SIntraSearchP or Squal ≤ SIntraSearchQ and when the UE is configured any of the following relaxed measurement critera:

- Relaxed measurement criterion for a stationary UE defined in clause 5.2.4.9.X in [1],

- Relaxed measurement criterion for a stationary UE not at cell edge defined in clause 5.2.4.9.Y in [1],

- Both low mobility criterion and stationary criterion as defined in clause 5.2.4.9.1 and 5.2.4.9.X in [1] respectively.

The 1 Rx RedCap UE for the evaluation of one or more relaxed measurement criteria defined in clause 5.2.4.9 [1] applies:

- *s-SearchDeltaP-r16* as the signaled value of *s-SearchDeltaP-r16* [2] - 1 dB.

- *s-SearchDeltaP-Stationary-r17* as the signaled value of *s-SearchDeltaP-Stationary-r17* [2] - 1 dB.

- *s-SearchThresholdP-r16* as the signaled value of *s-SearchThresholdP-r16* [2] + 1 dB.

- *s-SearchThresholdQ-r16* as the signaled value of *s-SearchThresholdQ-r16* [2] + 1 dB.

- *s-SearchThresholdP2-r17* as the signaled value of *s-SearchThresholdP2-r17* [2] + 1 dB.

- s-SearchThresholdQ2-r17 as the signaled value of s-SearchThresholdQ2-r17 [2] + 1 dB.

##### 4.2B.2.11.2 Measurements for UE fulfilling stationary criterion

This clause contains requirements for measurements on inter-RAT E-UTRAN cells provided that:

- UE is configured with *stationaryMobilityEvaluation* [2] criterion and UE has fulfilled that criterion, or

- UE is configured with both *stationaryMobilityEvaluation* [2] criterion and *cellEdgeEvaluationWhileStationary* [2] criterion and *combineRelaxedMeasCondition2* [2] not configured, and UE has fulfilled only the *stationaryMobilityEvaluation* [2] criterion, and

The requirements defined in clause 4.2B.2.5 apply for this clause except that:

- Tdetect,EUTRAN\_RedCap Relax as specified in Table 4.2B.2.11.2-1 and Table 4.2B.2.11.2-2 for 1 Rx RedCap and 2 Rx RedCap respectively.

- Tmeasure,EUTRAN RedCap Relax as specified in Table 4.2B.2.11.2-1 and Table 4.2B.2.11.2-2 for 1 Rx RedCap and 2 Rx RedCap respectively.

- Tevaluate,EUTRAN RedCap Relax as specified in Table 4.2B.2.11.2-1 and Table 4.2B.2.11.2-2 for 1 Rx RedCap and 2 Rx RedCap respectively.

If the UE is configured with eDRX\_IDLE cycle then the requirements in Table 4.2B.2.11.2-3 are applicable for eDRX cycle < 10.24 s.

If the UE is configured with eDRX\_IDLE cycle ≥ 10.24 s, then the requirements in Table 4.2B.2.11.2-4 apply provided that filtering of a measurement is done within a single PTW and provided that the eDRX cycle is ≤ [163.84] sec and evaluation/measurement time with relaxation on one carrier is not greater than single PTW window length.

Table 4.2B.2.11.2-1: Tdetect,EUTRAN\_RedCap\_Relax, Tmeasure,EUTRAN\_RedCap\_Relax, and Tevaluate,EUTRAN\_RedCap\_Relax for 1 Rx RedCap

|  |  |  |  |
| --- | --- | --- | --- |
| DRX cycle length [s] | Tdetect,EUTRAN\_Relax [s] (number of DRX cycles) | Tmeasure,EUTRAN\_Relax [s] (number of DRX cycles) | Tevaluate,EUTRAN\_Relax  [s] (number of DRX cycles) |
| 0.32 | 11.52 x K5 (36 x K5) | 1.28 x K5 (4 x K5) | 5.12 x K5 (16 x K5) |
| 0.64 | 17.92 x K5 (28 x K5) | 1.28 x K5 (2 x K5) | 5.12 x K5 (8 x K5) |
| 1.28 | 32 x K5 (25 x K5) | 1.28 x K5 (1 x K5) | 6.4 x K5 (5 x K5) |
| 2.56 | 58.88 x K5 (23 x K5) | 2.56 x K5 (1 x K5) | 7.68 x K5 (3 x K5) |
| Note 1: K5 = 6 is the measurement relaxation factor applicable for UE fulfilling the *stationaryMobilityEvaluation* [2] criterion. | | | |

Table 4.2B.2.11.2-2: Tdetect,EUTRAN\_Relax, Tmeasure,EUTRAN\_Relax, and Tevaluate,EUTRAN\_Relax for 2 Rx RedCap

|  |  |  |  |
| --- | --- | --- | --- |
| DRX cycle length [s] | Tdetect,EUTRAN\_Relax [s] (number of DRX cycles) | Tmeasure,EUTRAN\_Relax [s] (number of DRX cycles) | Tevaluate,EUTRAN\_Relax  [s] (number of DRX cycles) |
| 0.32 | 11.52 x K5 (36 x K5) | 1.28 x K5 (4 x K5) | 5.12 x K5 (16 x K5) |
| 0.64 | 17.92 x K5 (28 x K5) | 1.28 x K5 (2 x K5) | 5.12 x K5 (8 x K5) |
| 1.28 | 32 x K5 (25 x K5) | 1.28 x K5 (1 x K5) | 6.4 x K5 (5 x K5) |
| 2.56 | 58.88 x K5 (23 x K5) | 2.56 x K5 (1 x K5) | 7.68 x K5 (3 x K5) |

Table 4.2B.2.10.2-3: Tdetect,E-UTRAN \_RedCap\_Relax, Tmeasure,NR\_,E-UTRAN \_RedCap\_Relax and Tevaluate,NR\_,E-UTRAN \_RedCap\_Relax for UE configured with eDRX\_IDLE cycle

|  |  |  |  |
| --- | --- | --- | --- |
| **eDRX\_IDLE cycle length [s]** | **Tdetect,NR\_E-UTRAN\_RedCap\_Relax [s] (number of DRX cycles)** | **Tmeasure,NR\_E-UTRAN\_RedCap\_Relax [s] (number of DRX cycles)** | **Tevaluate,NR\_E-UTRAN\_RedCap\_Relax [s] (number of DRX cycles)** |
|
| 5.12 | 117.76 x K3 (23 x K3) | 5.12 x K3 (1 x K3) | 10.24 x K3 (2 x K3) |
| Note 1: M2 = 1.5 if SMTC periodicity of measured intra-frequency cell > 20 ms; otherwise M2=1. If different SMTC periodicities are configured for different cells, the SMTC periodicity in this note is the one used by the cell being identified. During PSS/SSS detection, the periodicity of the SMTC configured for the intra-frequency carrier is assumed, and if the actual SSB transmission periodicity is greater than the SMTC configured for the intra-frequency carrier, longer Tdetect, NR\_intra is expected.  Note 2: K3 = 6 is the measurement relaxation factor applicable for UE fulfilling the *stationaryMobilityEvaluation* [2] criterion. | | | |

Table 4.2B.2.10.2-4: Tdetect,E-UTRAN \_RedCap\_Relax, Tmeasure,NR\_,E-UTRAN \_RedCap\_Relax and Tevaluate,NR\_,E-UTRAN \_RedCap\_Relax for UE configured with eDRX\_IDLE cycle

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| eDRX\_IDLE cycle length [s] | DRX cycle length [s] | PTW length [s] (number of 1.28s periods) | Tdetect,EUTRAN\_RedCap\_Relax [s] (number of DRX or eDRX cycles Note 3) | Tmeasure,EUTRAN\_RedCap\_Relax [s] (number of DRX or eDRX cycles Note 3) | Tevaluate,E-UTRAN\_RedCap\_Relax  [s] (number of DRX or eDRX cycles Note 3) |
| 10.24 ≤ eDRX\_IDLE cycle length ≤ 2621.444 | 0.32 | ≥1.28 (1) | K3 x  (23 x K3) | 0.32 x K3 (1 x K3) | 0.64 x K3 (2 x K3) |
| 0.64 | ≥1.28 (1) | 0.64 x K3 (1 x K3) | 1.28 x K3 (2 x K3) |
| 1.28 | ≥2.56 (2) | 1.28 x K3 (1 x K3) | 2.56 x K3 (2 x K3) |
| 2.56 | ≥5.12 (4) | 2.56 x K3 (1 x K3) | 5.12 x K3 (2 x K3) |
| NOTE 1: The number of DRX cycles in this table is given for the DRX cycles within PTWs.  NOTE 2: The eDRX\_IDLE cycle lengths are as specified in Section 10.5.5.32 of TS 24.008 [34].  NOTE 3: Number of eDRX cycles when eDRX\_IDLE cycle length equals 5.12s, number of DRX cycles otherwise.  NOTE 4: The lower bound of PTW length is derived based on . | | | | | |

##### 4.2B.2.11.3 Measurements for a UE fulfilling stationary not at cell edge criterion

This clause contains requirements for measurements on inter-RAT E-UTRAN cells provided that:

- UE is configured with both *stationaryMobilityEvaluation* [2] criterion and *cellEdgeEvaluationWhileStationary* [2] criterion, and

- has also fulfilled both criteria, and

- less than 4 hours have passed since measurements for cell reselection were last performed, and

In this case the UE is not required to meet Tdetect,EUTRAN, Tmeasure,EUTRAN and Tevaluate,EUTRAN as defined in clause 4.2B.2.5.

In addition the the conditions listed above, if the UE is configured with eDRX\_IDLE cycle ≤ [163.84] sec then the UE is not required to meet Tdetect,NR\_Intra\_RedCap, Tmeasure,NR\_Intra\_RedCap and Tevaluate,NR\_Intra\_RedCap as defined in clause 4.2B.2.5 and evaluation/measurement time with relaxation on one carrier is not greater than single PTW window length.

##### 4.2B.2.11.3A Measurements for a UE fulfilling stationary and Rel-16 not at cell edge criterion

This clause contains requirements for measurements on inter-RAT E-UTRAN cells provided that:

- UE is configured with both *stationaryMobilityEvaluation* [2] criterion and *cellEdgeEvaluation* [2] criterion, and has also fulfilled both criteria, or

- UE is configured with *cellEdgeEvaluation* [2] criterion and with both *stationaryMobilityEvaluation* [2] criterion and *cellEdgeEvaluationWhileStationary* [2] criterion and *combineRelaxedMeasCondition2* [2] not configured, and UE has fulfilled *cellEdgeEvaluation* and *stationaryMobilityEvaluation* [2] criterion.

The requirements defined in clause 4.2B.2.5 apply for this clause except that:

- Tdetect,EUTRAN\_Relax as specified in Table 4.2B.2.11.2-1 and Table 4.2B.2.11.2-2 for 1 Rx RedCap and 2 Rx RedCap respectively.

- Tmeasure,EUTRAN\_Relax as specified in Table 4.2B.2.11.2-1 and Table 4.2B.2.11.2-2 for 1 Rx RedCap and 2 Rx RedCap respectively.

- Tevaluate,EUTRAN\_Relax as specified in Table 4.2B.2.11.2-1 and Table 4.2B.2.11.2-2 for 1 Rx RedCap and 2 Rx RedCap respectively.

If the UE is configured with eDRX\_IDLE cycle then the requirements in Table 4.2B.2.11.2-3 are applicable for eDRX cycle < 10.24 s.

If the UE is configured with eDRX\_IDLE cycle ≥ 10.24 s, then the requirements in Table 4.2B.2.11.2-4 apply provided that filtering of a measurement is done within a single PTW and provided that the eDRX cycle is ≤ [163.84] sec and evaluation/measurement time with relaxation on one carrier is not greater than single PTW window length.

##### 4.2B.2.11.4 Measurements for a UE fulfilling low mobility and stationary criteria

This clause contains requirements for measurements on inter-RAT E-UTRAN cells provided that:

- UE is configured with *lowMobilityEvaluation* [2] criterion and *stationaryMobilityEvaluation* [2] criterion, and has also fulfilled both criteria, or,

- UE is configured with *lowMobilityEvaluation* [2] criterion and with both *stationaryMobilityEvaluation* [2] criterion and *cellEdgeEvaluationWhileStationary* [2] criterion and *combineRelaxedMeasCondition2* [2] not configured, and UE has fulfilled *lowMobilityEvaluation* and *stationaryMobilityEvaluation* [2] criteria

The requirements defined in clause 4.2B.2.11.2 apply for this clause.

##### 4.2B.2.11.5 Measurements for a UE fulfilling low mobility and stationary not at cell edge criteria

This clause contains requirements for measurements on inter-RAT E-UTRAN cells provided that:

- UE is configured with *lowMobilityEvaluation* [2] criterion and UE has fulfilled this criterion, and

- UE is configured with *stationaryMobilityEvaluation* [2] and *cellEdgeEvaluationWhileStationary* [2] criterion, and UE has also fulfilled both criteria

The requirements defined in clause 4.2B.2.11.3 apply for this clause.

##### 4.2B.2.11.6 Measurements for a UE fulfilling not-at-cell edge criterion and stationary not at cell edge criteria

This clause contains requirements for measurements on inter-RAT E-UTRAN cells provided that:

* UE is configured with cellEdgeEvaluation [2] criterion and UE has fulfilled that criterion, and
* UE is configured with *stationaryMobilityEvaluation* [2] criterion and *cellEdgeEvaluationWhileStationary* [2] criterion, and has also fulfilled both criteria

The requirements defined in clause 4.2B.2.11.3 apply for this clause.

##### 4.2B.2.11.7 Measurements for a UE fulfilling low mobility not-at-cell edge criterion and stationary not at cell edge criteria

This clause contains requirements for measurements on inter-RAT E-UTRAN cells provided that:

* UE is configured with both *lowMobilityEvaluation* [2] criterion and *cellEdgeEvaluation* [2] criterion, and has fulfilled both criteria, and
* UE is configured with *stationaryMobilityEvaluation* [2] criterion and *cellEdgeEvaluationWhileStationary* [2] criterion, and has also fulfilled both criteria

The requirements defined in clause 4.2B.2.11.3 apply for this clause.

##### 4.2B.2.11.8 Measurements for a UE fulfilling low mobility not-at-cell edge criterion and stationary criteria

This clause contains requirements for measurements on inter-RAT E-UTRAN cells provided that:

- UE is configured with both *lowMobilityEvaluation* [2] criterion and *cellEdgeEvaluation* [2] criterion, and has fulfilled both criteria, and

- UE is configured with *stationaryMobilityEvaluation* [2] criterion and has also fulfilled that criterion, or UE is configured with both *stationaryMobilityEvaluation* [2] criterion and *cellEdgeEvaluationWhileStationary* [2] criterion and *combineRelaxedMeasCondition2* [2] not configured, and UE has fulfilled *stationaryMobilityEvaluation* [2] criteria.

The requirements defined in clause 4.2.2.11.4 apply for this clause.

## 4.2C Cell Re-selection for NR UE for Satellite Access

### 4.2C.1 Introduction

The cell reselection procedure allows the UE to select a more suitable cell and camp on it.

When the UE is in either *Camped* *Normally* state or *Camped on Any Cell* state on a cell, the UE shall attempt to detect, synchronise, and monitor intra-frequency and inter-frequency cells indicated by the serving cell. For intra-frequency and inter-frequency cells the serving cell may not provide explicit neighbour list but carrier frequency information and bandwidth information only. UE measurement activity is also controlled by measurement rules defined in [clause TBD], allowing the UE to limit its measurement activity.

### 4.2C.2 Requirements

#### 4.2C.2.1 UE measurement capability

For idle mode cell re-selection purposes, the UE shall be capable of monitoring at least:

- Intra-frequency carrier, and

- Depending on UE capability, [7] NR inter-frequency carriers, and

#### 4.2C.2.2 Measurement and evaluation of serving cell

The UE shall measure the SS-RSRP and SS-RSRQ level of the serving cell and evaluate the cell selection criterion S defined in [clause TBD] for the serving cell at least once every M1\*N1 DRX cycle; where:

- M1=2 if SMTC periodicity (TSMTC) > 20 ms and DRX cycle ≤ 0.64 second and NSMTC =1, upon one SMTC configured at the UE,

- M1=2.5 if SMTC periodicity (TSMTC) > 20 ms and DRX cycle ≤ 0.64 secondand 1<NSMTC ≤ 4,

- otherwise M1=1.

Where, NSMTC is the number of SMTCs configured by SAN.

The UE shall filter the SS-RSRP and SS-RSRQ measurements of the serving cell using at least 2 measurements. Within the set of measurements used for the filtering, at least two measurements shall be spaced by, at least DRX cycle/2.

If the UE has evaluated according to Table 4.2C.2.2-1 in Nserv consecutive DRX cycles that the serving cell does not fulfil the cell selection criterion S, the UE shall initiate the measurements of all neighbour cells indicated by the serving cell, regardless of the measurement rules currently limiting UE measurement activities. Additionally, if the UE is configured with ‘*t-service*’ [2], the UE should start measurements of the neighbour cells indicated by the serving cell before ‘*t-service*’ is reached according to the requirements provided in clause 4.2C.2.3 and 4.2C.2.4.

If the UE is not configured with*‘t-Service*’ [2] in the serving cell and if the UE in RRC\_IDLE has not found any new suitable cell based on searches and measurements using the intra-frequency, inter-frequency and inter-RAT information indicated in the system information for [10 s], the UE shall initiate cell selection procedures for the selected PLMN as defined in [clause TBD].

If the UE is configured with ‘*t-Service*’ in the serving cell then the UE shall initiate cell selection procedures for the selected PLMN as defined in TS 38.304 when any of the following conditions is fulfilled:

- If the UE in RRC\_IDLE has not found any new suitable cell based on searches and measurements using the intra-frequency, inter-frequency and inter-RAT information indicated in the system information within 10 s since time instance T1 provided that ‘*t-Service*’ > T1 or

- If the UE in RRC\_IDLE has not found any new suitable cell based on searches and measurements using the intra-frequency, inter-frequency and inter-RAT information indicated in the system information within 10 s since the time instance ‘*t-Service*’.

- Where, T1 is the time instance in seconds when the UE has determined that the serving cell does not fulfil the cell selection criterion S.

Table 4.2C.2.2-1: Nserv

|  |  |  |
| --- | --- | --- |
| **DRX cycle length [s]** | **Scaling Factor (N1)** | **Nserv [number of DRX cycles]** |
|  | **FR1** |  |
| 0.32 | 1 | M1\*N1\*4 |
| 0.64 | M1\*N1\*4 |
| 1.28 | N1\*2 |
| 2.56 | N1\*2 |
| Note 1: The UE is not required to meet the requirements for 2.56s DRX cycle length for earth-moving LEO deployment. | | |

#### 4.2C.2.3 Measurements of intra-frequency NR cells

The UE shall be able to identify new intra-frequency cells and perform SS-RSRP and SS-RSRQ measurements of the identified intra-frequency cells without an explicit intra-frequency neighbour list containing physical layer cell identities.

If Srxlev > SnonIntraSearchP and Squal > SnonIntraSearchQ, and the distance between UE and serving cell reference location is smaller than [threshold] if the [threshold] is configured and UE has location information, then the UE may not perform measurement of intra-frequency.

The UE shall be able to evaluate whether a newly detectable intra-frequency cell meets the reselection criteria defined in [clause TBD] within Kmulti\_SMTC \* Tdetect,NR\_Intrawhen that Treselection= 0 if the UE does not support [capability for enhanced requriements] or if the [NW configuration for enhanced requirements] is not enabled, or within Kmulti\_SMTC \* Kcarrier \* Tdetect,NR\_Intra\_enhif the UE supports [capability for enhanced requirements] and the [NW configuration for enhanced requirements] is enabled. An intra frequency cell is considered to be detectable according to the conditions defined in [clause TBD] for a corresponding Band.

The UE shall measure SS-RSRP and SS-RSRQ at least every Kmulti\_SMTC \* Tmeasure,NR\_Intra (see table 4.2C.2.3-1) if the UE does not support [capability for enhanced requirements] or if the [NW configuration for enhanced requirements] is not enabled, or every Kmulti\_SMTC \* Tmeasure,NR\_Intra\_enh (see table 4.2C.2.3-2) if the UE supports [capability for enhanced requiremetns] and the [NW configuration for enhanced requirements] is enabled, for intra-frequency cells that are identified and measured according to the measurement rules.

The UE shall filter SS-RSRP and SS-RSRQ measurements of each measured intra-frequency cell using at least 2 measurements. Within the set of measurements used for the filtering, at least two measurements shall be spaced by at least Kmulti\_SMTC \* Tmeasure,NR\_Intra/2.

The parameter Kmulti\_SMTC is the scaling factor for measurements of multiple SMTCs which correspond to different satellites [clause TBD].

The UE shall not consider a NR neighbour cell in cell reselection, if it is indicated as not allowed in the measurement control system information of the serving cell.

For an intra-frequency cell that has been already detected, but that has not been reselected to, the filtering shall be such that the UE shall be capable of evaluating that the intra-frequency cell has met reselection criterion defined in [clause TBD] within Tevaluate,NR\_Intra if the UE does not support [capability for enhanced requriements] or if the [NW configuration for enhanced requirements] is not enabled, or within Tevaluate,NR\_Intra\_enh if the UE supports [capability for enhanced requriements] and the [NW configuration for enhanced requirements] is enabled, when Treselection = 0as specified in table 4.2C.2.3-1 or table 4.2C.2.3-2 provided that:

- when *rangeToBestCell* is not configured:

- the cell is at least 3dB better ranked in FR1 or 4.5dB better ranked in FR2.

- when *rangeToBestCell* is configured:

- the cell has the highest number of beams above the threshold *absThreshSS-BlocksConsolidation* among all detected cells whose cell-ranking criterion R value in [clause TBD] is within *rangeToBestCell* of the cell-ranking criterion R value of the highest ranked cell.

- if there are multiple such cells, the cell has the highest rank among them.

- the cell is at least 3dB better ranked in FR1 or 4.5dB better ranked in FR2 if the current serving cell is among them.

When evaluating cells for reselection, the SSB side conditions apply to both serving and non-serving intra-frequency cells.

If Treselection timer has a nonzero value and the intra-frequency cell is satisfied with the reselection criteria which are defined in [clause TBD], the UE shall evaluate this intra-frequency cell for the Treselection time. If this cell remains satisfied with the reselection criteria within this duration, then the UE shall reselect that cell.

Table 4.2C.2.3-1: Tdetect,NR\_Intra, Tmeasure,NR\_Intra and Tevaluate,NR\_Intra

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **DRX cycle length [s]** | **Scaling Factor (N1)** | **Tdetect,NR\_Intra [s] (number of DRX cycles)** | **Tmeasure,NR\_Intra [s] (number of DRX cycles)** | **Tevaluate,NR\_Intra**  **[s] (number of DRX cycles)** |
|  | **FR1** |  |  |  |
| 0.32 | 1 | 11.52 x N1 x M2 (36 x N1 x M2) | 1.28 x N1 x M2 (4 x N1 x M2) | 5.12 x N1 x M2 (16 x N1 x M2) |
| 0.64 | 17.92 x N1 (28 x N1) | 1.28 x N1 (2 x N1) | 5.12 x N1 (8 x N1) |
| 1.28 | 32 x N1 (25 x N1) | 1.28 x N1 (1 x N1) | 6.4 x N1 (5 x N1) |
| 2.56 | 58.88 x N1 (23 x N1) | 2.56 x N1 (1 x N1) | 7.68 x N1 (3 x N1) |
| Note 1: M2 = 2 if SMTC periodicity of measured intra-frequency cell > 20 ms and 1<NSMTC ≤ 4 upon more than 1 SMTC configured at the UE; M2 = 1.5 if SMTC periodicity of measured intra-frequency cell > 20 ms and NSMTC=1 upon 1 SMTC configured at the UE; otherwise M2=1. Where, NSMTC is the number of SMTCs configured by SAN If different SMTC periodicities are configured for different cells, the SMTC periodicity in this note is the one used by the cell being identified. During PSS/SSS detection, the periodicity of the SMTC configured for the intra-frequency carrier is assumed, and if the actual SSB transmission periodicity is greater than the SMTC configured for the intra-frequency carrier, longer Tdetect, NR\_intra is expected.  Note 2: The UE is not required to meet the requirements for 2.56s DRX cycle length for earth-moving LEO deployment. | | | | |

Table 4.2C.2.3-2: Tdetect,NR\_Intra\_enh, Tmeasure,NR\_Intra\_enh and Tevaluate,NR\_Intra\_enh

|  |  |  |  |
| --- | --- | --- | --- |
| **DRX cycle length [s]** | **Tdetect,NR\_Intra\_enh [s] (number of DRX cycles)** | **Tmeasure,NR\_Intra\_enh [s] (number of DRX cycles)** | **Tevaluate,NR\_Intra\_enh [s] (number of DRX cycles)** |
|
| 0.32 | 2.56 x M2 (8 x M2)Note 1 | 0.32 x M3 (1 x M3) Note 1 | 0.96 x M4 (3 x M4) Note 1 |
| 0.64 | 5.12 (8) | 0.64 (1) | 1.92 (3) |
| 1.28 | 8.96 (7) | 1.28 (1) | 3.84 (3) |
| 2.56 | 58.88 (23) | 2.56 (1) | 7.68 (3) |
| Note 1: When SMTC < = 40 ms, M2 = M3 = M4 = 1; and when SMTC > 40 ms, M2 = 2, M3 = M4 = 2.5 | | | |

If [serving cell service time information] is broadcasted and applicable, UE shall be able to detect, measure, and evaluate neighbour cells before the serving cell stops serving the area regardless of whether the distance condition based on serving cell reference location is met [or the legacy Srxlev/Squal condition are met], and when to start the detection, measurement and evaluation on neighbour cells is up to UE implementation. This requirement does not apply when the time span from the last slot of SI transmission within SI modification period where the broadcasting of the last updated value for t-Service is acquired by the UE for the first time to the first slot when the cell is scheduled to stop serving the area according to the broadcasted information is less than Ttrigger.

Ttrigger = max(Tdetect,NR\_Intra, Kcarrier\* Tdetect,NR\_Inter),

where

- Kcarrier is the number of NR inter-frequency carriers indicated by the serving cell,

- Tdetect,NR\_Intra refers to HST intra-frequency cell detection delay in IDLE/INACTIVE mode defined Table Table 4.2C.2.3-2,

- Tdetect,NR\_Inter refers to HST inter-frequency cell detection delay in IDLE/INACTIVE mode defined Table 4.2C.2.4-2.

The requriements in this clause apply provided that the number of SMTCs for any inter-frequency carrier does not exceed the [UE capability], otherwise UE may select one or subset of all the configured SMTCs sequentially for performing the measurements until all of the SMTCs can be measured. The selection of SMTCs to be used is up to UE implementation, and in this case, measurement period longer than the corresponding measurement period specified in Table 4.2C.2.3-1 and Table 4.2C.2.3-2 is expected.

*Editor’s note: FFS whether to include side condition related to valid target satellite information*

*Editor’s note: FFS how to differentiate requirements between LEO and GEO systems*

#### 4.2C.2.4 Measurements of inter-frequency NR cells

The UE shall be able to identify new inter-frequency cells and perform SS-RSRP or SS-RSRQ measurements of identified inter-frequency cells if carrier frequency information is provided by the serving cell, even if no explicit neighbour list with physical layer cell identities is provided.

If Srxlev > SnonIntraSearchP and Squal > SnonIntraSearchQ, and the distance between UE and serving cell reference location is smaller than *distanceThresh* if *distanceThresh* is configured and UE has location information, then the UE shall search for inter-frequency layers of higher priority at least every Thigher\_priority\_search where Thigher\_priority\_search is described in clause TBD.

If Srxlev ≤ SnonIntraSearchP or Squal ≤ SnonIntraSearchQ, or the distance between UE and serving cell reference location is larger than *distanceThresh* if *distanceThresh* is configured and UE has location information, then the UE shall search for and measure inter-frequency layers of higher, equal or lower priority in preparation for possible reselection. The requirements apply provided that the distance exceeds the *distanceThresh* by a margin of 50 m. In this scenario, the minimum rate at which the UE is required to search for and measure higher priority layers shall be the same as that defined below in this clause.

The UE shall be able to evaluate whether a newly detectable inter-frequency cell meets the reselection criteria defined in TS38.304 [1] within Kmulti\_SMTC \* Kcarrier \* Tdetect,NR\_Inter if the UE does not support [capability for enhanced requriements] or if the [NW configuration for enhanced requirements] is not enabled, or within Kmulti\_SMTC \* Kcarrier \* Tdetect,NR\_Inter\_enh if the UE supports [capability for enhanced requirements] and the [NW configuration for enhanced requirements] is enabled, if at least carrier frequency information is provided for inter-frequency neighbour cells by the serving cells when Treselection = 0 provided that the reselection criteria is met by a margin of at least [TBD]dB in FR1 for reselections based on ranking or [TBD]dB in FR1 for SS-RSRP reselections based on absolute priorities or [TBD]dB in FR1 for SS-RSRQ reselections based on absolute priorities. The parameter Kcarrier is the number of NR inter-frequency carriers indicated by the serving cell.

The parameter Kmulti\_SMTC is the scaling factor for measurement of multiple SMTCs or multiple satellites

- If SMTCs do not overlap with each other,

- , if GEO satellites are measured on the carrier;

- , if LEO satellites are measured on the carrier;

- If SMTCs partially overlap with each other,

- , if only GEO satellites are measured on the carrier;

- , if only LEO satellites are measured on the carrier;

where

is the number of LEO satellites to be measured within i-th SMTC,

is the number of LEO satellites that UE can measure in parallel within an SMTC,

is the number of SMTCs that partially overlap with each other.An inter-frequency cell is considered to be detectable according to the conditions defined in Annex B.1.z for a corresponding Band.

When higher priority cells are found by the higher priority search, they shall be measured at least every Tmeasure,NR\_Inter. If, after detecting a cell in a higher priority search, it is determined that reselection has not occurred then the UE is not required to continuously measure the detected cell to evaluate the ongoing possibility of reselection. However, the minimum measurement filtering requirements specified later in this clause shall still be met by the UE before it makes any determination that it may stop measuring the cell. If the UE detects on a NR carrier a cell whose physical identity is indicated as not allowed for that carrier in the measurement control system information of the serving cell, the UE is not required to perform measurements on that cell.

The UE shall measure SS-RSRP or SS-RSRQ at least every Kmulti\_SMTC \* Kcarrier \* Tmeasure,NR\_Inter (see table 4.2C.2.4-1) if the UE does not support [capability for enhanced requriements] or if the [NW configuration for enhanced requirements] is not enabled, or every Kmulti\_SMTC \* Kcarrier \* Tmeasure,NR\_Inter\_enh (see table 4.2C.2.4-2) if the UE supports [capability for enhanced requriements] and the [NW configuration for enhanced requirements] is enabled, for identified lower or equal priority inter-frequency cells. If the UE detects on a NR carrier a cell whose physical identity is indicated as not allowed for that carrier in the measurement control system information of the serving cell, the UE is not required to perform measurements on that cell.

The UE shall filter SS-RSRP or SS-RSRQ measurements of each measured higher, lower and equal priority inter-frequency cell using at least 2 measurements. Within the set of measurements used for the filtering, at least two measurements shall be spaced by at least Tmeasure,NR\_Inter/2.

The UE shall not consider a NR neighbour cell in cell reselection, if it is indicated as not allowed in the measurement control system information of the serving cell.

For an inter-frequency cell that has been already detected, but that has not been reselected to, the filtering shall be such that the UE shall be capable of evaluating that the inter-frequency cell has met reselection criterion defined TS 38.304 [1] within Kmulti\_SMTC \* Kcarrier \* Tevaluate,NR\_Inter if the UE does not support [capability for enhanced requriements] or if the [NW configuration for enhanced requirements] is not enabled, or within Kmulti\_SMTC \* Kcarrier \* Tevaluate,NR\_Inter\_enh if the UE supports [capability for enhanced requriements] and the [NW configuration for enhanced requirements] is enabled, when Treselection = 0as specified in table 4.2C.2.4-1 provided that the reselection criteria is met by

- the condition when performing equal priority reselection and

when *rangeToBestCell* is not configured:

- the cell is at least [TBD]dB better ranked in FR1 or.

when *rangeToBestCell* is configured:

- the cell has the highest number of beams above the threshold *absThreshSS-BlocksConsolidation* among all detected cells whose cell-ranking criterion R value in TS38.304 [1] is within *rangeToBestCell* of the cell-ranking criterion R value of the highest ranked cell.

- if there are multiple such cells, the cell has the highest rank among them

- the cell is at least [TBD]dB better ranked in FR1 if the current serving cell is among them. or

- [TBD]dB in FR1 for SS-RSRP reselections based on absolute priorities or

- [TBD]dB in FR1 for SS-RSRQ reselections based on absolute priorities.

When evaluating cells for reselection, the SSB side conditions apply to both serving and inter-frequency cells.

If Treselection timer has a non zero value and the inter-frequency cell is satisfied with the reselection criteria, the UE shall evaluate this inter-frequency cell for the Treselection time. If this cell remains satisfied with the reselection criteria within this duration, then the UE shall reselect that cell.

The UE is not expected to meet the measurement requirements for an inter-frequency carrier under DRX cycle=320 ms defined in Table 4.2C.2.4-1 under the following conditions:

- TSMTC\_intra = TSMTC\_inter = 160 ms; where

- TSMTC\_intra is the periodicity of the SMTC configured for the intra-frequency carrier if no identified intra-frequency cell is in the PCI list of smtc2-LP on this intra-frequency carrier; TSMTC\_intra is the periodicity of the smtc2-LP configured for the intra-frequency carrier if at least one identified intra-frequency cell is in the PCI list of smtc2-LP on this intra-frequency carrier. During PSS/SSS detection, the periodicity of the SMTC configured for the intra-frequency carrier is assumed for TSMTC\_intra. If the actual SSB transmission periodicity is greater than the SMTC configured for the intra-frequency carrier, longer Tdetect, NR\_intra is expected.

- TSMTC\_inter is the actual SMTC periodicity used by the inter-frequency cell being identified. During PSS/SSS detection, the periodicity of the SMTC configured for the inter-frequency carrier is assumed for TSMTC\_inter. If the actual SSB transmission periodicity is greater than the SMTC configured for the inter-frequency carrier, longer Tdetect, NR\_inter is expected.

- SMTC occasions configured for the inter-frequency carrier occur up to 1 ms before the start or up to 1 ms after the end of the SMTC occasions configured for the intra-frequency carrier, and

- SMTC occasions configured for the intra-frequency carrier and for the inter-frequency carrier occur up to 1 ms before the start or up to 1 ms after the end of the paging occasion in TS38.304 [1].

Table 4.2C.2.4-1: Tdetect,NR\_Inter, Tmeasure,NR\_Inter and Tevaluate,NR\_Inter

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| DRX cycle length [s] | Scaling Factor (N1) | Tdetect,NR\_Inter [s] (number of DRX cycles) | Tmeasure,NR\_Inter [s] (number of DRX cycles) | Tevaluate,NR\_Inter [s] (number of DRX cycles) |
| FR1 |
| 0.32 | 1 | 11.52 x N1 x 1.5 (36 x N1 x 1.5) | 1.28 x N1 x 1.5 (4 x N1 x 1.5) | 5.12 x N1 x 1.5 (16 x N1 x 1.5) |
| 0.64 | 17.92x N1 (28 x N1) | 1.28 x N1 (2 x N1) | 5.12 x N1 (8 x N1) |
| 1.28 | 32 x N1 (25 x N1) | 1.28 x N1 (1 x N1) | 6.4 x N1 (5 x N1) |
| 2.56 | 58.88 x N1 (23 x N1) | 2.56 x N1 (1 x N1) | 7.68 x N1 (3 x N1) |
| Note 1: UE is not required to fulfil the requirements for 2.56s DRX cycle length for earth-moving LEO deployment. | | | | |

Table 4.2C.2.4-2: Tdetect,NR\_Inter\_enh, Tmeasure,NR\_Inter\_enh and Tevaluate,NR\_Inter\_enh

|  |  |  |  |
| --- | --- | --- | --- |
| DRX cycle length [s] | Tdetect,NR\_Inter\_enh [s] (number of DRX cycles) | Tmeasure,NR\_Inter\_enh [s] (number of DRX cycles) | Tevaluate,NR\_Inter\_enh [s] (number of DRX cycles) |
|
| 0.32 | [3.2 x M2 (10 x M2)] Note 1 | [0.32 x M3 ([1] x M3)] Note 1 | 0.96 x M4 (3 x M4) Note 1 |
| 0.64 | [6.4 (10)] | [0.64 (1)] | 1.92 (3) |
| 1.28 | [10.24 (8)] | 1.28 (1) | 3.84 (3) |
| 2.56 | 58.88 (23) | 2.56 (1) | 7.68 (3) |
| Note 1: When SMTC < = 40 ms, M2 = M3 = M4 = 1; and when SMTC > 40 ms, M2 = 1.5, M3 = M4 = 2 | | | |

If *t-Service* is broadcasted and applicable, UE shall be able to detect, measure, and evaluate neighbour cells before the serving cell stops serving the area regardless of whether the distance condition based on serving cell reference location or the legacy Srxlev/Squal condition are met, and when to start detection, measurement, and evaluation is up to UE implementation. This requirement does not apply when the time span from the last slot of SI transmission within SI modification period where the broadcasting of the last updated value for t-Service is acquired by the UE for the first time to the first slot when the cell is scheduled to stop serving the area according to the broadcasted information is less than Ttrigger, and Ttrigger = max(Tdetect,NR\_Intra, Kcarrier\* Tdetect,NR\_Inter) when serving cell is below the search threshold, and Ttrigger = max(Tdetect,NR\_Intra, Nlayer\* [60s]) when serving cell is above the search threshold, where

- Kcarrier is the number of NR inter-frequency carriers indicated by the serving cell,

- Nlayer is the total number of higher priority NR carrier frequencies broadcasted in system information,

- Tdetect,NR\_Intra refers to HST intra-frequency cell detection delay in IDLE/INACTIVE mode defined Table 4.2.2.3-2,

- Tdetect,NR\_Inter refers to HST inter-frequency cell detection delay in IDLE/INACTIVE mode defined Table 4.2.2.4-2.

The requriements in this clause apply provided that the number of SMTCs for any inter-frequency carrier does not exceed the [UE capability], otherwise UE may select one or subset of all the configured SMTCs sequentially until all of the SMTCs can be measured, the selection of SMTCs to be used is up to UE implementation, and longer measurement delay than the corresponding measurement period specified in Table 4.2C.2.4-1 and Table 4.2C.2.4-2 is expected.

The requirements in this clause apply provided that the valid information for the satellite serving the target cell has been provided by the serving cell.

The requirements in this clause apply provided that SSB of neighbour cells are within the time shifted SMTC.

#### 4.2C.2.5 Maximum interruption in paging reception

UE shall perform the cell re-selection with minimum interruption in monitoring downlink channels for paging reception.

At intra-frequency and inter-frequency cell re-selection, the UE shall monitor the downlink of serving cell for paging reception until the UE is capable to start monitoring downlink channels of the target intra-frequency and inter-frequency cell for paging reception. The interruption time shall not exceed TSI-NR + K\*Ttarget\_cell\_SMTC\_period ms.

Where,

If the target cell belongs to the same satellite as the current one, and if the target cell is known, then K = 2.

If the target cell belongs to a different satellite than the current one and the target cell’s satellite is GEO, and if the target cell is known, then K = 2.

If the target cell belongs to a different satellite than the current one and the target cell’s satellite is non-GEO, then K = 5 if the target cell is known.

Ttarget\_cell\_SMTC\_period is the periodicity of the SMTC occasions configured for the target NR cell. If the target cell is in the PCI list of *smtc2-LP*, the SMTC periodicityfollows *smtc2-LP*; otherwise, the SMTC periodicity follows *smtc*.

TSI-NR is the time required for receiving all the relevant system information data according to the reception procedure and the RRC procedure delay of system information blocks defined in TS 38.331 [2] for an NR cell.

The target cell is considered as known if it has been detectable during Tdetect,NR\_Intra or Tdetect,NR\_Inter, and the time span between SIB broadcasting cell stop time and the cell stop time is not less than Ttrigger. Otherwise, the target cell is considered as unknown, where Tdetect,NR\_Intra, Tdetect,NR\_Inter and Ttrigger are defined in 4.2C.2.3 and 4.2C.2.4. A longer interruption can be expected if the target cell is unknown.

These requirements assume sufficient radio conditions, so that decoding of system information can be made without errors and does not take into account cell re-selection failure.

#### 4.2C.2.6 Minimum requirement at transitions

The requriements in clause 4.2.2.8 apply provided that target cell’s satellite is GEO.

#### 4.2C.2.7 Measurements of intra-frequency NR cells for UE configured with relaxed measurement criterion

The requriements in clause 4.2.2.9 apply provided that target cell’s satellite is GEO.

#### 4.2C.2.8 Measurements of inter-frequency NR cells for UE configured with relaxed measurement criterion

The requriements in clause 4.2.2.10 apply provided that target cell’s satellite is GEO.

#### 4.2C.2.9 General requirements

The UE shall search every layer of higher priority at least every Thigher\_priority\_search = (60 \* Nlayers) seconds, where Nlayers is the total number of higher priority NR carrier frequencies broadcasted in system information.

## 4.3 Minimization of Drive Tests (MDT)

### 4.3.1 Introduction

UE supporting minimisation of drive tests in RRC\_IDLE shall be capable of:

- logging measurements in RRC\_IDLE, reporting the logged measurements and meeting requirements in clause 4.3;

- logging of RRC connection establishment failure, reporting the logged failure and meeting requirements in clause 4.3;

- logging of radio link failure and handover failure, reporting the logged failure and meeting requirements in clause 4.3.

The logged MDT requirements consist of measurement requirements as specified in clause 4.3.2 and relative time stamp accuracy requirements as specified in clause 4.3.3. Both sets of requirements are applicable for intra-frequency, inter-frequency and inter-RAT cases in RRC\_IDLE state. The MDT procedures are described in TS 37.320 [31].

For RRC connection establishment failure logging and reporting, the MDT requirements consist of requirements for measurements performed and logged in RRC\_IDLE state specified in clause 4.3.2 and relative time stamp accuracy requirement for RRC connection establishment failure log reporting as specified in clause 4.3.4.

### 4.3.2 Measurement Requirements

The requirements specified in this clause apply for the following measurements performed and logged by the UE for MDT in RRC\_IDLE:

- inter-RAT E-UTRA FDD and TDD RSRP,

- inter-RAT E-UTRA FDD and TDD RSRQ,

- SS-RSRP per cell,

- SS-RSRQ per cell,

- SS-RSRP per SSB index of the serving cell,

- SS-RSRQ per SSB index of the serving cell,

- best SSB index of the serving cell,

- the number of SSBs with different SSB index which are above the threshold *absThreshSS-BlocksConsolidation* for all detected cells whose cell-ranking criterion R value is within *rangeToBestCell* of the cell-ranking criterion R value of the highest ranked cell.

The requirements apply for the measurements included in logged MDT reports and RRC connection establishment failure reports.

The measurement values that are used to meet

- serving cell and reselection requirements as specified in clauses 4.2.2.2−4.2.2.7

- shall also apply to values logged for MDT measurements in RRC\_IDLE state.

### 4.3.3 Requirements for Relative Time Stamp Accuracy

The relative time stamp for a logged measurement is defined as the time from the moment the MDT configuration was received at the UE until the measurement was logged, see TS 38.331 [2].

The accuracy of the relative time stamping is such that the drift of the time stamping shall be not more than ± 2 seconds per hour.

### 4.3.4 Requirements for Relative Time Stamp Accuracy for RRC Connection Establishment Failure Log Reporting

Relative time stamp for RRC connection establishment failure log reporting is defined as the time elapsed from the last RRC connection establishment failure to the time when the log is included in the report TS 38.331 [2]. The UE shall report the RRC connection establishment failure log, while meeting the accuracy requirement specified in this clause.

The accuracy of the relative time stamping for RRC connection establishment failure log reporting is such that the drift of the time stamping shall not be larger than ± 0.72 seconds per hour and ± 10 seconds over 48 hours. The relative time stamp accuracy requirements shall apply provided that:

- no power off or detach occurs after the RRC connection establishment failure had been detected and until the log is time-stamped.

### 4.3.5 Requirements for Relative Time Stamp Accuracy for Radio Link Failure and Handover Failure Log Reporting

The UE shall report the radio link and handover failure log, while meeting the accuracy requirements specified in this clause.

Relative time stamp accuracy requirements for *timeSinceFailure* reported for MDT in a radio link failure or handover failure log are specified in this clause. *timeSinceFailure* determines the time elapsed from the last radio link failure or handover failure in NR to the time when the log is included in the report TS 38.331 [2].

The accuracy of the relative time stamping for *timeSinceFailure* is such that the drift of the time stamping shall not be larger than ± 0.72 seconds per hour and ± 10 seconds over 48 hours. These relative time stamp accuracy requirements shall apply provided that:

- no power off or detach occurs after the RLF or handover failure had been detected and until the log is time-stamped.

## 4.3C Minimization of Drive Tests (MDT) for Satellite Access

*Editor’s note: the exact signalling names in the clause and values are subject to confirmation by RAN2 and change during performance requirement phase, respectively. And the brackets shall be removed by further agreements.*

### 4.3C.1 Introduction

UE supporting minimisation of drive tests in RRC\_IDLE shall be capable of:

- logging measurements in RRC\_IDLE, reporting the logged measurements and meeting requirements in clause 4.3C;

- logging of RRC connection establishment failure, reporting the logged failure and meeting requirements in clause 4.3C;

- logging of radio link failure and handover failure, reporting the logged failure and meeting requirements in clause 4.3C.

The logged MDT requirements consist of measurement requirements as specified in clause 4.3C.2 and relative time stamp accuracy requirements as specified in clause 4.3C.3. Both sets of requirements are applicable for intra-frequency, inter-frequency and inter-RAT cases in RRC\_IDLE state. The MDT procedures are described in TS 37.320 [31].

For RRC connection establishment failure logging and reporting, the MDT requirements consist of requirements for measurements performed and logged in RRC\_IDLE state specified in clause 4.3C.2 and relative time stamp accuracy requirement for RRC connection establishment failure log reporting as specified in clause 4.3C.4.

### 4.3C.2 Measurement Requirements

The requirements specified in this clause apply for the following measurements performed and logged by the UE for MDT in RRC\_IDLE:

- SS-RSRP per cell,

- SS-RSRQ per cell,

- SS-RSRP per SSB index of the serving cell,

- SS-RSRQ per SSB index of the serving cell,

- best SSB index of the serving cell,

- the number of SSBs with different SSB index which are above the threshold *absThreshSS-BlocksConsolidation* for all detected cells whose cell-ranking criterion R value is within *rangeToBestCell* of the cell-ranking criterion R value of the highest ranked cell.

The requirements apply for the measurements included in logged MDT reports and RRC connection establishment failure reports.

The measurement values that are used to meet

* serving cell and reselection requirements as specified in clauses 4.2C.2.2−4.2C.2.9

shall also apply to values logged for MDT measurements in RRC\_IDLE state.

### 4.3C.3 Requirements for Relative Time Stamp Accuracy

The relative time stamp for a logged measurement is defined as the time from the moment the MDT configuration was received at the UE until the measurement was logged, see TS 38.331 [2].

The accuracy of the relative time stamping is such that the drift of the time stamping shall be not more than ± 2 seconds per hour.

### 4.3C.4 Requirements for Relative Time Stamp Accuracy for RRC Connection Establishment Failure Log Reporting

Relative time stamp for RRC connection establishment failure log reporting is defined as the time elapsed from the last RRC connection establishment failure to the time when the log is included in the report TS 38.331 [2]. The UE shall report the RRC connection establishment failure log, while meeting the accuracy requirement specified in this clause.

The accuracy of the relative time stamping for RRC connection establishment failure log reporting is such that the drift of the time stamping shall not be larger than ± 0.72 seconds per hour and ± 10 seconds over 48 hours. The relative time stamp accuracy requirements shall apply provided that:

- no power off or detach occurs after the RRC connection establishment failure had been detected and until the log is time-stamped.

### 4.3C.5 Requirements for Relative Time Stamp Accuracy for Radio Link Failure and Handover Failure Log Reporting

The UE shall report the radio link and handover failure log, while meeting the accuracy requirements specified in this clause.

Relative time stamp accuracy requirements for *timeSinceFailure* reported for MDT in a radio link failure or handover failure log are specified in this clause. *timeSinceFailure* determines the time elapsed from the last radio link failure or handover failure in NR to the time when the log is included in the report TS 38.331 [2].

The accuracy of the relative time stamping for *timeSinceFailure* is such that the drift of the time stamping shall not be larger than ± 0.72 seconds per hour and ± 10 seconds over 48 hours. These relative time stamp accuracy requirements shall apply provided that:

- no power off or detach occurs after the RLF or handover failure had been detected and until the log is time-stamped.

## 4.4 Idle Mode CA/DC Measurements

### 4.4.1 Introduction

A UE supporting *idleInactiveNR-MeasReport-r16* or *idleInactiveEUTRA-MeasReport-r16* shall perform the idle mode measurement on the inter-frequency CA and DC candidate frequencies/cells and E-UTRAN inter-RAT DC candidate frequencies/cells indicated by higher layers and meet the requirement specified in this clause. The UE shall perform idle mode measurements provided that the serving cell support early measurement and is within the validity area. The idle mode measurement requirements apply to a configured carrier frequency and the serving cell are among the supported band combination of the UE.

### 4.4.2 Measurement Requirements

For a UE which supports *idleInactiveNR-MeasReport-r16* or *idleInactiveEUTRA-MeasReport-r16* the UE shall support the idle mode CA measurements on the serving cell, and carriers configured for idle mode CA/DC measurement reporting provided T331 has not expired, the serving cell is supporting idle mode CA/DC measurement reporting and the serving cell is in the validity area.

#### 4.4.2.1 Detected cell requirement during state transition and Idle mode

This subclause defines the requirements for the detected cell status for the idle mode CA/DC measurement when UE transitions from RRC Connected mode to Idle mode and after UE has entered Idle mode. The requirements are applicable to an NE-DC and NR carrier aggregation capable UE which has been configured with one or more of following, one or more SCells, one E-UTRAN PSCell or one or more downlink E-UTRAN SCells during the Connected mode and which supports *idleInactiveNR-MeasReport-r16* or *idleInactiveEUTRA-MeasReport-r16.* The requirements are applicable for SCell(s) and E-UTRAN FDD and TDD PSCell and SCells.

Upon releasing the connection and if the UE has been configured with idle mode CA measurement reporting, following requirements apply concerning the detected cells in Connected mode upon state transitioning to Idle mode and during Idle mode:

- A cell which is detected cell in Connected mode prior to connection release, shall remain detected after UE has entered Idle mode and during Idle mode, provided that the following conditions are met:

- The UE has been provided with a list of cells and/or carrier frequencies for early measurement reporting by dedicated RRC signaling and

- The detected cell is among the list of cells or on a carrier frequency provided for early measurement reporting, and

- The UE is provided with a valid timer T331 by dedicated RRC signaling, and

- The detected cell and SSBs remains detectable until UE reconnect to the network and transmits the early measurement report, and

- The carrier frequency of the detected cell and the carrier frequency of the serving cell are among the supported band combination of the UE.

An inter-RAT E-UTRAN cell is considered detectable according to RSRP, RSRP Ês/Iot, SCH\_RP and SCH Ês/Iot defined in Annex B.1.1 and Annex B.1.2 in [15] for a corresponding Band. An inter-frequency cell is considered detectable according to the conditions in Annex B.1.2 and B.1.3 for a corresponding band. An SSB of an inter-frequency cell is considered detectable according to SSB\_RP and SSB Ês/Iot defined in Annex B.1.2 and B.1.3 for a corresponding Band.

#### 4.4.2.2 Measurements of inter-frequency CA/DC candidate cells

While T331 is running, the UE shall perform measurement on the configured inter-frequency carriers for idle mode CA/DC measurement reporting according to the UE measurement capability.

A UE which supports *idleInactiveNR-MeasReport-r16* shall support idle mode CA/DC measurements of:

- at least 7 inter-frequency carriers which are also configured for inter-frequency mobility measurements, and

- at least 7 inter-frequency carriers which are not configured for inter-frequency mobility measurements.

The UE shall be capable of monitoring a total of at least 7 inter-frequency carriers for idle mode CA/DC measurements comprising of carriers configured for inter-frequency mobility measurements and carriers not configured for inter-frequency mobility measurements.

For inter-frequency carriers configured for idle mode CA/DC measurements, if Srxlev ≤ SnonIntraSearchP or Squal ≤ SnonIntraSearchQ the inter-frequency measurement requirements in clause 4.2.2.4 shall apply, where UE shall search for and measure inter-frequency layers configured for idle mode CA/DC measurements in preparation for possible reporting. If Srxlev > SnonIntraSearchP and Squal > SnonIntraSearchQ the UE shall search for inter-frequency layers configured for idle mode CA/DC measurements at least every Thigher\_priority\_search where Thigher\_priority\_search is described in clause 4.2.2.7, where UE shall search for and measure inter-frequency layers configured for idle mode CA/DC measurements in preparation for possible reporting.

For UE supporting *idleInactiveNR-MeasBeamReport-r16*, if the UE is configured with *beamMeasConfigIdle-r16* for idle mode CA/DC measurement, the UE shall be capable of performing SS-RSRP, SS-RSRQ for at least

- 7 SSBs with different SSB index and/or PCI on an inter-frequency layer in FR1,

- 10 SSBs with different SSB index and/or PCI on an inter-frequency layer in FR2.

For UE supporting *idleInactiveNR-MeasBeamReport-r16*, if the UE is configured with *beamMeasConfigIdle-r16* on one or more carrier for idle mode CA/DC measurement, the UE, on each carrier, shall be able to:

- detect a newly detectable inter-frequency NR cell and perform RSRP/RSRQ measurement in preparation for reporting, and

- acquire the SSB index for a newly detectable inter-frequency NR cell if *beamMeasConfigIdle-r16* if configured on this carrier and perform RSRP/RSRQ measurement in preparation for reporting,

within the requirements defined in clause 4.2.2.4 plus k\*TSSB\_index,NR, where k is the number of carriers configured for idle mode CA measurement with *beamMeasConfigIdle-r16*, and TSSB\_index,NR is the additional time period used to acquire the index of the SSB being measured as defined in table 4.4.2.2-1.

Table 4.4.2.2-1: TSSB\_index,NR\_Inter

|  |  |  |  |
| --- | --- | --- | --- |
| DRX cycle length [s] | Scaling Factor (N1) | | TSSB\_index,NR\_Inter [s] (number of DRX cycles) |
|  | FR1 | FR2Note1 |  |
| 0.32 | 1 | 8 | N2 x 1.28 x N1 x 1.5 (N2 x 4 x N1 x 1.5) |
| 0.64 |  | 5 | N2 x 1.28 x N1 (N2 x 2 x N1) |
| 1.28 |  | 4 | N2 x 1.28 x N1 (N2 x 1 x N1) |
| 2.56 |  | 3 | N2 x 2.56 x N1 (N2 x 1 x N1) |
| Note 1: Applies for UE supporting power class 2&3&4. For UE supporting power class 1, N1 = 8 for all DRX cycle length.  NOTE 2: N2 = 3 if the NR inter-frequency carrier for idle mode CA/DC measurement reporting is in FR1, and N2 = 3, 5 if the NR inter-frequency carrier for idle mode CA/DC measurement reporting is in FR2. | | | |

In the absence or expiration of T331, it is up to UE implementation to perform the idle mode CA/DC measurement.

For inter-frequency carriers configured for idle mode CA/DC measurements, the UE shall be capable of performing SS-RSRP and SS-RSRQ measurements of the carriers, and the UE physical layer shall be capable of reporting SS-RSRP and SS-RSRQ measurements of the carriers configured for idle mode CA/DC measurements to higher layers, with measurement accuracy as specified in clauses 10.1.4B and 10.1.5B and 10.1.9B and 10.1.10B, respectively.

The UE shall be able to report idle mode CA/DC measurements when idle mode CA/DC measurement reporting is requested by the network.

#### 4.4.2.3 Measurements on serving cell

The UE shall measure the RSRP and RSRQ level of the serving cell and evaluate the cell selection criterion S defined in clause 4.2.2.2 and the UE physical layer shall be capable of reporting RSRP and RSRQ measurements of the serving cell to higher layers, with measurement accuracy as specified in 10.1.2B, 10.1.3B, 10.1.7B and 10.1.8B.

#### 4.4.2.4 Measurements of E-UTRAN inter-RAT DC candidate cells

While T331 is running, the UE shall perform measurement on the configured inter-RAT carriers for idle mode CA/DC measurement reporting according to the UE measurement capability.

A UE which supports *idleInactiveEUTRA-MeasReport-r16* shall support idle mode DC measurements of:

- at least 7 E-UTRAN inter-RAT carriers which are also configured for E-UTRAN inter-RAT mobility measurements, and

- at least 1 E-UTRAN inter-RAT carrier which is not configured for E-UTRAN inter-RAT mobility measurements.

The UE shall be capable of monitoring a total of at least 7 inter-RAT carriers for idle mode CA/DC measurements comprising of carriers configured for inter-RAT mobility measurements and carriers not configured for inter-RAT mobility measurements.

For inter-RAT carriers configured for idle mode CA/DC measurements, if Srxlev ≤ SnonIntraSearchP or Squal ≤ SnonIntraSearchQ the inter-RAT measurement requirements in clause 4.2.2.5 shall apply, where UE shall search for and measure inter-RAT layers configured for idle mode CA/DC measurements in preparation for possible reporting. If Srxlev > SnonIntraSearchP and Squal > SnonIntraSearchQ the UE shall search for inter-RAT layers configured for idle mode CA/DC measurements at least every Thigher\_priority\_search where Thigher\_priority\_search is described in clause 4.2.2, where UE shall search for and measure inter-RAT layers configured for idle mode CA/DC measurements in preparation for possible reporting.

For overlapping inter-RAT carriers configured for idle mode CA/DC measurements, the UE shall be capable of performing RSRP and RSRQ measurements of the carriers, and the UE physical layer shall be capable of reporting RSRP and RSRQ measurements of the carriers configured for idle mode CA/DC measurements to higher layers, with measurement accuracy as specified in clauses in 9.1.3B.3 and 9.1.6B.2, respectively.

The UE shall be able to report idle mode CA measurements when idle mode CA measurement reporting is requested by the network.

# 5 SA: RRC\_INACTIVE state mobility

## 5.1 Cell Re-selection

### 5.1.1 Introduction

The cell reselection procedure allows the UE to select a more suitable cell and camp on it.

When the UE is in *Camped Normally* state on a cell, the UE shall attempt to detect, synchronise, and monitor intra-frequency, inter-frequency and inter-RAT cells indicated by the serving cell. For intra-frequency and inter-frequency cells the serving cell may not provide explicit neighbour list but carrier frequency information and bandwidth information only. UE measurement activity is also controlled by measurement rules defined in TS38.304 [1], allowing the UE to limit its measurement activity.

### 5.1.2 Requirements

#### 5.1.2.1 UE measurement capability

The requirements in clause 4.2.2.1 shall apply.

#### 5.1.2.2 Measurement and evaluation of serving cell

The requirements in clause 4.2.2.2 shall apply.

#### 5.1.2.3 Measurements of intra-frequency NR cells

The requirements in clause 4.2.2.3 shall apply. The requirements in clause 4.2.2.9 apply for UE configured with relaxed measurement criterion.

#### 5.1.2.4 Measurements of inter-frequency NR cells

If UE is not configured to perform PRS measurement, or if UE is configured to perform PRS measurement and supports [Parallel PRS measurements in RRC\_INACTIVE state], the requirements in clause 4.2.2.4 shall apply regardless of whether the serving cell is subject to CCA or not.

If UE is configured to perform PRS measurement but does not support [Parallel PRS measurements in RRC\_INACTIVE state], the requirements in clause 4.2.2.4 shall apply with Kcarrier being replaced with Kcarrier + 1, regardless of whether the serving cell is subject to CCA or not.

If UE is not configured to perform PRS measurement, or if UE is configured to perform PRS measurement and supports [Parallel PRS measurements in RRC\_INACTIVE state], the requirements in clause 4.2.2.10 shall apply regardless of whether the serving cell is subject to CCA or not for UE configured with relaxed measurement criterion.

If UE is configured to perform PRS measurement but does not support [Parallel PRS measurements in RRC\_INACTIVE state], the requirements in clause 4.2.2.10 shall apply with Kcarrier being replaced with Kcarrier + 1, regardless of whether the serving cell is subject to CCA or not for UE configured with relaxed measurement criterion.

#### 5.1.2.5 Measurements of inter-RAT E-UTRAN cells

The requirements in clause 4.2.2.5 shall apply. The requirements in clause 4.2.2.11 shall apply for UE configured with relaxed measurement criterion.

#### 5.1.2.6 Maximum interruption in paging reception

The requirements in clause 4.2.2.6 shall apply.

#### 5.1.2.7 General requirements

If UE is not configured to perform PRS measurement, or if UE is configured to perform PRS measurement and supports [Parallel PRS measurements in RRC\_INACTIVE state], the requirements in clause 4.2.2.7 shall apply.

If UE is configured to perform PRS measurement but does not support [Parallel PRS measurements in RRC\_INACTIVE state], the requirements in clause 4.2.2.7 shall apply with Nlayers being replaced with Nlayers + 1.

## 5.1A Cell Re-selection with CCA

### 5.1A.1 Introduction

The cell reselection procedure allows the UE to select a more suitable cell and camp on it. The requirements in subclauses 5.1A.2.3, 5.1A.2.4, and 5.1A.2.6 apply when at least the target cell is on a carrier frequency with CCA, and the requirements in subclauses 5.1A.2.2 and 5.1A.2.5 apply when at least the camping cell is on a carrier frequency with CCA.

When the UE is in *Camped Normally* state on a cell, the UE shall attempt to detect, synchronise, and monitor intra-frequency, inter-frequency and inter-RAT cells indicated by the serving cell. For intra-frequency and inter-frequency cells the serving cell may not provide explicit neighbour list but carrier frequency information and bandwidth information only. UE measurement activity is also controlled by measurement rules defined in TS38.304, allowing the UE to limit its measurement activity.

### 5.1A.2 Requirements

#### 5.1A.2.1 UE measurement capability

The requirements in clause 4.2A.2.1 shall apply.

#### 5.1A.2.2 Measurement and evaluation when CCA is used on the serving cell

The requirements in clause 4.2A.2.2 shall apply.

#### 5.1A.2.3 Measurements of intra-frequency NR cells when CCA is used on the serving cell and target cell

The requirements in clause 4.2A.2.3 shall apply.

#### 5.1A.2.4 Measurements of inter-frequency NR cells when CCA is used on the target cell

The requirements in clause 4.2A.2.4 shall apply.

#### 5.1A.2.5 Measurements of inter-RAT E-UTRAN cells when CCA is used on the serving cell

The requirements in clause 4.2.2.5 shall apply.

#### 5.1A.2.6 Maximum interruption in paging reception when CCA is used on the target cell

The requirements in clause 4.2A.2.6 shall apply.

#### 5.1A.2.7 General requirements

The requirements in clause 4.2.2.7 shall apply.

## 5.1B Cell Re-selection for RedCap

### 5.1B.1 Introduction

### 5.1B.2 Requirements

#### 5.1B.2.1 UE measurement capability

The requirements in clause 4.2B.2.1 shall apply.

#### 5.1B.2.2 Measurement and evaluation of serving cell

The requirements in clause 4.2B.2.2 shall apply when UE is not configured with eDRX\_IDLE.

When UE is configured with eDRX\_IDLE, the UE shall measure the SS-RSRP and SS-RSRQ level of the serving cell and evaluate the cell selection criterion S defined in TS 38.304 [1] for the serving cell at least once every M1\* T for FR1 and N1\*T for FR2; where:

- T is dertermined according to clause 7.1 in [1],

- M1=2 if SMTC periodicity (TSMTC) > 20 ms and T ≤ 0.64 second, otherwise M1=1.

The UE shall filter the SS-RSRP and SS-RSRQ measurements of the serving cell using at least 2 measurements. Within the set of measurements used for the filtering, at least two measurements shall be spaced by, at least T/2.

If the UE has evaluated according to Table 5.1B.2.2-1or and Table 5.1B.2.2-2 in Nserv\_RedCap consecutive T that the serving cell does not fulfil the cell selection criterion S, the UE shall initiate the measurements of all neighbour cells indicated by the serving cell, regardless of the measurement rules currently limiting UE measurement activities.

Table 5.1B.2.2-1: Nserv\_RedCapfor inactive Redcap UE configured with eDRX\_IDLE cycle, (Frequency range FR1)

|  |  |  |  |
| --- | --- | --- | --- |
| eDRX\_IDLE cycle length [s] | DRX or eDRX INACTIVE cycle length[s] | T [s] | Nserv \_RedCap [number of T ] |
| 2.56 ≤eDRX\_IDLE cycle length ≤10485.76 | 0.32 ≤DRX\_Inactive cycle length ≤2.56; or  2.56 ≤eDRX\_Inactive cycle length ≤10.24 if inactive eDRX is configured | 0.32 | 4\*M1 |
| 0.64 | 4\*M1 |
| 1.28 | 2 |
| 2.56 | 2 |
| 5.12 | 2 |
| 10.24 | 2 |
| Note1: T is dertermined according to clause 7.1 in [1].  Note2: M1=2 if SMTC periodicity (TSMTC) > 20 ms and T≤ 0.64 second, otherwise M1=1. | | | |

Table 5.1B.2.2-2: Nserv\_RedCapfor inactive Redcap UE configured with eDRX\_IDLE cycle, (Frequency range FR2)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| eDRX\_IDLE cycle length [s] | DRX or eDRX INACTIVE cycle length[s] | T [s] | Scaling Factor (N1) | Nserv\_RedCap [number of T] |
| 2.56 ≤eDRX\_IDLE cycle length ≤10485.76 | 0.32 ≤DRX\_Inactive cycle length ≤2.56; or  2.56 ≤eDRX\_Inactive cycle length ≤10.24 if inactive eDRX is configured | 0.32 | 8 | 4\* N1 |
| 0.64 | 5 | 4\* N1 |
| 1.28 | 4 | 2\* N1 |
| 2.56 | 3 | 2\* N1 |
| 5.12 | 3 | 2\* N1 |
| 10.24 | 3 | 2\* N1 |
| Note1: T is dertermined according to clause 7.1 in [1]. | | | | |

When UE transitions from measurements within PTW and to measurements outside PTW or vice versa during one measurement period, the UE measurement requirements apply based on the longer measurement period requirements before or after the transition.

If the UE in RRC\_INACTIVE has not found any new suitable cell based on searches and measurements using the intra-frequency, inter-frequency and inter-RAT information indicated in the system information during the time T’, the UE shall initiate cell selection procedures for the selected PLMN as defined in TS 38.304 [1], where

- T’= 10 s, if the UE is not configured with eDRX\_inactive cycle, or

- T’= MAX (10 s, one eDRX\_inactive cycle) if the UE is configured with eDRX\_inactive cycle for FR1, or

- T’= MAX (10 s, N1\* eDRX\_inactive cycle) if the UE is configured with eDRX\_inactive cycle for FR2.

#### 5.1B.2.3 Measurements of intra-frequency NR cells

The requirements in clause 4.2.2.3 shall apply when UE is not configured with eDRX\_IDLE. When UE is configured with eDRX\_IDLE, the requirements defined in section 4.2.2.3 shall apply with Tdetect,NR\_Intra\_RedCap, Tmeasure,NR\_Intra\_RedCap and Tevaluate,NR\_Intra\_RedCap defined in Table 5.1B.2.3-1 and Table 5.1B.2.3-2.

Table 5.1B.2.3-1: Tdetect, Tmeas and Tevaluate for inactive Redcap UE configured with eDRX\_IDLE cycle, (Frequency range FR1)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| eDRX\_IDLE cycle length [s] | DRX or eDRX INACTIVE cycle length [s] | Tdetect,NR\_Intra\_RedCap [s] (number of DRX or eDRX INACTIVE cycles) | Tmeasure,NR\_Intra\_RedCap [s] (number of DRX or eDRX INACTIVE cycles) | Tevaluate,NR\_Intra\_RedCap [s] (number of DRX or INACTIVE eDRX cycles) |
|
| 2.56 ≤eDRX\_IDLE cycle length ≤ 10485.76 | 0.32 | 11.52 x M2 (36 x M2) | 1.28 x M2 (4 x M2) | 5.12 x M2 (16 x M2) |
| 0.64 | 17.92 (28) | 1.28 (2) | 5.12 (8) |
| 1.28 | 32 (25) | 1.28 (1) | 6.4 (5) |
| 2.56 | 58.88 (23) | 2.56 (1) | 7.68 (3) |
| 5.12 | 117.76 (23) | 5.12 (1) | 15.36 (3) |
| 10.24 | 235.52 (23) | 10.24 (1) | 30.72 (3) |
| Note1: M2 = 1.5 if SMTC periodicity of measured intra-frequency cell > 20 ms; otherwise M2=1. | | | | |

Table 5.1B.2.3-2: Tdetect, Tmeas and Tevaluate for inactive Redcap UE configured with eDRX\_IDLE cycle, (Frequency range FR2)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| eDRX\_IDLE cycle length [s] | DRX or eDRX INACTIVE cycle length [s] | Scaling Factor (N1) | Tdetect,NR\_Intra\_RedCap [s] (number of DRX or eDRX INACTIVE cycles) | Tmeasure,NR\_Intra\_RedCap [s] (number of DRX or eDRX INACTIVE cycles) | Tevaluate,NR\_Intra\_RedCap [s] (number of DRX or eDRX INACTIVE cycles) |
|
| 2.56 ≤eDRX\_IDLE cycle length ≤ 10485.76 | 0.32 | 8 | 11.52 x N1 x M2 (36 x N1 x M2) | 1.28 x N1 x M2 (4 x N1 x M2) | 5.12 x N1 x M2 (16 x N1 x M2) |
| 0.64 | 5 | 17.92x N1 (28 x N1) | 1.28 x N1 (2 x N1) | 5.12 x N1 (8 x N1) |
| 1.28 | 4 | 32 x N1 (25 x N1) | 1.28 x N1 (1 x N1) | 6.4 x N1 (5 x N1) |
| 2.56 | 3 | 58.88 x N1 (23 x N1) | 2.56 x N1 (1 x N1) | 7.68 x N1 (3 x N1) |
| 5.12 | 3 | 117.76 x N1 (23 x N1) | 5.12 x N1 (1 x N1) | 15.36 x N1 (3 x N1) |
| 10.24 | 3 | 235.52 x N1 (23 x N1) | 10.24 x N1 (1 x N1) | 30.72 x N1 (3 x N1) |
| Note1: M2 = 1.5 if SMTC periodicity of measured intra-frequency cell > 20 ms; otherwise M2=1. | | | | | |

#### 5.1B.2.4 Measurements of inter-frequency NR cells

The requirements in clause 4.2.2.4 shall apply when UE is not configured with eDRX\_IDLE. When UE is configured with eDRX\_IDLE, the requirements defined in section 4.2.2.4 shall apply with Tdetect,NR\_Inter\_RedCap, Tmeasure,NR\_Inter\_RedCap and Tevaluate,NR\_Inter\_RedCap defined in Table 5.1B.2.4-1 and Table 5.1B.2.4-2.

Table 5.1B.2.4-1: Tdetect, Tmeas and Tevaluate for inactive Redcap UE configured with eDRX\_IDLE cycle, (Frequency range FR1)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| eDRX\_IDLE cycle length [s] | DRX or eDRX INACTIVE cycle length [s] | Tdetect,NR\_Inter\_RedCap [s] (number of DRX or eDRX INACTIVE cycles) | Tmeasure,NR\_Inter\_RedCap [s] (number of DRX or eDRX INACTIVE cycles) | Tevaluate,NR\_Inter\_RedCap [s] (number of DRX or eDRX INACTIVE cycles) |
|
| 2.56 ≤eDRX\_IDLE cycle length ≤ 10485.76 | 0.32 | 11.52 x 1.5 (36 x 1.5) | 1.28 x 1.5 (4 x 1.5) | 5.12 x 1.5 (16 x 1.5) |
| 0.64 | 17.92 (28) | 1.28 (2) | 5.12 (8) |
| 1.28 | 32 (25) | 1.28 (1) | 6.4 (5) |
| 2.56 | 58.88 (23) | 2.56 (1) | 7.68 (3) |
| 5.12 | 117.76 (23) | 5.12 (1) | 15.36 (3) |
| 10.24 | 235.52(23) | 10.24 (1) | 30.72 (3) |

Table 5.1B.2.4-2: Tdetect, Tmeas and Tevaluate for inactive Redcap UE configured with eDRX\_IDLE cycle, (Frequency range FR2)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| eDRX\_IDLE cycle length [s] | DRX or eDRX INACTIVE cycle length [s] | Scaling Factor (N1) | Tdetect,NR\_Inter\_RedCap [s] (number of DRX or eDRX INACTIVE cycles) | Tmeasure,NR\_Inter\_RedCap [s] (number of DRX or eDRX INACTIVE cycles) | Tevaluate,NR\_Inter\_RedCap [s] (number of DRX or eDRX INACTIVE cycles) |
|
| 2.56 ≤eDRX\_IDLE cycle length ≤ 10485.76 | 0.32 | 8 | 11.52 x N1 x 1.5 (36 x N1 x 1.5) | 1.28 x N1 x 1.5 (4 x N1 x 1.5) | 5.12 x N1 x 1.5 (16 x N1 x 1.5) |
| 0.64 | 5 | 17.92x N1 (28 x N1) | 1.28 x N1 (2 x N1) | 5.12 x N1 (8 x N1) |
| 1.28 | 4 | 32 x N1 (25 x N1) | 1.28 x N1 (1 x N1) | 6.4 x N1 (5 x N1) |
| 2.56 | 3 | 58.88 x N1 (23 x N1) | 2.56 x N1 (1 x N1) | 7.68 x N1 (3 x N1) |
| 5.12 | 3 | 117.76 x N1 (23 x N1) | 5.12 x N1 (1 x N1) | 15.36 x N1 (3 x N1) |
| 10.24 | 3 | 235.52 x N1 (23 x N1) | 10.24 x N1 (1 x N1) | 30.72 x N1 (3 x N1) |

#### 5.1B.2.5 Measurements of inter-RAT E-UTRAN cells

The requirements in clause 4.2B.2.5 shall apply.

#### 5.1B.2.6 Maximum interruption in paging reception

The requirements in clause 4.2B.2.6 shall apply for RedCap UEs.

For RedCap UE in HD-FDD mode, if a paging occasion overlaps with CG-SDT transmission then the UE shall monitor the paging during the paging occasion. In this case the UE is allowed to drop the CG-SDT transmission.

#### 5.1B.2.7 General requirements

The requirements in sub-clause 4.2B.2.7 shall apply.

#### 5.1B.2.8 Minimum requirement at transitions

The requirements in sub-clause 4.2B.2.8 shall apply.

#### 5.1B.2.9 Measurements of intra-frequency NR cells for UE configured with relaxed measurement criterion

The requirements in clause 4.2B.2.9 apply for UE configured with relaxed measurement criterion.

#### 5.1B.2.10 Measurements of inter-frequency NR cells for UE configured with relaxed measurement criterion

The requirements in clause 4.2B.2.10 apply for UE configured with relaxed measurement criterion.

#### 5.1B.2.11 Measurements of inter-RAT E-UTRAN cells for UE configured with relaxed measurement criterion

The requirements in clause 4.2B.2.11 apply for UE configured with relaxed measurement criterion.

## 5.2 Void

## 5.2B Configured Grant based Small Data Transmissions (CG-SDT) for RedCap

### 5.2B.1 Introduction

This section contains the requirements for Small Data Transmissions (SDT) for 1 Rx RedCap and 2 Rx RedCap.

The 1 Rx RedCap UE for determining whether to perform SDT procedure defined in clause 5.27 [7] applies:

- sdt-RSRP-Threshold-r17 as the signaled value of sdt-RSRP-Threshold-r17 [2] + 1 dB.

### 5.2B.2 Requirements on UE synchronization for small data transmissions for RedCap

The requirements in clause 5.2B.2 shall apply for RedCap UEs.

5.2B.2.1 TA validation requirements for RedCap

When *cg-SDT-RSRP-ChangeThreshold* [TS 38.331] is configured for TA validation based on the RSRP change criterion according to clause 5.8.2 in [TS 38.321], the UE is allowed to transmit using CG-SDT using the timing derived using the latest available value as specified in subclause 7.1 provided that

- the first RSRP (RSRP1) measurement and the second RSRP (RSRP2) measurements used in the TA validation are valid measurements and,

- timing alignment validation for transmission using CG-SDT is valid according to the validation criteria in clause 5.8.2 in [TS 38.321].

RSRP1 and RSRP2 are considered valid provided that the conditions in Table 5.2B.2-1 are met for FR1 when UE is not configured with any eDRX cycle by serving gNB or core network.

RSRP1 and RSRP2 are considered valid provided that the conditions in Table 5.2B.2-2 are met for FR2 regardless of whether the UE is configured with eDRX cycle by serving gNB or core network (AMF).

RSRP1 and RSRP2 are considered valid provided that the conditions in Table 5.2B.2-3 are met for FR1 when UE is configured:

- only with RAN eDRX cycle (TeDRX-RAN) by the serving gNB, or

- with both TeDRX-RAN by serving gNB and CN eDRX cycle (TeDRX-CN) by the core network (AMF)

Table 5.2B.2.1-1 Valid measurement for FR1 without eDRX cycle

|  |  |
| --- | --- |
| Measurement | FR1 |
| RSRP1 | (T1 – min(640ms, M1\*TDRX)) ≤ T1’ ≤ (T1 + min(640ms, M1\*TDRX)) |
| RSRP2 | (T2 – min(640ms, M1\*TDRX)) ≤ T2’ ≤ T2 |

Table 5.2B.2.1-2 Valid measurement for FR2

|  |  |
| --- | --- |
| Measurement | FR2 |
| RSRP1 | (T1 – max{480ms, 8\*SMTC periodicity}) ≤ T1’ ≤ (T1 + max{480ms, 8\*SMTC periodicity}) |
| RSRP2 | (T2 – max{480ms, 8\*SMTC periodicity}) ≤ T2’ ≤ T2 |

Table 5.2B.2.1-3 Valid measurement for FR1 with eDRX cycle

|  |  |
| --- | --- |
| Measurement | FR1 |
| RSRP1 | (T1 – min(640ms, M1\* T)) ≤ T1’ ≤ (T1 + min(640ms, M1\* T)) |
| RSRP2 | (T2 – min(640ms, M1\* TeDRX-RAN)) ≤ T2’ ≤ T2 |
| Note1: T is dertermined according to clause 7.1 in [1]. | |

If at least one of RSRP1 and RSRP2 is considered to be invalid based on the above conditions, then the UE shall not validate the CG-SDT using RSRP1 and RSRP2 and shall not transmit using CG-SDT. Additionally, the UE shall not transmit in an CG-SDT occasion that occurs more than [640 ms] after T2.

Where:

- T1 is the time when the latest was obtained by the UE via Timing Advance Command MAC control element.

- T1’ is the time when the UE has completed RSRP1.

- T2 is the time when the UE performs TA validation as defined in clause 5.8.2.x in [TS 38.321] for transmission using CG-SDT.

- T2’ is the time when the UE has completed RSRP2.

- TDRX is the DRX cycle length in ms.

- M1 the scaling factor as defined in clause 4.2.2.2.

#### 5.2B.2.2 Scheduling restriction

The requirements in clause 5.1B.2.4 shall apply for RedCap UEs.

## 5.3 Minimization of Drive Tests (MDT)

### 5.3.1 Introduction

UE supporting minimisation of drive tests in RRC\_INACTIVE shall be capable of:

- logging measurements in RRC\_INACTIVE, reporting the logged measurements and meeting requirements in clause 5.3.1;

- logging of RRC connection establishment failure, reporting the logged failure and meeting requirements in clause 5.3.1;

- logging of radio link failure and handover failure, reporting the logged failure and meeting requirements in clause 5.3.1.

The logged MDT requirements consist of measurement requirements as specified in clause 5.3.2 and relative time stamp accuracy requirements as specified in clause 5.3.3. Both sets of requirements are applicable for intra-frequency, inter-frequency and inter-RAT cases in RRC\_INACTIVE state. The MDT procedures are described in TS 37.320 [31].

For RRC connection establishment failure logging and reporting, the MDT requirements consist of requirements for measurements performed and logged in RRC\_INACTIVE state specified in clause 5.3.2 and relative time stamp accuracy requirement for RRC connection establishment failure log reporting as specified in clause 5.3.4.

### 5.3.2 Measurement Requirements

The measurements and measurement requirements applicable for MDT in RRC\_INACTIVE are the same as specified for MDT in RRC\_IDLE in clause 4.3.2.

### 5.3.3 Requirements for Relative Time Stamp Accuracy

The requirements for relative time stamp accuracy applicable for MDT in RRC\_INACTIVE are the same as specified for MDT in RRC\_IDLE in clause 4.3.3.

### 5.3.4 Requirements for Relative Time Stamp Accuracy for RRC Connection Establishment Failure Log Reporting

The requirements for relative time stamp accuracy for RRC connection establishment failure applicable for MDT in RRC\_INACTIVE are the same as specified for MDT in RRC\_IDLE in clause 4.3.4.

### 5.3.5 Requirements for Relative Time Stamp Accuracy for Radio Link Failure and Handover Failure Log Reporting

The requirements for relative time stamp accuracy for RRC link failure and handover failure applicable for MDT in RRC\_INACTIVE are the same as specified for MDT in RRC\_IDLE in clause 4.3.5.

### 5.3.6 Requirements for Relative Time Stamp Accuracy for RRC Resume Failure Log Reporting

The requirements for relative time stamp accuracy for RRC resume failure applicable for MDT in RRC\_INACTIVE are the same as specified for MDT in RRC\_IDLE in clause 4.3.4.

## 5.3C Minimization of Drive Tests (MDT) for Satellite Access

*Editor’s note: the exact signalling names in the clause and values are subject to confirmation by RAN2 and change during performance requirement phase, respectively. And the brackets shall be removed by further agreements.*

### 5.3C.1 Introduction

UE supporting minimisation of drive tests in RRC\_INACTIVE shall be capable of:

- logging measurements in RRC\_INACTIVE, reporting the logged measurements and meeting requirements in clause 5.3C;

- logging of RRC connection establishment failure, reporting the logged failure and meeting requirements in clause 5.3C;

- logging of radio link failure and handover failure, reporting the logged failure and meeting requirements in clause 5.3C.

The logged MDT requirements consist of measurement requirements as specified in clause 5.3C.2 and relative time stamp accuracy requirements as specified in clause 5.3C.3. Both sets of requirements are applicable for intra-frequency and inter-frequency cases in RRC\_INACTIVE state. The MDT procedures are described in TS 37.320 [31].

For RRC connection establishment failure logging and reporting, the MDT requirements consist of requirements for measurements performed and logged in RRC\_INACTIVE state specified in clause 5.3C.2 and relative time stamp accuracy requirement for RRC connection establishment failure log reporting as specified in clause 5.3C.4.

### 5.3C.2 Measurement Requirements

The measurements and measurement requirements applicable for MDT in RRC\_INACTIVE are the same as specified for MDT in RRC\_IDLE in clause 4.3C.2.

### 5.3C.3 Requirements for Relative Time Stamp Accuracy

The requirements for relative time stamp accuracy applicable for MDT in RRC\_INACTIVE are the same as specified for MDT in RRC\_IDLE in clause 4.3C.3.

### 5.3C.4 Requirements for Relative Time Stamp Accuracy for RRC Connection Establishment Failure Log Reporting

The requirements for relative time stamp accuracy for RRC connection establishment failure applicable for MDT in RRC\_INACTIVE are the same as specified for MDT in RRC\_IDLE in clause 4.3C.4.

### 5.3C.5 Requirements for Relative Time Stamp Accuracy for Radio Link Failure and Handover Failure Log Reporting

The requirements for relative time stamp accuracy for RRC link failure and handover failure applicable for MDT in RRC\_INACTIVE are the same as specified for MDT in RRC\_IDLE in clause 4.3C.5.

### 5.3C.6 Requirements for Relative Time Stamp Accuracy for RRC Resume Failure Log Reporting

The requirements for relative time stamp accuracy for RRC resume failure applicable for MDT in RRC\_INACTIVE are the same as specified for MDT in RRC\_IDLE in clause 4.3C.4.

## 5.4 Idle Mode CA/DC Measurements

### 5.4.1 Introduction

A UE supporting *IdleInactiveMeasurements-r16* or *idleInactiveEUTRA-MeasReport-r16* shall perform the idle mode measurement on the inter-frequency CA and DC candidate frequencies/cells and E-UTRAN inter-RAT DC candidate frequencies/cells indicated by higher layers and meet the requirement specified in this clause. The UE shall perform idle mode measurements provided that the serving cell support early measurement and is within the validity area. The idle mode measurement requirements apply to a configured carrier frequency and the serving cell are among the supported band combination of the UE.

### 5.4.2 Measurement Requirements

The requirements in clause 4.4.2 shall apply.

#### 5.4.2.1 Detected cell requirement during state transition and Idle mode

The requirements in clause 4.4.2.1 shall apply.

#### 5.4.2.2 Measurements of inter-frequency CA/DC candidate cells

The requirements in clause 4.4.2.2 shall apply.

#### 5.4.2.3 Measurements on serving cell

The requirements in clause 4.4.2.3 shall apply.

#### 5.4.2.4 Measurements on E-UTRAN inter-RAT DC candidate cells

The requirements in clause 4.4.2.4 shall apply.

## 5.5 Configured Grant based Small Data Transmissions (CG-SDT)

### 5.5.1 Introduction

The requirements in this clause are applicable when the UE is configured with timing alignment (TA) validation using *cg-SDT-RSRP-ChangeThreshold* for transmitting in uplink using CG-SDT as specified in [TS 38.331].

### 5.5.2 Requirements on UE synchronization for small data transmissions

The requirements in this clause are applicable for the UE performing small data tranmissions using configured resources as [TS 38.331].

The UE is allowed to transmit using the configured uplink resources provided that the UE is synchronized towards (i.e. using the timing derived using the latest available value as specified in subclause 7.1.2) the serving cell prior to transmission. If the UE is not able to obtain the synchronization towards the serving cell then the UE shall drop the small data transmission. The UE determines the small data transmission occasion according to the received CG-SDT configuration [TS 38.331].

### 5.5.3 TA validation requirements

When *cg-SDT-RSRP-ChangeThreshold* [TS 38.331] is configured for TA validation based on the RSRP change criterion according to clause 5.8.2.x in [TS 38.321], the UE is allowed to transmit using CG-SDT using the timing derived using the latest available value as specified in subclause 7.1 provided that

- the first RSRP (RSRP1) measurement and the second RSRP (RSRP2) measurements used in the TA validation are valid measurements and,

- timing alignment validation for transmission using CG-SDT is valid according to the validation criteria in clause 5.8.2 in [TS 38.321].

RSRP1 and RSRP2 are considered valid provided that the conditions in Table 5.5.3-1 and Table 5.5.3-2 are met for FR1 and FR2-1.

Table 5.5.3-1 Valid measurement for FR1

|  |  |
| --- | --- |
| Measurement | FR1 |
| RSRP1 | (T1 – min(640ms, M1\*TDRX)) ≤ T1’ ≤ (T1 + min(640ms, M1\*TDRX)) |
| RSRP2 | (T2 – min(640ms, M1\*TDRX)) ≤ T2’ ≤ T2 |

Table 5.5.3-2 Valid measurement for FR2-1

|  |  |
| --- | --- |
| Measurement | FR2-1 |
| RSRP1 | (T1 – max(480ms, 8\*SMTC periodicity)) ≤ T1’ ≤ (T1 + max(480ms, 8\*SMTC periodicity)) |
| RSRP2 | (T2 – max(480ms, 8\*SMTC periodicity)) ≤ T2’ ≤ T2 |

If at least one of RSRP1 and RSRP2 is considered to be invalid based on the above conditions, then the UE shall not validate the CG-SDT using RSRP1 and RSRP2 and shall not transmit using CG-SDT. Additionally, the UE shall not transmit in an CG-SDT occasion that occurs more than 640 ms after T2.

Where:

- T1 is the time when

- *RRCRelease* with CG-SDT configuration (TS 38.331 [2]) is received

- the latest TA is received if TA is received while in RRC\_INACITVE state.

- T1’ is the time when the UE has completed RSRP1.

- T2 is the time when the UE performs TA validation as defined in clause 5.27.2 in (TS 38.321 [7]) for transmission using CG-SDT.

- T2’ is the time when the UE has completed RSRP2.

- TDRX is the DRX cycle length in ms.

- M1 the scaling factor as defined in clause 4.2.2.2.

### 5.5.4 Scheduling restriction

#### 5.5.4.1 Scheduling availability of UE performing measurements in TDD bands on FR1

When the UE performs intra-frequency measurements in a TDD band, the following restrictions apply due to SS-RSRP measurement

- The UE is not expected to transmit PUCCH/PUSCH/SRS on SSB symbols to be measured, and on 1 data symbol before each consecutive SSB symbols to be measured and 1 data symbol after each consecutive SSB symbols to be measured within SMTC window duration.

When the UE performs intra-frequency measurements in a TDD band, the following restrictions apply due to SS-RSRQ measurement

- The UE is not expected to transmit PUCCH/PUSCH/SRS on SSB symbols to be measured, RSSI measurement symbols, and on 1 data symbol before each consecutive SSB to be measured/RSSI symbols and 1 data symbol after each consecutive SSB to be measured/RSSI symbols within SMTC window duration.

#### 5.5.4.2 Scheduling availability of UE performing measurements with a different subcarrier spacing than PDSCH/PDCCH on FR1

For UE which do not support *simultaneousRxDataSSB-DiffNumerology* [14] the following restrictions apply due to SS-RSRP/RSRQ measurement

- If *deriveSSB\_IndexFromCell* is enabled the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH on SSB symbols to be measured, and on 1 data symbol before each consecutive SSB symbols to be measured and 1 data symbol after each consecutive SSB symbols to be measured within SMTC window duration.

- If *deriveSSB\_IndexFromCell* is not enabled the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH on all symbols within SMTC window duration.

For UEs which do not support *simultaneousRxDataSSB-DiffNumerology* [14] the following restrictions apply due to measurement of serving cell.

- The UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/ on SSB symbols of the serving cell.

#### 5.5.4.3 Scheduling availability of UE performing measurements on FR2

The following scheduling restriction applies due to SS-RSRP measurement on an FR2 intra-frequency cell

- The UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH on SSB symbols to be measured, and on 1 data symbol before each consecutive SSB symbols to be measured and 1 data symbol after each consecutive SSB symbols to be measured within SMTC window duration (The signaling *deriveSSB\_IndexFromCell* is always enabled for FR2).

The following scheduling restriction applies to SS-RSRQ measurement on an FR2 intra-frequency cell

- The UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/ on SSB symbols to be measured, RSSI measurement symbols, and on 1 data symbol before each consecutive SSB to be measured/RSSI symbols and 1 data symbol after each consecutive SSB to be measured/RSSI symbols within SMTC window duration (The signaling *deriveSSB\_IndexFromCellc* is always enabled for FR2).

The following scheduling restriction applies to measurement on an FR2 serving cell

- The UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/ on SSB symbols of the serving cell.

### 5.5.5 Applicability conditions for SDT

The UE is not required to meet the following measurement requirements during subsequent SDT transmissions:

- Measurements of inter-frequency NR cells in clause 5.1.2.4

- Measurements of inter-RAT E-UTRAN cells in clause 5.1.2.5

- Idle Mode CA/DC Measurements in clause 5.4

The UE is allowed to delay the reception of PRS resources on the positioning frequency layer until the SDT session is completed if the measurement using PRS resource overlaps with the SDT resources.

## 5.6 NR measurements for positioning

### 5.6.1 Introduction

This clause contains requirements for UE capable of performing NR positioning measurements defined in TS 38.215 [4], including RSTD, PRS-RSRP, UE Rx-Tx time difference and PRS-RSRPP, in RRC\_INACTIVE state.

The requirements in clauses 5.6.2, 5.6.3, 5.6.4 and 5.6.5 are applicable to PRS resources that do not collide with other DL signals/channels which include SSB, SIB1, CORESET0, MSG2/MSGB, paging and DL SDT.If a PRS resource is within the intitial DL BWP, a PRS resource instance collides with another DL signal/channel if any portion of the other DL signal/channel overlaps in time with the PRS instance, taking into account *nr-DL- PRS-ExpectedRSTD-Uncertainty* and *nr-DL-PRS-ExpectedRSTD.*

If a PRS resource is outside the intitial DL BWP, a PRS resource instance collides with another DL signals/channel~~s~~ if any portion of the other DL signal/channel overlaps with the time interval starting X symbols before the PRS instance and ending X symbols after the PRS instance, taking into account *nr-DL- PRS-ExpectedRSTD-Uncertainty* and *nr-DL-PRS-ExpectedRSTD.* Where X is defined in Table 5.6.1-1.

Table 5.6.1-1: Value of X number of symbols

|  |  |  |  |
| --- | --- | --- | --- |
| FR |  | NR Slot  length (ms) | X symbols |
|  |  |
| FR1 | 0 | 1 | 7 |
| 1 | 0.5 | 14 |
| 2 | 0.25 | 28 |
| FR2 | 2 | 0.25 | 14 |
| 3 | 0.125 | 28 |
| Note 1: The FR1 value applies if one or both of the serving cell and the positioning frequency layer are in FR1. FR2 value applies both of the serving cell and the positioning frequency layer are in FR2. | | | |

All measurement requirements specified in clauses 5.6.2, 5.6.3, 5.6.4 and 5.6.5 shall apply for any DRX configuration specified in TS 38.331 [2].

The requirements in clauses 5.6.2, 5.6.3, 5.6.4 and 5.6.5 are applicable provided that the cell selection procedure for the selected PLMN defined in TS 38.304 [1] is not triggered during PRS measurement period.

The requirements in clauses 5.6.2, 5.6.3, 5.6.4 and 5.6.5 apply provided that all PRS resources within a PFL are within up to 2 separate windows within Tavailable, where each window is up to 10ms.

The UE is not required to perform additional SSB measurement for the SSB configured as QCL source of PRS resources.

When the UE is configured with measurement for more than one positioning requests, the measurement period for each request may be longer than measurement period when UE is configured with measurement for single positioning request.

### 5.6.2 RSTD measurements

#### 5.6.2.1 Introduction

The requirements in clause 5.6.2 shall apply provided the UE has received *NR-DL-TDOA-RequestLocationInformation* message from the LMF via LPP [34] requesting the UE to measure and report DL RSTD measurements defined in TS 38.215 [4].

#### 5.6.2.2 Requirements Applicability

The requirements in clause 5.6.2 apply for periodic and triggered RSTD measurements, provided:

- PRS-RSTD related side conditions given in clause 10.1.23 for FR1 and FR2 are fulfilled, for a corresponding Band.

#### 5.6.2.3 Measurement Capability

The UE PRS RSTD measurement capability in RRC\_INACTIVE state is as indicated by the UE in *NR-DL-TDOA-ProvideCapabilities*, according to TS 37.355 [34].

5.6.2.4 Measurement Reporting Requirements

The measurement reporting delay is defined as the time between the moment when the periodic measurement report is triggered and the moment when the UE is ready to transmit the measurement report over the air interface. If the UE supports reporting of NR positioning measurements via SDT, the UE may be able to report the measurements while it remains in RRC\_INACTIVE state; otherwise, the UE will transition to RRC\_CONNECTED state prior to transmitting the measurement report.

For RSTD measurements performed by the UE in RRC\_INACTIVE state, The measurement reporting delay excludes all of the following:

- additional delay caused other LPP signalling on the DCCH,

- delay uncertainty introduced when inserting the measurement report in the TTI of the uplink DCCH, equal to 2 x TTIDCCH where TTIDCCH is the duration of subframe or slot or subslot when the measurement report is transmitted on the PUSCH with subframe or slot or subslot duration,

- any delay caused by unavailability of UL resources to transmit the measurement report,

- any transmission delay needed by SDT,

- the time needed to transition to RRC\_CONNECTED state to report the measurements.

The reported RSTD measurement values contained in measurement reports shall be based on the measurement report mapping requirements specified in clauses 10.1.23.3.

The RSTD measurements performed and reported according to this section shall meet the RSTD measurement accuracy requirements in clause 10.1.23, for each measured DL PRS resource.

#### 5.6.2.5 Measurements Period Requirements

After receiving both *NR-TDOA-ProvideAssistanceData* message and *NR-TDOA-RequestLocationInformation* message from the LMF via LPP [34]*,* the UE shall be able to measure multiple (up to the UE capability specified in Clause 5.6.2.3) DL RSTD measurements, defined in TS 38.215 [4], during the measurement period defined as:

Where:

- is the index of positioning frequency layer,

- is total number of positioning frequency layers, and

- is the periodicity of the PRS RSTD measurement in positioning frequency layer i

is the measurement period for PRS RSTD measurement in positioning frequency layer *i* as specified below:

,

Where:

- is the UE Rx beam sweeping factor:

- = 1 if positioning frequency layer *i* is in FR1, and if positioning frequency layer *i* is in FR2

- equals to the value as UE reported in *lowerRxBeamSweepingThan8-FR2* if the capability is reported by the UE for the band containing positioning frequency layer i, and LMF indicates *lowerRxBeamSweepingThan8-FR2* in *NR-TDOA-RequestLocationInformation*.

- equals to 8, otherwise.

- is a scaling factor for PRS-based NR positioning measurements in RRC\_INACTIVE. If the UE supports *parallelPRS-MeasRRC-Inactive-r17*, Kcarrier\_PRS = 1; otherwise,

- If Srxlev ≤ SnonIntraSearchP or Squal ≤ SnonIntraSearchQ, , where is defined in clause 4.2.2.4

- If Srxlev > SnonIntraSearchP and Squal > SnonIntraSearchQ, , where is defined in clause 4.2.2.7.

- is the Rx TEG specific scaling factor:

- =1 if the UE is not configured by the LMF to measure a PRS resource with multiple Rx TEGs via *measureSameDL-PRS-ResourceWithDifferentRxTEGs-r17* [34].

- is defined as follows if the UE is configured by the LMF with *measureSameDL-PRS-ResourceWithDifferentRxTEGs-r17* [34] to perform measurement on same DL PRS resource of a TRP using different Rx TEGs in *NR-DL-TDOA-RequestLocationInformation* [34]:

- , if the UE is not capable of receiving same DL PRS resource simultaneously from multiple Rx TEGs, where P is the number of UE Rx TEGs that the UE is requested by LMF to measure the same DL-PRS Resource of a TRP indicated by *measureSameDL-PRS-ResourceWithDifferentRxTEGs-r17* in [34].

- , if the UE is capable of receiving the same DL PRS resource simultaneously from multiple Rx TEGs, where is the number of UE Rx TEGs for measuring the same DL-PRS Resource simultaneously indicated by *measureSameDL-PRS-ResourceWithDifferentRxTEGsSimul-r17* in [34].

- is the maximum number of DL PRS resources in positioning frequency layer *i* configured in a slot.

- is the time duration of available PRS in positioning frequency layer *i* to be measured , and is calculated in the same way as PRS duration K defined in clause 5.1.6.5 of TS 38.214 [26]. For calculation of , only unmuted PRS resources that are not fully overlapped with other higher-priority DL signals/channels are considered.

- is the number of PRS RSTD samples, where

- = 1 if the UE supports *supportedDL-PRS-ProcessingSamples-RRC-Inactive* [34], and the LMF requests the UE to perform positioning measurements with reduced number of samples, and meets the following conditions:

- PRS bandwidth is within the initial BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within 6 dB.

- = 2 if the UE supports *supportedDL-PRS-ProcessingSamples-RRC-Inactive* [34], and the LMF requests the UE to perform positioning measurements with reduced number of samples, and does not meet the following conditions:

- PRS bandwidth is within the initial BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within 6 dB.

- = 4 otherwise.

- is the measurement duration for the last PRS RSTD sample in positioning frequency layer *i*, including the sampling time and processing time, = + ,

- is the periodicity of the PRS RSTD measurement in positioning frequency layer i defined as:

=

Where:

- corresponds to *durationOfPRS-ProcessingSymbolsInEveryTms-r17* in TS 37.355 [34],

- , the least common multiple between and the DRX cycle length

- is the periodicity of DL PRS resource with muting on positioning frequency layer *i*.

If more than one PRS periodicities are configured in positioning frequency layer *i*, the least common multiple of PRS periodicities among all DL PRS resource sets in the positioning frequency layer is used to derive , where,

- , is the PRS periodicity with muting per PRS resource,

- is the periodicity of PRS resource sets given by the higher-layer parameter *DL-PRS-Periodicity*.

- is the scaling factor considering PRS resource muting. , where

- is the muting repetition factor given by the higher-layer parameter *DL-PRS-MutingBitRepetitionFactor*, and is the size of the bitmap .

- is the UE capability combination per band for RRC\_INACTIVE state where N is a duration of DL PRS symbols in ms corresponding to *durationOfPRS-ProcessingSymbols-r17* in TS 37.355 [34], T (ms) corresponds to *durationOfPRS-ProcessingSymbolsInEveryTms-r17* in TS 37.355 [34], [ and T-N (>0) is the time required to process duration N of DL PRS symbols already buffered in memory], for a given maximum bandwidth supported by UE corresponding to *supportedBandwidthPRS* in TS 37.355 [34],

- is UE capability for number of DL PRS resources that it can process in a slot [in RRC\_INACTIVE state as indicated by *maxNumOfDL-PRS-ResProcessedPerSlot-RRC-Inactive-r17* specified in TS 37.355 [34].

The time *s*tarts from the first DRX cycle containing the DL PRS resource(s) in the assistance data after both the *NR-TDOA-ProvideAssistanceData* message and *NR-TDOA-RequestLocationInformation* message are delivered from LMF to the UE via LPP [34].

Note: No per-positioning frequency layer requirement is applied in scenarios when multiple positioning frequency layers are configured.

If the DRX cycle is reconfigured during the RSTD measurement period, then the measurement period can be longer.

When PRS-RSRP is configured for DL-TDOA, RSTD and PRS-RSRP are performed over the same measurement period.

The measurement requirements do not apply to any PRS resource that always collides with other higher-priority DL signals/channels, as specified in clause 5.6.1.

Longer RSTD measurement period is expected when there are collisions between PRS resources and other higher-priority DL signals/channels.

If changes for any PFL during the measurement period, the measurement period could be longer.

The measurement requirements do not apply for a PRS resource, if the PRS resource is across two sampling duration of N within duration .

The measurement requirements do not apply for a PRS resource, if time span of the PRS resource instance (including at least the minimum number of repetitions specified in the accuracy requirements) is greater than UE reported capability N.

The requirements in clause 5.6.2 do not apply if the PRS configuration given by higher layer paramters *NR-DL-PRS-AssistanceData* exceeds any of the UE measurement capabilities given by *NR-DL-PRS-ResourcesCapability* in *NR-DL-TDOA-ProvideCapabilities*, and it is up to UE implementation which PRS resources are measured, subject to UE measurement capabilities*.*

If cell re-selection occurs while RSTD measurements are being performed, then the UE shall continue and complete the on-going RSTD measurements after the cell selection is completed. The RSTD measurement period can be longer.

If the RRC state transition occurs from RRC\_INACTIVE to RRC\_CONNECTED state during the RSTD measurement period then the UE shall continue the RSTD measurement in the RRC\_CONNECTED state. The RSTD measurement period can be longer.

The UE shall meet the RSTD measurement accuracy requirements in clause 10.1.23.

### 5.6.3 PRS-RSRP measurements

#### 5.6.3.1 Introduction

The requirements in clause 5.6.3 shall apply provided the UE has received a message from LMF via LPP [34] requesting the UE to measure and report PRS-RSRP measurements defined in TS 38.215 [4]. And the UE is capable of supporting the PRS-RSRP measurement in RRC INACTIVE state.

#### 5.6.3.2 Requirements applicability

The requirements in clause 5.6.3 apply for periodic and triggered PRS-RSRP measurements, provided:

- PRS-RSRP related side conditions given in clause 10.1.24 are met for a corresponding Band.

#### 5.6.3.3 Measurement Capability

UE PRS-RSRP measurement capability is as indicated by the UE in *NR-DL-AoD-ProvideCapabilities* according to TS 37.355 [34].

#### 5.6.3.4 Measurement Reporting Requirements

The measurement reporting delay is defined as the time between the moment when the periodic measurement report is triggered and the moment when the UE is ready to transmit the measurement report over the air interface. If the UE supports reporting of NR positioning measurements via SDT, the UE may be able to report the measurements while it remains in RRC\_INACTIVE state; otherwise, the UE will transition to RRC\_CONNECTED state prior to transmitting the measurement report.

For PRS-RSRP measurements performed by the UE in RRC\_INACTIVE state, the measurement reporting delay excludes all of the following:

- any delay caused other LPP signalling on the DCCH,

- delay uncertainty introduced when inserting the measurement report in the TTI of the uplink DCCH which is equal to 2 x TTIDCCH where TTIDCCH is the duration of subframe or slot or subslot when the measurement report is transmitted on the PUSCH with subframe or slot or subslot duration,

- any delay caused by no UL resources for UE to send the measurement report,

- any transmission delay needed by SDT,

- the time needed to transition to RRC\_CONNECTED state to report the measurements.

The reported PRS-RSRP measurement values contained in measurement reports shall be based on the measurement report mapping requirements specified in clauses 10.1.24.

The PRS-RSRP measurement accuracy for all measured PRS resources shall be fulfilled according to the accuracy requriements specified in the clauses 10.1.24.

#### 5.6.3.5 Measurement Period Requirements

When the physical layer receives *NR-DL-AoD-ProvideAssistanceData* message and *NR-DL-AoD-RequestLocationInformation* message from LMF via LPP [34], the UE shall be able to measure multiple (up to the UE capability specified in Clause 5.6.3.3) PRS-RSRP measurements, defined in TS 38.215 [4], from configured PRS resources for configured TRPs on configured positioning frequency layers, within ms.

Where:

*- i* is the index of positioning frequency layer,

- L is total number of positioning frequency layers,

- is the periodicity of the PRS-RSRP measurement in positioning frequency layer *i*.

Where:

- is a scaling factor for PRS-based NR positioning measurements in RRC\_INACTIVE. If the UE supports *parallelPRS-MeasRRC-Inactive-r17*, = 1. Otherwise,

- If Srxlev ≤ SnonIntraSearchP or Squal ≤ SnonIntraSearchQ, equals to the sum of Kcarrier in 4.2.2.4 and one positioning layer.

- If Srxlev > SnonIntraSearchP and Squal > SnonIntraSearchQ, equals to the sum of Nlayer in 4.2.2.7 and one positioning layer.

- is the scaling factor for Rx beam sweeping:

* =1 if positioning frequency layer *i* is in FR1, and if positioning frequency layer *i* is in FR2

- equals to the value as UE reported in *lowerRxBeamSweepingThan8-FR2* if the capability is reported by the UE for the band containing positioning frequency layer i, and LMF indicates *lowerRxBeamSweepingThan8-FR2* in *NR-TDOA-RequestLocationInformation*.

- equals to 8, otherwise.

- is the time duration of available PRS to be measured in the positioning frequency layer i to be measured during , and is calculated in the same way as PRS duration K defined in clause 5.1.6.5 of TS 38.214 [26]. For calculation of , only unmuted PRS resources that are not fully overlapped with other higher-priority DL signals/channels are considered.

- is the maximum number of DL PRS resources of positioning frequency layer i configured in a slot,

- is UE capability combination per band where N is a duration of DL PRS symbols in ms corresponding to *durationOfPRS-ProcessingSymbols-r17* in TS 37.355 [34] processed every T ms corresponding to *durationOfPRS-ProcessingSymbolsInEveryTms-r17*in TS 37.355 [34] for a given maximum bandwidth supported by UE corresponding to *supportedBandwidthPRS* in TS 37.355 [34],

- is UE capability for number of DL PRS resources that it can process in a slot as indicated by *maxNumOfDL-PRS-ResProcessedPerSlot-RRC-Inactive-r17* in clause 6.4.3 of TS 37.355 [34],

- is the number of PRS-RSRP measurement samples and

- = 1, if UE supports *supportedDL-PRS-ProcessingSamples-RRC-Inactive* [34], and the LMF indicates the UE to perform positioning measurements with reduced number of samples by *requestedDL-PRS-ProcessingSamples* [34], and the following conditions are met:

- PRS bandwidth is within the initial BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within 6 dB.

- = 2, if UE supports *supportedDL-PRS-ProcessingSamples-RRC-Inactive* [34], and the LMF indicates the UE to perform positioning measurements with reduced number of samples by *requestedDL-PRS-ProcessingSamples* [34], and the following conditions are not met

- PRS bandwidth is within the initial BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within 6 dB.

- = 4 otherwise

-  *= +* is the measurement duration for the last PRS-RSRP sample, including the sampling time and processing time,

- is the periodicity of PRS-RSRP measurement in positioning frequency layer *i*,

- corresponds to *durationOfPRS-ProcessingSymbolsInEveryTms-r17* in TS 37.355 [34],

- the least common multiple between and ,

- is the maximum PRS resource periodicity among all PRS resources in positioning frequency layer i,

- is the DRX cycle length.

If positioning frequency layer *i* has more than one DL PRS resource set with different PRS periodicities with muting, , the least common multiple of among the DL PRS resource sets is used to derive , where:

- is the periodicity of PRS resource sets given by the higher-layer parameter *DL-PRS-Periodicity*.

- is the scaling factor considering PRS resource muting. , where is the muting repetition factor given by the higher-layer parameter *DL-PRS-MutingBitRepetitionFactor*, and is the size of the bitmap .

When PRS-RSRP measurements are configured for DL-AoD, the time starts from the first DRX cycle containing the DL PRS resources in the assistance data after both the *NR-DL-AoD-RequestLocationInformation* message and *NR-DL-AoD-ProvideAssistanceData* message from LMF via LPP [34] are delivered to the physical layer of UE.

Note: No per-positioning frequency layer requirement is applied in scenarios when multiple positioning frequency layers are configured.

When the PRS-RSRP measurement is configured together with RSTD measurement then the PRS-RSRP measurement shall meet the RSTD measurement requirements defined in clause 5.6.2.

When the PRS-RSRP measurement is configured together with UE Rx-Tx time difference measurement then the PRS-RSRP measurement shall meet the UE Rx-Tx time difference measurement requirements defined in clause 5.6.4.

The measurement requirements do not apply for a PRS resource:

- if the PRS resource is across two sampling duration of N within duration or

- if time span of the PRS resource instance (including at least the minimum number of repetitions specified in the accuracy requirements) is greater than UE reported capability N.

Longer PRS-RSRP measurement period is expected when there is collision/overlap between other DL signals/channels and PRS resources in RRC\_INACTIVE state.

The requirements in clause 5.6.3 do not apply if the PRS configuration given by higher layer paramters *NR-DL-PRS-AssistanceData* exceeds any of the UE measurement capabilities given by *NR-DL-PRS-ResourcesCapability* in *NR-DL-AoD-ProvideCapabilities*, and it is up to UE implementation which PRS resources are measured, subject to UE measurement capabilities*.*

If the DRX cycle is reconfigured during the PRS-RSRP measurement period then the PRS-RSRP measurement period can be longer.

If cell reselection occurs while PRS-RSRPP measurement is being performed, then the UE shall continue and complete the on-going PRS-RSRP measurement after the cell selection is completed. The PRS-RSRP measurement period can be longer.

If the UE’s RRC state changes from the RRC\_INACTIVE to RRC\_CONNECTED during the PRS-RSRP measurement period, then the UE shall continue the PRS-RSRP measurement in the RRC\_CONNECTED state. The PRS-RSRP measurement period can be longer.

The UE shall meet the PRS-RSRP measurement accuracy requirements in clause 10.1.X.

### 5.6.4 UE Rx-Tx time difference measurements

#### 5.6.4.1 Introduction

The requirements in this clause shall apply, provided the UE has received *nr-Multi-RTT-RequestLocationInformation* message from LMF via LPP [34] requesting the UE to measure and report one or more UE Rx-Tx time difference measurements defined in TS 38.215 [4].

#### 5.6.4.2 Requirements Applicability

The requirements in clause 5.6.4 apply for periodic and triggered UE Rx-Tx time difference measurements, provided:

- UE Rx-Tx time difference measurement related side conditions given in clause 10.1.25 are met for a corresponding band.

- SRS is configured on the PCell.

#### 5.6.4.3 Measurement Capability

UE Rx-Tx time difference measurement capability is as indicated by the UE in *NR-Multi-RTT-ProvideCapabilities,* according to TS 37.355 [34].

#### 5.6.4.4 Measurement Reporting Requirements

The measurement reporting delay is defined as the time between the moment the measurement report is triggered and the moment when the UE starts to transmit the measurement report over the air interface.

This measurement reporting delay excludes the delay caused by any of the following:

- delay caused by other LPP signalling on the DCCH.

- delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 x TTIDCCH where TTIDCCH is the duration of subframe or slot or subslot when the measurement report is transmitted on the PUSCH with subframe or slot or subslot duration.

- delay caused due to lack of UL resources for UE to send the measurement report.

- delay required by SDT for reporting the measurement using SDT resouces.

- delay required for transition to RRC\_CONNECTED state for report the measurement in RRC\_CONNECTED.

The UE Rx-Tx time difference measurement values contained in measurement reports shall be based on the measurement report mapping requirements specified in clause 10.1.X.

The UE Rx-Tx time difference measurement accuracy for all measured DL PRS resourcesshall be fulfilled according to the accuracy requirements specified in clause 10.1.X.

#### 5.6.4.5 Measurement Period Requirements

When physical layer receives last of *NR-Multi-RTT-ProvideAssistanceData* message and *NR-Multi-RTT-RequestLocationInformation* message from LMF via LPP [34]*,* UE shall be able to measure multiple (up to the UE capability specified in clause 5.6.4.3) UE Rx-Tx time difference measurements as defined in TS 38.215 [4] in configured positioning frequency layers within the measurement period ms.

Where:

- is the index of positioning frequency layer,

- is the measurement period for UE Rx-Tx time difference measurements in positioning frequency layer *i* as further defined in this clause,

- L is total number of positioning frequency layers,

- is the periodicity of the UE Rx-Tx time difference measurement in positioning frequency layer *i* as defined further in this clause.

Where:

- =1 if the UE is capable of *parallelPRS-MeasRRC-Inactive-r17* defined in [34].

- if the UE is not capable of *parallelPRS-MeasRRC-Inactive-r17* defined in [34] and if Srxlev > SnonIntraSearchP and Squal > SnonIntraSearchQ; where is defined in clause 4.2.2.7.

- if the UE is not capable of *parallelPRS-MeasRRC-Inactive-r17* defined in [34] and if Srxlev ≤ SnonIntraSearchP or Squal ≤ SnonIntraSearchQ; where is defined in clause 4.2.2.4.

- is the scaling factor for UE Rx beam sweeping:

- =1 if positioning frequency layer *i* is in FR1, and if positioning frequency layer *i* is in FR2.

- equals to the value as UE reported in *lowerRxBeamSweepingThan8-FR2* if the capability is reported by the UE for the band containing positioning frequency layer i, and LMF indicates *lowerRxBeamSweepingThan8-FR2* in *NR-Multi-RTT -RequestLocationInformation*.

- equals to 8, otherwise.

is the Rx TEG specific scaling factor:

- = 1 if UE is not configured by LMF with measureSameDL-PRS-ResourceWithDifferentRxTxTEGs-r17 [34].

- = measureSameDL-PRS-ResourceWithDifferentRxTxTEGs-r17 if UE is configured by LMF to measurement same DL PRS with multiple UE RxTx TEGs [34].

- is the time duration of available PRS resources in the positioning frequency layer *i*, to be measured during , and is calculated in the same way as PRS duration K defined in clause 5.1.6.5 of TS 38.214 [26]. For calculation of , only unmuted PRS resources that are not fully overlapped with other higher-priority DL signals/channels are considered.

- is the maximum number of DL PRS resources of positioning frequency layer i configured in a slot,

- is UE capability combination per band where N is a duration of DL PRS symbols in ms corresponding to *durationOfPRS-ProcessingSymbols-r17* in TS 37.355 [34] processed every T ms corresponding to *durationOfPRS-ProcessingSymbolsInEveryTms-r17* in TS 37.355 [34] for a given maximum bandwidth supported by UE corresponding to *supportedBandwidthPRS* in clause 4.2.7.2 of TS 37.355 [34],

- is UE capability for number of DL PRS resources that it can process in a slot corresponding to *maxNumOfDL-PRS-ResProcessedPerSlot-RRC-Inactive-r17* as specified in clause 6.4.3 of TS 37.355 [34],

- is the number of UE Rx-Tx time difference measurement samples:

- = 4 if the UE is not capable of *supportedDL-PRS-ProcessingSamples-RRC-Inactive* defined in [34] or not configured to perform positioning measurements with reduced number of samples by *requestedDL-PRS-ProcessingSamples* [34].

- = 1 if the UE is capable of *supportedDL-PRS-ProcessingSamples-RRC-Inactive* defined in [34] and LMF requests the UE to perform positioning measurements with reduced number of samples by *requestedDL-PRS-ProcessingSamples* [34] and the following conditions are met:

- PRS bandwidth is within the initial BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within 6 dB.

- = 2 if the UE is capable of *supportedDL-PRS-ProcessingSamples-RRC-Inactive* defined in [34] and the LMF requests the UE to perform positioning measurements with reduced number of samples by *requestedDL-PRS-ProcessingSamples* [34] but the following conditions are not met:

- PRS bandwidth is within the initial BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within 6 dB.

- is the measurement duration for the last UE Rx-Tx time difference measurement sample in the positioning layer i, including the sampling time and processing time,  *= +*  ,

- is periodicity of UE Rx-Tx time difference measurement in positioning frequency layer *i*:

Where:

- corresponds to *durationOfPRS-ProcessingSymbolsInEveryTms-r17* in TS 37.355 [34],

- , the least common multiple between and .

- is the DRX cycle of the UE in the serving cell.

- is the PRS resource periodicity in positioning frequency layer *i*. If the positioning frequency layer *i* has more than one DL PRS resource sets with different PRS periodicities with muting, , the least common multiple of among DL PRS resource sets is used to derive , where:

- is the periodicity of PRS resource sets given by the higher-layer parameter *DL-PRS-Periodicity*.

- is the scaling factor considering PRS resource muting. , where is the muting repetition factor given by the higher-layer parameter *DL-PRS-MutingBitRepetitionFactor*, and is the size of the bitmap

The time starts from the first DRX cycle containing the DL PRS resources in the assistance data after both the *NR-Multi-RTT-RequestLocationInformation* message and *NR-Multi-RTT-ProvideAssistanceData* message from LMF via LPP [34] are delivered to the physical layer of UE.

Note: No per-positioning frequency layer requirement is applied in scenarios when multiple positioning frequency layers are configured.

If the RRC state transion occurs from RRC\_INACTIVE to RRC\_CONNECTED state during the UE Rx-Tx time difference measurement period then the UE shall restart the UE Rx-Tx time difference measurement after it obtains SRS configuration and Timing Advance command from the serving cell.

If cell reselection occurs during the UE Rx-Tx time difference measurement period then the UE shall restart the UE Rx-Tx time difference measurement after it obtains SRS configuration and Timing Advance command from the new serving cell.

The measurement requirements do not apply for a PRS resource:

- if the PRS resource is across two sampling duration of N within duration or

- if time span of the PRS resource instance (including at least the minimum number of repetitions specified in the accuracy requirements) is greater than UE reported capability N.

If the DRX cycle is reconfigured during the UE Rx-Tx time difference measurement period then the UE Rx-Tx time difference measurement period can be longer.

If during UE Rx-Tx time difference measurement period PRS resources overlap with other DL signals/channels then the UE Rx-Tx time difference measurement period can be longer.

When PRS-RSRP is configured for multi-RTT, the UE Rx-Tx time difference measurements and PRS-RSRP measurements are performed over the same measurement period.

The requirements in clause 5.6.4 do not apply if the PRS configuration given by higher layer paramters *NR-DL-PRS-AssistanceData* exceeds any of the UE measurement capabilities given by *NR-DL-PRS-ResourcesCapability* in *NR-Multi-RTT-ProvideCapabilities*, and it is up to UE implementation which PRS resources are measured, subject to UE measurement capabilities*.*

If UE uplink transmission timing changes due to the network-configured Timing Advance command during the UE Rx-Tx measurement period, then the UE Rx-Tx time difference measurement period is restarted after uplink transmission timing changes, and the UE Rx-Tx time difference measurement period requirements in this clause shall not apply.

If UE uplink transmission timing changes due to the change in the NTA\_offset defined in Table 7.1.2-2 during the UE Rx-Tx measurement period, then the UE Rx-Tx time difference measurement period is restarted after uplink transmission timing changes, and the UE Rx-Tx time difference measurement period requirements in this clause shall not apply.

The UE shall meet the UE Rx-Tx time difference measurement accuracy requirements in clause 10.1.25.

### 5.6.5 PRS-RSRPP measurements

#### 5.6.5.1 Introduction

The requirements in clause 5.6.5 shall apply provided the UE has received a message from LMF via LPP requesting the UE to measure and report PRS-RSRPP measurements defined in TS 38.215 [4]. And the UE is capable of supporting the PRS-RSRPP measurement in RRC INACTIVE state.

#### 5.6.5.2 Requirements applicability

The requirements in clause 5.6.5 apply for periodic and triggered PRS-RSRPP measurements, provided:

- PRS-RSRPP related side conditions given in clause 10.1.x are met for a corresponding Band.

#### 5.6.5.3 Measurement capability

UE PRS-RSRPP measurement capability is as indicated by the UE in *NR-DL-AoD-ProvideCapabilities* according to TS 37.355 [34].

#### 5.6.5.4 Measurement reporting requirements

The measurement reporting delay is defined as the time between the moment when the periodic measurement report is triggered and the moment when the UE is ready to transmit the measurement report over the air interface. If the UE supports reporting of NR positioning measurements via SDT, the UE may be able to report the measurements while it remains in RRC\_INACTIVE state; otherwise, the UE will transition to RRC\_CONNECTED state prior to transmitting the measurement report.

For PRS-RSRPP measurements performed by the UE in RRC\_INACTIVE state, the measurement reporting delay excludes all of the following:

- any delay caused other LPP signalling on the DCCH,

- delay uncertainty introduced when inserting the measurement report in the TTI of the uplink DCCH which is equal to 2 x TTIDCCH where TTIDCCH is the duration of subframe or slot or subslot when the measurement report is transmitted on the PUSCH with subframe or slot or subslot duration,

- any delay caused by no UL resources for UE to send the measurement report,

- any transmission delay needed by SDT,

- the time needed to transition to RRC\_CONNECTED state to report the measurements.

T The reported PRS-RSRPP measurement values contained in measurement reports shall be based on the measurement report mapping requirements specified in clauses 10.1.x.

The PRS-RSRPP measurement accuracy for all measured PRS resources shall be fulfilled according to the accuracy requriements specified in the clauses 10.1.x.

#### 5.6.5.5 Measurement period requirements

When the physical layer receives *NR-DL-AoD-ProvideAssistanceData* message and *NR-DL-AoD-RequestLocationInformation* message in RRC\_INACTIVE state, measurement period requirements for PRS-RSRP defined in 5.6.3 is re-used for PRS-RSRPP measurement.

## 5.7 Random access based Small Data Transmissions (RA-SDT)

### 5.7.1 Introduction

The requirements in this clause are applicable for the UE performing small data transmissions using 2-step RA or 4-step RA procedures [3].

### 5.7.2 Requirements for small data transmissions based on 2-step RA

The requirements in clause 6.2.2.3 shall apply.

### 5.7.3 Requirements for small data transmissions based on 4-step RA

The requirements in clause 6.2.2.2 shall apply.

# 6 RRC\_CONNECTED state mobility

## 6.1 Handover

### 6.1.1 NR Handover

#### 6.1.1.1 Introduction

The purpose of NR handover is to change the NR PCell to another NR cell. The requirements in this clause are applicable to SA NR, NE-DC and NR-DC.

#### 6.1.1.2 NR FR1 - NR FR1 Handover

The requirements in this clause are applicable to both intra-frequency and inter-frequency handovers from NR FR1 cell to NR FR1 cell, and to inter-frequency handover from NR FR1 cell in a carrier frequency with CCA to NR FR1 cell.

##### 6.1.1.2.1 Handover delay

When the UE receives a RRC message implying handover the UE shall be ready to start the transmission of the new uplink PRACH channel within Dhandover msec from the end of the last TTI containing the RRC command.

Where:

Dhandover equals the applicable RRC procedure delay defined in clause 12 in TS 38.331 [2] plus the interruption time stated in clause 6.1.1.2.2.

##### 6.1.1.2.2 Interruption time

The interruption time is the time between end of the last TTI containing the RRC command on the old PDSCH and the time the UE starts transmission of the new PRACH, excluding the RRC procedure delay.

When intra-frequency or inter-frequency handover is commanded, the interruption time shall be less than Tinterrupt

Tinterrupt = Tsearch + TIU + Tprocessing + T∆ + Tmargin ms

Where:

Tsearch is the time required to search the target cell when the target cell is not already known when the handover command is received by the UE. If the target cell is known, then Tsearch = 0 ms. If the target cell is an unknown intra-frequency cell and the target cell Es/Iot≥-2 dB, then Tsearch = Trs ms. If the target cell is an unknown inter-frequency cell and the target cell Es/Iot≥-2 dB, then Tsearch = 3\* Trs ms. Regardless of whether DRX is in use by the UE, Tsearch shall still be based on non-DRX target cell search times.

T∆ is time for fine time tracking and acquiring full timing information of the target cell. T∆ = Trs for both known and unknown target cell.

Tprocessing is time for UE processing. Tprocessing can be up to 20ms.

Tmargin is time for SSB post-processing. Tmargin can be up to 2ms.

TIU is the interruption uncertainty in acquiring the first available PRACH occasion in the new cell. TIU can be up to the summation of SSB to PRACH occasion association period and 10 ms. SSB to PRACH occasion associated period is defined in the table 8.1-1 of TS 38.213 [3].

Trs is the SMTC periodicity of the target NR cell if the UE has been provided with an SMTC configuration for the target cellin the handover command, otherwise Trs is the SMTC configured in the measObjectNR having the same SSB frequency and subcarrier spacing. If the measObjectNRs having the same SSB frequency and subcarrier spacing configured by MN and SN have different SMTC, Trs is the periodicity of one of the SMTC which is up to UE implementation. If the UE is not provided SMTC configuration or measurement object on this frequency, the requirement in this clause is applied with Trs=5ms assuming the SSB transmission periodicity is 5ms. There is no requirement if the SSB transmission periodicity is not 5ms. If the UE has been provided with higher layer in TS 38.331 [2] signaling of *smtc2*prior to the handover command, Trs follows *smtc1* or *smtc2* according to the physical cell ID of the target cell.

In the interruption requirement a cell is known if it has been meeting the relevant cell identification requirement during the last 5 seconds otherwise it is unknown. Relevant cell identification requirements are described in Clause 9.2.5 for intra-frequency handover and Clause 9.3.4 for inter-frequency handover.

#### 6.1.1.3 NR FR2- NR FR1 Handover

The requirements in this clause are applicable to inter-frequency handovers from NR FR2 cell to NR FR1 cell.

##### 6.1.1.3.1 Handover delay

When the UE receives a RRC message implying handover the UE shall be ready to start the transmission of the new uplink PRACH channel within Dhandover  ms from the end of the last TTI containing the RRC command.

Where:

Dhandover equals the applicable RRC procedure delay defined in clause 12 in TS 38.331 [2] plus the interruption time stated in clause 6.1.1.3.2.

##### 6.1.1.3.2 Interruption time

The interruption time is the time between the end of the last TTI containing the RRC command on the old PDSCH and the time the UE starts transmission of the new PRACH, excluding the RRC procedure delay.

When inter-frequency handover is commanded, the interruption time shall be less than Tinterrupt

Tinterrupt = Tsearch + TIU + Tprocessing + T∆ + Tmargin ms

Where:

Tsearch is the time required to search the target cell when the target cell is not already known when the handover command is received by the UE. If the target cell is known, then Tsearch = 0 ms. If the target cell is an unknown inter-frequency cell and the target cell Es/Iot ≥ -2 dB, then Tsearch = 3\* Trs ms. Regardless of whether DRX is in use by the UE, Tsearch shall still be based on non-DRX target cell search times.

T∆ is time for fine time tracking and acquiring full timing information of the target cell. T∆ = Trs for both known and unknown target cell.

Tprocessing is time for UE processing. Tprocessing can be up to 40ms.

Tmargin is time for SSB post-processing. Tmargin can be up to 2ms.

TIU is the interruption uncertainty in acquiring the first available PRACH occasion in the new cell. TIU can be up to the summation of SSB to PRACH occasion association period and 10 ms. SSB to PRACH occasion associated period is defined in the table 8.1-1 of TS 38.213 [3].

Trs is the SMTC periodicity of the target NR cell if the UE has been provided with an SMTC configuration for the target cell in the handover command, otherwise Trs is the SMTC configured in the measObjectNR having the same SSB frequency and subcarrier spacing. If such measObjectNRs configured by MN and SN have different SMTC, Trs is the periodicity of one of the SMTC which is up to UE implementation. If the UE is not provided SMTC configuration or measurement object on this frequency, the requirement in this clause is applied with Trs=5ms assuming the SSB transmission periodicity is 5ms. There is no requirement if the SSB transmission periodicity is not 5ms.

In the interruption requirement a cell is known if it has been meeting the relevant cell identification requirement during the last 5 seconds otherwise it is unknown. Relevant cell identification requirements are described in Clause 9.2.5 for intra-frequency handover and Clause 9.3.4 for inter-frequency handover.

#### 6.1.1.4 NR FR2- NR FR2 Handover

The requirements in this clause are applicable to both intra-frequency and inter-frequency handovers from NR FR2 cell to NR FR2 cell.

##### 6.1.1.4.1 Handover delay

When the UE receives a RRC message implying handover the UE shall be ready to start the transmission of the new uplink PRACH channel within Dhandover ms from the end of the last TTI containing the RRC command.

Where:

Dhandover equals the applicable RRC procedure delay defined in clause 12 in TS 38.331 [2] plus the interruption time stated in clause 6.1.1.4.2.

##### 6.1.1.4.2 Interruption time

The interruption time is the time between end of the last TTI containing the RRC command on the old PDSCH and the time the UE starts transmission of the new PRACH, excluding the RRC procedure delay.

When intra-frequency or inter-frequency handover is commanded, the interruption time shall be less than Tinterrupt

Tinterrupt = Tsearch + TIU + Tprocessing + T∆ + Tmargin ms

Where:

Tsearch is the time required to search the target cell when the handover command is received by the UE. If the target cell is a known cell, then Tsearch = 0 ms. If the target cell is an unknown intra-frequency cell and the target cell Es/Iot≥-2 dB, then Tsearch = N\* Trs ms. If the target cell is an unknown inter-frequency cell and the target cell Es/Iot≥-2 dB, then Tsearch = N\*3\* Trs ms. N = 8 when the target cell is in FR2-1, and N = 12 when the target cell is in FR2-2. Regardless of whether DRX is in use by the UE, Tsearch shall still be based on non-DRX target cell search times.

Tprocessing is time for UE processing. Tprocessing can be up to 20ms.

Tmargin is time for SSB post-processing. Tmargin can be up to 2ms.

T∆ is time for fine time tracking and acquiring full timing information of the target cell. T∆ = Trs for both known and unknown target cell.

TIU is the interruption uncertainty in acquiring the first available PRACH occasion in the new cell. TIU can be up to the summation of SSB to PRACH occasion association period and 10 ms. SSB to PRACH occasion associated period is defined in the table 8.1-1 of TS 38.213 [3].

Trs is the SMTC periodicity of the target NR cell if the UE has been provided with an SMTC configuration for the target cell in the handover command, otherwise Trs is the SMTC configured in the measObjectNR having the same SSB frequency and subcarrier spacing. If such measObjectNRs configured by MN and SN have different SMTC, Trs is the periodicity of one of the SMTC which is up to UE implementation. If the UE is not provided SMTC configuration or measurement object on this frequency, the requirement in this clause is applied with Trs=5ms assuming the SSB transmission periodicity is 5ms. There is no requirement if the SSB transmission periodicity is not 5ms. If the UE has been provided with higher layer in TS 38.331 [2] signaling of *smtc2*prior to the handover command, Trs follows *smtc1* or *smtc2* according to the physical cell ID of the target cell.

In FR2, the target cell is known if it has been meeting the following conditions:

- During the last 5 seconds before the reception of the handover command:

- the UE has sent a valid measurement report for the target cell and

- One of the SSBs measured from the NR target cell being configured remains detectable according to the cell identification conditions specified in clause 9.3,

- One of the SSBs measured from the target cell also remains detectable during the handover delay according to the cell identification conditions specified in clause 9.3.

otherwise it is unknown.

#### 6.1.1.5 NR FR1- NR FR2 Handover

The requirements in this clause are applicable to inter-frequency handovers from NR FR1 cell to NR FR2 cell.

##### 6.1.1.5.1 Handover delay

When the UE receives a RRC message implying handover the UE shall be ready to start the transmission of the new uplink PRACH channel within Dhandover ms from the end of the last TTI containing the RRC command.

Where:

Dhandover equals the applicable RRC procedure delay defined in clause 12 in TS 38.331 [2] plus the interruption time stated in clause 6.1.1.5.2.

##### 6.1.1.5.2 Interruption time

The interruption time is the time between end of the last TTI containing the RRC command on the old PDSCH and the time the UE starts transmission of the new PRACH, excluding the RRC procedure delay.

When in inter-frequency handover is commanded, the interruption time shall be less than Tinterrupt

Tinterrupt = Tsearch + TIU + Tprocessing + T∆ + Tmargin ms

Where:

Tsearch is the time required to search the target cell when the handover command is received by the UE. If the target cell is a known cell, then Tsearch = 0 ms. If the target cell is an unknown inter-frequency cell and the target cell Es/Iot≥-2 dB, then Tsearch = N\*3\* Trs ms. N = 8 when the target cell is in FR2-1, and N = 12 when the target cell is in FR2-2. Regardless of whether DRX is in use by the UE, Tsearch shall still be based on non-DRX target cell search times.

Tprocessing is time for UE processing. Tprocessing can be up 40ms.

Tmargin is time for SSB post-processing. Tmargin can be up to 2ms.

T∆ is time for fine time tracking and acquiring full timing information of the target cell. T∆ = Trs for both known and unknown target cell.

TIU is the interruption uncertainty in acquiring the first available PRACH occasion in the new cell. TIU can be up to the summation of SSB to PRACH occasion association period and 10 ms. SSB to PRACH occasion associated period is defined in the table 8.1-1 of TS 38.213 [3].

Trs is the SMTC periodicity of the target NR cell if the UE has been provided with an SMTC configuration for the target cell in the handover command, otherwise Trs is the SMTC configured in the measObjectNR having the same SSB frequency and subcarrier spacing. If such measObjectNRs configured by MN and SN have different SMTC, Trs is the periodicity of one of the SMTC which is up to UE implementation. If the UE is not provided SMTC configuration or measurement object on this frequency, the requirement in this clause is applied with Trs=5ms assuming the SSB transmission periodicity is 5ms. There is no requirement if the SSB transmission periodicity is not 5ms.

In FR2, the target cell is known if it has been meeting the following conditions:

- During the last 5 seconds before the reception of the handover command:

- the UE has sent a valid measurement report for the target cell and

- One of the SSBs measured from the NR target cell being configured remains detectable according to the cell identification conditions specified in clause 9.3,

- One of the SSBs measured from the target cell also remains detectable during the handover delay according to the cell identification conditions specified in clause 9.3.

otherwise it is unknown.

### 6.1.2 NR Handover to other RATs

#### 6.1.2.1 NR – E-UTRAN Handover

##### 6.1.2.1.1 Introduction

The purpose of inter-RAT handover from NR to E-UTRAN is to change the radio access mode of PCell from NR to E-UTRAN. The handover procedure is initiated from NR with a RRC message that implies a handover as described in TS 38.331 [2]. The requirements in this clause are applicable to SA NR, NE-DC and NR-DC, and to handover from SA NR cell in a carrier frequency with CCA to E-UTRAN.

##### 6.1.2.1.2 Handover delay

When the UE receives a RRC message implying handover to E-UTRAN the UE shall be ready to start the transmission of the uplink PRACH channel in E-UTRA within Dhandover ms from the end of the last TTI containing the RRC command. Dhandover is defined as

Dhandover = TRRC\_procedure\_delay + Tinterrupt

Where:

TRRC\_procedure\_delay: it is the RRC procedure delay, which is 50ms

Tinterrupt: it is the time between end of the last TTI containing the RRC command on the NR PDSCH and the time the UE starts transmission of the PRACH in E-UTRAN, excluding TRRC\_procedure\_delay. Tinterrupt is defined in clause 6.1.2.1.3.

##### 6.1.2.1.3 Interruption time

When the inter-RAT handover to E-UTRAN is commanded, the interruption time shall be less than Tinterrupt

Tinterrupt = Tsearch + TIU + 20 ms

Where:

Tsearch is the time required to search the target cell when the target cell is not already known when the handover command is received by the UE. If the target cell is known, then Tsearch = 0 ms. If the target cell is unknown and signal quality is sufficient for successful cell detection on the first attempt, then Tsearch = 80 ms. Regardless of whether DRX is in use by the UE, Tsearch shall still be based on non-DRX target cell search times.

TIU is the interruption uncertainty in acquiring the first available PRACH occasion in the new cell. TIU can be up to 30 ms.

NOTE: The actual value of TIU shall depend upon the PRACH configuration used in the target cell.

In the interruption requirement a cell is known if it has been meeting the relevant cell identification requirement during the last 5 seconds otherwise it is unknown. Relevant E-UTRAN cell identification requirements are described in clause 9.4.1.

#### 6.1.2.2 NR – UTRAN Handover

#### 6.1.2.2.1 Introduction

The purpose of inter-RAT handover from NR to UTRAN is to change the radio access mode from NR to UTRAN. The handover procedure is initiated from NR with a RRC message that implies a hard handover as described in TS 38.331 [2].

##### 6.1.2.2.2 Handover delay

When the UE receives a RRC message implying handover to UTRAN the UE shall be ready to start the transmission of the new UTRA uplink DPCCH within Dhandover msfrom the end of the last NR TTI containing the RRC *MobilityfromNRCommand* command.

where:

- Dhandover equals the RRC procedure delay, which is 50 ms plus the interruption time stated in clause 6.1.2.2.3.

##### 6.1.2.2.3 Interruption time

The interruption time is the time between the end of the last TTI containing the RRC command on the NR PDSCH and the time the UE starts transmission on the uplink DPCCH in UTRAN, excluding the RRC procedure delay. The interruption time depends on whether the target cell is known to the UE or not.

The target cell is known if it has been measured by the UE during the last 5 seconds otherwise it is unknown. The UE shall always perform a UTRA synchronisation procedure as part of the handover procedure.

If the target cell is known the interruption time shall be less than Tinterrupt1

Tinterrupt1 = TIU+Tsync+50+ 10\*Fmax + TMC ms

If the target cell is unknown the interruption time shall be less than Tinterrupt2

Tinterrupt2 = TIU+Tsync+150 + 10\*Fmax + TMC ms

This requirement shall be met, provided that there is one target cell in the *MobilityfromNRCommand* command. Performance requirements for E-UTRA to UTRA soft handover are not specified. When UE is connected to an NR cell, UTRA SFN timing measurements are not reported. This implies that the timing of the DPCH of the UTRA target cells in the active set cannot be configured by UTRAN to guarantee that all target cells fall within the UE reception window of T0 +/- 148 chips.

Where:

- TIU is the interruption uncertainty when changing the timing from the NR to the new UTRAN cell. TIU can be up to one UTRA frame (10 ms).

- Fmax denotes the maximum number of radio frames within the transmission time intervals of all transport channels that are multiplexed into the same CCTrCH on the UTRA target cell. If HS-PDSCH is configured in the UTRA target cell, Fmax is 4 radio frames.

- Tsync is the time required for measuring the downlink DPCCH channel as stated in TS 25.214 [32], clause 4.3.1.2. In case higher layers indicate the usage of a post-verification period Tsync=0 ms. Otherwise Tsync=40 ms.

- TMC is 0ms if a single UTRA cell is configured as the handover target, otherwise 20ms if handover to UTRA with 1, 2 or 3 UTRA carriers with secondary HS-PDSCH is configured.

The phase reference is the primary CPICH.

The requirements in this clause assume that N312 has the smallest possible value i.e. only one insync is required.

### 6.1.3 NR DAPS Handover

#### 6.1.3.1 Introduction

The requirements in this clause are applicable to DAPS handover to change the NR PCell to another NR cell.

Note: requirements only apply if

- the UE indicates ‘no-gap’ via *intraFreq-needForGap* for intra-frequency measurement of source cell and intra-frequency measurement of target cell, or

- the SSB of source cell is completely contained in the active DL BWP of the source cell, and the SSB of target cell is completely contained in the active DL BWP of the target cell, or

- the initial DL and UL BWP of source cell is confined within the active DL and UL BWP of the source cell respectively, and the initial DL and UL BWP of target cell is confined within the active DL and UL BWP of the target cell respectively.

#### 6.1.3.2 NR FR1 - NR FR1 DAPS Handover

The requirements in this clause are applicable to both intra-frequency and inter-frequency handovers from NR FR1 cell to NR FR1 cell. A DAPS handover is intra-frequency if the centre frequency of the SSB of the source cell and the centre frequency of the SSB of the target cell are the same, and the subcarrier spacing of the two SSBs are also the same.

Note: For intra-frequency DAPS handover, no requirement applies if active DL and UL BWP of target cell is not confined within the active DL and UL BWP of the source cell respectively.

Note: For inter-frequency DAPS handover, no requirement applies if the BWP of target cell is overlaped with the BWP of source cell in frequency domain.

An FR1 DAPS handover is synchronous if it meets the conditions in table 6.1.3.2-1, otherwise it is asynchronous

Table 6.1.3.2-1: Sync conditions for FR1 DAPS handover

|  |  |  |
| --- | --- | --- |
| Type of handover | Maximum receive timing difference between source and target cell (µs) for sync DAPS handover | Maximum transmit timing difference between source and target cell (µs) for sync DAPS handover |
| Intra-frequencyNote 1,2,3 | 6µs | 7.6 µs |
| Intra-band inter-frequency Note 1,2,3 | 6µs | 7.6 µs |
| Inter-band inter-frequency | 33 µs | 34.6 µs |
| Note 1: For synchonous DAPS handover, if the receive time difference exceeds the cyclic prefix length of that SCS, demodulation performance degradation is expected for the first symbol of the slot. For asynchronous DAPS handover, if the receive time difference exceeds the cyclic prefix length of that SCS, interruptions may occur depending on UE implementation. The duration and frequency of occurrence of such interruptions is not specified.  Note 2: For DAPS handover on a TDD band, after starting RACH procedure, a UE is not required to transmit in the uplink to any of source and target cells earlier than NRX-TX after the end of the last received downlink symbol from any of source and target cells in the same TDD band where NRX-TX=25600Tc.  Note 3: For DAPS handover on a TDD band, after starting RACH procedure, a UE is not required to receive in the downlink from any of source and target cells earlier than NTX-RX after the end of the last transmitted uplink symbol to any of source and target cells in the same TDD band where NTX-RX=25600Tc. | | |

##### 6.1.3.2.1 DAPS handover delay

Procedure delays for the procedure that can command a DAPS handover are specified in TS 38.331 [2].

When the UE receives a RRC message implying handover, the UE shall be ready to start the transmission of the new uplink PRACH channel within Dhandover1 seconds from the end of the last TTI containing the RRC command when UE is configured with dual active protocol stack handover.

Dhandover1 = TRRC\_procedure + Tsearch + TIU + Tprocessing + T∆ + Tmargin ms

Where:

TRRC\_procedure is the maximum RRC procedure delay as specified in clause 12 in TS 38.331 [2].

Tsearch, TIU, Tprocessing, T∆ and Tmargin are defined in clause 6.1.1.2.2.

After successful RACH procedure of the target cell, when the UE receives an RRC message implying source cell release command, the UE shall accomplish the release actions specified in TS 38.331 [2] within Dhandover2.

Dhandover2 = TRRC\_procedure+ Tinterrupt2

Where:

TRRC\_procedure is the RRC procedure delay as specified in clause 12 in TS 38.331 [2].

Tinterrupt2 is defined in clause 6.1.3.2.2.

##### 6.1.3.2.2 Interruption time

During Dhandover1, the UE is allowed an interruption of up to Tinterrupt1 on source cell.

For FR1-to-FR1 intra-frequency handover, Tinterrupt1 is specified in Table 6.1.3.2.2-1.

Table 6.1.3.2.2-1: Tinterrupt1 for FR1-to-FR1 intra-frequency DAPS HO

|  |  |  |  |
| --- | --- | --- | --- |
|  | NR Slot length (ms) | Interruption length Tinterrupt1 (slotsNote 1), synchronous DAPS HO | Interruption length Tinterrupt1 (slotsNote 1), asynchronous DAPS HO |
| 0 | 1 | 1 | 2 |
| 1 | 0.5 | 2 | 3 |
| 2 | 0.25 | 4 | 5 |
| Note 1: The same SCS of source cell and target cell is assumed.  Note 2: It is assumed that the BWP of target cell is not larger than the BWP of source cell. It is assumed that the CBW of target cell is not larger than the CBW of source cell  Note 3: Void | | | |

For FR1-to-FR1 intra-band inter-frequency handover, Tinterrupt1 is specified in Table 6.1.3.2.2-2.

Table 6.1.3.2.2-2: Tinterrupt1 for FR1-to-FR1 intra-band inter-frequency DAPS HO

|  |  |  |  |
| --- | --- | --- | --- |
|  | NR Slot length (ms) | Tinterrupt1 (slotsNote 1), synchronous DAPS HO | Tinterrupt1 (slotsNote 1), asynchronous DAPS HO |
| 0 | 1 | 1 + TSMTC\_duration \* | 2+ TSMTC\_duration \* |
| 1 | 0.5 | 2 + TSMTC\_duration \* | 3+ TSMTC\_duration \* |
| 2 | 0.25 | 4 + TSMTC\_duration \* | 5+ TSMTC\_duration \* |
| Note 1: The same SCS of source cell and target cell is assumed.  Note 2: TSMTC\_duration measured in subframes is the longest SMTC duration between source cell and target cell.  Note 3: Void  Note 4: is as defined in TS 38.211 [6]. | | | |

For FR1-to-FR1 inter-band handover, Tinterrupt1 is specified in Table 6.1.3.2.2-3.

Table 6.1.3.2.2-3: Tinterrupt1 for FR1-to-FR1 inter-band DAPS HO

|  |  |  |  |
| --- | --- | --- | --- |
|  | NR Slot length (ms) | Tinterrupt1 (slots) | |
|  | of source cell | Sync | Async |
| 0 | 1 | 1 | 2 |
| 1 | 0.5 | 2 | 3 |
| 2 | 0.25 | 5 | 5 |

For FR1-to-FR1 intra-frequency handover, Tinterrupt2 is specified in Table 6.1.3.2.2-4 when the BWP of target cell is smaller than the BWP of source cell, and Tinterrupt2 is specified in Table 6.1.3.2.2-5 when the same BWP is used for target cell and source cell.

Table 6.1.3.2.2-4: Tinterrupt2 for FR1-to-FR1 intra-frequency DAPS HO

|  |  |  |  |
| --- | --- | --- | --- |
|  | NR Slot length (ms) | Interruption length X (slotsNote 1) | Tinterrupt2 (slotsNote 1) for asynchronous DAPS HO |
| 0 | 1 | 2 | 3 |
| 1 | 0.5 | 4 | 5 |
| 2 | 0.25 | 8 | 9 |
| Note 1: The same SCS of source cell and target cell is assumed.  Note 2: It is assumed that the BWP of target cell is smaller than the BWP of source cell. | | | |

Table 6.1.3.2.2-5: Tinterrupt2 for FR1-to-FR1 intra-frequency DAPS HO

|  |  |  |  |
| --- | --- | --- | --- |
|  | NR Slot length (ms) | Interruption length X (slotsNote 1) | Tinterrupt2 (slotsNote 1) for asynchronous DAPS HO |
| 0 | 1 | 1 | 2 |
| 1 | 0.5 | 2 | 3 |
| 2 | 0.25 | 4 | 5 |
| Note 1: The same SCS of source cell and target cell is assumed.  Note 2: It is assumed that the BWP of target cell is the same as the BWP of source cell.  Note 3: Void | | | |

For FR1-to-FR1 intra-band inter-frequency handover, Tinterrupt2 is specified in Table 6.1.3.2.2-6.

Table 6.1.3.2.2-6: Tinterrupt2 for FR1-to-FR1 intra-band inter-frequency DAPS HO

|  |  |  |  |
| --- | --- | --- | --- |
|  | NR Slot length (ms) | Tinterrupt2 (slotsNote 1) for synchronous DAPS HO | Tinterrupt2 (slotsNote 1) for asynchronous DAPS HO |
| 0 | 1 | 1 + TSMTC\_duration \* | 2+ TSMTC\_duration \* |
| 1 | 0.5 | 2 + TSMTC\_duration \* | 3+ TSMTC\_duration \* |
| 2 | 0.25 | 4 + TSMTC\_duration \* | 5+ TSMTC\_duration \* |
| Note 1: The same SCS of source cell and target cell is assumed.  Note 2: TSMTC\_duration measured in subframes is the longest SMTC duration between source cell and target cell.  Note 3: Void.  Note 4: is as defined in TS 38.211 [6]. | | | |

For FR1-to-FR1 inter-band handover, Tinterrupt2 is specified in Table 6.1.3.2.2-7.

Table 6.1.3.2.2-7: Tinterrupt2 for FR1-to-FR1 inter-band DAPS HO

|  |  |  |  |
| --- | --- | --- | --- |
|  | NR slot length (ms) | Tinterrupt2 (slots) | |
|  | of target cell | Sync | Async |
| 0 | 1 | 1 | 2 |
| 1 | 0.5 | 2 | 3 |
| 2 | 0.25 | 5 | 5 |

#### 6.1.3.3 NR FR2- NR FR1 DAPS Handover

The requirements in this clause are applicable to inter-frequency handovers from NR FR2 cell to NR FR1 cell.

An FR2-FR1 DAPS handover is synchronous if it meets the conditions in table 6.1.3.3-1, otherwise it is asynchronous

Table 6.1.3.3-1: Sync condition for FR2-FR1 DAPS handover

|  |  |  |
| --- | --- | --- |
| Frequency Range of the pair of carriers | Maximum receive timing difference between source and taget cell (µs) for sync DAPS handover | Maximum transmit timing difference between source and taget cell (µs) for sync DAPS handover |
| Between FR1 and FR2 | 25 | 26.1 |

##### 6.1.3.3.1 DAPS handover delay

Procedure delays for the procedure that can command a DAPS handover are specified in TS 38.331 [2].

When the UE receives a RRC message implying handover, the UE shall be ready to start the transmission of the new uplink PRACH channel within Dhandover1 ms from the end of the last TTI containing the RRC command when UE is configured with dual active protocol stack handover.

Dhandover1 = TRRC\_procedure + Tsearch + TIU + Tprocessing + T∆ + Tmargin ms

Where:

TRRC\_procedure is the maximum RRC procedure delay as specified in clause 12 in TS 38.331 [2].

Tsearch, TIU, Tprocessing, T∆ and Tmargin are defined in clause 6.1.1.3.2.

After successful RACH procedure of the target cell, when the UE receives an RRC message implying source cell release command, the UE shall accomplish the release actions specified in TS 38.331 [2] within Dhandover2.

Dhandover2 = TRRC\_procedure+ Tinterrupt2

Where:

TRRC\_procedure is the RRC procedure delay as specified in clause 12 in TS 38.331 [2].

Tinterrupt2 is defined in clause 6.1.3.3.2.

##### 6.1.3.3.2 Interruption time

During Dhandover1, the UE is allowed an interruption of up to Tinterrupt1 on source cell.

For FR2-to-FR1 inter-band handover, Tinterrupt1 is specified in Table 6.1.3.3.2-1.

Table 6.1.3.3.2-1: Tinterrupt1 for FR2-to-FR1 inter-band DAPS HO

|  |  |  |  |
| --- | --- | --- | --- |
|  | NR slot length (ms) | Tinterrupt1 (slots) | |
|  | of source cell | Sync | Async |
| 2 | 0.25 | 5 | 5 |
| 3 | 0.125 | 9 | 9 |

During Dhandover2, the UE is allowed an interruption of up to Tinterrupt2 on target cell.

For FR2-to-FR1 inter-band handover, Tinterrupt2 is specified in Table 6.1.3.3.2-2.

Table 6.1.3.3.2-2: Tinterrupt2 for FR2-to-FR1 inter-band DAPS HO

|  |  |  |  |
| --- | --- | --- | --- |
|  | NR slot length (ms) | Tinterrupt2 (slots) | |
|  | of target cell | Sync | Async |
| 0 | 1 | 1 | 2 |
| 1 | 0.5 | 2 | 3 |
| 2 | 0.25 | 5 | 5 |

#### 6.1.3.4 NR FR1- NR FR2 DAPS Handover

The requirements in this clause are applicable to inter-frequency handovers from NR FR1 cell to NR FR2 cell.

An FR1-FR2 DAPS handover is synchronous if it meets the conditions in table 6.1.3.4-1, otherwise it is asynchronous

Table 6.1.3.4-1, : Sync condition for FR1-FR2 DAPS handover

|  |  |  |
| --- | --- | --- |
| Frequency Range of the pair of carriers | Maximum receive timing difference between source and taget cell (µs) for sync DAPS handover | Maximum transmit timing difference between source and taget cell (µs)Note 1 sync DAPS handover |
| Between FR1 and FR2 | 25 | 26.1 |

##### 6.1.3.4.1 DAPS handover delay

Procedure delays for the procedure that can command a DAPS handover are specified in TS 38.331 [2].

When the UE receives a RRC message implying handover, the UE shall be ready to start the transmission of the new uplink PRACH channel within Dhandover1 ms from the end of the last TTI containing the RRC command when UE is configured with dual active protocol stack handover.

Dhandover1 = TRRC\_procedure + Tsearch + TIU + Tprocessing + T∆ + Tmargin ms

Where:

TRRC\_procedure is the maximum RRC procedure delay as specified in clause 12 in TS 38.331 [2].

Tsearch, TIU, Tprocessing, T∆ and Tmargin are defined in clause 6.1.1.5.2.

After successful RACH procedure of the target cell, when the UE receives an RRC message implying source cell release command, the UE shall accomplish the release actions specified in TS 38.331 [2] within Dhandover2.

Dhandover2 = TRRC\_procedure+ Tinterrupt2

Where:

TRRC\_procedure is the RRC procedure delay as specified in clause 12 in TS 38.331 [2].

Tinterrupt2 is defined in clause 6.1.3.4.2.

##### 6.1.3.4.2 Interruption time

During Dhandover1, the UE is allowed an interruption of up to Tinterrupt1 on source cell.

For FR1-to-FR2 inter-band handover, Tinterrupt1 is specified in Table 6.1.3.4.2-1.

Table 6.1.3.4.2-1: Tinterrupt1 for FR1-to-FR2 inter-band DAPS HO

|  |  |  |  |
| --- | --- | --- | --- |
|  | NR slot length (ms) | Tinterrupt1 (slots) | |
|  | of source cell | Sync | Async |
| 0 | 1 | 1 | 2 |
| 1 | 0.5 | 2 | 3 |
| 2 | 0.25 | 5 | 5 |

During Dhandover2, the UE is allowed an interruption of up to Tinterrupt2 on target cell.

For FR1-to-FR2 inter-band handover, Tinterrupt2 is specified in Table 6.1.3.4.2-2.

Table 6.1.3.4.2-2: Tinterrupt2 for FR1-to-FR2 inter-band DAPS HO

|  |  |  |  |
| --- | --- | --- | --- |
|  | NR slot length (ms) | Tinterrupt2 (slots) | |
|  | of target cell | Sync | Async |
| 2 | 0.25 | 5 | 5 |
| 3 | 0.125 | 9 | 9 |

### 6.1.4 NR Conditional Handover

#### 6.1.4.1 Introduction

The requirements in this clause are applicable to conditional handover to change the NR PCell to another NR cell.

#### 6.1.4.2 NR FR1 – NR FR1 conditional handover

The requirements in this clause are applicable to both intra-frequency and inter-frequency conditional handover from NR FR1 cell to NR FR1 cell.

6.1.4.2.1 Handover delay

Procedure delays for all procedures that can command a conditional handover are specified in TS 38.331 [2].

When the UE receives a RRC message implying conditional handover the UE shall be ready to start the transmission of the new uplink PRACH channel within DCHO seconds from the end of the last TTI containing the RRC command.

DCHO = TRRC + TEvent\_DU + Tmeasure + Tinterrupt + TCHO\_execution

Where:

TRRC is the RRC procedure delay defined in clause 12 in TS 38.331 [2].

TEvent\_DU is the delay uncertainty which is the time from when the UE successfully decodes a conditional handover command until a condition exists at the measurement reference point which will trigger the conditional handover.

Tmeasure is the measurements time stated in clause 6.1.4.2.2.

TCHO\_execution is the conditional execution preparation time in clause 6.1.4.2.3.

Tinterrupt is the interruption time stated in clause 6.1.4.2.4.

6.1.4.2.2 Measurement time

The measurement time delay is defined from the end of TEvent\_DU until UE executes a handover to a target cell and interruption time starts.

For intra-frequency handover, the measurement time delay measured without Time To Trigger (TTT) and L3 filtering shall be less than Tidentify intra with index or Tidentify\_intra\_without\_index defined in clause 9.2.5.1 or clause 9.2.6.2.

For inter-frequency handover, the measurement time delay measured without Time To Trigger (TTT) and L3 filtering shall be less than Tidentify\_inter\_with\_index or Tidentify\_inter\_without\_index defined in clause 9.3.4.

When TTT or L3 filtering is used an additional delay can be expected.

A cell is detectable only if at least one SSB measured from the cell being configured remains detectable during the time period Tidentify\_intra\_without\_index or Tidentify\_intra\_with\_index for intra-frequency handover or Tidentify\_inter\_without\_index for inter-frequency handover. If a cell which has been detectable at least for the time period Tidentify\_intra\_without\_index or Tidentify\_intra\_with\_index for intra-frequency handover or Tidentify\_inter\_without\_index for inter-frequency handover becomes undetectable for a period and then the cell becomes detectable again and triggers a handover, the measurement time delay shall be less than TSSB\_measurement\_period\_intra or TSSB\_measurement\_period\_inter provided the timing to that cell has not changed more than ± 3200/ Tc while the measurement gap has not been available and the L3 filter has not been used, where *µ* is the SCS configuration as defined in clause 4.2 of TS 38.211 [3]. When L3 filtering is used, an additional delay can be expected.

6.1.4.2.3 Preparation time

TCHO\_execution is the UE execution preparation time for conditional handover, and starts after UE realizes the condition of CHO is met and identity of the target cell is determined. TCHO\_execution can be up to 10ms.

6.1.4.2.4 Interruption time

The interruption time is the time between when the UE starts to execute the conditional handover to the target cell and the time the UE starts transmission of the new PRACH.

For intra-frequency or inter-frequency conditional conditional handover, the interruption time shall be less than

Tinterrupt = Tprocessing + TIU + T∆ + Tmargin ms

Where:

Tprocessing is time for UE processing. Tprocessing can be up to 20ms.

TIU is the interruption uncertainty in acquiring the first available PRACH occasion in the new cell. TIU can be up to the summation of SSB to PRACH occasion association period and 10 ms. SSB to PRACH occasion associated period is defined in the table 8.1-1 of TS 38.213 [3]

T∆ is time for fine time tracking and acquiring full timing information of the target cell. TΔ = Trs.

Tmargin is time for SSB post-processing. Tmargin can be up to 2ms.

Trs is the SMTC periodicity of the target NR cell if the UE has been provided with an SMTC configuration for the target cellin the handover command, otherwise Trs is the SMTC configured in the measObjectNR having the same SSB frequency and subcarrier spacing. If the UE is not provided SMTC configuration or measurement object on this frequency, the requirement in this clause is applied with Trs=5ms assuming the SSB transmission periodicity is 5ms. There is no requirement if the SSB transmission periodicity is not 5ms. If the UE has been provided with higher layer in TS 38.331 [2] signaling of *smtc2*prior to the handover command, Trs follows *smtc1* or *smtc2* according to the physical cell ID of the target cell.

NOTE 1: The actual value of TIU shall depend upon the PRACH configuration used in the target cell.

#### 6.1.4.3 NR FR2 – NR FR1 conditional handover

The requirements in this clause are applicable to inter-frequency conditional handover from NR FR2 cell to NR FR1 cell.

The requirements defined in clause 6.1.4.2 applies assuming inter-frequency handover and:

Tprocessing is time for UE processing. Tprocessing can be up to 40ms.

#### 6.1.4.4 NR FR2 – NR FR2 conditional handover

The requirements in this clause are applicable to both intra-frequency and inter-frequency conditional handover from NR FR2 cell to NR FR2 cell.

##### 6.1.4.4.1 Handover delay

Procedure delays for all procedures that can command a conditional handover are specified in TS 38.331 [2].

When the UE receives a RRC message implying conditional handover the UE shall be ready to start the transmission of the new uplink PRACH channel within DCHO seconds from the end of the last TTI containing the RRC command.

DCHO = TRRC + TEvent\_DU + Tmeasure + Tinterrupt + TCHO\_execution

Where:

TRRC is the RRC procedure delay defined in clause 12 in TS 38.331 [2].

TEvent\_DU is the delay uncertainty which is the time from when the UE successfully decodes a conditional handover command until a condition exists at the measurement reference point which will trigger the conditional handover.

Tmeasure is the measurements time stated in clause 6.1.4.4.2.

TCHO\_execution is the conditional execution preparation time in clause 6.1.4.4.3. Tinterrupt is the interruption time stated in clause 6.1.4.4.4.

##### 6.1.4.4.2 Measurement time

The measurement time delay is defined from the end of TEvent\_DU until UE executes a handover to a target cell and interruption time starts.

For intra-frequency handover, the measurement time delay measured without Time To Trigger (TTT) and L3 filtering shall be less than Tidentify intra with index or Tidentify\_intra\_without\_index defined in clause 9.2.5.1 or clause 9.2.6.2.

For inter-frequency handover, the measurement time delay measured without Time To Trigger (TTT) and L3 filtering shall be less than Tidentify\_inter\_with\_index or Tidentify\_inter\_without\_index defined in clause 9.3.4.

When TTT or L3 filtering is used an additional delay can be expected.

A cell is detectable only if at least one SSB measured from the cell being configured remains detectable during the time period Tidentify\_intra\_without\_index or Tidentify\_intra\_with\_index for intra-frequency handover or Tidentify\_inter\_without\_index for inter-frequency handover. If a cell which has been detectable at least for the time period Tidentify\_intra\_without\_index or Tidentify\_intra\_with\_index for intra-frequency handover or Tidentify\_inter\_without\_index for inter-frequency handover becomes undetectable for a period and then the cell becomes detectable again and triggers a handover, the measurement time delay shall be less than TSSB\_measurement\_period\_intra or TSSB\_measurement\_period\_inter provided the timing to that cell has not changed more than ± 3200/ Tc while the measurement gap has not been available and the L3 filter has not been used, where *µ* is the SCS configuration as defined in clause 4.2 of TS 38.211 [3]. When L3 filtering is used, an additional delay can be expected.

##### 6.1.4.4.3 Preparation time

TCHO\_execution is the UE execution preparation time for conditional handover, and starts after UE realizes the condition of CHO is met and identity of the target cell is determined. TCHO\_execution can be up 10ms.

##### 6.1.4.4.4 Interruption time

The interruption time is the time between when the UE starts to execute the conditional handover to the target cell and the time the UE starts transmission of the new PRACH.

For intra-frequency or inter-frequency conditional conditional handover, the interruption time shall be less than

Tinterrupt = Tprocessing + TIU + T∆ + Tmargin ms

Where:

Tprocessing is time for UE processing. Tprocessing can be up to 20ms.

TIU is the interruption uncertainty in acquiring the first available PRACH occasion in the new cell. TIU can be up to the summation of SSB to PRACH occasion association period and 10 ms. SSB to PRACH occasion associated period is defined in the table 8.1-1 of TS 38.213 [3]

T∆ is time for fine time tracking and acquiring full timing information of the target cell. TΔ = Trs.

Tmargin is time for SSB post-processing. Tmargin can be up to 2ms.

Trs is the SMTC periodicity of the target NR cell if the UE has been provided with an SMTC configuration for the target cellin the handover command, otherwise Trs is the SMTC configured in the measObjectNR having the same SSB frequency and subcarrier spacing. If the UE is not provided SMTC configuration or measurement object on this frequency, the requirement in this clause is applied with Trs=5ms assuming the SSB transmission periodicity is 5ms. There is no requirement if the SSB transmission periodicity is not 5ms. If the UE has been provided with higher layer in TS 38.331 [2] signaling of *smtc2*prior to the handover command, Trs follows *smtc1* or *smtc2* according to the physical cell ID of the target cell.

NOTE 1: The actual value of TIU shall depend upon the PRACH configuration used in the target cell.

#### 6.1.4.5 NR FR1 – NR FR2 conditional handover

The requirements in this clause are applicable to inter-frequency conditional handover from NR FR1 cell to NR FR2 cell.

The requirements defined in clause 6.1.4.4 applies assuming inter-frequency handover and:

Tprocessing is time for UE processing. Tprocessing can be up to 40ms.

### 6.1.5 NR Handover with PSCell

#### 6.1.5.1 Introduction

The purpose of NR handover with PSCell is to change the NR PCell to another NR cell or E-UTRA cell and add or change the PSCell along with PCell handover. The requirements in this clause are applicable to:

- Handover with PSCell from NR SA to EN-DC

- Handover with PSCell from NR-DC to NR-DC

- Requirements in this clause only applies to FR1+FR2 NR-DC

- Handover with PSCell from NE-DC to NE-DC

- Requirements in this clause only applies to NE-DC with FR1 PCell

#### 6.1.5.2 Handover with PSCell from NR SA to EN-DC

The requirements in this clause are applicable to inter-RAT handover from NR to E-UTRAN and FR1/FR2 PSCell addition.

When the UE receives a RRC message implying handover with PSCell, the UE shall be ready to start the transmission of the new uplink PRACH channel on target E-UTRA PCell within DHOwithPSCell\_PCell msec from the end of the last TTI containing the RRC command, and the UE shall be ready to start the transmission of the new uplink PRACH channel on target PSCell within DHOwithPSCell\_PSCell msec from the end of the last TTI containing the RRC command.

Where:

- DHOwithPSCell\_PCell equals the applicable RRC procedure delay (i.e., 50ms) plus the interruption time stated in clause 6.1.5.2.1.

- DHOwithPSCell\_PSCell equals the PSCell addition delay stated in clause 6.1.5.2.2.

##### 6.1.5.2.1 Interruption time for inter-RAT HO from NR to E-UTRAN

The interruption time is the time between end of the last TTI containing the RRC command on the old PDSCH and the time the UE starts transmission of the new PRACH, excluding the RRC procedure delay

When handover with PSCell from NR SA to EN-DC is commanded, the interruption time shall be less than Tinterrupt

Tinterrupt = Tsearch\_HO + TIU + Tprocessing

Where:

- Tsearch\_HO is same as the Tsearch defined in section 6.1.2.1.3.

- TIU is same as the one defined in section 6.1.2.1.3.

- Tprocessing is the SW processing time needed by UE, including RF warm up period. When target PSCell is unknown and SMTC configuration of target unknown PSCell is present in *RRCConnectionReconfiguration* [2], Tprocessing = 30ms if new PSCell is in FR1, Tprocessing = 50ms if new PSCell is in FR2; otherwise, Tprocessing = 25ms if new PSCell is in FR1, Tprocessing = 45ms if new PSCell is in FR2.

In the interruption requirement a cell is known if it has been meeting the relevant cell identification requirement during the last 5 seconds otherwise it is unknown. Relevant E-UTRA cell identification requirements are described in clause 9.4.1.

##### 6.1.5.2.2 PSCell addition in HO with PSCell for NR SA to EN-DC

The requirements in this section shall apply for PSCell addition during handover with PSCell from NR SA to EN-DC.

When handover with PSCell from NR SA to EN-DC is commanded, the PSCell addition time shall be less than DHOwithPSCell\_PSCell:

- DHOwithPSCell\_PSCell = TRRC\_delay + Tprocessing + Tsearch\_PCell + Tsearch\_PSCell + T∆ + TPSCell\_ DU + 2 ms

Where:

- TRRC\_delay is the RRC procedure delay. TRRC\_delay = 50ms.

- Tprocessing is as defined in section 6.1.5.2.1.

- Tsearch\_PCell is the time for obtaining the timing reference of target PCell. Tsearch\_PCell = Tsearch\_HO which is as defined in section 6.1.5.2.1 if target PSCell is unknown and SMTC configuration of target unknown PSCell is configured in *RRCConnectionReconfiguration* of *targetRAT-MessageContainer* [2]. Otherwise, Tsearch\_PCell = 0.

- Tsearch\_PSCell is same as Tsearch in section 7.31.2 of TS36.133[15], and T∆ and TPSCell\_ DU is same as the one defined in section 7.31.2 of TS36.133[15]. The Trs definition from section 7.31.2 of TS36.133[15] is modified as following for requirement in this section:

- Trs is the SMTC periodicity of the target NR cell if target PSCell is unknown and SMTC configuration of target unknown PSCell is present in *RRCConnectionReconfiguration* [2], otherwise Trs is the SMTC configured in the measObjectNR having the same SSB frequency and subcarrier spacing. If the UE is not provided SMTC configuration or measurement object on this frequency, the requirement in this section is applied with Trs = 5 ms assuming the SSB transmission periodicity is 5 ms. There is no requirement if the SSB transmission periodicity is not 5 ms.

PSCell known and unknown condition is as defined in section 7.31.2 of TS36.133[15].

#### 6.1.5.3 HO with PSCell from NE-DC to NE-DC

The requirements in this clause are applicable to both intra-frequency and inter-frequency handovers from NR PCell to NR PCell on FR1, and the PSCell addition is on LTE.

##### 6.1.5.3.1 Handover delay

When the UE receives a RRC message implying PCell handover with PSCell change, the UE shall be ready to start the transmission of the new uplink PRACH channel on target NR PCell within DHOwithPSCell\_PCell from the end of the last TTI containing the RRC command, and UE shall be ready to start the transmission of the new uplink PRACH channel on target E-UTRA PSCell within DHOwithPSCell\_PSCell from the end of the last TTI containing the RRC command.

The PCell handover delay, DHOwithPSCell\_PCell, is equals the applicable RRC procedure delay defined in clause 12 in TS 38.331 [2] plus the PCell interruption time (Tinterrupt) define in clause 6.1.5.3.2.

PSCell addition/change delay, DHOwithPSCell\_PSCell is defined in clause 6.1.5.3.3.

##### 6.1.5.3.2 HO with PSCell - PCell Interruption time

When intra-frequency or inter-frequency handover is commanded, the interruption time shall be less than Tinterrupt

Tinterrupt = Tsearch\_PCell + T∆\_PCell + Tmargin\_PCell + TIU\_PCell + Tprocessing ms

Where:

- If the source cell is in FR1 and target cell is in FR1, Tsearch\_PCell,  T∆\_PCell, Tmargin\_PCell is same as the Tsearch, T∆, Tmargin defined in section 6.1.1.2.2 respectively. Tprocessing is UE software processing and RF warmup delay for PCell HO and for this case Tprocessing can be up to 25ms. TIU\_PCell can be up to the summation of SSB to PRACH occasion association period and 10 ms if there is no collision between PCell RACH and PSCell RACH occasion or UE can perform PCell RACH and PSCell RACH occasion simaltaneously as defined in TS38.213[39] section 7.6.1A; otherwise, longer TIU\_PCell is expected to include the uncertainty in acquiring the next available RACH occasion for PCell RACH transmission.

##### 6.1.5.3.3 PSCell addition/change in NE-DC to NE-DC HO with PSCell

When HO with PSCell addition is commanded, the PSCell addition/change time shall be less than DHOwithPSCel\_PSCell.

- DHOwithPSCel\_PSCell = Tconfig\_EUTRAN-PSCell + Tprocessing\_margin .

where

- Tconfig\_EUTRAN-PSCell isdefined in clause8.8.2, and

- Tprocessing\_margin = 5ms is the additional delay margin for RF warm-up and software processing in handover with PSCell.

#### 6.1.5.4 HO with PSCell from NR-DC to NR-DC

The requirements in this clause are applicable to handover with PSCell from NR-DC to NR-DC. The requirements in this clause are only applicable to FR1+FR2 NR-DC.

This clause defines requirements for the delay within which the UE shall be able to handover from NR cell to NR cell and add NR PSCell in the meantime.

When the UE receives a RRC message implying handover with PSCell,

- The UE shall be ready to start the transmission of the new uplink PRACH channel of the target PCell within DHOwithPSCell\_PCell ms from the end of the last TTI containing the RRC command, and

- The UE shall be capable of transmitting PRACH preamble towards the target PSCell no later than DHOwithPSCell\_PSCell ms from the end of the last TTI containing the RRC command.

Where:

- DHOwithPSCell\_PCell equals the applicable RRC procedure delay defined in clause 12 in TS 38.331 [2] plus the interruption time stated in clause 6.1.5.4.1.

- DHOwithPSCell\_PSCell is the PSCell change delay stated in clause 6.1.5.4.2.

6.1.5.4.1 HO with PSCell – PCell Interruption time

The interruption time is the time between end of the last TTI containing the RRC command on the old PDSCH and the time the UE starts transmission of the new PRACH, excluding the RRC procedure delay.

When handover with PSCell from NR-DC to NR-DC is commanded, the interruption time shall be less than Tinterrupt

Tinterrupt = Tsearch + TIU + Tprocessing + T∆ + Tmargin ms

Where:

- Tsearch, TIU, T∆ and Tmargin are the same as defined in clause 6.1.1.2.2.

- Tprocessing is the SW processing time needed by UE, including RF warm up period. Tprocessing = 30 ms if SMTC of the target unknown PSCell is configured in *targetcellSMTC-SCG-r16* but not configured in *reconfigurationWithSync*. Otherwise, Tprocessing = 25 ms.

In the interruption requirement a cell is known if it has been meeting the relevant cell identification requirement during the last 5 seconds otherwise it is unknown. Relevant cell identification requirements are described in Clause 9.2.5 for intra-frequency handover and Clause 9.3.4 for inter-frequency handover.

6.1.5.4.2 HO with PSCell – PSCell change delay

The requirements in this section shall apply for PSCell change during handover with PSCell from NR DC to NR-DC.

When handover with PSCell from NR-DC to NR-DC is commanded, the PSCell change time shall be less than DHOwithPSCell\_PSCell:

- DHOwithPSCell\_PSCell = TRRC\_delay + Tprocessing + Tsearch\_PCell + Tsearch\_PSCell + T∆ + TPSCell\_ DU + 2 ms

Where:

- TRRC\_delay Tprocessing, Tsearch\_PSCell, T∆ and TPSCell\_ DU are the same as defined in clause 8.9.2.

- Tprocessing is the SW processing time needed by UE, including RF warm up period. Tprocessing = 30 ms if SMTC of the target unknown PSCell is configured in *targetcellSMTC-SCG-r16* but not configured in *reconfigurationWithSync*. Otherwise, Tprocessing = 25 ms.

- Tsearch\_PCell is the time for obtaining the timing reference of target PCell. If SMTC of the target unknown PSCell is configured in *targetcellSMTC-SCG-r16* but not configured in *reconfigurationWithSync*, Tsearch\_PCell = Tsearch + TΔ + Tmargin, where Tsearch, TΔ and Tmargin are specified in clause 6.1.5.4.1. Otherwise, Tsearch\_PCell = 0 ms.

The Trs definition from clause 8.9.2 is modified as following for requirements in this section:

- Trs is the SMTC periodicity of the target NR cell if target PSCell is unknown and SMTC configuration of target unknown PSCell is present in either *targetcellSMTC-SCG-r16* or *reconfigurationWithSync*, otherwise Trs is the SMTC configured in the measObjectNR having the same SSB frequency and subcarrier spacing. If the measObjectNRs having the same SSB frequency and subcarrier spacing configured by MN and SN have different SMTC, Trs is the periodicity of one of the SMTC which is up to UE implementation. If the UE is not provided SMTC configuration or measurement object on this frequency, the requirement in this section is applied with Trs = 5 ms assuming the SSB transmission periodicity is 5 ms. There is no requirement if the SSB transmission periodicity is not 5 ms.

PSCell known and unknown condition is as defined in clause 8.9.2.

#### 6.1.5.5 Handover with PSCell from NR SA to EN-DC with PSCell using CCA

##### 6.1.5.5.1 Introduction

When the UE receives a RRC message implying handover with PSCell change, the UE shall be ready to start the transmission of the new uplink PRACH channel on target E-UTRA PCell within DHOwithPSCell\_PCell ms from the end of the last TTI containing the RRC command, and UE shall be ready to start the transmission of the new uplink PRACH channel on a target PSCell on a carrier frequency with CCA within DHOwithPSCell\_PSCell seconds and from the end of the last TTI containing the RRC command.

Where:

DHOwithPSCell\_PCell equals the maximum RRC procedure delay defined in clause 11.2 in TS 36.331 [2] plus the interruption time stated in clause 6.1.5.5.2.

DHOwithPSCell\_PSCell is the PSCell addition delay stated in clause 6.1.5.5.3

##### 6.1.5.5.2 NR SA to EN-DC HO with PSCell- NR to E-UTRA HO Interruption time

The interruption time is the time between end of the last TTI containing the RRC command on the old PDSCH and the time the UE starts transmission of the new PRACH excluding the RRC procedure delay. This requirement applies when UE is not required to perform any synchronisation procedure before transmitting on the new PRACH or on the new PUSCH.

When Handover with PSCell is commanded, the interruption time shall be less than Tinterrupt

Tinterrupt = Tsearch + TIU + Tprocessing ms

Where:

Tsearch is same as the Tsearch defined in section 6.1.2.1.3

TIU is same as the one defined in section 6.1.2.1.3.

Tprocessing is the SW processing time needed by UE, including RF warm up period. When target PSCell is unknown and SMTC configuration of target unknown PSCell is present in *RRCConnectionReconfiguration* [2], Tprocessing = 30ms, otherwise, Tprocessing­­­ = 25 ms.

NOTE: The actual value of TIU shall depend upon the PRACH configuration used in the target E-UTRA cell.

In the interruption requirement, a cell is known if it has been meeting the relevant cell identification requirement during the last 5 seconds. Otherwise, it is unknown. Relevant E-UTRA cell identification requirements are described in clause 9.4.1.

##### 6.1.5.5.3 NR SA to EN-DC HO with PSCell - NR PSCell Addition Delay requirements

When Handover with PSCell is commanded, the NR PSCell on a carrier frequency with CCA changing delay shall be less than DHOwithPSCell\_PSCell:

DHOwithPSCell\_PSCell = TRRC\_delay + Tprocessing + Tsearch\_PCell + Tsearch\_PSCell + T∆ + TIU\_PSCell + 2 ms

Where:

TRRC\_delay is maximum RRC procedure delay defined in clause 11.2 in TS 36.331 [2].

Tsearch\_PCell is the time for obtaining the timing reference of target PCell. Tsearch\_PCell is same as Tsearch\_HO as defined in section 6.1.5.2.1, if target PSCell is unknown and SMTC configuration of target unknown PSCell is present in *RRCConnectionReconfiguration* [2]. Otherwise, Tsearch\_PCell = 0

Tsearch\_PSCell is the time required to search the target cell when the target cell is not already known when the handover command is received by the UE. If the target cell is known, then Tsearch\_PSCell = 0 ms. If the target cell is an unknown cell and target cell Es/Iot ≥ [-2] dB, then Tsearch\_PSCell = (3+L1) \*Trs ms. Regardless of whether DRX is in use by the UE, Tsearch shall still be based on non-DRX target cell search times.

L1 is the number of SMTC occasions not available at the UE during the inter-RAT detection period. Regardless of whether DRX is in use by the UE, Tsearch shall still be based on non-DRX target cell search times.

T∆ is same as T∆ in section 7.31A.2.

Tprocessing is time for UE processing and is same as defined in 6.1.5.5.2.

Tmargin is time for SSB post-processing. Tmargin can be up to 2 ms.

TIU\_PSCell is the delay uncertainty due to the random-access procedure when sending PRACH to the new cell. TIU\_PSCell can be up to: (1+ L3) \*TSSB,RO + 10 ms; where TSSB,RO is the SSB to PRACH occasion association period as defined in Table 8.1-1 of TS 38.213 [39] and L3 is the number of consecutive SSB to PRACH occasion association periods during which no PRACH occasion is available for PRACH transmission due to UL CCA failures or RACH collision between PCell and PSCell. L3 = 0 for Type 2C UL channel access procedure as defined in TS 37.213 [57] and when there are no RACH collisions between PCell and PSCell.When the UE is configured with both the UL BWP with PRACH occasion on the target cell and UL LBT failure detection/recovery, the interruption can be longer.

NOTE 1: The actual value of TIU\_PSCell shall depend upon the PRACH configuration used in the target cell.

NOTE 2: The interruption time extended by L1, L2, and L3 parameters, and by the UL LBT failure detection/recovery mechanism is limited by the T304 timer. The UE behaviour at the T304 timer expiry is specified in TS 38.331 [38].

Trs is the SMTC periodicity of the target NR cell if target PSCell is unknown and SMTC configuration of target unknown PSCell is present in *RRCConnectionReconfiguration* [2], otherwise Trs is the SMTC configured in the measObjectNR having the same SSB frequency and subcarrier spacing. If the UE is not provided SMTC configuration or measurement object on this frequency, the requirement in this section is applied with Trs = 5 ms assuming the SSB transmission periodicity is 5 ms. There is no requirement if the SSB transmission periodicity is not 5 ms.

A cell on a carrier frequency with CCA is known if it has been meeting the relevant cell identification requirement during the last 5 seconds. Otherwise, it is unknown. Relevant cell identification requirements are described in clause 8.1.2.4.21A, and 8.1.2.4.22A.

## 6.1A Void

### 6.1A.1 Void

#### 6.1A.1.1 Void

#### 6.1A.1.2 Void

##### 6.1A.1.2.1 Void

##### 6.1A.1.2.2 Void

## 6.1B Handover to target cell using CCA

### 6.1B.1 NR Handover

#### 6.1B.1.1 Introduction

The purpose of NR handover to target cell using CCA is to change the NR PCell to a target NR cell in a carrier frequency with CCA. The requirements in this clause are applicable to NR SA.

In the requirements of clause 6.1B.1, the term SMTC occasion not available at the UE refers to when the SMTC contains SSBs configured by gNB in a cell on a carrier frequency subject to CCA, but the first two successive candidate SSB positions for the same SSB index within the discovery burst transmission window are not available at the UE due to DL CCA failures at gNB during the corresponding detection or time tracking period; otherwise the SMTC occasion is considered as available at the UE.

In the requirements of clause 6.1B.1, the term PRACH occasion unavailable for transmission refers to when the PRACH occasion is configured by gNB but not transmitted by the UE during the corresponding period due to UL CCA failure at the UE.

#### 6.1B.1.2 NR FR1 - NR FR1 Handover

The requirements in this clause are applicable to inter-frequency handovers from NR FR1 cell to NR FR1 cell in carrier frequencies with CCA, and to both intra-frequency and inter-frequency handovers from NR FR1 cell in carrier frequencies with CCA to NR FR1 cell in carrier frequencies with CCA.

##### 6.1B.1.2.1 Handover delay

When the UE receives an RRC message implying handover the UE shall be ready to start the transmission of the new uplink PRACH channel within Dhandover ms from the end of the last TTI containing the RRC command.

Where:

Dhandover equals the applicable RRC procedure delay to be defined in clause12 in TS 38.331 [2] plus the interruption time stated in clause 6.1B.1.2.2.

##### 6.1B.1.2.2 Interruption time

The interruption time is the time between end of the last TTI containing the RRC command on the old PDSCH and the time the UE starts transmission of the new PRACH, excluding the RRC procedure delay.

When intra-frequency or inter-frequency handover is commanded, the interruption time shall be less than Tinterrupt

Tinterrupt = Tsearch + TIU + Tprocessing + T∆ + Tmargin ms

Where:

Tsearch is the time required to search the target cell when the target cell is not already known when the handover command is received by the UE. If the target cell is known, then Tsearch = 0 ms. If the target cell is an unknown intra-frequency cell and the target cell Es/Iot≥-2 dB, then Tsearch = (1+L1) \*Trs. If the target cell is an unknown inter-frequency cell and the target cell Es/Iot≥-2 dB, then Tsearch = (3+L1´) \*Trs where L1 and L1´ are the number of SMTC occasions not available at the UE during the intra-frequency and inter-frequency detection period, respectively. Regardless of whether DRX is in use by the UE, Tsearch shall still be based on non-DRX target cell search times.

T∆ is time for fine time tracking and acquiring full timing information of the target cell. T∆ = (1+ L2) \*Trs ms, where L2 is the number of SMTC occasions not available at the UE during the time tracking period.

Tprocessing is time for UE processing. Tprocessing can be up to 20ms.

Tmargin is time for SSB post-processing. Tmargin can be up to 2ms.

TIU is the interruption uncertainty due to the random access procedure when sending PRACH to the new cell. TIU can be up to: (1+ L3)\*TSSB,RO + 10 ms where TSSB,RO is the SSB to PRACH occasion association period as defined in Table 8.1-1 of TS 38.213 [3] and L3 is the number of consecutive SSB to PRACH occasion association periods during which no PRACH occasion is available for PRACH transmission due to UL CCA failure. L3 = 0 for Type 2C UL channel access procedure as defined in TS 37.213 [33]. When the UE is configured with both the UL BWP with PRACH occasion on the target cell and UL CCA failure detection/recovery, the interruption can be longer.

Trs is the SMTC periodicity of the target NR cell in a carrier frequency with CCA if the UE has been provided with an SMTC configuration for the target cell in the handover command, otherwise Trs is the SMTC configured in the measObjectNR having the same SSB frequency and subcarrier spacing. If the UE is not provided SMTC configuration or measurement object on this frequency, the requirement in this clause is applied with Trs=5ms assuming the SSB transmission periodicity is 5ms. There is no requirement if the SSB transmission periodicity is not 5ms.

NOTE 1: The interruption time considering the potential extensions caused by L1,L1´,L2 , L3 and by the UL CCA failure detection/recovery mechanism is limited by the T304 timer. The UE behaviour at the T304 timer expiry is detailed in TS 38.331 [2].

In the interruption requirement a cell is known if it has been meeting the relevant cell identification requirement during the last 5 seconds otherwise it is unknown. Relevant cell identification requirements are described in Clause 9.2A.5 for intra-frequency handover and Clause 9.3A.4 for inter-frequency handover to a carrier frequency with CCA.

#### 6.1B.1.3 NR FR2-2 NR FR2-2 Handover

The requirements in this clause are applicable to inter-frequency handovers from NR FR2-2 cell to NR FR2-2 cell in carrier frequencies with CCA, and to both intra-frequency and inter-frequency handovers from NR FR2-2 cell in carrier frequencies with CCA to NR FR2-2 cell in carrier frequencies with CCA.

##### 6.1B.1.3.1 Handover delay

When the UE receives a RRC message implying handover the UE shall be ready to start the transmission of the new uplink PRACH channel within Dhandover ms from the end of the last TTI containing the RRC command.

Where:

- Dhandover equals the applicable RRC procedure delay defined in clause 12 in TS 38.331 [2] plus the interruption time stated in clause 6.1B.1.3.2.

##### 6.1B.1.3.2 Interruption time

The interruption time is the time between end of the last TTI containing the RRC command on the old PDSCH and the time the UE starts transmission of the new PRACH, excluding the RRC procedure delay.

When intra-frequency or inter-frequency handover is commanded, the interruption time shall be less than Tinterrupt

Tinterrupt = Tsearch + TIU + Tprocessing + T∆ + Tmargin ms

Where:

- Tsearch is the time required to search the target cell when the handover command is received by the UE. If the target cell is a known cell, then Tsearch = 0 ms. If the target cell is an unknown intra-frequency cell and the target cell Es/Iot≥-2 dB, then Tsearch = (1+L1) \* N \* Trs ms. If the target cell is an unknown inter-frequency cell and the target cell Es/Iot≥-2 dB, then Tsearch = (3+L1´) \* N \* Trs where L1 and L1´ are the number of SMTC occasion groups not available at the UE during the intra-frequency and inter-frequency detection period, respectively. An SMTC occasion group consists of N consecutive SMTC occasions. An SMTC occasion group is not available, when at least one SMTC occasion in the group is not transmitted by the gNB. N is equal to 12. Regardless of whether DRX is in use by the UE, Tsearch shall still be based on non-DRX target cell search times.

- Tprocessing is time for UE processing. Tprocessing can be up to 20ms.

- Tmargin is time for SSB post-processing. Tmargin can be up to 2ms.

- T∆ is time for fine time tracking and acquiring full timing information of the target cell. T∆ = (1+ L2) \* Trs, where L2 is the number of SMTC occasions not available at the UE during the time tracking period.

- TIU is the interruption uncertainty due to the random access procedure when sending PRACH to the new cell. TIU can be up to (1+ L3)\*TSSB,RO + 10ms, where TSSB,RO is SSB to PRACH occasion associated period is defined in the table 8.1-1 of TS 38.213 [3] and L3 is the number of consecutive SSB to PRACH occasion association periods during which no PRACH occasion is available for PRACH transmission due to UL CCA failure. L3 = 0 for Type 3 channel access procedure as defined in TS 37.213 [33].

- Trs is the SMTC periodicity of the target NR cell in a carrier frequency with CCA if the UE has been provided with an SMTC configuration for the target cell in the handover command, otherwise Trs is the SMTC configured in the measObjectNR having the same SSB frequency and subcarrier spacing. If the UE is not provided SMTC configuration or measurement object on this frequency, the requirement in this clause is applied with Trs=5ms assuming the SSB transmission periodicity is 5ms. There is no requirement if the SSB transmission periodicity is not 5ms.

NOTE 1: The interruption time considering the potential extensions caused by L1,L1´,L2 , L3 and by the UL CCA failure detection/recovery mechanism is limited by the T304 timer. The UE behaviour at the T304 timer expiry is detailed in TS 38.331 [2].

In FR2-2, the target cell is known if it has been meeting the following conditions:

- During the last 5 seconds before the reception of the handover command:

- the UE has sent a valid measurement report for the target cell and

- One of the SSBs measured from the NR target cell being configured remains detectable according to the cell identification conditions specified in Clause 9.2A.5 for intra-frequency handover and Clause 9.3A.4 for inter-frequency handover to a carrier frequency with CCA,

- One of the SSBs measured from the target cell also remains detectable during the handover delay according to the cell identification conditions specified in Clause 9.2A.5 for intra-frequency handover and Clause 9.3A.4 for inter-frequency handover to a carrier frequency with CCA.

otherwise it is unknown.

#### 6.1B.1.4 NR FR1- NR FR2-2 Handover

The requirements in this clause are applicable to inter-frequency handovers from NR FR1 cell to NR FR2-2 cell in carrier frequencies with CCA.

##### 6.1B.1.4.1 Handover delay

When the UE receives a RRC message implying handover the UE shall be ready to start the transmission of the new uplink PRACH channel within Dhandover ms from the end of the last TTI containing the RRC command.

Where:

Dhandover equals the applicable RRC procedure delay defined in clause 12 in TS 38.331 [2] plus the interruption time stated in clause 6.1B.1.4.2.

##### 6.1B.1.4.2 Interruption time

The interruption time is the time between end of the last TTI containing the RRC command on the old PDSCH and the time the UE starts transmission of the new PRACH, excluding the RRC procedure delay.

When in inter-frequency handover is commanded, the interruption time shall be less than Tinterrupt

Tinterrupt = Tsearch + TIU + Tprocessing + T∆ + Tmargin ms

Where:

Tsearch is the time required to search the target cell when the handover command is received by the UE. If the target cell is a known cell, then Tsearch = 0 ms. If the target cell is an unknown inter-frequency cell and the target cell Es/Iot≥-2 dB, then Tsearch = (3+L1) \* N \* Trs, where L1 is the number of SMTC occasion groups not available at the UE during the inter-frequency detection period. An SMTC occasion group consists of N consecutive SMTC occasions. An SMTC occasion group is not available, when at least one SMTC occasion in the group is not transmitted by the gNB. N is equal to 12. Regardless of whether DRX is in use by the UE, Tsearch shall still be based on non-DRX target cell search times.

Tprocessing is time for UE processing. Tprocessing can be up 40ms.

Tmargin is time for SSB post-processing. Tmargin can be up to 2ms.

T∆ is time for fine time tracking and acquiring full timing information of the target cell. T∆ = (1+ L2) \* Trs, where L2 is the number of SMTC occasions not available at the UE during the time tracking period.

TIU is the interruption uncertainty due to the random access procedure when sending PRACH to the new cell. TIU can be up to (1+ L3)\*TSSB,RO + 10ms, where TSSB,RO is SSB to PRACH occasion associated period is defined in the table 8.1-1 of TS 38.213 [3] and L3 is the number of consecutive SSB to PRACH occasion association periods during which no PRACH occasion is available for PRACH transmission due to UL CCA failure. L3 = 0 for Type 3 channel access procedure as defined in TS 37.213 [33].

- Trs is the SMTC periodicity of the target NR cell in a carrier frequency with CCA if the UE has been provided with an SMTC configuration for the target cell in the handover command, otherwise Trs is the SMTC configured in the measObjectNR having the same SSB frequency and subcarrier spacing. If the UE is not provided SMTC configuration or measurement object on this frequency, the requirement in this clause is applied with Trs=5ms assuming the SSB transmission periodicity is 5ms. There is no requirement if the SSB transmission periodicity is not 5ms.

NOTE 1: The interruption time considering the potential extensions caused by L1,L2 , L3 and by the UL CCA failure detection/recovery mechanism is limited by the T304 timer. The UE behaviour at the T304 timer expiry is detailed in TS 38.331 [2].

In FR2-2, the target cell is known if it has been meeting the following conditions:

During the last 5 seconds before the reception of the handover command:

- the UE has sent a valid measurement report for the target cell and

One of the SSBs measured from the NR target cell being configured remains detectable according to the cell identification conditions specified in Clause 9.2A.5 for intra-frequency handover and Clause 9.3A.4 for inter-frequency handover to a carrier frequency with CCA,

- One of the SSBs measured from the target cell also remains detectable during the handover delay according to the cell identification conditions specified in Clause 9.2A.5 for intra-frequency handover and Clause 9.3A.4 for inter-frequency handover to a carrier frequency with CCA.

otherwise it is unknown.

## 6.1C Handover for SAN

*Editor’s note: Applicability of frequency range, CA, DA, duplex mode, inter-RAT measurement, etc is subject to updates/changes based on the scope of the corresponding WID.*

*Editor’s note: Terminology will be further clarified and selected between, e.g. NTN and satellite access, based on further agreements.*

### 6.1C.1 NR SAN Handover

#### 6.1C.1.1 Introduction

The purpose of NR SAN handover is to change the NR SAN PCell to another NR SAN cell. The requirements in this clause are applicable to SA NR SAN.

#### 6.1C.1.2 NR SAN FR1 – NR SAN FR1 Handover

The requirements in this clause are applicable to both intra-frequency and inter-frequency handovers from NR SAN FR1 cell to NR SAN FR1 cell.

##### 6.1C.1.2.1 Handover delay

When the UE receives a RRC message implying handover to NR SAN cell, the UE shall be ready to start the transmission of the new uplink PRACH channel within Dhandover msec from the end of the last TTI containing the RRC command.

Where:

- Dhandover equals the applicable RRC procedure delay defined in clause 12 in TS 38.331 [2] plus the interruption time stated in clause 6.1C.1.2.2.

##### 6.1C.1.2.2 Interruption time

The interruption time is the time between end of the last TTI containing the RRC command on the old PDSCH and the time the UE starts transmission of the new PRACH, excluding the RRC procedure delay.

When intra-frequency or inter-frequency handover to NR SAN cell is commanded,

If the valid parameters of ephemeris information, epoch time of the ephemeris, common TA, validity timer information, DL and UL Polarization information, Koffset, and Kmac for target NR SAN cell are send to UE,

the interruption time shall be less than Tinterrupt

Tinterrupt = Tsearch + TIU + Tprocessing + T∆ + Tmargin ms

Otherwise, no interruption time requirement is applied.

Where:

- Tsearch is the time required to search the target NR SAN cell when the target cell is not already known when the handover command is received by the UE. If the target cell is known, then Tsearch = 0 ms. If the target cell is an unknown intra-frequency cell and the target cell Es/Iot ≥ -2 dB, then Tsearch = Trs ms. If the target cell is an unknown inter-frequency cell and the target cell Es/Iot ≥ -2 dB, then Tsearch = 3\* Trs ms. Regardless of whether DRX is in use by the UE, Tsearch shall still be based on non-DRX target cell search times.

- T∆ is time for fine time tracking and acquiring full timing information of the target cell. T∆ = Trs.

- Tprocessing is time for UE processing. Tprocessing can be up to 20ms.

- Tmargin is time for SSB post-processing. Tmargin can be up to 2ms.

- TIU is the interruption uncertainty in acquiring the first available PRACH occasion in the new cell. TIU can be up to the summation of SSB to PRACH occasion association period and [x] ms. SSB to PRACH occasion associated period is defined in the table 8.1-1 of TS 38.213 [3].

- Trs is the SMTC periodicity of the target NR SAN cell if the UE has been provided with an SMTC configuration for the target cell in the handover command, otherwise Trs is the SMTC configured in the measObjectNR having the same SSB frequency and subcarrier spacing. If the UE is not provided SMTC configuration or measurement object on this frequency, the requirement in this clause is applied with Trs=5ms assuming the SSB transmission periodicity is 5ms. There is no requirement if the SSB transmission periodicity is not 5ms. If the UE has been provided with higher layer in TS 38.331 [2] signaling of *smtc2*prior to the handover command, Trs follows *smtc1* or *smtc2* according to the physical cell ID of the target cell.

In the interruption requirement a cell is known if it has been meeting the relevant cell identification requirement during the last 5 seconds otherwise it is unknown. Relevant cell identification requirements are described in Clause 9.2.5 for intra-frequency handover and Clause 9.3.4 for inter-frequency handover.

### 6.1C.2 NR SAN Conditional Handover

#### 6.1C.2.1 Introduction

The requirements in this clause are applicable to conditional handover to change the NR SAN PCell to another NR SAN cell.

#### 6.1C.2.2 NR SAN FR1 – NR SAN FR1 conditional handover

The requirements in this clause are applicable to both intra-frequency and inter-frequency conditional handover from NR SAN FR1 cell to NR SAN FR1 cell.

##### 6.1C.2.2.1 Handover delay

Procedure delays for all procedures that can command a conditional handover are specified in TS 38.331 [2]. UE should start RRM measurement before the time or distance condition is met, the time/distance condition is defined in clause 5.5.4 in TS 38.331[2]

When the UE receives a RRC message implying conditional handover the UE shall be ready to start the transmission of the new uplink PRACH channel within Dhandover seconds from the end of the last TTI containing the RRC command.

DCHO = TRRC + TEvent\_DU + Tmeasure + Tinterrupt + TCHO\_execution

Where:

- TRRC is the RRC procedure delay defined in clause 12 in TS 38.331 [2].

- TEvent\_DU is the delay uncertainty which is the time from when the UE successfully decodes a conditional handover command until a condition exists at the measurement reference point which will trigger the conditional handover

- Tmeasure is the measurements time stated in clause 6.1C.4.2.2.

- TCHO\_execution is the UE conditional execution preparation time for conditional handover in clause 6.C1.2.2.3.

- Tinterrupt is the interruption time stated in clause 6.1C.2.2.4.

The conditional handover delay requirements are applied if condition T1-2 is later than the end of Tmeasure for time based CHO, or both condition D1-1 and condition D1-2 are fulfilled before the end of Tmeasure for location-based CHO, otherwise no CHO requirement is applied.

##### 6.1C.2.2.2 Measurement time

The measurement time delay is defined from the end of TEvent\_DU until UE executes a handover to a target cell and interruption time starts.

For intra-frequency handover, the requirements for identifying a new detectable intra frequency cell measured without Time To Trigger (TTT) and L3 filtering, Tidentify\_intra\_with\_index or Tidentify\_intra\_without\_index, defined in clause 9.2C.5.1 and clause 9.2C.6.2 are used.

For time-based conditional intra-frequency handover:

- If condition T1-1 occurs earlier than TEvent\_DU + Tidentify\_intra\_with\_index or TEvent\_DU + Tidentify\_intra\_without\_index, then the measurement time delay equal to Tidentify\_intra\_with\_index or Tidentify\_intra\_without\_index assuming UE only performs the measurements within SMTC window of the target cell.

- If condition T1-1 occurs later than TEvent\_DU + Tidentify\_intra\_with\_index or TEvent\_DU + Tidentify\_intra\_without\_index, then the measurement time delay equals to the time from the end of Tevent\_DU until condition T1-1.

For location-based conditional intra-frequency handover:

- If both condition D1-1 and condition D1-2 are fulfilled earlier than TEvent\_DU + Tidentify\_intra\_with\_index or TEvent\_DU + Tidentify\_intra\_without\_index, then the measurement time delay equal to Tidentify\_intra\_with\_index or Tidentify\_intra\_without\_index assuming UE only performs measurements within SMTC window of the target cell.

- If both condition D1-1 and condition D1-2 are fulfilled is later than TEvent\_DU plus Tidentify\_intra\_with\_index or Tidentify\_intra\_without\_index for intra-frequency handover, then the measurement time delay equal to the time from the end of Tevent\_DU until time when both condition D1-1 and condition D1-2 are fulfilled.

For inter-frequency handover, the requirements for identifying a new detectable inter frequency cell measured without Time To Trigger (TTT) and L3 filtering, Tidentify\_inter\_with\_index or Tidentify\_inter\_without\_index, defined in clause 9.3C.7.1 are used.

For time-based conditional inter-frequency handover:

- If condition T1-1 occurs earlier than TEvent\_DU + Tidentify\_inter\_with\_index or TEvent\_DU + Tidentify\_inter\_without\_index, then the measurement time delay equal to Tidentify\_inter\_with\_index or Tidentify\_inter\_without\_index assuming that the UE uses only the SMTC window of the target inter-frequency carrier for performing the measurements. In this case Ksatellite=1, CSSFinter=1.

- If condition T1-1 occurs later than TEvent\_DU + Tidentify\_inter\_with\_index or TEvent\_DU + Tidentify\_inter\_without\_index, then the measurement time delay equals to the time from the end of Tevent\_DU until condition T1-1.

For location-based conditional inter-frequency handover,

- If both condition D1-1 and condition D1-2 are fulfilled earlier than TEvent\_DU + Tidentify\_inter\_with\_index or TEvent\_DU + Tidentify\_inter\_without\_index, then the measurement time delay equal to Tidentify\_inter\_with\_index or Tidentify\_inter\_without\_index, assuming that the UE uses only the SMTC window of the target inter-frequency carrier for performing the measurements. In this case Ksatellite=1, CSSFinter=1.

- If both condition D1-1 and condition D1-2 are fulfilled later than TEvent\_DU plus Tidentify\_inter\_with\_index or Tidentify\_inter\_without\_index, then the measurement time delay equal to the time from the end of Tevent\_DU until time of both condition D1-1 and condition D1-2 are fulfilled.

When TTT or L3 filtering is used an additional delay can be expected.

A cell is detectable only if at least one SSB measured from the cell being configured remains detectable during the time period [Tidentify\_intra\_without\_index] or [Tidentify\_intra\_with\_index] for intra-frequency handover or [Tidentify\_inter\_without\_index] for inter-frequency handover.

##### 6.1C.2.2.3 Preparation time

TCHO\_execution is the UE execution preparation time for conditional handover, and starts after UE realizes the condition of CHO is met and identity of the target cell is determined. TCHO\_execution can be up to 10ms.

##### 6.1C.2.2.4 Interruption time

The interruption time is the time between when the UE starts to execute the conditional handover to the target cell and the time the UE starts transmission of the new PRACH.

For intra-frequency or inter-frequency conditional conditional handover, the measurment time shall be less than

Tinterrupt = Tprocessing + TIU + T∆ + Tmargin ms

Where:

- Tprocessing is time for UE processing. Tprocessing can be up to 20ms.

- TIU is the interruption uncertainty in acquiring the first available PRACH occasion in the new cell. TIU can be up to the summation of SSB to PRACH occasion association period and [10] ms. SSB to PRACH occasion associated period is defined in the table 8.1-1 of TS 38.213 [3]

- T∆ is time for fine time tracking and acquiring full timing information of the target cell. TΔ = Trs.

- Tmargin is time for SSB post-processing. Tmargin can be up to 2ms.

- Trs is the SMTC periodicity of the target NR SAN cell if the UE has been provided with an SMTC configuration for the target cellin the handover command, otherwise Trs is the SMTC configured in the measObjectNR having the same SSB frequency and subcarrier spacing. If the UE is not provided SMTC configuration or measurement object on this frequency, the requirement in this clause is applied with Trs=5ms assuming the SSB transmission periodicity is 5ms. There is no requirement if the SSB transmission periodicity is not 5ms. If the UE has been provided with higher layer in TS 38.331 [2] signaling of *smtc2*prior to the handover command, Trs follows *smtc1* or *smtc2* according to the physical cell ID of the target cell.

NOTE 1: The actual value of TIU shall depend upon the PRACH configuration used in the target cell.

## 6.1D Handover for RedCap

### 6.1D.1 NR Handover

#### 6.1D.1.1 Introduction

The purpose of NR handover is to change the NR PCell to another NR cell for RedCap UE. The requirements in this clause are applicable to SA NR.

The requirements in this clause apply for the following handover scenarios:

Handover to a target cell’s initial BWP associated with CD-SSB;

Handover to a target cell’s specific Redcap BWP associated with NCD-SSB besides to the initial BWP associated with CD-SSB (i.e. UE directly sync to the NCD-SSB and perform RACH on that BWP).

#### 6.1D.1.2 NR FR1 - NR FR1 Handover

The requirements in this clause are applicable to both intra-frequency and inter-frequency handovers from NR FR1 cell to NR FR1 cell. The requirements in clause 6.1.1.2 shall apply when RedCap UE is capable of 2 Rx. When UE is only required to support 1 Rx antenna, the requirements defined in clause 6.1.1.2 shall apply except that:

Tsearch is the time required to search the target cell when the target cell is not already known when the handover command is received by the UE. If the target cell is known, then Tsearch = 0 ms. If the target cell is an unknown intra-frequency cell and the target cell Es/Iot≥-2 dB, then Tsearch = 2\*Trs ms. If the target cell is an unknown inter-frequency cell and the target cell Es/Iot≥-2 dB, then Tsearch = 5\* Trs ms. Regardless of whether DRX is in use by the UE, Tsearch shall still be based on non-DRX target cell search times.

- Trs is the SMTC periodicity of the target NR cell if the UE has been provided with an SMTC configuration for the target cellin the handover command, otherwise,

- Trs is the SMTC configured in the measObjectNR having the same SSB frequency and subcarrier spacing as NCD-SSB indicated by nonCellDefiningSSB-r17 if the first active DL BWP included in handover command is configured with nonCellDefiningSSB-r17, otherwise, as CD-SSB indicated by absoluteFrequencySSB in frequencyInfoDL in handover command.

- If the measObjectNRs having the same SSB frequency and subcarrier spacing configured by MN and SN have different SMTC, Trs is the periodicity of one of the SMTC which is up to UE implementation. If the UE is not provided SMTC configuration or measurement object on this frequency, the requirement in this clause is applied with Trs=5ms assuming the SSB transmission periodicity is 5ms. There is no requirement if the SSB transmission periodicity is not 5ms. If the UE has been provided with higher layer in TS 38.331 [2] signaling of *smtc2*prior to the handover command, Trs follows *smtc1* or *smtc2* according to the physical cell ID of the target cell.

For RedCap UE with HD-FDD, the handover requirements are met provided that

SSB is available at the UE once every SMTC period during Tsearch

One SSB is available during T∆

One SSB is available during TIU.

#### 6.1D.1.3 NR FR2- NR FR2 Handover

The requirements in this clause are applicable to both intra-frequency and inter-frequency handovers from NR FR2 cell to NR FR2 cell. The requirements in clause 6.1.1.4 shall apply when RedCap UE is capable of 2 Rx.

### 6.1D.2 NR Handover to other RATs

#### 6.1D.2.1 NR – E-UTRAN Handover

The purpose of inter-RAT handover from NR to E-UTRAN is to change the radio access mode of PCell from NR to E-UTRAN for RedCap UE. The handover procedure is initiated from NR with a RRC message that implies a handover as described in TS 38.331 [2]. The requirements in this clause are applicable to SA NR.

The requirements in clause 6.1.2.1 shall apply when RedCap UE is capable of 2 Rx. When UE is only required to support 1 Rx antenna, the requirements for category 1bis UE defined in clause 5.1.2 in [15] shall apply.

## 6.2 RRC Connection Mobility Control

### 6.2.1 SA: RRC Re-establishment

#### 6.2.1.1 Introduction

This clause contains requirements on the UE regarding RRC connection re-establishment procedure. RRC connection re-establishment is initiated when a UE in RRC\_CONNECTED state on the carrier without CCA or on the carrier with CCA loses RRC connection due to any of failure cases, including radio link failure, handover failure, and RRC connection reconfiguration failure. The RRC connection re-establishment procedure is specified in clause 5.3.7 of TS 38.331 [2].

The requirements in this clause are applicable for RRC connection re-establishment to NR cell.

#### 6.2.1.2 Requirements

In RRC\_CONNECTED state the UE shall be capable of sending *RRCReestablishmentRequest* message within Tre-establish\_delay seconds from the moment it detects a loss in RRC connection. The total RRC connection delay (Tre-establish\_delay) shall be less than:

TUL\_grant: It is the time required to acquire and process uplink grant from the target PCell. The uplink grant is required to transmit *RRCReestablishmentRequest* message.

The UE re-establishment delay (TUE\_re-establish\_delay) is specified in clause 6.2.1.2.1.

##### 6.2.1.2.1 UE Re-establishment delay requirement

The UE re-establishment delay (TUE\_re-establish\_delay) is the time between the moments when any of the conditions requiring RRC re-establishment as defined in clause 5.3.7 in TS 38.331 [2] is detected by the UE and when the UE sends PRACH to the target PCell. The UE re-establishment delay (TUE\_re-establish\_delay) requirement shall be less than:

The intra-frequency target NR cell shall be considered detectable if each relevant SSB can satisfy that:

- SS-RSRP related side conditions given in clause 10.1.2 and 10.1.3 are fulfilled for a corresponding NR Band for FR1 and FR2, respectively, and

- the conditions of SSB\_RP and SSB Ês/Iot according to Annex B.2.2 for a corresponding NR Band are fulfilled.

The inter-frequency target NR cell shall be considered detectable when for each relevant SSB:

- SS-RSRP related side conditions given in clause 10.1.4 and 10.1.5 are fulfilled for a corresponding NR Band for FR1 and FR2, respectively, and

- the conditions of SSB\_RP and SSB Ês/Iot according to Annex B.2.3 for a corresponding NR Band are fulfilled.

Tidentify\_intra\_NR: It is the time to identify the target intra-frequency NR cell and it depends on whether the target NR cell is known cell or unknown cell and on the FR of the target NR cell. If the UE is not configured with intra-frequency NR carrier for RRC re-establishment then Tidentify\_intra\_NR=0; otherwise Tidentify\_intra\_NR shall not exceed the values defined in Table 6.2.1.2.1-1 when *highSpeedMeasFlagFR2-r17* is not configured or UE is not capable of FR2 power class 6 and Table 6.2.1.2.1-3 when *highSpeedMeasFlagFR2-r17* is configured and UE is capable of FR2 power class 6.

Tidentify\_inter\_NR,i: It is the time to identify the target inter-frequency NR cell on inter-frequency carrier *i* configured for RRC re-establishment and it depends on whether the target NR cell is known cell or unknown cell and on the FR of the target NR cell. Tidentify\_inter\_NR,i shall not exceed the values defined in Table 6.2.1.2.1-2.

TSMTC: It is the periodicity of the SMTC occasion configured for the intra-frequency carrier. If the UE has been provided with higher layer in TS 38.331 [2] signaling of *smtc2*, Tsmtc follows *smtc1* or *smtc2* according to the physical cell ID of the target cell.

TSMTC,i: It is the periodicity of the SMTC occasion configured for the inter-frequency carrier *i*. If it is not configured, the UE may assume that the target SSB periodicity is no larger than 20 ms.

TSI-NR: It is the time required for receiving all the relevant system information according to the reception procedure and the RRC procedure delay of system information blocks defined in TS 38.331 [2] for the target NR cell.

TPRACH: It is the delay uncertainty in acquiring the first available PRACH occasion in the target NR cell. TPRACH can be up to the summation of SSB to PRACH occasion association period and 10 ms. SSB to PRACH occasion associated period is defined in the table 8.1-1 of TS 38.213 [3].

Nfreq: It is the total number of NR frequencies to be monitored for RRC re-establishment; Nfreq = 1 if the target intra-frequency NR cell is known, else Nfreq = 2 and Tidentify\_intra\_NR = 0 if the target inter-frequency NR cell is known.

There is no requirement if the target cell does not contain the UE context.

In the requirement defined in the below tables, the target FR1 cell is known if it has been meeting the relevant cell identification requirement during the last 5 seconds otherwise it is unknown.

Table 6.2.1.2.1-1: Time to identify target NR cell for RRC connection re-establishment to NR intra-frequency cell

|  |  |  |  |
| --- | --- | --- | --- |
| Serving cell | FR of target NR | Tidentify\_intra\_NR [ms] | |
| SSB Ês/Iot (dB) | cell | Known NR cell | Unknown NR cell |
| ≥ -8 | FR1 | MAX (200 ms, 5 x TSMTC) | MAX (800 ms, 10 x TSMTC) |
| ≥ -8 | FR2-1 | N/A | MAX (1000 ms, 80 x TSMTC)) |
| ≥ -8 | FR2-2 | N/A | MAX (1000 ms, 120 x TSMTC)) |
| < -8 | FR1 | N/A | 800Note1 |
| < -8 | FR2-1 | N/A | 3520Note1 |
| < -8 | FR2-2 | N/A | 5280Note1 |
| Note 1: The UE is not required to successfullyidentify a cell on any NR frequency layer when TSMTC > 20 ms and serving cell SSB Ês/Iot < -8 dB. | | | |

T Table 6.2.1.2.1-2: Time to identify target NR cell for RRC connection re-establishment to NR inter-frequency cell

|  |  |  |  |
| --- | --- | --- | --- |
| Serving cell SSB Ês/Iot (dB) | FR of target NR cell | Tidentify\_inter\_NR, i [ms] | |
|  |  | Known NR cell | Unknown NR cell |
| ≥ -8 | FR1 | MAX (200 ms, 6 x TSMTC, i) | MAX (800 ms, 13 x TSMTC, i) |
| ≥ -8 | FR2-1 | N/A | MAX (1000 ms, 104 x TSMTC, i)) |
| ≥ -8 | FR2-2 | N/A | MAX (1000 ms, 156 x TSMTC, i)) |
| < -8 | FR1 | N/A | 800Note1 |
| < -8 | FR2-1 | N/A | 4000Note1 |
| < -8 | FR2-2 | N/A | 6000 Note1 |
| Note 1: The UE is not required to successfully identify a cell on any NR frequency layer when TSMTC,i > 20 ms and serving cell SSB Ês/Iot < -8 dB. | | | |

Table 6.2.1.2.1-3: Time to identify target NR cell for RRC connection re-establishment to NR intra-frequency cell when *highSpeedMeasFlagFR2-r17* is configured (Frequency range FR2)

|  |  |  |  |
| --- | --- | --- | --- |
| Serving cell | FR of target NR | Tidentify\_intra\_NR [ms] | |
| SSB Ês/Iot (dB) | cell | Known NR cell | Unknown NR cell |
| ≥ -8 | FR2 | N/A | MAX (1000 ms, 10 xN2 x TSMTC)) |
|  |  |  |  |
| Note 1: The UE is not required to successfullyidentify a cell on any NR frequency layer when TSMTC > 20 ms and serving cell SSB Ês/Iot < -8 dB.  Note 2: When SMTC <= 40ms, N2=2 when *highSpeedMeasFlagFR2-r17* = set1; N2=6 when *highSpeedMeasFlagFR2-r17* = set2. | | | |

### 6.2.1A RRC Re-establishment with CCA

#### 6.2.1A.1 Introduction

This clause contains requirements on the UE regarding RRC connection re-establishment procedure on the carrier with CCA. RRC connection re-establishment on the carrier with CCA is initiated when a UE in RRC\_CONNECTED state on the carrier w/o or with CCA loses RRC connection due to any of failure cases, including radio link failure, handover failure, and RRC connection reconfiguration failure. The RRC connection re-establishment procedure is specified in clause 5.3.7 of TS 38.331 [2].

In the requirements of clause 6.2.1A, the term SMTC occasion not available at the UE refers to when the SMTC contains SSBs configured by gNB in a cell on a carrier frequency subject to CCA, but the first two successive candidate SSB positions for the same SSB index within the discovery burst transmission window are not available at the UE due to DL CCA failures at gNB during the corresponding RRC re-establishment period; otherwise the SMTC occasion is considered as available at the UE.

In the requirements of clause 6.2.1A, the term PRACH occasion unavailable for transmission refers to when the PRACH occasion is configured by gNB but not transmitted by the UE during the corresponding period due to UL CCA failure at the UE; otherwise the PRACH occasion is considered as available for transmission.

The requirements in this clause are applicable for RRC connection re-establishment to NR cell on the carrier with CCA.

When the RRC connection re-establishment is performed on a cell in FR2-2 with shared spectrum channel access, UE shall determine the CCA mode of the neighbour cell according to *channelAccessMode2-r17* if configured. If *channelAccessMode2-r17* of the cell is enabled, UE shall assume that CCA applies to the cell and perform measurement accordingly, and the requirements in clause 6.2.1A shall apply; otherwise, UE shall assume that CCA does not apply to the cell and perform measurement accordingly, and requirements in 6.2.1 shall apply.

#### 6.2.1A.2 Requirements

In RRC\_CONNECTED state on the carrier w/o or with CCA the UE shall be capable of sending *RRCReestablishmentRequest* message within Tre-establish\_delay\_CCA seconds from the moment it detects a loss in RRC connection. The total RRC connection delay (Tre-establish\_delay\_CCA) shall be less than:

TUL\_grant: It is the time required to acquire and process uplink grant from the target PCell with CCA. The uplink grant is required to transmit *RRCReestablishmentRequest* message.

The UE re-establishment delay (TUE\_re-establish\_delay\_CCA) is specified in clause 6.2.1A.2.1.

##### 6.2.1A.2.1 UE Re-establishment with CCA delay requirement

The UE re-establishment on the carrier with CCA delay (TUE\_re-establish\_delay\_CCA) is the time between the moments when any of the conditions requiring RRC re-establishment on the carrier with CCA as defined in clause 5.3.7 in TS 38.331 [2] is detected by the UE and when the UE sends PRACH to the target PCell on the carrier with CCA . The UE re-establishment delay requirement (TUE\_re-establish\_delay\_CCA) on the carrier with CCA shall be less than:

The intra-frequency target NR cell with CCA shall be considered detectable if each relevant SSB can satisfy that:

- SS-RSRP related side conditions given in clause 10.1.2 and 10.1.3 are fulfilled for a corresponding NR Band for FR1 and FR2-2, respectively, and

- the conditions of SSB\_RP and SSB Ês/Iot according to Annex B.2.3 for a corresponding NR Band are fulfilled.

The inter-frequency target NR cell on the carrier with CCA shall be considered detectable when for each relevant SSB:

- SS-RSRP related side conditions given in clause 10.1.4 and 10.1.5 are fulfilled for a corresponding NR Band for FR1 and FR2-2, respectively, and

- the conditions of SSB\_RP and SSB Ês/Iot according to Annex B.2.2 for a corresponding NR Band are fulfilled.

Tidentify\_intra\_NR\_CCA: If the target intra-frequency carrier is the carrier without CCA, it is the time to identify the target intra-frequency NR cell which is defined in clause 6.2.1; otherwise it is the time to identify the target intra-frequency NR cell on the carrier with CCA and it depends on whether the target NR cell on the carrier with CCA is known cell or unknown cell and on the frequency range (FR) of the target NR cell on the carrier with CCA. If the UE is not configured with intra-frequency NR carrier with CCA for RRC re-establishment then Tidentify\_intra\_NR\_CCA=0; otherwise Tidentify\_intra\_NR\_CCA shall not exceed the values defined in Table 6.2.1A.2.1-1.

Tidentify\_inter\_NR\_CCA,i: If the target inter-frequency carrier is the carrier without CCA, it is the time to identify the target inter-frequency NR cell which is defined in clause 6.2.1; otherwise it is the time to identify the target inter-frequency NR cell on inter-frequency carrier *i* with CCA configured for RRC re-establishment and it depends on whether the target NR cell on the inter-frequency carrier with CCA is known or unknown. Tidentify\_inter\_NR\_CCA,i shall not exceed the values defined in Table 6.2.1A.2.1-2.

TSMTC: It is the periodicity of the SMTC occasion configured for the intra-frequency carrier. If the UE has been provided with higher layer in TS 38.331 [2] signaling of *smtc2*, Tsmtc follows *smtc1* or *smtc2* according to the physical cell ID of the target cell.

TSMTC,i: It is the periodicity of the SMTC occasion configured for the inter-frequency carrier *i*. If it is not configured, the UE may assume that the target SSB periodicity is not larger than 20 ms.

TSI-NR\_CCA: It is the time required for receiving all the relevant system information according to the reception procedure and the RRC procedure delay of system information blocks defined in TS 38.331 [2] for the target NR cell on the carrier with CCA.

TPRACH\_CCA is the delay uncertainty in acquiring the first available PRACH occasion in the target NR Cell on the carrier with CCA:

TPRACH\_CCA = (1+ K3)\*TSSB,RO + 10 ms, where:

- TSSB,RO is the SSB to PRACH occasion association period as defined inTable 8.1-1 of TS 38.213 [39].

- K3 is the number of consecutive SSB to PRACH occasion association periods during which no PRACH occasion is available for PRACH transmission due to UL CCA failure. K3 = 0 for Type 2C UL channel access procedure as defined in TS 37.213 [57].

Nfreq: It is the total number of NR frequencies to be monitored for RRC re-establishment; Nfreq = 1 if the target NR cell on the intra-frequency carrier with CCA is known, else Nfreq = 2 and Tidentify\_intra\_NR\_CCA = 0 if the target NR cell on the inter-frequency carrier with CCA is known.

There is no requirement if the target cell on the carrier with CCA does not contain the UE context.

In the requirement defined in the below tables, the target FR1 cell on the carrier with CCA is known if it has been meeting the relevant cell identification requirement during the last 8 seconds otherwise it is unknown.

Table 6.2.1A.2.1-1: Time to identify target NR cell for RRC connection re-establishment to NR intra-frequency cell with CCA

|  |  |  |  |
| --- | --- | --- | --- |
| Serving cell | Frequency range | Tidentify\_intra\_NR\_CCA [ms] | |
| SSB Ês/Iot (dB) | (FR) of target NR cell | Known NR cell | Unknown NR cell |
| ≥ -8 | FR1 | MAX (200 ms, (5+K1) x TSMTC) | MAX (800 ms, (10+ K1) x TSMTC) |
| ≥ -8 | FR2-2 | N/A | MAX (1000 ms, N x (10+ K3) x TSMTC) |
| < -8 | FR1 | N/A | (800+20 x K1)Note1 |
| < -8 | FR2-2 | N/A | N x (440+20 x K3)Note1 |
| Note 1: The UE is not required to successfullyidentify a cell on any NR frequency layer with CCA when TSMTC > 20 ms and serving cell SSB Ês/Iot < -8 dB.  Note 2: K1 is the number of SMTC occasions not available at the UE due during RRC re-establishment period on the carrier with CCA.  Note 3: K3 is the number of SMTC occasion groups not available at the UE during RRC re-establishment period on the carrier with CCA. An SMTC occasion group consists of N consecutive SMTC occasions. An SMTC occasion group is not available, when at least one SMTC occasion in the group is not transmitted by the gNB. N is equal to 12. | | | |

Table 6.2.1A.2.1-2: Time to identify target NR cell for RRC connection re-establishment to NR inter-frequency cell on the carrier with CCA

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Serving cell SSB Ês/Iot (dB) | Frequency range | Tidentify\_inter\_NR\_CCA, i [ms] | | |
|  | (FR) of target NR cell | Known NR cell | | Unknown NR cell |
| ≥ -8 | FR1 | MAX (200 ms, ([6]+K2,i) x TSMTC, i) | MAX (800 ms, ([13]+K2,i) x TSMTC, i) | |
| < -8 | FR1 | N/A | (800+20 x K2,i) Note1 | |
| Note 1: The UE is not required to successfully identify a cell on any NR frequency layer with CCA when TSMTC,i > 20 ms and serving cell SSB Ês/Iot < -8 dB.  Note 2: K2,i is the number of SMTC occasions not available at the UE during RRC re-establishment period on the “i” th carrier with CCA, | | | | |

### 6.2.1B SA: RRC Re-establishment for RedCap

#### 6.2.1B.1 Introduction

This clause contains requirements on the RedCap UE regarding RRC connection re-establishment procedure.

#### 6.2.1B.2 Requirements

The requirements in clause 6.2.1 shall apply when RedCap UE is capable of 2 Rx. When UE is only required to support 1 Rx antenna, the requirements defined in clause 6.2.1 shall apply except that:

- Tidentify\_intra\_NRas specified in Table 6.2.1B.2-1.

- Tidentify\_inter\_NR, i as specified in Table 6.2.1B.2-2.

Table 6.2.1B.2-1: Time to identify target NR cell for RRC connection re-establishment to NR intra-frequency cell

|  |  |  |  |
| --- | --- | --- | --- |
| Serving cell | FR of target NR | Tidentify\_intra\_NR [ms] | |
| SSB Ês/Iot (dB) | cell | Known NR cell | Unknown NR cell |
| ≥ -8 | FR1 | MAX (200 ms, 6 x TSMTC) | MAX (800 ms, [11] x TSMTC) |
| < -8 | FR1 | N/A | 800Note1 |
| Note 1: The UE is not required to successfullyidentify a cell on any NR frequency layer when TSMTC > 20 ms and serving cell SSB Ês/Iot < -8 dB. | | | |

Table 6.2.1B.2-2: Time to identify target NR cell for RRC connection re-establishment to NR inter-frequency cell

|  |  |  |  |
| --- | --- | --- | --- |
| Serving cell SSB Ês/Iot (dB) | FR of target NR cell | Tidentify\_inter\_NR, i [ms] | |
|  |  | Known NR cell | Unknown NR cell |
| ≥ -8 | FR1 | MAX (200 ms, 7 x TSMTC, i) | MAX (800 ms, [14] x TSMTC, i) |
| < -8 | FR1 | N/A | 800Note1 |
| Note 1: The UE is not required to successfully identify a cell on any NR frequency layer when TSMTC,i > 20 ms and serving cell SSB Ês/Iot < -8 dB. | | | |

When the Redcap specific initial BWP is configured for random access, in clause 6.2.1 is extended by 6ms.

### 6.2.2 Random access

#### 6.2.2.1 Introduction

This clause contains requirements on the UE regarding random access procedure. The random access procedure is initiated to establish uplink time synchronization for a UE which either has not acquired or has lost its uplink synchronization, or to convey UE’s request Other SI, or for beam failure recovery. The random access is specified in clause 8 of TS 38.213 [3] and the control of the RACH transmission is specified in clause 5.1 of TS 38.321 [7]. Two types of procedure are defined for the random access, the 4-step RA type, and the 2-step RA type [7]. The decision on which type of procedure to adopt is as described in clause 5.1.1 of TS 38.321 [7]. The requirements for the 4-step RA type procedure are described in clause 6.2.2.2, whereas the requirements for the 2-step RA type procedure are described in the clause 6.2.2.3 of this specification.

#### 6.2.2.2 Requirements for 4-step RA type

The UE shall select the type of random access at initiation of the random access procedure based on network configuration, as specified in clause 5.1.1 in TS 38.321 [7].

The UE shall have capability to calculate PRACH transmission power according to the PRACH power formula defined in clause 7.4 of TS 38.213 [3] and apply this power level at the first preamble or additional preambles. The absolute power applied to the first preamble shall have an accuracy as specified in Table 6.3.4.2-1 of TS 38.101-1 [18] for FR1 and in Table 6.3.4.2-1 of TS 38.101-2 [19] for FR2. The relative power applied to additional preambles shall have an accuracy as specified in Table 6.3.4.3-1 of TS 38.101-1 [18] for FR1 and clause 6.3.4.3 of TS38.101-2 [19] for FR2.

The UE shall indicate a random access problem to upper layers if the maximum number of preamble transmission counter has been reached for the random access procedure on PCell or PSCell as specified in clause 5.1.4 in TS 38.321 [7].

The requirements in this clause apply for UE in SA operation mode or any MR-DC operation mode.

##### 6.2.2.2.1 Contention based random access

###### 6.2.2.2.1.1 Correct behaviour when transmitting Random Access Preamble

With the UE selected SSB with SS-RSRP above *rsrp-ThresholdSSB*, UE shall have the capability to select a Random Access Preamble randomly with equal probability from the Random Access Preambles associated with the selected SSB if the association between Random Access Preambles and SSB is configured, as specified in clause 5.1.2 in TS 38.321 [7].

With the UE selected SSB with SS-RSRP above *rsrp-ThresholdSSB*, UE shall have the capability to transmit Random Access Preamble on the next available PRACH occasion from the PRACH occasions corresponding to the selected SSB permitted by the restrictions given by the *ra-ssb-OccasionMaskIndex* if configured, if the association between PRACH occasions and SSBs is configured, and PRACH occasion shall be randomly selected with equal probability amongst the selected SSB associated PRACH occasions occurring simultaneously but on different subcarriers, as specified in clause 5.1.2 in TS 38.321 [7].

###### 6.2.2.2.1.2 Correct behaviour when receiving Random Access Response

The UE may stop monitoring for Random Access Response(s) and shall transmit the msg3 if the Random Access Response contains a Random Access Preamble identifier corresponding to the transmitted Random Access Preamble.

The UE shall again perform the Random Access Resource selection procedure defined in clause 5.1.2 in TS 38.321 [7], and transmit with the calculated PRACH transmission power when the backoff time expires if all received Random Access Responses contain Random Access Preamble identifiers that do not match the transmitted Random Access Preamble.

###### 6.2.2.2.1.3 Correct behaviour when not receiving Random Access Response

The UE shall again perform the Random Access Resource selection procedure defined in clause 5.1.2 in TS 38.321 [7], and transmit with the calculated PRACH transmission power when the backoff time expires if no Random Access Response is received within the RA Response window defined in clause 5.1.4 in TS 38.321 [7].

###### 6.2.2.2.1.4 Correct behaviour when receiving an UL grant for msg3 retransmission

The UE shall re-transmit the msg3 upon the reception of anUL grant for msg3 retransmission.

###### 6.2.2.2.1.5 SA: Correct behaviour when receiving a message over Temporary C-RNTI

The UE shall send ACK if the Contention Resolution is successful.

The UE shall again perform the Random Access Resource selection procedure defined in clause 5.1.2 in TS 38.321 [7], and transmit with the calculated PRACH transmission power when the backoff time expires unless the received message includes a UE Contention Resolution Identity MAC control element and the UE Contention Resolution Identity included in the MAC control element matches the CCCH SDU transmitted in the uplink message.

###### 6.2.2.2.1.6 Correct behaviour when contention Resolution timer expires

The UE shall re-select a preamble and transmit with the calculated PRACH transmission power when the backoff time expires if the Contention Resolution Timer expires.

##### 6.2.2.2.2 Non-Contention based random access

###### 6.2.2.2.2.1 Correct behaviour when transmitting Random Access Preamble

If the contention-free Random Access Resources and the contention-free PRACH occasions associated with SSBs is configured, with the UE selected SSB with SS-RSRP above *rsrp-ThresholdSSB* amongst the associated SSBs, UE shall have the capability to select the Random Access Preamble corresponding to the selected SSB, and to transmit Random Access Preamble on the next available PRACH occasion from the PRACH occasions corresponding to the selected SSB permitted by the restrictions given by the *ra-ssb-OccasionMaskIndex* if configured, and PRACH occasion shall be randomly selected with equal probability amongst the selected SSB associated PRACH occasions occurring simultaneously but on different subcarriers, as specified in clause 5.1.2 in TS 38.321 [7].

If the contention-free Random Access Resources and the contention-free PRACH occasions associated with CSI-RSs is configured, with the UE selected CSI-RS with CSI-RSRP above *rsrp-ThresholdCSI-RS* amongst the associated CSI-RSs, UE shall have the capability to select the Random Access Preamble corresponding to the selected CSI-RS, and to transmit Random Access Preamble on the next available PRACH occasion from the PRACH occasions in *ra-OccasionList* corresponding to the selected CSI-RS, and PRACH occasion shall be randomly selected with equal probability amongst the selected CSI-RS associated PRACH occasions occurring simultaneously but on different subcarriers, as specified in clause 5.1.2 in TS 38.321 [7].

If the random access procedure is initialized for beam failure recovery and if the contention-free Random Access Resources and the contention-free PRACH occasions for beam failure recovery request associated with any of the SSBs and/or CSI-RSs is configured, UE shall have the capability to select the Random Access Preamble corresponding to the selected SSB with SS-RSRP above *rsrp-ThresholdSSB* amongst the associated SSBs or the selected CSI-RS with CSI-RSRP above *rsrp-ThresholdCSI-RS* amongst the associated CSI-RSs, and to transmit Random Access Preamble on the next available PRACH occasion from the PRACH occasions corresponding to the selected SSB permitted by the restrictions given by the *ra-ssb-OccasionMaskIndex* if configured, or from the PRACH occasions in *ra-OccasionList* corresponding to the selected CSI-RS, and PRACH occasion shall be randomly selected with equal probability amongst the selected SSB assocated PRACH occasions or the selected CSI-RS associated PRACH occasions occurring simultaneously but on different subcarriers, as specified in clause 5.1.2 in TS 38.321 [7].

###### 6.2.2.2.2.2 Correct behaviour when receiving Random Access Response

The UE may stop monitoring for Random Access Response(s), if the Random Access Response contains a Random Access Preamble identifier corresponding to the transmitted Random Access Preamble, unless the random access procedure is initialized for Other SI request from UE.

The UE may stop monitoring for Random Access Response(s) and shall monitor the Other SI transmission if the Random Access Response only contains a Random Access Preamble identifier which is corresponding to the transmitted Random Access Preamble and the random access procedure is initialized for SI request from UE, as specified in clause 5.1.4 in TS 38.321 [7].

The UE may stop monitoring for Random Access Response(s), if the contention-free Random Access Preamble for beam failure recovery request was transmitted and if the PDCCH addressed to UE’s C-RNTI is received, as specified in clause 5.1.4 in TS 38.321 [7].

The UE shall again perform the Random Access Resource selection procedure defined in clause 5.1.2 in TS 38.321 [7] for the next available PRACH occasion, and transmit the preamblewith the calculated PRACH transmission power if all received Random Access Responses contain Random Access Preamble identifiers that do not match the transmitted Random Access Preamble.

###### 6.2.2.2.2.3 Correct behaviour when not receiving Random Access Response

The UE shall again perform the Random Access Resource selection procedure defined in clause 5.1.2 in TS 38.321 [7] for the next available PRACH occasion, and transmit the preamble with the calculated PRACH transmission power, if no Random Access Response is received within the RA Response window configured in *RACH-ConfigCommon* or if no PDCCH addressed to UE’s C-RNTI is received within the RA Response window configured in *BeamFailureRecoveryConfig*, as defined in clause 5.1.4 in TS 38.321 [7].

##### 6.2.2.2.3 UE behaviour when configured with supplementary UL

In addition to the requirements defined in clause 6.2.2.2.1 and 6.2.2.2.2, a UE configured with supplementary UL carrier shall use RACH configuration for the supplementary UL carrier contained in RMSI and RRC dedicated signalling. If the cell for the random access procedure is configured with supplementary UL, the UE shall transmit or re-transmit PRACH preamble on the supplementary UL carrier if the SS-RSRP measured by the UE on the DL carrier is lower than the *rsrp-ThresholdSSB-SUL* as defined in TS 38.331 [2].

#### 6.2.2.3 Requirements for 2-step RA type

The UE shall select the type of random access at initiation of the random access procedure based on network configuration, as specified in clause 5.1.1 in TS 38.321 [7].

The UE shall have capability to calculate MsgA PRACH transmission power according to the PRACH power formula defined in clause 7.4 of TS 38.213 [3] and the MsgA PUSCH power formula of clause 7.1.1 of TS 38.213 [3] and apply this power level at the first MsgA or additional MsgA repetitions. The absolute power applied to the first preamble shall have an accuracy as specified in Table 6.3.4.2-1 of TS 38.101-1 [18] for frequency range 1 and in Table 6.3.4.2-1 of TS 38.101-2 [19] for frequency range 2. The relative power applied to additional preambles shall have an accuracy as specified in Table 6.3.4.3-1 of TS 38.101-1 [18] for frequency range 1 and clause 6.3.4.3 of TS38.101-2 [19] for frequency range 2.

The UE shall switch to 4-step RA type procedure if the MsgA transmission counter has exceeded *msgA-TransMax*, if configured, as specified in clause 5.1.4a of TS 38.321 [7]. The UE shall indicate a Random Access problem to upper layers if the maximum number of preamble transmission counter has been reached for the random access procedure on PCell or PSCell as specified in clause 5.1.4a in TS 38.321 [7].

The requirements in this clause apply for UE in SA operation mode or any MR-DC operation mode.

##### 6.2.2.3.1 Contention based random access

###### 6.2.2.3.1.1 Correct behaviour when transmitting MsgA

With the UE selected SSB with SS-RSRP above *msgA-RSRP-ThresholdSSB*, the UE shall have the capability to select a Random Access Preamble randomly with equal probability from the Random Access Preambles associated with the selected SSB if the association between Random Access Preambles and SS blocks is configured, as specified in clause 5.1.2a in TS 38.321 [7].

With the UE selected SSB with SS-RSRP above *msgA-RSRP-ThresholdSSB*, UE shall have the capability to transmit MsgA PRACH on the next available PRACH occasion from the PRACH occasions corresponding to the selected SSB permitted by the restrictions given first by the *msgA-SSB-SharedRO-MaskIndex* if configured, or next by the *ra-ssb-OccasionMaskIndex* if configured, if the association between PRACH occasions and SSBs is configured.

The PRACH preamble and PRACH occasion shall be randomly selected with equal probability amongst the selected SSB associated PRACH occasions occurring simultaneously but on different subcarriers, as specified in clause 5.1.2a in TS 38.321 [7].

In association with the MsgA PRACH, the UE should have the capability to transmit MsgA PUSCH on the corresponding PUSCH occasion associated with a DMRS resource, which is mapped from the MsgA PRACH ocasion, and preamble index as defined in clause 8.1A in TS 38.213 [3].

###### 6.2.2.3.1.2 Correct behaviour when receiving MsgB

The UE shall stop monitoring for MsgB, when the UE has successfully received the PDCCH addressed to UE as specified in clause 8.2A in TS 38.213 [3] containing a successRAR MAC subPDU or a fallbackRAR MAC subPDU as described in clause 5.1.4a in TS 38.321 [7].

The UE shall send ACK if Success RAR is received in MsgB and the Contention Resolution is successful, as defined in clause 5.1.4a in TS 38.321 [7].

If MsgB contains a fallbackRAR MAC subPDU the UE shall fallback to the 4-step RA type by transmitting the msg3 containing the payload of MsgA PUSCH and monitor contention resolution as described in clause 8.2A in TS 38.213 [3].

The UE shall again perform the Random Access Resource selection procedure defined in clause 5.1.2a in TS 38.321 [7], and transmit with the calculated MsgA PRACH and MsgA PUSCH transmission power when the backoff time expires unless the Random Access Response reception is considered as successful, as defined in clause 5.1.4a in TS 38.321 [7].

###### 6.2.2.3.1.3 Correct behaviour when not receiving MsgB

The UE shall again perform the Random Access Resource selection procedure defined in clause 5.1.2a in TS 38.321 [7], and transmit with the calculated MsgA PRACH and MsgA PUSCH transmission power when the backoff time expires unless the Random Access Response reception is considered as successful, as defined in clause 5.1.4a in TS 38.321 [7].

##### 6.2.2.3.2 Non-Contention based random access

###### 6.2.2.3.2.1 Correct behaviour when transmitting MsgA

If the contention-free Random Access Resources and the contention-free PRACH occasions associated with SSBs is configured, with the UE selected SSB with SS-RSRP above *msgA-RSRP-ThresholdSSB* amongst the associated SSBs, UE shall have the capability to select the Random Access Preamble corresponding to the selected SSB, and to transmit Random Access Preamble on the next available PRACH occasion from the PRACH occasions corresponding to the selected SSB permitted by the restrictions given first by the *msgA-SSB-SharedRO-MaskIndex* if configured, or next by the *ra-ssb-OccasionMaskIndex* if configured, and PRACH occasion shall be randomly selected with equal probability amongst the selected SSB associated PRACH occasions occurring simultaneously but on different subcarriers, as specified in clause 5.1.2a in TS 38.321 [7].

In association with the MsgA PRACH, the UE should have the capability to transmit MsgA PUSCH on the corresponding PUSCH occasion associated with a DMRS resource, which is mapped from the MsgA PRACH ocasion, and preamble index as defined in clause 8.1A in TS 38.213 [3].

###### 6.2.2.3.2.2 Correct behaviour when receiving MsgB

The UE may stop monitoring for MsgB, when the UE has successfully received the PDCCH addressed to UE as specified in clause 8.2A in TS 38.213 [3] containing a successRAR MAC subPDU or a fallbackRAR MAC subPDU as described in clause 5.1.4a in TS 38.321 [7].

If MsgB contains a fallbackRAR MAC subPDU the UE shall fallback to the 4-step RA type by transmitting the msg3 containing the payload of MsgA PUSCH as described in clause 8.2A in TS 38.213 [3].

The UE shall again perform the Random Access Resource selection procedure defined in clause 5.1.2a in TS 38.321 [7] for the next available PRACH occasion, and transmit the preamblewith the calculated MsgA PRACH and MsgA PUSCH transmission power if all received MsgBs contain Random Access Preamble identifiers that do not match the transmitted Random Access Preamble.

###### 6.2.2.3.2.3 Correct behaviour when not receiving MsgB

The UE shall again perform the Random Access Resource selection procedure defined in clause 5.1.2a in TS 38.321 [7] for the next available PRACH occasion, and transmit MsgA with the calculated MsgA PRACH and MsgA PUSCH transmission power, if no MsgB is received within the MsgB Response window configured in *RACH-ConfigGenericTwoStepRA* and the Random Access Response Reception has not been considered as successful as defined in clause 5.1.4a in TS 38.321 [7].

##### 6.2.2.3.3 UE behaviour when configured with supplementary UL

In addition to the requirements defined in clause 6.2.2.3.1 and 6.2.2.3.2, a UE configured with supplementary UL carrier shall use RACH configuration for the supplementary UL carrier contained in RMSI and RRC dedicated signalling. If the cell for the random access procedure is configured with supplementary UL, the UE shall transmit or re-transmit PRACH preamble on the supplementary UL carrier if the SS-RSRP measured by the UE on the DL carrier is lower than the *rsrp-ThresholdSSB-SUL* as defined in TS 38.321 [7].

### 6.2.2A Random access when CCA is used on target frequency

#### 6.2.2A.1 Introduction

This clause contains requirements on the UE regarding random access procedure when CCA is used on the target frequency. The random access procedure is initiated to establish uplink time synchronization for a UE which either has not acquired or has lost its uplink synchronization, or to convey UE’s request Other SI, or for beam failure recovery. The random access is specified in clause 8 of TS 38.213 [3] and the control of the RACH transmission is specified in clause 5.1 of TS 38.321 [7]. Two types of procedure are defined for the random access, the 4-step RA type, and the 2-step RA type [7]. The decision on which type of procedure to adopt is as described in clause 5.1.1 of TS 38.321 [7]. The requirements for the 4-step RA type procedure are described in clause 6.2.2A.2, whereas the requirements for the 2-step RA type procedure are described in the clause 6.2.2A.3 of this specification.

#### 6.2.2A.2 Requirements for 4-step RA type

The UE shall select the type of random access at initiation of the random access procedure based on network configuration, as specified in clause 5.1.1 in TS 38.321 [7].

The UE shall have capability to calculate PRACH transmission power according to the PRACH power formula defined in clause 7.4 of TS 38.213 [3] and apply this power level at the first preamble or additional preambles. The absolute power applied to the first preamble shall have an accuracy as specified in Table 6.3.4.2-1 of TS 38.101-1 [18]. The relative power applied to additional preambles shall have an accuracy as specified in Table 6.3.4.3-1 of TS 38.101-1 [18].

The UE shall indicate a random access problem to upper layers if the maximum number of preamble transmission counter has been reached for the random access procedure on PCell or PSCell as specified in clause 5.1.4 in TS 38.321 [7].

The requirements in this clause apply for UE operating in a carrier frequency with CCA in SA operation mode or any MR-DC operation mode, in a carrier frequency with CCA.

##### 6.2.2A.2.1 Contention based random access

###### 6.2.2A.2.1.1 Correct behaviour when transmitting Random Access Preamble

With the UE selected SSB with SS-RSRP above *rsrp-ThresholdSSB*, UE shall have the capability to select a Random Access Preamble randomly with equal probability from the Random Access Preambles associated with the selected SSB if the association between Random Access Preambles and SSB is configured, as specified in clause 5.1.2 in TS 38.321 [7].

If the UL CCA is successful on the next available PRACH occasion, with the UE selected SSB with SS-RSRP above *rsrp-ThresholdSSB*, UE shall transmit Random Access Preamble on the next available PRACH occasion from the PRACH occasions corresponding to the selected SSB permitted by the restrictions given by the *ra-ssb-OccasionMaskIndex* if configured, if the association between PRACH occasions and SSBs is configured, and PRACH occasion shall be randomly selected with equal probability amongst the selected SSB associated PRACH occasions occurring simultaneously but on different subcarriers, as specified in clause 5.1.2 in TS 38.321 [7].

If UE is configured *lbt-FailureRecoveryConfig* and is capable of *ul-LBT-FailureDetectionRecovery* [2] then upon detecting uplink CCA failure during the random access procedure for random access preamble transmission, as outlined in Clause 5.21.2 of TS 38.321 [7], the UE shall perform the Random Access Resource selection procedure again, as specified in clause 5.1.3 in TS 38.321 [7].

If UE is not configured *lbt-FailureRecoveryConfig* or is not capable of *ul-LBT-FailureDetectionRecovery* [2] then upon detecting uplink CCA failure during the random access procedure for random access preamble transmission, as outlined in Clause 5.21.2 of TS 38.321 [7], the UE shall increment PREAMBLE\_TRANSMISSION\_COUNTER by 1. The UE shall again perform the Random Access Resource selection procedure if PREAMBLE\_TRANSMISSION\_COUNTER < *preambleTransMax* + 1, as specified in clause 5.1.3 in TS 38.321 [7].

###### 6.2.2A.2.1.2 Correct behaviour when receiving Random Access Response

The UE may stop monitoring for Random Access Response(s) and shall transmit the msg3 if the Random Access Response contains a Random Access Preamble identifier corresponding to the transmitted Random Access Preamble.

The UE shall again perform the Random Access Resource selection procedure defined in clause 5.1.2 in TS 38.321 [7], and transmit with the calculated PRACH transmission power when the backoff time expires if all received Random Access Responses contain Random Access Preamble identifiers that do not match the transmitted Random Access Preamble.

###### 6.2.2A.2.1.3 Correct behaviour when not receiving Random Access Response

The UE shall again perform the Random Access Resource selection procedure defined in clause 5.1.2 in TS 38.321 [7], if the UL CCA is successful, and transmit with the calculated PRACH transmission power when the backoff time expires if no Random Access Response is received within the RA Response window defined in clause 5.1.4 in TS 38.321 [7].

###### 6.2.2A.2.1.4 Correct behaviour when receiving an UL grant for msg3 retransmission

The UE shall re-transmit the msg3 upon the reception of an UL grant for msg3 retransmission, if the UL CCA is successful,

6.2.2A.2.1.5 Correct behaviour when receiving a message over Temporary C-RNTI

If the UL CCA is successful, The UE shall send ACK if the Contention Resolution is successful.

The UE shall again perform the Random Access Resource selection procedure defined in clause 5.1.2 in TS 38.321 [7], and transmit with the calculated PRACH transmission power when the backoff time expires and the UL CCA is successful, unless the received message includes a UE Contention Resolution Identity MAC control element and the UE Contention Resolution Identity included in the MAC control element matches the CCCH SDU transmitted in the uplink message.

###### 6.2.2A.2.1.6 Correct behaviour when contention Resolution timer expires

The UE shall re-select a preamble and transmit with the calculated PRACH transmission power when the backoff time expires if the Contention Resolution Timer expires.

##### 6.2.2A.2.2 Non-Contention based random access

###### 6.2.2A.2.2.1 Correct behaviour when transmitting Random Access Preamble

If the UL CCA is successful on the next available PRACH occasion and if the contention-free Random Access Resources and the contention-free PRACH occasions associated with SSBs is configured, with the UE selected SSB with SS-RSRP above *rsrp-ThresholdSSB* amongst the associated SSBs, UE shall have the capability to select the Random Access Preamble corresponding to the selected SSB, and to transmit Random Access Preamble on the next available PRACH occasion from the PRACH occasions corresponding to the selected SSB permitted by the restrictions given by the *ra-ssb-OccasionMaskIndex* if configured, and PRACH occasion shall be randomly selected with equal probability amongst the selected SSB associated PRACH occasions occurring simultaneously but on different subcarriers, as specified in clause 5.1.2 in TS 38.321 [7].

If the UL CCA is successful, and if the random access procedure is initialized for beam failure recovery and if the contention-free Random Access Resources and the contention-free PRACH occasions for beam failure recovery request associated with SSBs configured, UE shall have the capability to select the Random Access Preamble corresponding to the selected SSB with SS-RSRP above *rsrp-ThresholdSSB* amongst the associated SSBs, and to transmit Random Access Preamble on the next available PRACH occasion from the PRACH occasions corresponding to the selected SSB permitted by the restrictions given by the *ra-ssb-OccasionMaskIndex* if configured, and PRACH occasion shall be randomly selected with equal probability amongst the selected SSB associated PRACH occasions occurring simultaneously but on different subcarriers, as specified in clause 5.1.2 in TS 38.321 [7].

If UE is configured *lbt-FailureRecoveryConfig* and is capable of *ul-LBT-FailureDetectionRecovery* [2] then upon detecting uplink CCA failure during the random access procedure for random access preamble transmission, as outlined in Clause 5.21.2 of TS 38.321 [7], the UE shall perform the Random Access Resource selection procedure again, as specified in clause 5.1.3 in TS 38.321 [7].

If UE is not configured *lbt-FailureRecoveryConfig* or is not capable of *ul-LBT-FailureDetectionRecovery* [2] then upon detecting uplink CCA failure during the random access procedure for random access preamble transmission, as outlined in Clause 5.21.2 of TS 38.321 [7], the UE shall increment PREAMBLE\_TRANSMISSION\_COUNTER by 1. The UE shall again perform the Random Access Resource selection procedure if PREAMBLE\_TRANSMISSION\_COUNTER < *preambleTransMax* + 1, as specified in clause 5.1.3 in TS 38.321 [7].

###### 6.2.2A.2.2.2 Correct behaviour when receiving Random Access Response

The UE may stop monitoring for Random Access Response(s), if the Random Access Response contains a Random Access Preamble identifier corresponding to the transmitted Random Access Preamble, unless the random access procedure is initialized for Other SI request from UE.

The UE may stop monitoring for Random Access Response(s) and shall monitor the Other SI transmission if the Random Access Response only contains a Random Access Preamble identifier which is corresponding to the transmitted Random Access Preamble and the random access procedure is initialized for SI request from UE, as specified in clause 5.1.4 in TS 38.321 [7].

The UE may stop monitoring for Random Access Response(s), if the contention-free Random Access Preamble for beam failure recovery request was transmitted and if the PDCCH addressed to UE’s C-RNTI is received, as specified in clause 5.1.4 in TS 38.321 [7].

The UE shall again perform the Random Access Resource selection procedure defined in clause 5.1.2 in TS 38.321 [7] for the next available PRACH occasion if the UL CCA is successful, and transmit the preamblewith the calculated PRACH transmission power if all received Random Access Responses contain Random Access Preamble identifiers that do not match the transmitted Random Access Preamble.

###### 6.2.2A.2.2.3 Correct behaviour when not receiving Random Access Response

The UE shall again perform the Random Access Resource selection procedure defined in clause 5.1.2 in TS 38.321 [7] for the next available PRACH occasion if the UL CCA is successful, and transmit the preamble with the calculated PRACH transmission power, if no Random Access Response is received within the RA Response window configured in *RACH-ConfigCommon* or if no PDCCH addressed to UE’s C-RNTI is received within the RA Response window configured in *BeamFailureRecoveryConfig*, as defined in clause 5.1.4 in TS 38.321 [7].

#### 6.2.2A.3 Requirements for 2-step RA type

The UE shall select the type of random access at initiation of the random access procedure based on network configuration, as specified in clause 5.1.1 in TS 38.321 [7].

The UE shall have capability to calculate MsgA PRACH transmission power according to the PRACH power formula defined in clause 7.4 of TS 38.213 [3] and the MsgA PUSCH power formula of clause 7.1.1 of TS 38.213 [3] and apply this power level at the first MsgA or additional MsgA repetitions. The absolute power applied to the first preamble shall have an accuracy as specified in Table 6.3.4.2-1 of TS 38.101-1 [18]. The relative power applied to additional preambles shall have an accuracy as specified in Table 6.3.4.3-1 of TS 38.101-1 [18].

The UE shall switch to 4-step RA type procedure if the MsgA transmission counter has exceeded *msgA-TransMax*, if configured, as specified in clause 5.1.4a of TS 38.321 [7]. The UE shall indicate a Random Access problem to upper layers if the maximum number of preamble transmission counter has been reached for the random access procedure on PCell or PSCell as specified in clause 5.1.4a in TS 38.321 [7].

The requirements in this clause apply for UE operating in a carrier frequency with CCA in SA operation mode or any MR-DC operation mode, in a carrier frequency with CCA.

##### 6.2.2A.3.1 Contention based random access

###### 6.2.2A.3.1.1 Correct behaviour when transmitting MsgA

With the UE selected SSB with SS-RSRP above *msgA-RSRP-ThresholdSSB*, the UE shall have the capability to select a Random Access Preamble randomly with equal probability from the Random Access Preambles associated with the selected SSB if the association between Random Access Preambles and SS blocks is configured, as specified in clause 5.1.2a in TS 38.321 [7].

If the UL CCA is successful on the next available PRACH occasion, with the UE selected SSB with SS-RSRP above *msgA-RSRP-ThresholdSSB*, UE shall have the capability to transmit MsgA PRACH on the next available PRACH occasion from the PRACH occasions corresponding to the selected SSB permitted by the restrictions given first by the *msgA-SSB-SharedRO-MaskIndex* if configured, or next by the *ra-ssb-OccasionMaskIndex* if configured, if the association between PRACH occasions and SSBs is configured.

The PRACH preamble and PRACH occasion shall be randomly selected with equal probability amongst the selected SSB associated PRACH occasions occurring simultaneously but on different subcarriers, as specified in clause 5.1.2a in TS 38.321 [7].

In association with the MsgA PRACH, if the UL CCA is successful, the UE should have the capability to transmit MsgA PUSCH on the corresponding PUSCH occasion associated with a DMRS resource, which is mapped from the MsgA PRACH occasion, and preamble index as defined in clause 8.1A in TS 38.213 [3].

If UE is configured *lbt-FailureRecoveryConfig* and is capable of *ul-LBT-FailureDetectionRecovery* [2] then upon detecting uplink CCA failure during the random access procedure for MsgA transmission, as outlined in Clause 5.21.2 of TS 38.321 [7], the UE shall cancel the transmission of the MsgA payload on the associated PUSCH resource and perform the Random Access Resource selection procedure, as specified in clause 5.1.3a in TS 38.321 [7].

If UE is not configured *lbt-FailureRecoveryConfig* or is not capable of *ul-LBT-FailureDetectionRecovery* [2] then upon detecting uplink CCA failure during the random access procedure for MsgA transmission, as outlined in Clause 5.21.2 of TS 38.321 [7], the UE shall cancel the transmission of the MsgA payload on the associated PUSCH resource and increment PREAMBLE\_TRANSMISSION\_COUNTER by 1. The UE shall again perform the Random Access Resource selection procedure if PREAMBLE\_TRANSMISSION\_COUNTER < *preambleTransMax* + 1, as specified in clause 5.1.3a in TS 38.321 [7]. If the Random Access Procedure is not complete and the UE is configured with *msgA-TransMax* then, as specified in clause 5.1.3a in TS 38.321 [7], the UE shall perform the Random Access Resource selection procedure with 4-step RA type provided that PREAMBLE\_TRANSMISSION\_COUNTER = *msgA-TransMax* + 1.

###### 6.2.2A.3.1.2 Correct behaviour when receiving MsgB

The UE shall stop monitoring for MsgB, when the UE has successfully received the PDCCH addressed to UE as specified in clause 8.2A in TS 38.213 [3] containing a successRAR MAC subPDU or a fallbackRAR MAC subPDU as described in clause 5.1.4a in TS 38.321 [7].

If the UL CCA is successful, the UE shall send ACK if Success RAR is received in MsgB and the Contention Resolution is successful, as defined in clause 5.1.4a in TS 38.321 [7].

If MsgB contains a fallbackRAR MAC subPDU the UE shall fallback to the 4-step RA type by transmitting the msg3 containing the payload of MsgA PUSCH if the UL CCA is successful, and monitor contention resolution as described in clause 8.2A in TS 38.213 [3].

The UE shall again perform the Random Access Resource selection procedure defined in clause 5.1.2a in TS 38.321 [7], and transmit with the calculated MsgA PRACH and MsgA PUSCH transmission power, if the UL CCA is successful on the next available PRACH occasion, when the backoff time expires unless the Random Access Response reception is considered as successful, as defined in clause 5.1.4a in TS 38.321 [7].

###### 6.2.2A.3.1.3 Correct behaviour when not receiving MsgB

The UE shall again perform the Random Access Resource selection procedure defined in clause 5.1.2a in TS 38.321 [7], and if the UL CCA is successful, transmit with the calculated MsgA PRACH and MsgA PUSCH transmission power if the UL CCA is successful on the next available PRACH occasion when the backoff time expires unless the Random Access Response reception is considered as successful, as defined in clause 5.1.4a in TS 38.321 [7].

##### 6.2.2A.3.2 Non-Contention based random access

###### 6.2.2A.3.2.1 Correct behaviour when transmitting MsgA

If the UL CCA is successful, if the contention-free Random Access Resources and the contention-free PRACH occasions associated with SSBs is configured, with the UE selected SSB with SS-RSRP above *msgA-RSRP-ThresholdSSB* amongst the associated SSBs, UE shall have the capability to select the Random Access Preamble corresponding to the selected SSB, and to transmit Random Access Preamble on the next available PRACH occasion from the PRACH occasions corresponding to the selected SSB permitted by the restrictions given first by the *msgA-SSB-SharedRO-MaskIndex* if configured, or next by the *ra-ssb-OccasionMaskIndex* if configured, and PRACH occasion shall be randomly selected with equal probability amongst the selected SSB associated PRACH occasions occurring simultaneously but on different subcarriers, as specified in clause 5.1.2a in TS 38.321 [7].

In association with the MsgA PRACH, the UE should have the capability to transmit MsgA PUSCH, if the UL CCA is successful, on the corresponding PUSCH occasion associated with a DMRS resource, which is mapped from the MsgA PRACH occasion, and preamble index as defined in clause 8.1A in TS 38.213 [3].

If UE is configured *lbt-FailureRecoveryConfig* and is capable of *ul-LBT-FailureDetectionRecovery* [2] then upon detecting uplink CCA failure during the random access procedure for MsgA transmission, as outlined in Clause 5.21.2 of TS 38.321 [7], the UE shall have cancel the transmission of the MsgA payload on the associated PUSCH resource and perform the Random Access Resource selection procedure, as specified in clause 5.1.3a in TS 38.321 [7].

If UE is not configured *lbt-FailureRecoveryConfig* or is not capable of *ul-LBT-FailureDetectionRecovery* [2] then upon detecting uplink CCA failure during the random access procedure for MsgA transmission, as outlined in Clause 5.21.2 of TS 38.321 [7], the UE shall cancel the transmission of the MsgA payload on the associated PUSCH resource and increment PREAMBLE\_TRANSMISSION\_COUNTER by 1. The UE shall again perform the Random Access Resource selection procedure if PREAMBLE\_TRANSMISSION\_COUNTER < *preambleTransMax* + 1, as specified in clause 5.1.3a in TS 38.321 [7]. If the Random Access Procedure is not complete and the UE is configured with *msgA-TransMax* then, as specified in clause 5.1.3a in TS 38.321 [7], the UE shall perform the Random Access Resource selection procedure with 4-step RA type provided that PREAMBLE\_TRANSMISSION\_COUNTER = *msgA-TransMax* + 1.

###### 6.2.2A.3.2.2 Correct behaviour when receiving MsgB

The UE may stop monitoring for MsgB, when the UE has successfully received the PDCCH addressed to UE as specified in clause 8.2A in TS 38.213 [3] containing a successRAR MAC subPDU or a fallbackRAR MAC subPDU as described in clause 5.1.4a in TS 38.321 [7].

If MsgB contains a fallbackRAR MAC subPDU the UE shall fallback to the 4-step RA type by transmitting the msg3 containing the payload of MsgA PUSCH if the UL CCA is successful, as described in clause 8.2A in TS 38.213 [3].

The UE shall again perform the Random Access Resource selection procedure defined in clause 5.1.2a in TS 38.321 [7] for the next available PRACH occasion, and transmit the preamblewith the calculated MsgA PRACH and MsgA PUSCH transmission power if the UL CCA is successful, if all received MsgBs contain Random Access Preamble identifiers that do not match the transmitted Random Access Preamble.

###### 6.2.2A.3.2.3 Correct behaviour when not receiving MsgB

The UE shall again perform the Random Access Resource selection procedure defined in clause 5.1.2a in TS 38.321 [7] for the next available PRACH occasion, and transmit MsgA with the calculated MsgA PRACH and MsgA PUSCH transmission power if the UL CCA is successful on the next available PRACH occasion, if no MsgB is received within the MsgB Response window configured in *RACH-ConfigGenericTwoStepRA* and the Random Access Response Reception has not been considered as successful as defined in clause 5.1.4a in TS 38.321 [7].

### 6.2.2B Random access for RedCap

#### 6.2.2B.1 Introduction

This clause contains requirements on the RedCap UE regarding random access procedure. The random access procedure is initiated to establish uplink time synchronization for a UE which either has not acquired or has lost its uplink synchronization, or to convey UE’s request Other SI, or for beam failure recovery. The random access is specified in clause 8 of TS 38.213 [3] and the control of the RACH transmission is specified in clause 5.1 of TS 38.321 [7]. Two types of procedure are defined for the random access, the 4-step RA type, and the 2-step RA type [7]. The decision on which type of procedure to adopt is as described in clause 5.1.1 of TS 38.321 [7].

The 1 Rx RedCap UE for performing the random access procedure defined in clause 5.1 [7] applies:

*- rsrp-ThresholdSSB* as the signaled value of *rsrp-ThresholdSSB* [2] + 1 dB.

*- msgA-RSRP-ThresholdSSB* as the signaled value of *msgA-RSRP-ThresholdSSB* [2] + 1 dB.

- msgA-RSRP-Threshold as the signaled value of msgA-RSRP-Threshold [2] + 1 dB.

#### 6.2.2B.2 Requirements

The requirements for the 4-step RA type procedure described in clause 6.2.2.2 and the requirements for the 2-step RA type procedure described in the clause 6.2.2.3 are applicable for TDD and FDD RedCap UEs. The 4-step and 2-step RA requirements for contention based random access defined in clause 6.2.2.2 and 6.2.2.3 respectively apply to HD-FDD UE with the following conditions:

* The RedCap UE operating in HD-FDD mode is not expected to perform PRACH transmission on a PRACH resource of a cell if UE has not received at least one SSB associated with that PRACH resource during the last Tp period in the cell, where Tp=160 ms.
* The RedCap UE operating in HD-FDD mode shall meet the PRACH requirements when performing PRACH transmission on a PRACH resource of a cell provided that the UE has received at least one SSB associated with that PRACH resource during the last Tp period before the PRACH transmission, where Tp=160 ms.

### 6.2.3 SA: RRC Connection Release with Redirection

#### 6.2.3.1 Introduction

This clause contains requirements on the UE regarding RRC connection release with redirection procedure. RRC connection release with redirection is initiated by the *RRCRelease* message with redirection to E-UTRAN or NR from NR specified in TS 38.331 [2]. The RRC connection release with redirection procedure is specified in clause 5.3.8 of TS 38.331 [2].

In the requirements of clause 6.2.3.2, the term SMTC occasion not available at the UE refers to when the SMTC contains SSBs configured by gNB in a cell on a carrier frequency subject to CCA, but the first two successive candidate SSB positions for the same SSB index within the discovery burst transmission window are not available at the UE due to DL CCA failures at gNB during the corresponding identification period; otherwise the SMTC occasion is considered as available at the UE.

In the requirements of clause 6.2.3.2, the term PRACH occasion unavailable for transmission refers to when the PRACH occasion is configured by gNB but not transmitted by the UE during the corresponding period due to UL CCA failure at the UE.

When the RRC connection release with redirection is performed on a cell in FR2-2 with shared spectrum channel access, UE shall determine the CCA mode of the neighbour cell according to *channelAccessMode2-r17* if configured. If *channelAccessMode2-r17* of the cell is enabled, UE shall assume that CCA applies to the cell and perform measurement accordingly, and the requirements in clause 6.2.3.2.3 shall apply; otherwise, UE shall assume that CCA does not apply to the cell and perform measurement accordingly, and requirements in 6.2.3.2.1 shall apply.

#### 6.2.3.2 Requirements

##### 6.2.3.2.1 RRC connection release with redirection to NR

The UE shall be capable of performing the RRC connection release with redirection to the target NR cell within Tconnection\_release\_redirect\_NR.

The time delay (Tconnection\_release\_redirect\_NR) is the time between the end of the last slot containing the RRC command, “*RRCRelease*” (TS 38.331 [2]) on the NR PDSCH and the time the UE starts to send random access to the target NR cell. The time delay (Tconnection\_release\_redirect\_NR) shall be less than:

Tconnection\_release\_redirect\_NR = TRRC\_procedure\_delay + Tidentify-NR + TSI-NR + TRACH

The target NR cell shall be considered detetable when for each relevant SSB, the side conditions should be met that,

- the conditions of SSB\_RP and SSB Ês/Iot according to Annex B.2.5 for a corresponding NR Band are fulfilled.

TRRC\_procedure\_delay: It is the RRC procedure delay for processing the received message “*RRCRelease*” as defined in clause 6.2.2 of TS 38.331 [2].

Tidentify-NR: It is the time to identify the target NR cell and depends on the FR of the target NR cell. It is defined in Table 6.2.3.2.1-1. Note that Tidentify-NR = TPSS/SSS-sync + Tmeas, in which TPSS/SSS-sync is the cell search time and Tmeas is the measurement time due to cell selection criteria evaluation.

TSI-NR: It is the time required for acquiring all the relevant system information of the target NR cell. This time depends upon whether the UE is provided with the relevant system information of the target NR cell or not by the old NR cell before the RRC connection is released. TRACH: It is the delay uncertainty in acquiring the first available PRACH occasion in the target NR cell. TRACH can be up to the summation of SSB to PRACH occasion association period and 10 ms. SSB to PRACH occasion associated period is defined in the table 8.1-1 of TS 38.213 [3].

Trs is the SMTC periodicity of the target NR cell if the UE has been provided with an SMTC configuration for the target cell in the redirection command, otherwise Trs is the SMTC periodicity configured in the *measObjectNR* having the same SSB frequency and subcarrier spacing configured for the RRC connection release with redirection. If the measObjectNRs having the same SSB frequency and subcarrier spacing configured by MN and SN have different SMTC, Trs is the periodicity of one of the SMTC which is up to UE implementation. If the UE is not provided with SMTC configuration or measurement object for the frequency which is also configured for the RRC connection release with redirection then:

- the requirement in this clause is applied with Trs = 20 ms if the SSB transmission periodicity is not larger than 20 ms; otherwise,

- there is no requirement if the SSB transmission periodicity is larger than 20ms.

Table 6.2.3.2.1-1: Time to identify target NR cell for RRC connection release with redirection to NR

|  |  |
| --- | --- |
| FR of target NR cell | Tidentify-NR |
| FR1 | MAX (680 ms, 11 x Trs) |
| FR2-1 | MAX (880 ms, 8x11 x Trs) |
| FR2-2 | MAX (880 ms, 12x11 x Trs) |
| Note: If the UE has been provided with higher layer signaling of *smtc2*specified in TS 38.331 [2] prior to the redirection command, Trs follows *smtc1* or *smtc2* according to the physical cell ID of the target cell. | |

##### 6.2.3.2.2 RRC connection release with redirection to E-UTRAN

The UE shall be capable of performing the RRC connection release with redirection to the target E-UTRAN cell within Tconnection\_release\_redirect\_E-UTRA.

The time delay (Tconnection\_release\_redirect\_E-UTRA) is the time between the end of the last slot containing the RRC command, “*RRCRelease*” (TS 38.331 [2]) on the PDSCH and the time the UE starts to send random access to the target E-UTRA cell. The time delay (Tconnection\_release\_redirect\_E-UTRA) shall be less than:

Tconnection\_release\_redirect\_E-UTRA = TRRC\_procedure\_delay + Tidentify-E-UTRA + TSI-E-UTRA + TRACH

The target E-UTRA FDD or TDD cell shall be considered detectable provided the following conditions are fulfilled:

- the same conditions as for inter-frequency RSRP measurements specified in annex B.1.2 of TS 36.133 [15] are fulfilled for a corresponding Band, and

- the same conditions as for inter-frequency RSRQ measurements specified in annex B.1.2 of TS 36.133 [15] are fulfilled for a corresponding Band, and

- SCH conditions specified in annex B.1.2 of TS 36.133 [15] are fulfilled for a corresponding Band.

TRRC\_procedure\_delay: It is the RRC procedure delay for processing the received message “*RRCRelease*” as defined in clause 6.2.2 of TS 38.331 [2].

Tidentify-E-UTRA: It is the time to identify the target E-UTRA cell. It shall be less than 320 ms.

TSI-E-UTRA: It is the time required for acquiring all the relevant system information of the target E-UTRA cell. This time depends upon whether the UE is provided with the relevant system information (SI) of the target E-UTRA cell or not by the old NR cell before the RRC connection is released.

TRACH: It is the delay caused due to the random access procedure when sending random access to the target E-UTRA cell.

##### 6.2.3.2.3 RRC connection release with redirection to NR carrier subject to CCA

The UE shall be capable of performing the RRC connection release with redirection to the target NR cell subject to CCA within Tconnection\_release\_redirect\_NR\_CCA.

The time delay (Tconnection\_release\_redirect\_NR\_CCA) is the time between the end of the last slot containing the RRC command, “*RRCRelease*” (TS 38.331 [2]) on the NR PDSCH and the time the UE starts to send random access to the target NR cell. The time delay (Tconnection\_release\_redirect\_NR\_CCA) shall be less than:

Tconnection\_release\_redirect\_NR\_CCA = TRRC\_procedure\_delay + Tidentify-NR\_CCA + TSI-NR\_CCA + TRACH\_CCA

The target NR cell shall be considered detetable when for each relevant SSB, the side conditions should be met that,

- the conditions of SSB\_RP and SSB Ês/Iot according to Annex B.2.5 for a corresponding NR Band are fulfilled.

- TRRC\_procedure\_delay: It is the RRC procedure delay for processing the received message “*RRCRelease*” as defined in clause 6.2.2 of TS 38.331 [2].

- Tidentify-NR\_CCA: It is the time to identify the target NR cell and is defined as:

- Tidentify-NR\_CCA = TPSS/SSS-sync + Tmeas; TPSS/SSS-sync is the cell search time and Tmeas is the measurement time due to cell selection criteria evaluation.

- For FR1 target NR cell: Tidentify-NR\_CCA = MAX (680 ms, (L1+11) × Trs);

- For FR2-2 target NR cell: Tidentify-NR\_CCA = MAX (880 ms, N×(L1´+11) × Trs);

- where L1 is the number of SMTC occasions not available at the UE due to DL CCA failures and L1´ is the number of SMTC occasion groups not available at the UE due to DL CCA failures. An SMTC occasion group consists of N consecutive SMTC occasions. An SMTC occasion group is not available, when at least one SMTC occasion in the group is not transmitted by the gNB. N is equal to 12. If L1 > L1,max or L1´ > L1,max then the UE shall initiate cell selection procedures for the selected PLMN as defined in TS 38.304 [1]; where L1,max is defined in Table 6.2.3.2.3-1.

- TSI-NR\_CCA: It is the time required for acquiring all the relevant system information of the target NR cell. This time depends upon whether the UE is provided with the relevant system information of the target NR cell or not by the old NR cell before the RRC connection is released.

- TRACH\_CCA: It is the delay uncertainty in acquiring the first available PRACH occasion in the target NR cell:

- TRACH\_CCA = (1+L2)×TSSB,RO + 10 ms TPRACH; where:

- L2 is the consecutive number of SSB to PRACH occasion association periods during which no PRACH occasion is available for PRACH transmission due to UL CCA failures. L2 = 0 for Type 2C UL channel access procedure as defined in TS 37.213 [33].

- TSSB,RO is the SSB to PRACH occasion association period as defined in the table 8.1-1 of TS 38.213 [3].

- The value of L2 is limited by *PREAMBLE\_TRANSMISSION\_COUNTER*, which is increased when PRACH occasion is unavailable for PRACH transmission due to UL CCA failure as specified in TS 38.321 [7]. The UE behaviour when *PREAMBLE\_TRANSMISSION\_COUNTER* reaches the *preambleTransMax* is specified in TS 38.321 [7].

- Trs is the SMTC periodicity of the target NR cell if the UE has been provided with an SMTC configuration for the target cell in the redirection command, otherwise Trs is the SMTC periodicity configured in the *measObjectNR* having the same SSB frequency and subcarrier spacing configured for the RRC connection release with redirection. If the UE is not provided with SMTC configuration or measurement object for the frequency which is also configured for the RRC connection release with redirection then:

- the requirement in this clause is applied with Trs = 20 ms if the SSB transmission periodicity is not larger than 20 ms;

- otherwise, there is no requirement if the SSB transmission periodicity is larger than 20ms.

Table 6.2.3.2.3-1: Maximum allowed number of missed SMTC occasions during cell identification

|  |  |
| --- | --- |
| SMTC periodicity (Trs) [ms] | Maximum allowed number of missed SMTC occasions (L1,max) |
| Trs ≤ 40 | 8 |
| Trs > 40 | 4 |

### 6.2.3A SA: RRC Connection Release with Redirection for RedCap

#### 6.2.3A.1 Introduction

This clause contains requirements on the RedCap UE regarding RRC connection release with redirection procedure. RRC connection release with redirection is initiated by the *RRCRelease* message with redirection to E-UTRAN or NR from NR specified in TS 38.331 [2]. The RRC connection release with redirection procedure is specified in clause 5.3.8 of TS 38.331 [2].

#### 6.2.3A.2 Requirements

##### 6.2.3A.2.1 RRC connection release with redirection to NR

The requirements in clause 6.2.3.2.1 shall apply when RedCap UE is capable of 2 Rx. When UE is only required to support 1 Rx antenna, the requirements defined in clause 6.2.3.2.1 shall apply except that:

- Tidentify-NRas specified in Table 6.2.3A.2.1-1.

Table 6.2.3A.2.1-1: Time to identify target NR cell for RRC connection release with redirection to NR

|  |  |
| --- | --- |
| FR of target NR cell | Tidentify-NR |
| FR1 | MAX (680 ms, [12] x Trs) |
| Note: If the UE has been provided with higher layer signaling of *smtc2*specified in TS 38.331 [2] prior to the redirection command, Trs follows *smtc1* or *smtc2* according to the physical cell ID of the target cell. | |

The HD-FDD UE shall meet the RRC connection release with redirection requirements provided that SSB is available at the UE once every SMTC period during Tsearch.

When the Redcap specific initial BWP is configured for random access, Tconnection\_release\_redirect\_NR in clause 6.2.3.2.1 is extended by 6ms.

##### 6.2.3A.2.2 RRC connection release with redirection to E-UTRAN

The requirements in clause 6.2.3.2.2 shall apply.

## 6.2C RRC Connection Mobility Control for Satellite Access

### 6.2C.1 SA: RRC Re-establishment for Satellite Access

#### 6.2C.1.1 Introduction

This clause contains requirements on the UE regarding RRC connection re-establishment procedure. RRC connection re-establishment is initiated when a UE in RRC\_CONNECTED state on the carrier loses RRC connection due to any of failure cases, including radio link failure, handover failure, and RRC connection reconfiguration failure. The RRC connection re-establishment procedure is specified in clause [5.3.7] of TS 38.331 [2].

The requirements in this clause are applicable for RRC connection re-establishment to NR cell, which is served by satellite access node (SAN).

#### 6.2C.1.2 Requirements

In RRC\_CONNECTED state the UE shall be capable of sending *RRCReestablishmentRequest* message within Tre-establish\_delay seconds from the moment it detects a loss in RRC connection. The total RRC connection delay (Tre-establish\_delay) shall be less than:

TUL\_grant: It is the time required to acquire and process uplink grant from the target PCell. The uplink grant is required to transmit *RRCReestablishmentRequest* message.

The UE re-establishment delay (TUE\_re-establish\_delay) is specified in clause 6.2C.1.2.1.

##### 6.2C.1.2.1 UE Re-establishment delay requirement

The UE re-establishment delay (TUE\_re-establish\_delay) is the time between the moments when any of the conditions requiring RRC re-establishment as defined in clause [5.3.7] in TS 38.331 [2] is detected by the UE and when the UE sends PRACH to the target PCell. The UE re-establishment delay (TUE\_re-establish\_delay) requirement shall be less than:

The intra-frequency target NR cell shall be considered detectable if each relevant SSB can satisfy that:

- SS-RSRP related side conditions given in clause 10.1.2 and 10.1.3 are fulfilled for a corresponding NR Band for FR1, and

- the conditions of SSB\_RP and SSB Ês/Iot according to Annex B.2.x1 for a corresponding NR Band are fulfilled.

The inter-frequency target NR cell shall be considered detectable when for each relevant SSB:

- SS-RSRP related side conditions given in clause 10.1.4 are fulfilled for a corresponding NR Band for FR1, and

- the conditions of SSB\_RP and SSB Ês/Iot according to Annex B.2.x2 for a corresponding NR Band are fulfilled.

Tidentify\_intra\_NR: It is the time to identify the target intra-frequency NR cell and it depends on whether the target NR cell is known cell or unknown cell. If the UE is not configured with intra-frequency NR carrier for RRC re-establishment then Tidentify\_intra\_NR=0; otherwise Tidentify\_intra\_NR shall not exceed the values defined in Table 6.2C.1.2.1-1.

Tidentify\_inter\_NR,i: It is the time to identify the target inter-frequency NR cell on inter-frequency carrier *i* configured for RRC re-establishment and it depends on whether the target NR cell is known cell or unknown cell. Tidentify\_inter\_NR,i shall not exceed the values defined in Table 6.2C.1.2.1-2.

TSMTC: It is the periodicity of the SMTC occasion configured for the intra-frequency carrier. If the UE has been provided with higher layer in TS 38.331 [2] signaling of *smtc2*, Tsmtc follows *smtc1* or *smtc2* according to the physical cell ID of the target cell.

TSMTC,i: It is the periodicity of the SMTC occasion configured for the inter-frequency carrier *i*. If it is not configured, the UE may assume that the target SSB periodicity is no larger than 20 ms.

TSI-NR: It is the time required for receiving all the relevant system information according to the reception procedure and the RRC procedure delay of system information blocks defined in TS 38.331 [2] for the target NR cell.

TPRACH: It is the delay uncertainty in acquiring the first available PRACH occasion in the target NR cell. TPRACH can be up to the summation of SSB to PRACH occasion association period and [10] ms. SSB to PRACH occasion associated period is defined in the table 8.1-1 of TS 38.213 [3].

Nfreq: It is the total number of NR frequencies to be monitored for RRC re-establishment; Nfreq = 1 if the target intra-frequency NR cell is known, else Nfreq = 2 and Tidentify\_intra\_NR = 0 if the target inter-frequency NR cell is known.

There is no requirement if the target cell does not contain the UE context.

In the requirement defined in the below tables, the target FR1 cell is known if it has been meeting the relevant cell identification requirement during the last 5 seconds otherwise it is unknown.

The requirements in this clause apply provided that the ephemeris information provided by the serving cell for the target cell is valid during UE re-establishment delay (TUE\_re-establish\_delay).

Table 6.2C.1.2.1-1: Time to identify target NR cell for RRC connection re-establishment to NR intra-frequency cell

|  |  |  |  |
| --- | --- | --- | --- |
| Serving cell | FR of target NR | Tidentify\_intra\_NR [ms] | |
| SSB Ês/Iot (dB) | cell | Known NR cell | Unknown NR cell |
| ≥ -8 | FR1 | MAX (200 ms, 5 x TSMTC) | Kmulti\_SMTC \* MAX (800 ms, 10 x TSMTC) |
| < -8 | FR1 | N/A | k \* 800 ms Note1, 3 |
| Note 1: The UE is not required to successfullyidentify a cell on any NR frequency layer when TSMTC > 20 ms and serving cell SSB Ês/Iot < -8 dB.  Note 2: Kmulti\_SMTC is defined in clause 9.2C.5.1.  Note 3: k = 1 if the cells on the target frequency are served by GEO. k = (N+1) if the cells on the target frequency are served by LEO, where N is the number of different satellites associated to the list of configured neighbor cells in ntn-NeighCellConfigList and ntn-NeighCellConfigListExt. | | | |

Table 6.2C.1.2.1-2: Time to identify target NR cell for RRC connection re-establishment to NR inter-frequency cell

|  |  |  |  |
| --- | --- | --- | --- |
| Serving cell SSB Ês/Iot (dB) | FR of target NR cell | Tidentify\_inter\_NR, i [ms] | |
|  |  | Known NR cell | Unknown NR cell |
| ≥ -8 | FR1 | MAX (200 ms, 6 x TSMTC, i) | K\_satellite \* MAX (800 ms, 13 x TSMTC, i) |
| < -8 | FR1 | N/A | k \* 800 ms Note1, 3 |
| Note 1: The UE is not required to successfully identify a cell on any NR frequency layer when TSMTC,i > 20 ms and serving cell SSB Ês/Iot < -8 dB.  Note 2: K\_satellite is defined in clause 9.3C.4.  Note 3: k = 1 if the cells on the target frequency are served by GEO. k = (N+1) if the cells on the target frequency are served by LEO, where N is the number of different satellites associated to the list of configured neighbor cells in ntn-NeighCellConfigList and ntn-NeighCellConfigListExt. | | | |

### 6.2C.2 Random access for satellite access

#### 6.2C.2.1 Introduction

This clause contains requirements on the UE regarding random access procedure. The random access procedure is initiated to establish uplink time synchronization for a UE which either has not acquired or has lost its uplink synchronization, or to convey UE’s request Other SI, or for beam failure recovery. The random access is specified in clause 8 of TS 38.213 [3] and the control of the RACH transmission is specified in clause 5.1 of TS 38.321 [7]. Two types of procedure are defined for the random access, the 4-step RA type, and the 2-step RA type [7]. The decision on which type of procedure to adopt is as described in clause 5.1.1 of TS 38.321 [7]. The requirements for the 4-step RA type procedure are described in clause 6.2.2.2, whereas the requirements for the 2-step RA type procedure are described in the clause 6.2.2.3 of this specification.

#### 6.2C.2.2 Requirements for 4-step RA type

The UE shall select the type of random access at initiation of the random access procedure based on network configuration, as specified in clause 5.1.1 in TS 38.321 [7].

The UE shall have capability to calculate PRACH transmission power according to the PRACH power formula defined in clause 7.4 of TS 38.213 [3] and apply this power level at the first preamble or additional preambles. The absolute power applied to the first preamble shall have an accuracy as specified in Table 6.3.4.2-1 of TS 38.101-1 [18] for FR1. The relative power applied to additional preambles shall have an accuracy as specified in Table 6.3.4.3-1 of TS 38.101-1 [18] for FR1.

The UE shall indicate a random access problem to upper layers if the maximum number of preamble transmission counter has been reached for the random access procedure on PCell or PSCell as specified in clause 5.1.4 in TS 38.321 [7].

The requirements in this clause apply for UE in SA operation mode.

##### 6.2C.2.2.1 Contention based random access

###### 6.2C.2.2.1.1 Correct behaviour when transmitting Random Access Preamble

With the UE selected SSB with SS-RSRP above *rsrp-ThresholdSSB*, UE shall have the capability to select a Random Access Preamble randomly with equal probability from the Random Access Preambles associated with the selected SSB if the association between Random Access Preambles and SSB is configured, as specified in clause 5.1.2 in TS 38.321 [7].

With the UE selected SSB with SS-RSRP above *rsrp-ThresholdSSB*, UE shall have the capability to transmit Random Access Preamble on the next available PRACH occasion from the PRACH occasions corresponding to the selected SSB permitted by the restrictions given by the *ra-ssb-OccasionMaskIndex* if configured, if the association between PRACH occasions and SSBs is configured, and PRACH occasion shall be randomly selected with equal probability amongst the selected SSB associated PRACH occasions occurring simultaneously but on different subcarriers, as specified in clause 5.1.2 in TS 38.321 [7].

###### 6.2C.2.2.1.2 Correct behaviour when receiving Random Access Response

The UE may stop monitoring for Random Access Response(s) and shall transmit the msg3 if the Random Access Response contains a Random Access Preamble identifier corresponding to the transmitted Random Access Preamble.

The UE shall again perform the Random Access Resource selection procedure defined in clause 5.1.2 in TS 38.321 [7], and transmit with the calculated PRACH transmission power when the backoff time expires if all received Random Access Responses contain Random Access Preamble identifiers that do not match the transmitted Random Access Preamble.

###### 6.2C.2.2.1.3 Correct behaviour when not receiving Random Access Response

The UE shall again perform the Random Access Resource selection procedure defined in clause 5.1.2 in TS 38.321 [7], and transmit with the calculated PRACH transmission power when the backoff time expires if no Random Access Response is received within the RA Response window defined in clause 5.1.4 in TS 38.321 [7].

###### 6.2C.2.2.1.4 Correct behaviour when receiving an UL grant for msg3 retransmission

The UE shall re-transmit the msg3 upon the reception of anUL grant for msg3 retransmission.

###### 6.2C.2.2.1.5 SA: Correct behaviour when receiving a message over Temporary C-RNTI

The UE shall send ACK if the Contention Resolution is successful.

The UE shall again perform the Random Access Resource selection procedure defined in clause 5.1.2 in TS 38.321 [7], and transmit with the calculated PRACH transmission power when the backoff time expires unless the received message includes a UE Contention Resolution Identity MAC control element and the UE Contention Resolution Identity included in the MAC control element matches the CCCH SDU transmitted in the uplink message.

###### 6.2C.2.2.1.6 Correct behaviour when contention Resolution timer expires

The UE shall re-select a preamble and transmit with the calculated PRACH transmission power when the backoff time expires if the Contention Resolution Timer expires.

##### 6.2C.2.2.2 Non-Contention based random access

###### 6.2C.2.2.2.1 Correct behaviour when transmitting Random Access Preamble

If the contention-free Random Access Resources and the contention-free PRACH occasions associated with SSBs is configured, with the UE selected SSB with SS-RSRP above *rsrp-ThresholdSSB* amongst the associated SSBs, UE shall have the capability to select the Random Access Preamble corresponding to the selected SSB, and to transmit Random Access Preamble on the next available PRACH occasion from the PRACH occasions corresponding to the selected SSB permitted by the restrictions given by the *ra-ssb-OccasionMaskIndex* if configured, and PRACH occasion shall be randomly selected with equal probability amongst the selected SSB associated PRACH occasions occurring simultaneously but on different subcarriers, as specified in clause 5.1.2 in TS 38.321 [7].

If the contention-free Random Access Resources and the contention-free PRACH occasions associated with CSI-RSs is configured, with the UE selected CSI-RS with CSI-RSRP above *rsrp-ThresholdCSI-RS* amongst the associated CSI-RSs, UE shall have the capability to select the Random Access Preamble corresponding to the selected CSI-RS, and to transmit Random Access Preamble on the next available PRACH occasion from the PRACH occasions in *ra-OccasionList* corresponding to the selected CSI-RS, and PRACH occasion shall be randomly selected with equal probability amongst the selected CSI-RS associated PRACH occasions occurring simultaneously but on different subcarriers, as specified in clause 5.1.2 in TS 38.321 [7].

If the random access procedure is initialized for beam failure recovery and if the contention-free Random Access Resources and the contention-free PRACH occasions for beam failure recovery request associated with any of the SSBs and/or CSI-RSs is configured, UE shall have the capability to select the Random Access Preamble corresponding to the selected SSB with SS-RSRP above *rsrp-ThresholdSSB* amongst the associated SSBs or the selected CSI-RS with CSI-RSRP above *rsrp-ThresholdCSI-RS* amongst the associated CSI-RSs, and to transmit Random Access Preamble on the next available PRACH occasion from the PRACH occasions corresponding to the selected SSB permitted by the restrictions given by the *ra-ssb-OccasionMaskIndex* if configured, or from the PRACH occasions in *ra-OccasionList* corresponding to the selected CSI-RS, and PRACH occasion shall be randomly selected with equal probability amongst the selected SSB assocated PRACH occasions or the selected CSI-RS associated PRACH occasions occurring simultaneously but on different subcarriers, as specified in clause 5.1.2 in TS 38.321 [7].

###### 6.2C.2.2.2.2 Correct behaviour when receiving Random Access Response

The UE may stop monitoring for Random Access Response(s), if the Random Access Response contains a Random Access Preamble identifier corresponding to the transmitted Random Access Preamble, unless the random access procedure is initialized for Other SI request from UE.

The UE may stop monitoring for Random Access Response(s) and shall monitor the Other SI transmission if the Random Access Response only contains a Random Access Preamble identifier which is corresponding to the transmitted Random Access Preamble and the random access procedure is initialized for SI request from UE, as specified in clause 5.1.4 in TS 38.321 [7].

The UE may stop monitoring for Random Access Response(s), if the contention-free Random Access Preamble for beam failure recovery request was transmitted and if the PDCCH addressed to UE’s C-RNTI is received, as specified in clause 5.1.4 in TS 38.321 [7].

The UE shall again perform the Random Access Resource selection procedure defined in clause 5.1.2 in TS 38.321 [7] for the next available PRACH occasion, and transmit the preamblewith the calculated PRACH transmission power if all received Random Access Responses contain Random Access Preamble identifiers that do not match the transmitted Random Access Preamble.

###### 6.2C.2.2.2.3 Correct behaviour when not receiving Random Access Response

The UE shall again perform the Random Access Resource selection procedure defined in clause 5.1.2 in TS 38.321 [7] for the next available PRACH occasion, and transmit the preamble with the calculated PRACH transmission power, if no Random Access Response is received within the RA Response window configured in *RACH-ConfigCommon* or if no PDCCH addressed to UE’s C-RNTI is received within the RA Response window configured in *BeamFailureRecoveryConfig*, as defined in clause 5.1.4 in TS 38.321 [7].

#### 6.2C.2.3 Requirements for 2-step RA type

The UE shall select the type of random access at initiation of the random access procedure based on network configuration, as specified in clause 5.1.1 in TS 38.321 [7].

The UE shall have capability to calculate MsgA PRACH transmission power according to the PRACH power formula defined in clause 7.4 of TS 38.213 [3] and the MsgA PUSCH power formula of clause 7.1.1 of TS 38.213 [3] and apply this power level at the first MsgA or additional MsgA repetitions. The absolute power applied to the first preamble shall have an accuracy as specified in Table 6.3.4.2-1 of TS 38.101-1 [18] for frequency range 1 and in Table 6.3.4.2-1 of TS 38.101-2 [19] for frequency range 2. The relative power applied to additional preambles shall have an accuracy as specified in Table 6.3.4.3-1 of TS 38.101-1 [18] for frequency range 1 and clause 6.3.4.3 of TS38.101-2 [19] for frequency range 2.

The UE shall switch to 4-step RA type procedure if the MsgA transmission counter has exceeded *msgA-TransMax*, if configured, as specified in clause 5.1.4a of TS 38.321 [7]. The UE shall indicate a Random Access problem to upper layers if the maximum number of preamble transmission counter has been reached for the random access procedure on PCell or PSCell as specified in clause 5.1.4a in TS 38.321 [7].

The requirements in this clause apply for UE in SA operation mode or any MR-DC operation mode.

##### 6.2C.2.3.1 Contention based random access

###### 6.2C.2.3.1.1 Correct behaviour when transmitting MsgA

With the UE selected SSB with SS-RSRP above *msgA-RSRP-ThresholdSSB*, the UE shall have the capability to select a Random Access Preamble randomly with equal probability from the Random Access Preambles associated with the selected SSB if the association between Random Access Preambles and SS blocks is configured, as specified in clause 5.1.2a in TS 38.321 [7].

With the UE selected SSB with SS-RSRP above *msgA-RSRP-ThresholdSSB*, UE shall have the capability to transmit MsgA PRACH on the next available PRACH occasion from the PRACH occasions corresponding to the selected SSB permitted by the restrictions given first by the *msgA-SSB-SharedRO-MaskIndex* if configured, or next by the *ra-ssb-OccasionMaskIndex* if configured, if the association between PRACH occasions and SSBs is configured.

The PRACH preamble and PRACH occasion shall be randomly selected with equal probability amongst the selected SSB associated PRACH occasions occurring simultaneously but on different subcarriers, as specified in clause 5.1.2a in TS 38.321 [7].

In association with the MsgA PRACH, the UE should have the capability to transmit MsgA PUSCH on the corresponding PUSCH occasion associated with a DMRS resource, which is mapped from the MsgA PRACH ocasion, and preamble index as defined in clause 8.1A in TS 38.213 [3].

###### 6.2C.2.3.1.2 Correct behaviour when receiving MsgB

The UE shall stop monitoring for MsgB, when the UE has successfully received the PDCCH addressed to UE as specified in clause 8.2A in TS 38.213 [3] containing a successRAR MAC subPDU or a fallbackRAR MAC subPDU as described in clause 5.1.4a in TS 38.321 [7].

The UE shall send ACK if Success RAR is received in MsgB and the Contention Resolution is successful, as defined in clause 5.1.4a in TS 38.321 [7].

If MsgB contains a fallbackRAR MAC subPDU the UE shall fallback to the 4-step RA type by transmitting the msg3 containing the payload of MsgA PUSCH and monitor contention resolution as described in clause 8.2A in TS 38.213 [3].

The UE shall again perform the Random Access Resource selection procedure defined in clause 5.1.2a in TS 38.321 [7], and transmit with the calculated MsgA PRACH and MsgA PUSCH transmission power when the backoff time expires unless the Random Access Response reception is considered as successful, as defined in clause 5.1.4a in TS 38.321 [7].

###### 6.2C.2.3.1.3 Correct behaviour when not receiving MsgB

The UE shall again perform the Random Access Resource selection procedure defined in clause 5.1.2a in TS 38.321 [7], and transmit with the calculated MsgA PRACH and MsgA PUSCH transmission power when the backoff time expires unless the Random Access Response reception is considered as successful, as defined in clause 5.1.4a in TS 38.321 [7].

##### 6.2C.2.3.2 Non-Contention based random access

###### 6.2C.2.3.2.1 Correct behaviour when transmitting MsgA

If the contention-free Random Access Resources and the contention-free PRACH occasions associated with SSBs is configured, with the UE selected SSB with SS-RSRP above *msgA-RSRP-ThresholdSSB* amongst the associated SSBs, UE shall have the capability to select the Random Access Preamble corresponding to the selected SSB, and to transmit Random Access Preamble on the next available PRACH occasion from the PRACH occasions corresponding to the selected SSB permitted by the restrictions given first by the *msgA-SSB-SharedRO-MaskIndex* if configured, or next by the *ra-ssb-OccasionMaskIndex* if configured, and PRACH occasion shall be randomly selected with equal probability amongst the selected SSB associated PRACH occasions occurring simultaneously but on different subcarriers, as specified in clause 5.1.2a in TS 38.321 [7].

In association with the MsgA PRACH, the UE should have the capability to transmit MsgA PUSCH on the corresponding PUSCH occasion associated with a DMRS resource, which is mapped from the MsgA PRACH ocasion, and preamble index as defined in clause 8.1A in TS 38.213 [3].

###### 6.2C.2.3.2.2 Correct behaviour when receiving MsgB

The UE may stop monitoring for MsgB, when the UE has successfully received the PDCCH addressed to UE as specified in clause 8.2A in TS 38.213 [3] containing a successRAR MAC subPDU or a fallbackRAR MAC subPDU as described in clause 5.1.4a in TS 38.321 [7].

If MsgB contains a fallbackRAR MAC subPDU the UE shall fallback to the 4-step RA type by transmitting the msg3 containing the payload of MsgA PUSCH as described in clause 8.2A in TS 38.213 [3].

The UE shall again perform the Random Access Resource selection procedure defined in clause 5.1.2a in TS 38.321 [7] for the next available PRACH occasion, and transmit the preamblewith the calculated MsgA PRACH and MsgA PUSCH transmission power if all received MsgBs contain Random Access Preamble identifiers that do not match the transmitted Random Access Preamble.

###### 6.2C.2.3.2.3 Correct behaviour when not receiving MsgB

The UE shall again perform the Random Access Resource selection procedure defined in clause 5.1.2a in TS 38.321 [7] for the next available PRACH occasion, and transmit MsgA with the calculated MsgA PRACH and MsgA PUSCH transmission power, if no MsgB is received within the MsgB Response window configured in *RACH-ConfigGenericTwoStepRA* and the Random Access Response Reception has not been considered as successful as defined in clause 5.1.4a in TS 38.321 [7].

### 6.2C.3 SA: RRC Connection Release with Redirection for Satellite Access

#### 6.2C.3.1 Introduction

This clause contains requirements on the UE regarding RRC connection release with redirection procedure. RRC connection release with redirection is initiated by the *RRCRelease* message with redirection to NR from NR specified in TS 38.331 [2]. The RRC connection release with redirection procedure is specified in clause 5.3.8 of TS 38.331 [2].

#### 6.2C.3.2 Requirements

##### 6.2C.3.2.1 RRC connection release with redirection to NR

The UE shall be capable of performing the RRC connection release with redirection to the target NR cell within Tconnection\_release\_redirect\_NR.

The time delay (Tconnection\_release\_redirect\_NR) is the time between the end of the last slot containing the RRC command, “*RRCRelease*” (TS 38.331 [2]) on the NR PDSCH and the time the UE starts to send random access to the target NR cell. The time delay (Tconnection\_release\_redirect\_NR) shall be less than:

Tconnection\_release\_redirect\_NR = TRRC\_procedure\_delay + Tidentify-NR + TSI-NR + TRACH

The target NR cell shall be considered detetable when for each relevant SSB, the side conditions should be met that,

- the conditions of SSB\_RP and SSB Ês/Iot according to Annex B.2.5 for a corresponding NR Band are fulfilled.

- TRRC\_procedure\_delay: It is the RRC procedure delay for processing the received message “*RRCRelease*” as defined in clause 6.2.2 of TS 38.331 [2].

- Tidentify-NR: It is the time to identify the target NR cell and depends on the FR of the target NR cell. It is defined in Table 6.2C.3.2.1-1. Note that Tidentify-NR = TPSS/SSS-sync + Tmeas, in which TPSS/SSS-sync is the cell search time and Tmeas is the measurement time due to cell selection criteria evaluation.

- TSI-NR: It is the time required for acquiring all the relevant system information of the target NR cell. This time depends upon whether the UE is provided with the relevant system information of the target NR cell or not by the old NR cell before the RRC connection is released. TRACH: It is the delay uncertainty in acquiring the first available PRACH occasion in the target NR cell. TRACH can be up to the summation of SSB to PRACH occasion association period and 10 ms. SSB to PRACH occasion associated period is defined in the table 8.1-1 of TS 38.213 [3].

- Trs is the SMTC periodicity of the target NR cell if the UE has been provided with an SMTC configuration for the target cell in the redirection command, otherwise Trs is the SMTC periodicity configured in the *measObjectNR* having the same SSB frequency and subcarrier spacing configured for the RRC connection release with redirection. If the measObjectNRs having the same SSB frequency and subcarrier spacing configured by MN and SN have different SMTC, Trs is the periodicity of one of the SMTC which is up to UE implementation. If the UE is not provided with SMTC configuration or measurement object for the frequency which is also configured for the RRC connection release with redirection then:

- the requirement in this clause is applied with Trs = 20 ms if the SSB transmission periodicity is not larger than 20 ms; otherwise,

- there is no requirement if the SSB transmission periodicity is larger than 20ms.

The requirements in this clause apply provided that the ephemeris information provided by the serving cell for the target cell is valid during time delay (Tconnection\_release\_redirect\_NR).

Table 6.2C.3.2.1-1: Time to identify target NR cell for RRC connection release with redirection to NR

|  |  |
| --- | --- |
| FR of target NR cell | Tidentify-NR |
| FR1 | K\_satellite \* MAX (680 ms, 11 x Trs) |
| Note 1: If the UE has been provided with higher layer signaling of *smtc2*specified in TS 38.331 [2] prior to the redirection command, Trs follows *smtc1* or *smtc2* according to the physical cell ID of the target cell.  Note 2: K\_satellite is defined in clause 9.3C.4. | |

# 7 Timing

## 7.1 UE transmit timing

### 7.1.1 Introduction

The UE shall have capability to follow the frame timing change of the reference cell in connected state or when transmiting PUSCH on CG resources for SDT in RRC\_Inactive. The uplink frame transmission takes place before the reception of the first detected path (in time) of the corresponding downlink frame from the reference cell. For serving cell(s) in pTAG, UE shall use the SpCell as the reference cell for deriving the UE transmit timing for cells in the pTAG. For serving cell(s) in sTAG, UE shall use any of the activated SCells as the reference cell for deriving the UE transmit timing for the cells in the sTAG. UE initial transmit timing accuracy and gradual timing adjustment requirements are defined in the following requirements.

In the requirements of clause 7.1.2, the term reference cell on a carrier frequency subject to CCA is not available at the UE refers to when at least one SSB is configured by gNB, but the first two successive candidate SSB positions for the same SSB index within the discovery burst transmission window are not available during at least one discovery burst transmission window, at the UE due to DL CCA failures at gNB during the last 1280 ms; otherwise the reference cell on the carrier frequency subject to CCA is considered as available at the UE.

### 7.1.2 Requirements

The UE initial transmission timing error shall be less than or equal to ±Te where the timing error limit value Te is specified in Table 7.1.2-1. This requirement applies:

- when it is the first transmission in a DRX cycle for PUCCH, PUSCH and SRS, or it is the PRACH transmission, or it is the msgA transmission, or it is the first transmission sent on the PSCell for activating the deactivated SCG without RACH.

- when it is the transmission for PUSCH on CG resources for SDT in RRC\_Inactive.

When the UL SCS is 120 kHz or smaller, the UE shall meet the Te requirement for an initial transmission provided that at least one SSB is available at the UE during the last 160 ms. When the UL SCS is 480 kHz the UE shall meet the Te requirement for an initial transmission provided that at least one SSB is available in the last 80 ms. When the UL SCS is 960 kHz the UE shall meet the Te requirement for an initial transmission provided that at least one SSB is available in the last 40 ms. The reference point for the UE initial transmit timing control requirement shall be the downlink timing of the reference cell minus . The downlink timing is defined as the time when the first path (in time) of the corresponding downlink frame used by the UE to determine downlink timing is received from the reference cell at the UE antenna. *N*TA for PRACH is defined as 0.

 (in *Tc* units) for other channels is the difference between UE transmission timing and the downlink timing immediately after when the last timing advance in clause 7.3 was applied. *N*TA for other channels is not changed until next timing advance is received. The value ofdepends on the duplex mode of the cell in which the uplink transmission takes place and the frequency range (FR). is defined in Table 7.1.2-2.

Table 7.1.2-1: Te Timing Error Limit

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency Range | SCS of SSB signals (kHz) | SCS of uplink signals (kHz) | Te |
| 1 | 15 | 15 | 12\*64\*Tc |
|  |  | 30 | 10\*64\*Tc |
|  |  | 60 | 10\*64\*Tc |
|  | 30 | 15 | 8\*64\*Tc |
|  |  | 30 | 8\*64\*Tc |
|  |  | 60 | 7\*64\*Tc |
| 2-1 | 120 | 60 | 3.5\*64\*Tc |
|  |  | 120 | 3.5\*64\*Tc |
|  | 240 | 60 | 3\*64\*Tc |
|  |  | 120 | 3\*64\*Tc |
| 2-2 | 120 | 120 | 3.5\*64\*Tc |
|  |  | 480 | [1.58]\*64\*Tc |
|  | 480 | 120 | 2.86\*64\*Tc |
|  |  | 480 | [1.35]\*64\*Tc |
|  |  | 960 | [0.90]\*64\*Tc |
|  | 960 | 120 | 2.80\*64\*Tc |
|  |  | 480 | [1.13]\*64\*Tc |
|  |  | 960 | [0.86]\*64\*Tc |
| Note 1: Tc is the basic timing unit defined in TS 38.211 [6] | | | |

Table 7.1.2-2: The Value of 

|  |  |
| --- | --- |
| Frequency range and band of cell used for uplink transmission | (Unit: TC) |
| FR1 FDD or TDD band with neither E-UTRA–NR nor NB-IoT–NR coexistence case | 25600 (Note 1) |
| FR1 FDD band with E-UTRA–NR and/or NB-IoT–NR coexistence case | 0 (Note 1) |
| FR1 TDD band with E-UTRA–NR and/or NB-IoT–NR coexistence case | 39936 (Note 1) |
| FR2 | 13792 |
| Note 1: The UE identifies  based on the information n-TimingAdvanceOffset as specified in TS 38.331 [2]. If UE is not provided with the information n-TimingAdvanceOffset, the default value of  is set as 25600 for FR1 band. In case of multiple UL carriers in the same TAG, UE expects that the same value of n-TimingAdvanceOffset is provided for all the UL carriers according to clause 4.2 in TS 38.213 [3] and the value 39936 of  can also be provided for a FDD serving cell.  Note 2: Void | |

When it is not the first transmission in a DRX cycle or there is no DRX cycle, and when it is the transmission for PUCCH, PUSCH and SRS transmission, the UE shall be capable of changing the transmission timing according to the received downlink frame of the reference cell except when the timing advance in clause 7.3 is applied.

Table 7.1.2-3: void

If the UE uses a reference cell on a carrier frequency subject to CCA for deriving the UE transmit timing, then the UE shall meet all the transmit timing requirements defined in clause 7.1.2 provided that the reference cell is available at the UE. If the reference cell is not available at the UE on a carrier frequency subject to CCA, then the UE is allowed to transmit in the uplink provided that the UE meets all the transmit timing requirements defined in clause 7.1.2; otherwise the UE shall not transmit any uplink signal.

If a reference cell on a carrier frequency belonging to the PTAG, which is subject to CCA, is not available at the UE then the UE is allowed to use any of available activated SCell(s) at the UE in PTAG as a new reference cell. If the SCell used as reference cell is deactivated, or becomes not available, the UE is allowed to use another active serving cell in PTAG as new reference cell.

If a reference cell on a carrier frequency belonging to the STAG, which is subject to CCA is not available at the UE then the UE is allowed to use any of available activated SCell(s) at the UE in STAG as a new reference cell.

#### 7.1.2.1 Gradual timing adjustment

Requirements in this section shall apply regardless of whether the reference cell is on a carrier frequency subject to CCA or not.

When the transmission timing error between the UE and the reference timing exceeds ±Te then the UE is required to adjust its timing to within ±Te. The reference timing shall be  before the downlink timing of the reference cell. All adjustments made to the UE uplink timing shall follow these rules:

1) The maximum amount of the magnitude of the timing change in one adjustment shall be Tq.

2) The minimum aggregate adjustment rate shall be Tp per second.

3) The maximum aggregate adjustment rate shall be Tq per 200 ms for SCS of UL signals smaller or equal to 120 kHz and 100 ms for SCS of upling signals larger or equal to 480 kHz.

where the maximum autonomous time adjustment step Tq and the aggregate adjustment rate Tp are specified in Table 7.1.2.1-1.

Table 7.1.2.1-1: Tq Maximum Autonomous Time Adjustment Step and Tp Minimum Aggregate Adjustment rate

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency Range | SCS of uplink signals (kHz) | Tq | Tp |
| 1 | 15 | 5.5\*64\*Tc | 5.5\*64\*Tc |
|  | 30 | 5.5\*64\*Tc | 5.5\*64\*Tc |
|  | 60 | 5.5\*64\*Tc | 5.5\*64\*Tc |
| 2-1 | 60 | K\*64\*Tc | 2.5\*64\*Tc |
|  | 120 | K\*64\*Tc | 2.5\*64\*Tc |
| 2-2 | 120 | 2.5\*64\*Tc | 2.5\*64\*Tc |
|  | 480 | [0.8]\*64\*Tc | [0.8]\*64\*Tc |
|  | 960 | [0.8]\*64\*Tc | [0.8]\*64\*Tc |
| NOTE 1: Tc is the basic timing unit defined in TS 38.211 [6]  NOTE 2: When *highSpeedMeasFlagFR2-r17* is configured for UE supporting power class 6, K = 4.5; otherwise, K = 2.5. | | | |

#### 7.1.2.2 Void

Table 7.1.2.2-1: Void

#### 7.1.2.3 One shot large UL timing adjustment for FR2 Power Class 6 UE

When *highSpeedMeasFlagFR2-r17* is configured and *highSpeedLargeOneStepUL-TimingFR2-r17* is enabled for UE supporting FR2 power class 6 and [*largeOneStepUL-timingFR2-r17*] capability, the following requirements apply to the UE:

- If the absolute value , the requirement in clause 7.1.2.1 apply to the first UL transmission after a TCI state switch.

- Otherwise, the UE transmit timing immediately after TCI state switch shall be and clause 7.1.2.1 requirements don’t apply.

- The UE UL transmission timing error after the TCI state switching procedure shall be less than or equal to ±Te as specified in clause 7.1.2 if the new target TCI state is within active TCI state list, otherwise ±[7Ts], and the reference point is .

Above,

- (in units) is the DL timing defined as the time when UE receives downlink frame with new target TCI state.

- (in units) is the DL timing defined as the time when UE receives downlink frame with old source TCI state.

## 7.1A UE transmit timing for RedCap

### 7.1A.1 Introduction

The UE shall have capability to follow the frame timing change of the reference cell in connected state or when transmiting PUSCH on CG resources for SDT in RRC\_Inactive. The uplink frame transmission takes place before the reception of the first detected path (in time) of the corresponding downlink frame from the reference cell. UE initial transmit timing accuracy and gradual timing adjustment requirements are defined in the following requirements.

### 7.1A.2 Requirements

The UE initial transmission timing error shall be less than or equal to ±Te where the timing error limit value Te is specified in Table 7.1A.2-1. This requirement applies:

- when it is the first transmission in a DRX cycle for PUCCH, PUSCH and SRS, or it is the PRACH transmission, or it is the msgA transmission.

- when it is the transmission for PUSCH on CG resources for SDT in RRC\_Inactive.

The UE shall meet the Te requirement for an initial transmission provided that at least one SSB (CD-SSB or NCD-SSB) is available at the UE for acquiring the frame timing of the reference cell during the last 160 ms on the condition that:

- the SSB is within the UE’s active BWP, or

- the SSB is not within the UE’s active BWP, and the measurement gap is configured.

The reference point for the UE initial transmit timing control requirement shall be the downlink timing of the reference cell minus . The downlink timing is defined as the time when the first ~~detected~~ path (in time) of the corresponding downlink frame used by the UE to determine downlink timing is received from the reference cell at UE antenna. *N*TA for PRACH is defined as 0.

 (in *Tc* units) for other channels is the difference between UE transmission timing and the downlink timing immediately after when the last timing advance in clause 7.3A was applied. *N*TA for other channels is not changed until next timing advance is received. The value ofdepends on the duplex mode of the cell in which the uplink transmission takes place and the frequency range (FR). is defined in Table 7.1A.2-2.

Table 7.1A.2-1: Te Timing Error Limit

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency Range | SCS of SSB signals (kHz) | SCS of uplink signals (kHz) | Te |
| 1 | 15 | 15 | 12\*64\*Tc |
|  |  | 30 | 10\*64\*Tc |
|  |  | 60 | 10\*64\*Tc |
|  | 30 | 15 | 8\*64\*Tc |
|  |  | 30 | 8\*64\*Tc |
|  |  | 60 | 7\*64\*Tc |
| 2 | 120 | 60 | 3.5\*64\*Tc |
|  |  | 120 | 3.5\*64\*Tc |
|  | 240 | 60 | 3\*64\*Tc |
|  |  | 120 | 3\*64\*Tc |
| Note 1: Tc is the basic timing unit defined in TS 38.211 [6] | | | |

Table 7.1A.2-2: The Value of 

|  |  |
| --- | --- |
| Frequency range and band of cell used for uplink transmission | (Unit: TC) |
| FR1 FDD or TDD band with neither E-UTRA–NR nor NB-IoT–NR coexistence case | 25600 (Note 1) |
| FR1 FDD band with E-UTRA–NR and/or NB-IoT–NR coexistence case | 0 (Note 1) |
| FR1 TDD band with E-UTRA–NR and/or NB-IoT–NR coexistence case | 39936 (Note 1) |
| FR2 | 13792 |
| Note 1: The UE identifies  based on the information n-TimingAdvanceOffset as specified in TS 38.331 [2]. If UE is not provided with the information n-TimingAdvanceOffset, the default value of  is set as 25600 for FR1 band.  Note 2: Void | |

When it is not the first transmission in a DRX cycle or there is no DRX cycle, and when it is the transmission for PUCCH, PUSCH and SRS transmission, the UE shall be capable of changing the transmission timing according to the received downlink frame of the reference cell except when the timing advance in clause 7.3A is applied.

#### 7.1A.2.1 Gradual timing adjustment

When the transmission timing error between the UE and the reference timing exceeds ±Te then the UE is required to adjust its timing to within ±Te. The reference timing shall be  before the downlink timing of the reference cell. All adjustments made to the UE uplink timing shall follow these rules:

1) The maximum amount of the magnitude of the timing change in one adjustment shall be Tq.

2) The minimum aggregate adjustment rate shall be Tp per second.

3) The maximum aggregate adjustment rate shall be Tq per 200 ms.

where the maximum autonomous time adjustment step Tq and the aggregate adjustment rate Tp are specified in Table 7.1A.2.1-1.

Table 7.1A.2.1-1: Tq Maximum Autonomous Time Adjustment Step and Tp Minimum Aggregate Adjustment rate

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency Range | SCS of uplink signals (kHz) | Tq | Tp |
| 1 | 15 | 5.5\*64\*Tc | 5.5\*64\*Tc |
|  | 30 | 5.5\*64\*Tc | 5.5\*64\*Tc |
|  | 60 | 5.5\*64\*Tc | 5.5\*64\*Tc |
| 2 | 60 | 2.5\*64\*Tc | 2.5\*64\*Tc |
|  | 120 | 2.5\*64\*Tc | 2.5\*64\*Tc |
| NOTE: Tc is the basic timing unit defined in TS 38.211 [6] | | | |

## 7.1C UE transmit timing for Satellite Access

### 7.1C.1 Introduction

The UE shall have capability to follow the frame timing change of the reference cell in connected state. The uplink frame transmission takes place before the reception of the first detected path (in time) of the corresponding downlink frame from the reference cell. UE initial transmit timing accuracy and gradual timing adjustment requirements are defined in the following requirements.

### 7.1C.2 Requirements

The UE initial transmission timing error shall be less than or equal to ±Te\_NTN where the timing error limit value Te\_NTN is specified in Table 7.1C.2-1. This requirement applies:

- when it is the first transmission in a DRX cycle for PUCCH, PUSCH and SRS, or it is the PRACH transmission, or it is the msgA transmission..

The UE shall meet the Te\_NTN requirement for an initial transmission provided that at least one SSB is available at the UE during the last 160 ms. and the UE has a validity time running for *N*TA,commonand *N*TA,UE-specific. The reference point for the UE initial transmit timing control requirement shall be the downlink timing of the reference cell minus .

The downlink timing is defined as the time when the first path (in time) of the corresponding downlink frame used by the UE to determine downlink timing is received from the reference cell at the UE antenna.

*N*TA for PRACH is defined as 0. (in *T*c units) for other channels is the difference between UE transmission timing and the downlink timing immediately after when the last timing advance in clause 7.3 was applied. or after the last update in or .

The value of *N*TA-offset depends on the duplex mode of the cell in which the uplink transmission takes place and the frequency range (FR). *N*TA-offset is defined in Table 7.1.2-2.

and are as defined in TS38.211 [6].

Table 7.1C.2-1: Te\_NTN Timing Error Limit

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency Range | SCS of SSB signals (kHz) | SCS of uplink signals (kHz) | Te\_NTN |
| 1 | 15 | 15 | 29\*64\*Tc |
|  |  | 30 | 24\*64\*Tc |
|  |  | 60 | N/A |
|  | 30 | 15 | 24\*64\*Tc |
|  |  | 30 | 22\*64\*Tc |
|  |  | 60 | N/A |
| Note 1: Tc is the basic timing unit defined in TS 38.211 [6] | | | |

When it is not the first transmission in a DRX cycle or there is no DRX cycle, and when it is the transmission for PUCCH, PUSCH and SRS transmission, the UE shall be capable of changing the transmission timing according to the received downlink frame of the reference cell, the updating of and the updating of , except when the timing advance in clause 7.3C is applied.

#### 7.1C.2.1 Gradual timing adjustment

adjust its timing to within ±Te\_NTN. The reference timing shall be before the downlink timing of the reference cell. All adjustments made to the UE uplink timing shall follow these rules:

1) The maximum amount of the magnitude of the timing change, apart from a change of due to satellite position update and between the previous transmission and the current transmission, in one adjustment shall be Tq\_NTN.

2) The minimum aggregate adjustment rate, apart from a change of due to satellite position update and during the last one second, shall be Tp\_NTN per second.

3) The maximum aggregate adjustment rate, apart from a change of due to satellite position update and during the last 200ms, shall be Tq\_NTN per 200 ms.

Where, the maximum autonomous time adjustment step Tq\_NTN and the aggregate adjustment rate Tp\_NTN are specified in Table 7.1C.2.1-1.

**Table 7.1C.2.1-1: Tq\_NTN Maximum Autonomous Time Adjustment Step and Tp\_NTN Minimum Aggregate Adjustment rate**

|  |  |  |  |
| --- | --- | --- | --- |
| **Frequency Range** | **SCS of uplink signals (kHz)** | **Tq\_NTN** | **Tp\_NTN** |
| 1 | 15 | 5.5\*64\*Tc | 5.5\*64\*Tc |
|  | 30 | 5.5\*64\*Tc | 5.5\*64\*Tc |
|  | 60 | N/A | N/A |
| NOTE: Tc is the basic timing unit defined in TS 38.211 [6] | | | |

## 7.2 UE timer accuracy

### 7.2.1 Introduction

UE timers are used in different protocol entities to control the UE behaviour.

### 7.2.2 Requirements

For UE timers specified in TS 38.331 [2], the UE shall comply with the timer accuracies according to Table 7.2.2-1.

The requirements are only related to the actual timing measurements internally in the UE. They do not include the following:

- Inaccuracy in the start and stop conditions of a timer (e.g. UE reaction time to detect that start and stop conditions of a timer is fulfilled), or

- Inaccuracies due to restrictions in observability of start and stop conditions of a UE timer (e.g. slot alignment when UE sends messages at timer expiry).

Table 7.2.2-1

|  |  |
| --- | --- |
| Timer value [s] | Accuracy |
| timer value < 4 | ± 0.1s |
| timer value ≥ 4 | ± 2.5% |

## 7.2A UE timer accuracy for RedCap

### 7.2A.1 Introduction

UE timers are used in different protocol entities to control the UE behaviour.

### 7.2A.2 Requirements

For UE timers specified in TS 38.331 [2], the UE shall comply with the timer accuracies according to Table 7.2A.2-1.

The requirements are only related to the actual timing measurements internally in the UE. They do not include the following:

- Inaccuracy in the start and stop conditions of a timer (e.g. UE reaction time to detect that start and stop conditions of a timer is fulfilled), or

- Inaccuracies due to restrictions in observability of start and stop conditions of a UE timer (e.g. slot alignment when UE sends messages at timer expiry).

Table 7.2A.2-1

|  |  |
| --- | --- |
| Timer value [s] | Accuracy |
| timer value < 4 | ± 0.1s |
| timer value ≥ 4 | ± 2.5% |

## 7.2C UE timer accuracy for satellite access

### 7.2C.1 Introduction

UE timers are used in different protocol entities to control the UE behaviour.

### 7.2C.2 Requirements

For UE timers specified in TS 38.331 [2], the UE shall comply with the timer accuracies according to Table 7.2C.2-1.

The requirements are only related to the actual timing measurements internally in the UE. They do not include the following:

- Inaccuracy in the start and stop conditions of a timer (e.g. UE reaction time to detect that start and stop conditions of a timer is fulfilled), or

- Inaccuracies due to restrictions in observability of start and stop conditions of a UE timer (e.g. slot alignment when UE sends messages at timer expiry).

Table 7.2C.2-1

|  |  |
| --- | --- |
| **Timer value [s]** | **Accuracy** |
| timer value < 4 | ± 0.1s |
| timer value ≥ 4 | ± 2.5% |

## 7.3 Timing advance

### 7.3.1 Introduction

The timing advance is initiated from gNB to UE in EN-DC, NR-DC, NE-DC and NR SA operation modes, with MAC message that implies the adjustment of the timing advance, as defined in clause 5.2 of TS 38.321 [7].

### 7.3.2 Requirements

#### 7.3.2.1 Timing Advance adjustment delay

UE shall adjust the timing of its uplink transmission timing at time slot *n*+ *k+1* for a timing advance command received in time slot *n*, and the value of *k* is defined in clause 4.2 in TS 38.213 [3]. The same requirement applies also when the UE is not able to transmit a configured uplink transmission due to the channel assessment procedure.

#### 7.3.2.2 Timing Advance adjustment accuracy

The UE shall adjust the timing of its transmissions with a relative accuracy better than or equal to the UE Timing Advance adjustment accuracy requirement in Table 7.3.2.2-1, to the signalled timing advance value compared to the timing of preceding uplink transmission. The timing advance command step is defined in TS 38.213 [3].

Table 7.3.2.2-1: UE Timing Advance adjustment accuracy

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| UL Sub Carrier Spacing(kHz) | 15 | 30 | 60 | 120 | 480 | 960 |
| UE Timing Advance adjustment accuracy | ±256 Tc | ±256 Tc | ±128 Tc | ±32 Tc | ±10 Tc | ±6 Tc |

## 7.3A Timing Advance for RedCap

### 7.3A.1 Introduction

The timing advance is initiated from gNB to UE configured with only PCell, with MAC message that implies the adjustment of the timing advance, as defined in clause 5.2 of TS 38.321 [7].

### 7.3A.2 Requirements

#### 7.3A.2.1 Timing Advance adjustment delay

UE shall adjust the timing of its uplink transmission at time slot *n*+ *k+1* for a timing advance command received in time slot *n*, and the value of *k* is defined in clause 4.2 in TS 38.213 [3]. The same requirement applies also when the UE is not able to transmit a configured uplink transmission due to the channel assessment procedure.

#### 7.3A.2.2 Timing Advance adjustment accuracy

The UE shall adjust the timing of its transmissions with a relative accuracy better than or equal to the UE Timing Advance adjustment accuracy requirement in Table 7.3A.2.2-1, to the signalled timing advance value compared to the timing of preceding uplink transmission. The timing advance command step is defined in TS 38.213 [3].

Table 7.3A.2.2-1: UE Timing Advance adjustment accuracy

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| UL Sub Carrier Spacing(kHz) | 15 | 30 | 60 | 120 |
| UE Timing Advance adjustment accuracy | ±256 Tc | ±256 Tc | ±128 Tc | ±32 Tc |

## 7.3C Timing advance for satellite access

### 7.3C.1 Introduction

The timing advance is initiated by UE configured with only PCell served by SAN, upon initiating a validity timer for and . The timing advance can be adjusted with MAC message that implies the adjustment of the timing advance, as defined in clause 5.2 of TS 38.321 [7].

### 7.3C.2 Requirements

#### 7.3C.2.1 Timing Advance adjustment delay

UE shall adjust the timing of its uplink transmission timing from the beginning of uplink at time slot *n*+ *k+1+2µ* for a timing advance command received in time slot *n*, and the value of *k, µ* and are defined in clause 4.2 in TS 38.213 [3]. The same requirement applies also when the UE is not able to transmit a configured uplink transmission due to the channel assessment procedure.

#### 7.3C.2.2 Timing Advance adjustment accuracy

The UE shall adjust the timing of its transmissions, apart from a change of and between the preceding uplink transmission and the current transmission, with a relative accuracy better than or equal to the UE Timing Advance adjustment accuracy requirement in Table 7.3C.2.2-1, to the signalled timing advance value compared to the timing of preceding uplink transmission. The timing advance command step is defined in TS 38.213 [3].

Table 7.3C.2.2-1: UE Timing Advance adjustment accuracy

|  |  |  |  |
| --- | --- | --- | --- |
| UL Sub Carrier Spacing(kHz) | 15 | 30 | 60 |
| UE Timing Advance adjustment accuracy | ±256 Tc | ±256 Tc | N/A |

*Editor’s Note: it would be further clairified with the additional conditions for TA adjustment accuracy requirement for satellite access*

## 7.4 Cell phase synchronization accuracy

### 7.4.1 Definition

Cell phase synchronization accuracy for TDD is defined as the maximum absolute deviation in frame start timing between any pair of cells on the same frequency that have overlapping coverage areas.

### 7.4.2 Minimum requirements

The cell phase synchronization accuracy measured at BS antenna connectors or radiated interface boundaries shall be better than 3 µs.

## 7.5 Maximum Transmission Timing Difference

### 7.5.1 Introduction

A UE shall be capable of handling a relative transmission timing difference between subframe timing boundary of E-UTRA PCell and the closest slot timing boundary of PSCell to be aggregated for EN-DC operation.

A UE shall be capable of handling a relative transmission timing difference among the closest slot timing boundaries of different carriers in FR1 and/or FR2-1 to be aggregated in NR carrier aggregation.

A UE shall be capable of handling a relative transmission timing difference among the closest subframe timing boundaries of different carriers to be aggregated in FR1 and FR2-2 NR inter-band carrier aggregation.

A UE shall be capable of handling a relative transmission timing difference between slot timing boundary of PCell and subframe timing boundary of E-UTRA PSCell to be aggregated for NE-DC operation.

A UE shall be capable of handling a relative transmission timing difference between slot timing boundaries of PCell in FR1 or FR2-1 and the closest slot timing boundary of PSCell in FR1 or FR2-1 to be aggregated in NR DC operation.

A UE shall be capable of handling a relative transmission timing difference between subframe timing boundaries of PCell in FR1 and the closest subframe timing boundary of PSCell in FR2-2 to be aggregated in NR DC operation.

### 7.5.2 Minimum Requirements for inter-band EN-DC

The UE shall be capable of handling a maximum uplink transmission timing difference between E-UTRA PCell and PSCell as shown in Table 7.5.2-1.

Table 7.5.2-1 Maximum uplink transmission timing difference requirement for asynchronous EN-DC

|  |  |  |
| --- | --- | --- |
| Sub-carrier spacing in E-UTRA PCell (kHz) | UL Sub-carrier spacing for data in PSCell (kHz) | Maximum uplink transmission timing difference (µs) |
| 15 | 15 | 500 |
| 15 | 30 | 250 |
| 15 | 60 | 125 |
| 15 | 120Note1 | 62.5 |
| NOTE 1: For E-UTRA FDD-NR FDD intra-band EN-DC, for which the requirement is defined in clause 7.5.3 and this Table 7.5.2-1 is also applicable, the scenario with 120kHz PSCell does not exist. | | |

Table 7.5.2-2 Void

#### 7.5.2.1 Minimum Requirements for inter-band synchronous EN-DC

The requirements in this clause apply as a reference for inter-band synchronous EN-DC.

The UE shall be capable of handling a maximum uplink transmission timing difference between E-UTRA PCell and PSCell for inter-band synchronous EN-DC as shown in Table 7.5.2.1-1 1. The requirements for synchronous EN-DC are applicable for E-UTRA TDD-NR TDD, E-UTRA FDD-NR FDD, E-UTRA TDD-NR FDD and E-UTRA FDD-NR TDD inter-band EN-DC.

Table 7.5.2.1-1 Maximum uplink transmission timing difference requirement for inter-band synchronous EN-DC

|  |  |  |
| --- | --- | --- |
| Sub-carrier spacing in E-UTRA PCell (kHz) | UL Sub-carrier spacing for data in PSCell (kHz) | Maximum uplink transmission timing difference (µs) |
| 15 | 15 | 35.21 |
| 15 | 30 | 35.21 |
| 15 | 60 | 35.21 |
| 15 | 120 | 35.21 |

### 7.5.3 Minimum Requirements for intra-band EN-DC

For intra-band EN-DC, only co-located deployment is applied.

The UE shall be capable of handling a maximum uplink transmission timing difference between E-UTRA PCell and PSCell as shown in Table 7.5.2-1 for E-UTRA FDD-NR FDD intra-band EN-DC provided the UE indicates that it is capable of asynchronous EN-DC operation [2].

The UE shall be capable of handling a maximum uplink transmission timing difference between E-UTRA PCell and PSCell as shown in Table 7.5.3-1 for E-UTRA TDD-NR TDD and E-UTRA FDD-NR FDD intra-band EN-DC provided the UE does not indicate that it is capable of asynchronous FDD-FDD EN-DC operation [16].

Table 7.5.3-1: Maximum uplink transmission timing difference requirement for intra-band synchronous EN-DC

|  |  |  |
| --- | --- | --- |
| Sub-carrier spacing in E-UTRA PCell (kHz) | UL Sub-carrier spacing for data in PSCell (kHz) | Maximum uplink transmission timing difference (µs) |
| 15 | 15 | 5.21Note1,Note 2 |
| 15 | 30 | 5.21Note 2 |
| 15 | 60 | 5.21 Note 2 |
| NOTE 1: This is not applicable for a UE which indicates the capability of only supporting single UL timing (*ul-TimingAlignmentEUTRA-NR* is signalled). Single UL timing for E-UTRA and NR cell is assumed for this UE.  NOTE 2: If the transmission timing difference exceeds the cyclic prefix length of the UL Sub-carrier spacing for data in PSCell, NR UE Tx EVM degradation is expected for the symbol that is overlapping the LTE subframe boundary | | |

### 7.5.4 Minimum Requirements for NR Carrier Aggregation

The UE shall be capable of handling at least a relative transmission timing difference between slot timing of all pairs of TAGs in FR1 and/or FR2-1 as shown in Table 7.5.4-1, provided that the UE is:

- configured with the pTAG and the sTAG for inter-band NR carrier aggregation in SA or NR-DC mode, or

- configured with more than one sTAG for inter-band NR carrier aggregation in EN-DC or NE-DC mode.

The UE shall be capable of handling at least a relative transmission timing difference between subframe timing of all pairs of TAGs between FR1 and FR2-2 as shown in Table 7.5.4-1, provided that the UE is:

- configured with the pTAG and the sTAG for inter-band NR carrier aggregation in SA or NR-DC mode.

Table 7.5.4-1: Maximum uplink transmission timing difference requirement for inter-band NR carrier aggregation

|  |  |
| --- | --- |
| Frequency Range of the pair of TAGs | Maximum uplink transmission timing difference (µs) |
| FR1 | 34.6 |
| FR2-1 | 8.5 Note1 |
| Between FR1 and FR2-1 | 26.1 |
| Between FR1 and FR2-2 | 26.1 |
| Note1: This requirement applies to the UE capable of independent beam management for FR2-1 inter-band CA. | |

### 7.5.5 Minimum Requirements for inter-band NE-DC

The UE shall be capable of handling a maximum uplink transmission timing difference between PCell and E-UTRA PSCell as shown in Table 7.5.5-1 for inter-band asynchronous NE-DC.

Table 7.5.5-1: Maximum uplink transmission timing difference requirement for inter-band asynchronous NE-DC

|  |  |  |
| --- | --- | --- |
| Sub-carrier spacing in PCell (kHz) | UL Sub-carrier spacing for data in E-UTRA PSCell (kHz) | Maximum uplink transmission timing difference (µs) |
| 15 | 15 | 500 |
| 30 | 15 | 250 |
| 60 | 15 | 125 |
| 120 | 15 | 62.5 |
| NOTE 1: Void | | |

Table 7.5.5-2 Void

#### 7.5.5.1 Minimum Requirements for inter-band synchronous NE-DC

The requirements in this clause apply as a reference for inter-band synchronous NE-DC.

The UE shall be capable of handling a maximum uplink transmission timing difference between PCell and E-UTRA PSCell for inter-band synchronous NE-DC as shown in Table 7.5.5.1-1. The requirements for synchronous NE-DC are applicable for NR TDD- E-UTRA TDD, NR FDD- E-UTRA FDD, NR TDD- E-UTRA FDD and NR FDD- E-UTRA TDD inter-band NE-DC.

Table 7.5.5.1-1: Maximum uplink transmission timing difference requirement for inter-band synchronous NE-DC

|  |  |  |
| --- | --- | --- |
| Sub-carrier spacing in PCell (kHz) | UL Sub-carrier spacing for data in E-UTRA PSCell (kHz) | Maximum uplink transmission timing difference (µs) |
| 15 | 15 | 35.21 |
| 30 | 15 | 35.21 |
| 60 | 15 | 35.21 |
| 120 | 15 | 35.21 |

### 7.5.6 Minimum Requirements for inter-band NR DC

The UE shall be capable of handling a maximum uplink transmission timing difference between PCell and PSCell as shown in Table 7.5.6-1 provided that the UE indicates that it is capable of synchronous NR DC only [14].

Table 7.5.6-1: Maximum uplink transmission timing difference requirement for inter-band synchronous NR DC

|  |  |  |
| --- | --- | --- |
| Frequency Range | | Maximum uplink transmission timing difference (µs) |
| Cell in MCG | Cell in SCG |  |
| FR1 | FR1 | 34.6 |
| FR2-1 | FR2-1 | 8.5 |
| FR1 | FR2-1 | 34.1 |
| FR1 | FR2-2 | 34.1 |

The UE shall be capable of handling a maximum uplink transmission timing difference between PCell and PSCell as shown in Table 7.5.6-2 provided that the UE indicates that it is capable of asynchronous NR DC [14].

Table 7.5.6-2 Maximum uplink transmission timing difference requirement for inter-band asynchronous NR DC

|  |  |
| --- | --- |
| Max {Sub-carrier spacing in PCell (kHz), Sub-carrier spacing in PSCell (kHz)} | Maximum uplink transmission timing difference (µs) |
| 15 | 500 |
| 30 | 250 |
| 60 | 125 |
| 120 | 62.5 |
| 480 | 15.625 |
| 960 | 7.8125 |

## 7.6 Maximum Receive Timing Difference

### 7.6.1 Introduction

A UE shall be capable of handling a relative receive timing difference between subframe timing boundary of an E-UTRA cell belonging to the MCG and the closest slot timing boundary of a cell belonging to SCG to be aggregated for EN-DC operation.

A UE shall be capable of handling a relative receive timing difference between subframe timing boundary of an E-UTRA cell belonging to the SCG to be aggregated for NE-DC operation and the closest slot timing boundary of a cell belonging to MCG.

A UE shall be capable of handling a relative receive timing difference between slot timing boundary of a cell belonging to MCG in FR1 or FR2-1 and the closest slot timing boundary of a cell belonging to the SCG FR1 or FR2-1 to be aggregated for NR DC operation.

A UE shall be capable of handling a relative receive timing difference between subframe timing boundary of a cell belonging to MCG in FR1 and the closest subframe timing boundary of a cell belonging to the SCG in FR2-2 to be aggregated for NR DC operation.

A UE shall be capable of handling a relative receive timing difference among the closest slot timing boundaries of different carriers in FR1 and/or FR2-1 to be aggregated in NR carrier aggregation.

A UE shall be capable of handling a relative receive timing difference among the closest subframe timing boundaries of different carriers to be aggregated in FR1 and FR2-2 NR inter-band carrier aggregation.

The requirements defined in clause 7.6 are also applicable when UE is configured to receive multiple PDSCH transmission occasions from one or more QCL sources on any one of the aggregated NR carriers.

### 7.6.2 Minimum Requirements for inter-band EN-DC

The UE shall be capable of handling at least a relative receive timing difference between subframe timing of signal from a E-UTRA cell belonging to the MCG and slot timing of signal from a cell belonging to SCG at the UE receiver as shown in Table 7.6.2-1.

Table 7.6.2-1: Maximum receive timing difference requirement for asynchronous EN-DC

|  |  |  |
| --- | --- | --- |
| Sub-carrier spacing of E-UTRA cell in MCG (kHz) | DL Sub-carrier spacing of cell in SCG (kHz) (Note 1) | Maximum receive timing difference (µs) |
| 15 | 15 | 500 |
| 15 | 30 | 250 |
| 15 | 60 | 125 |
| 15 | 120Note2 | 62.5 |
| NOTE 1: DL Sub-carrier spacing is min{SCSSS, SCSDATA}.  NOTE 2: For E-UTRA FDD-NR FDD intra-band EN-DC, for which the requirement is defined in clause 7.6.3 and this Table 7.6.2-1 is also applicable, the scenario with 120 kHz does not exit. | | |

Table 7.6.2-2 Void

Table 7.6.2-3 Void

#### 7.6.2.1 Minimum Requirements for inter-band synchronous EN-DC

The requirements in this clause apply as a reference for inter-band synchronous EN-DC.

The UE shall be capable of handling at least a relative receive timing difference between subframe timing of signal from an E-UTRA cell belonging to the MCG and slot timing of signal from a cell belonging to SCG at the UE receiver for inter-band synchronous EN-DC as shown in Table 7.6.2.1-1. The requirements for synchronous EN-DC are applicable for E-UTRA TDD-NR TDD, E-UTRA FDD-NR FDD, E-UTRA TDD-NR FDD and E-UTRA FDD-NR TDD inter-band EN-DC.

Table 7.6.2.1-1: Maximum receive timing difference requirement for inter-band synchronous EN-DC

|  |  |  |
| --- | --- | --- |
| Sub-carrier spacing of E-UTRA cell in MCG (kHz) | DL Sub-carrier spacing of cell in SCG (kHz) (Note1) | Maximum receive timing difference (µs) |
| 15 | 15 | 33 |
| 15 | 30 |  |
| 15 | 60 |  |
| 15 | 120 |  |
| Note 1: DL Sub-carrier spacing is min{SCSSS, SCSDATA}. | | |

### 7.6.3 Minimum Requirements for intra-band EN-DC

For intra-band EN-DC, only co-located deployment is applied.

The UE shall be capable of handling at least a relative receive timing difference between subframe timing of signal from a E-UTRA cell belonging to the MCG and slot timing of signal from a cell belonging to the SCG as shown in Table 7.6.2-1 for E-UTRA FDD-NR FDD intra-band EN-DC provided the UE indicates that it is capable of asynchronous EN-DC operation [2].

The UE shall be capable of handling at least a relative receive timing difference between subframe timing of signal from a E-UTRA cell belonging to the MCG and slot timing of signal from a cell belonging to the SCG as shown in Table 7.6.3-1 for E-UTRA FDD-NR FDD and E-UTRA TDD-NR TDD intra-band EN-DC provided the UE does not indicate that it is capable of asynchronous FDD-FDD EN-DC operation [16].

Table 7.6.3-1 Maximum receive timing difference requirement for intra-band synchronous EN-DC

|  |  |  |
| --- | --- | --- |
| Sub-carrier spacing of E-UTRA cell in MCG (kHz) | DL Sub-carrier spacing of cell in SCG (kHz) Note1 | Maximum receive timing difference (µs) |
| 15 | 15 | 3 |
| 15 | 30 | 3 |
| 15 | 60 | 3 |
| NOTE 1: DL Sub-carrier spacing is min{SCSSS, SCSDATA}. | | |

Table 7.6.3-2: Void

### 7.6.4 Minimum Requirements for NR Carrier Aggregation

For intra-band CA, only co-located deployment is applied. For intra-band non-contiguous NR carrier aggregation, the UE shall be capable of handling at least a relative receive timing difference between slot timing of different carriers to be aggregated at the UE receiver as shown in Table 7.6.4-1 below.

Table 7.6.4-1: Maximum receive timing difference requirement for intra-band non-contiguous NR carrier aggregation

|  |  |
| --- | --- |
| Frequency Range | Maximum receive timing difference (µs) |
| FR1 | 31 |
| FR2-1 | 0.26 |
| Note 1: In the case of different SCS on different CCs, if the receive time difference exceeds the cyclic prefix length of that SCS, demodulation performance degradation is expected for the first symbol of the slot. | |

For inter-band NR carrier aggregation,

- the UE shall be capable of handling at least a relative receive timing difference between slot timing of all pairs of carriers in FR1 and FR2-1 to be aggregated at the UE receiver as shown in Table 7.6.4-2 below.

- the UE shall be capable of handling at least a relative receive timing difference between subframe timing of all pairs of carriers in FR1 and FR2-2 to be aggregated at the UE receiver as shown in Table 7.6.4-2 below.

Table 7.6.4-2: Maximum receive timing difference requirement for inter-band NR carrier aggregation

|  |  |
| --- | --- |
| Frequency Range of the pair of carriers | Maximum receive timing difference (µs) |
| FR1 | 33 |
| FR2-1 | 8 note1 |
| Between FR1 and FR2-1 | 25 |
| Between FR1 and FR2-2 | 25 |
| Note1: This requirement applies to the UE capable of independent beam management for FR2-1 inter-band CA. | |

### 7.6.5 Minimum Requirements for inter-band NE-DC

The UE shall be capable of handling at least a relative receive timing difference between slot timing of signal from a cell belonging to the MCG and subframe timing of signal from an E-UTRA cell belonging to the SCG at the UE receiver for asynchronous NE-DC as shown in Table 7.6.5-1.

Table 7.6.5-1: Maximum receive timing difference requirement for asynchronous NE-DC

|  |  |  |
| --- | --- | --- |
| Sub-carrier spacing of cell in MCG (kHz) | DL Sub-carrier spacing of EUTRA cell in SCG (kHz) (Note 1) | Maximum receive timing difference (µs) |
| 15 | 15 | 500 |
| 30 | 15 | 250 |
| 60 | 15 | 125 |
| 120 | 15 | 62.5 |
| NOTE 1: DL Sub-carrier spacing is min{SCSSS, SCSDATA}.  NOTE 2: Void | | |

The UE shall be capable of handling at least a relative receive timing difference between slot timing of signal from a cell belonging to the MCG and subframe timing of signal from a E-UTRA cell belonging to the SCG at the UE receiver for inter-band synchronous NE-DC as shown in Table 7.6.5-2. The requirements for synchronous NE-DC are applicable for NR TDD- E-UTRA TDD, NR FDD- E-UTRA FDD, NR TDD- E-UTRA FDD and NR FDD- E-UTRA TDD inter-band NE-DC.

Table 7.6.5-2: Void

#### 7.6.5.1 Minimum Requirements for inter-band synchronous NE-DC

The requirements in this clause apply as a reference for inter-band synchronous NE-DC.

The UE shall be capable of handling at least a relative receive timing difference between slot timing of signal from a cell belonging to the MCG and subframe timing of signal from a E-UTRA cell belonging to the SCG at the UE receiver for inter-band synchronous NE-DC as shown in Table 7.6.5.1-1. The requirements for synchronous NE-DC are applicable for NR TDD- E-UTRA TDD, NR FDD- E-UTRA FDD, NR TDD- E-UTRA FDD and NR FDD- E-UTRA TDD inter-band NE-DC.

Table 7.6.5.1-1: Maximum receive timing difference requirement for inter-band synchronous NE-DC

|  |  |  |
| --- | --- | --- |
| Sub-carrier spacing of cell in MCG (kHz) | DL Sub-carrier spacing of EUTRA cell in SCG (kHz) (Note1) | Maximum receive timing difference (µs) |
| 15 | 15 | 33 |
| 30 | 15 |  |
| 60 | 15 |  |
| 120 | 15 |  |

### 7.6.6 Minimum Requirements for inter-band NR DC

The UE shall be capable of handling at least a relative receive timing difference between slot timing of signal from a cell belonging to the MCG in FR1 or FR2-1 and slot timing of signal from a cell belonging to the SCG in FR1 or FR2-1 at the UE receiver as shown in Table 7.6.6-1 provided that the UE indicates that it is capable of synchronous NR DC only [16].

The UE shall be capable of handling at least a relative receive timing difference between subframe timing of signal from a cell belonging to the MCG in FR1 and subframe timing of signal from a cell belonging to the SCG in FR2-2 at the UE receiver as shown in Table 7.6.6-1 provided that the UE indicates that it is capable of synchronous NR DC only [16].

Table 7.6.6-1: Maximum receive timing difference requirement for inter-band synchronous NR DC

|  |  |  |
| --- | --- | --- |
| Frequency Range | | Maximum receive timing difference (µs) |
| Cell in MCG | Cell in SCG |  |
| FR1 | FR1 | 33 |
| FR2-1 | FR2-1 | 8 |
| FR1 | FR2-1 | 33 |
| FR1 | FR2-2 | 33 |

The UE shall be capable of handling at least a relative receive timing difference between slot timing of signal from a cell belonging to the MCG in FR1 or FR2-1 and slot timing of signal from a cell belonging to the SCG in FR1 or FR2-1 at the UE receiver as shown in Table 7.6.6-2 provided that the UE indicates that it is capable of asynchronous NR DC [16].

The UE shall be capable of handling at least a relative receive timing difference between subframe timing of signal from a cell belonging to the MCG in FR1 and subframe timing of signal from a cell belonging to the SCG in FR2-2 at the UE receiver as shown in Table 7.6.6-2 provided that the UE indicates that it is capable of asynchronous NR DC [16].

Table 7.6.6-2 Maximum receive timing difference requirement for inter-band asynchronous NR DC

|  |  |
| --- | --- |
| Max {Sub-carrier spacing in PCell (kHz), Sub-carrier spacing in PSCell (kHz)} | Maximum receive timing difference (µs) |
| 15 | 500 |
| 30 | 250 |
| 60 | 125 |
| 120 | 62.5 |
| 480 | 15.625 |
| 960 | 7.8125 |

## 7.7 *deriveSSB-IndexFromCell* tolerance

### 7.7.1 Minimum requirements

When *deriveSSB-IndexFromCell* is enabled, the UE assumes frame boundary alignment (including half frame, subframe and slot boundary alignment) across cells on the same frequency carrier is within a tolerance not worse than

- min (2 SSB symbols, 1 PDSCH symbol) for sub-carrier spacings of SSB and PDSCH up-to 240 kHz,

- min (3 SSB symbols, NPDSCH PDSCH symbols) for sub-carrier spacing of 480 kHz and 960kHz of either SSB or PDSCH where NPDSCH is defined in Table 7.7.1-1

and the SFNs of all cells on the same frequency carrier are the same.

Table 7.7.1-1 NPDSCH when deriveSSB-IndexFromCell is enabled

|  |  |  |
| --- | --- | --- |
| SSB SCS (KHz) | PDSCH SCS (KHz) | NPDSCH |
| 120 | 480 | 3 |
| 120 | 960 | 6 |
| 480 | 120 | 1 |
| 480 | 480 | 3 |
| 480 | 960 | 6 |
| 960 | 120 | 1 |
| 960 | 480 | 2 |
| 960 | 960 | 3 |

When *deriveSSB-IndexFromCell* is not enabled, the UE assumes frame boundary alignment (including half frame, subframe and slot boundary alignment) across cells on the same frequency carrier is within a tolerance not worse than 6 SSB symbols for sub-carrier spacing of 960kHz and the SFNs of all cells on the same frequency carrier are the same.

## 7.7A deriveSSB-IndexFromCell tolerance for RedCap

### 7.7A.1 Minimum requirements

When *deriveSSB-IndexFromCell* is enabled, the RedCap UE assumes frame boundary alignment (including half frame, subframe and slot boundary alignment) across cells on the same frequency carrier is within a tolerance not worse than min(2 SSB symbols, 1 PDSCH symbol) and the SFNs of all cells on the same frequency carrier are the same.

## 7.8 Void

## 7.9 *deriveSSB-IndexFromCellInter-r17* tolerance

### 7.9.1 Minimum requirements

When *deriveSSB-IndexFromCellInter-r17* is enabled, the UE assumes frame boundary alignment (including half frame, subframe and slot boundary alignment) across cells on the target carrier and reference carrier is within a tolerance not worse than min(2 SSB symbols of target carrier, 1 PDSCH symbol of the reference cell) and the SFNs of all cells on the target carrier and reference carrier are the same. The reference cell is the serving cell which is used for SSB indexes derivation.

# 8 Signalling characteristics

## 8.1 Radio Link Monitoring

### 8.1.1 Introduction

The requirements in clause 8.1 apply for radio link monitoring on:

- PCell in SA NR, NR-DC and NE-DC operation mode,

- PSCell in NR-DC and EN-DC operation mode,

- Deactivated PSCell in NR-DC and EN-DC operation mode, when configured.

The UE shall monitor the downlink radio link quality based on the reference signal configured as RLM-RS resource(s) in order to detect the downlink radio link quality of the PCell, PSCell and deactivated PSCell if configured with *bfd-and-RLM* with value *true* as specified in TS 38.213 [3]. The configured RLM-RS resources can be all SSBs, or all CSI-RSs, or a mix of SSBs and CSI-RSs. UE is not required to perform RLM outside the active DL BWP.

On each RLM-RS resource, the UE shall estimate the downlink radio link quality and compare it to the thresholds Qout and Qin for the purpose of monitoring downlink radio link quality of the cell.

When a CORESET that the UE uses for monitoring PDCCH includes two TCI states and the UE is provided *sfnSchemePdcch* set to 'sfnSchemeA' or 'sfnSchemeB', the UE shall estimate a single downlink radio link quality to derive single SNR and compare it to the single thresholds Qout and Qin for the purpose of monitoring downlink radio link quality of the cell(s). How to compute the single SNR based on two active TCI states is up to UE implementation.

The threshold Qout is defined as the level at which the downlink radio link cannot be reliably received and shall correspond to the out-of-sync block error rate (BLERout) as defined in Table 8.1.1-1. For SSB based radio link monitoring, Qout\_SSB is derived based on the hypothetical PDCCH transmission parameters listed in Table 8.1.2.1-1. For CSI-RS based radio link monitoring, Qout\_CSI-RS is derived based on the hypothetical PDCCH transmission parameters listed in Table 8.1.3.1-1.

The threshold Qin is defined as the level at which the downlink radio link quality can be received with significantly higher reliability than at Qout and shall correspond to the in-sync block error rate (BLERin) as defined in Table 8.1.1-1. For SSB based radio link monitoring, Qin\_SSB is derived based on the hypothetical PDCCH transmission parameters listed in Table 8.1.2.1-2. For CSI-RS based radio link monitoring, Qin\_CSI-RS is derived based on the hypothetical PDCCH transmission parameters listed in Table 8.1.3.1-2.

The out-of-sync block error rate (BLERout) and in-sync block error rate (BLERin) are determined from the network configuration via parameter *rlmInSyncOutOfSyncThreshold* signalled by higher layers. When UE is not configured with *rlmInSyncOutOfSyncThreshold* from the network, UE determines out-of-sync and in-sync block error rates from Configuration #0 in Table 8.1.1-1 by default. All requirements in clause 8.1 are applicable for BLER Configuration #0 in Table 8.1.1-1.

Table 8.1.1-1: Out-of-sync and in-sync block error rates

|  |  |  |
| --- | --- | --- |
| Configuration | BLERout | BLERin |
| 0 | 10% | 2% |

UE shall be able to monitor up to NRLM RLM-RS resources of the same or different types in each corresponding carrier frequency range, depending on a maximum number  of SSBs per half frame according to TS 38.213 [3], where NRLM is specified in Table 8.1.1-2 according TS 38.213 [3], and meet the requirements as specified in clause 8.1. UE is not required to meet the requirements in clause 8.1 if RLM-RS is not configured and no TCI state for PDCCH is activated.

Table 8.1.1-2: Maximum number of RLM-RS resources NRLM

|  |  |  |
| --- | --- | --- |
| Carrier frequency range of PCell/PSCell |  | Maximum number of RLM-RS resources, NRLM |
| FR1, ≤ 3 GHzNote | 4 | 2 |
| FR1, > 3 GHzNote | 8 | 4 |
| FR2 | 64 | 8 |
| NOTE: For unpaired spectrum operation with Case C - 30 kHz SCS, 3GHz is replaced by 1.88GHz, as specified in clause 4.1 in TS 38.213 [3]. | | |

#### 8.1.1.1 Introduction of Requirement on Radio Link Monitoring for UE Configured with Relaxed Measurement Criteria

For the UE supports *rlm-Relaxation-r17*and configured with explicit signaling *goodServingCellEvaluationRLM*, which is always configured to the UE when the network enables RLM relaxation for the UE as specified in TS 38.331 [2], the relaxed requirements defined in clause 8.1.2.4 for SSB based radio link monitoring and the relaxed requirements defined in clause 8.1.3.4 for CSI-RS based radio link monitoring are allowed to apply to the relaxed RLM measurements on SpCell after fulfilling the following conditions:

- for the serving cells in intra-band carrier aggregation configured with SSB-based or CSI-RS based RLM on SpCell together with CSI-RS based BFD on SCell, when

- the good serving cell quality criterion defined in clause 5.7.13.2 of TS 38.331 [2] is fulfilled for the serving cell based on the measurements that are configured for SSB-based or CSI-RS based RLM on SpCell together with CSI-RS based BFD on Scell in the intra-band carrier aggregation if the *lowMobilityEvaluationConnected* is not configured, or

- the UE is also configured with *lowMobilityEvaluationConnected* and both low mobility criterion defined in clause 5.7.13.1 of TS 38.331 [2] is fulfilled for a period of *TSearchDeltaP-Connected* and good serving cell quality criterion defined in clause 5.7.13.2 of TS 38.331 [2] is fulfilled for the serving cell based on the measurements that are configured for SSB-based or CSI-RS based RLM on SpCell together with CSI-RS based BFD on Scell in the intra-band carrier aggregation.

- for other serving cells, when

- the good serving cell quality criterion defined in clause 5.7.13.2 of TS 38.331 [2] is fulfilled for the SpCell if the *lowMobilityEvaluationConnected* is not configured, or

- the UE is also configured with *lowMobilityEvaluationConnected*  and both low mobility criterion defined in clause 5.7.13.1 of TS 38.331 [2] is fulfilled for a period of TSearchDeltaP-Connected and good serving cell quality criterion defined in clause 5.7.13.2 of TS 38.331 [2] is fulfilled for the SpCell.

otherwise, UE shall apply the requirements defined in clause 8.1.2.2 for SSB based radio link monitoring and the requirements defined in clause 8.1.3.2 for CSI-RS based radio link monitoring. Note that when multiple resources are configured on a serving cell for RLM or BFD evaluation, the good serving cell quality critierion is considered as fulfilled for the serving cell when any resource configured for the cell fulfills the good serving defined in clause 5.7.13.2 of TS 38.331 [2].

The UE is no longer allowed to relax RLM measurements and apply the relaxed radio link monitoring provided that at least one of the following conditions is met:

- The UE sends out-of sync indications to the higher layers,

- The timer T310 is running.

- No DRX is used or DRX cycle is longer than 80ms

### 8.1.2 Requirements for SSB based radio link monitoring

#### 8.1.2.1 Introduction

The requirements in this clause apply for each SSB based RLM-RS resource configured for PCell, PSCell or deactivated PSCell, provided that the SSB configured for RLM is actually transmitted within UE active DL BWP during the entire evaluation period specified in clause 8.1.2.2.

Table 8.1.2.1-1: PDCCH transmission parameters for out-of-sync evaluation

|  |  |
| --- | --- |
| Attribute | Value for BLER Configuration #0 |
| DCI format | 1-0 |
| Number of control OFDM symbols | 2 |
| Aggregation level (CCE) | 8 |
| Ratio of hypothetical PDCCH RE energy to average SSS RE energy | 4dB |
| Ratio of hypothetical PDCCH DMRS energy to average SSS RE energy | 4dB |
| Bandwidth (PRBs) | 24 |
| Sub-carrier spacing (kHz) | SCS of the active DL BWP |
| DMRS precoder granularity | REG bundle size |
| REG bundle size | 6 |
| CP length | Normal |
| Mapping from REG to CCE | Distributed |

Table 8.1.2.1-2: PDCCH transmission parameters for in-sync evaluation

|  |  |
| --- | --- |
| Attribute | Value for BLER Configuration #0 |
| DCI payload size | 1-0 |
| Number of control OFDM symbols | 2 |
| Aggregation level (CCE) | 4 |
| Ratio of hypothetical PDCCH RE energy to average SSS RE energy | 0dB |
| Ratio of hypothetical PDCCH DMRS energy to average SSS RE energy | 0dB |
| Bandwidth (PRBs) | 24 |
| Sub-carrier spacing (kHz) | SCS of the active DL BWP |
| DMRS precoder granularity | REG bundle size |
| REG bundle size | 6 |
| CP length | Normal |
| Mapping from REG to CCE | Distributed |

#### 8.1.2.2 Minimum requirement

UE shall be able to evaluate whether the downlink radio link quality on the configured RLM-RS resource estimated over the last TEvaluate\_out\_SSB [ms] period becomes worse than the threshold Qout\_SSB within TEvaluate\_out\_SSB [ms] evaluation period.

UE shall be able to evaluate whether the downlink radio link quality on the configured RLM-RS resource estimated over the last TEvaluate\_in\_SSB [ms] period becomes better than the threshold Qin\_SSB within TEvaluate\_in\_SSB [ms] evaluation period.

TEvaluate\_out\_SSB and TEvaluate\_in\_SSB are defined in Table 8.1.2.2-1 for FR1.

TEvaluate\_out\_SSB and TEvaluate\_in\_SSB are defined in Table 8.1.2.2-2 for FR2 with scaling factor N=8 for FR2-1 and N=12 for FR2-2, for FR2 power classes other than power class 6 or for FR2 class 6 when *highSpeedMeasFlagFR2-r17* is not configured

TEvaluate\_out\_SSB and TEvaluate\_in\_SSB are defined in Table 8.1.2.2-3 for FR2 power class 6 UE configured with *highSpeedMeasFlagFR2-r17*.

TEvaluate\_out\_SSB and TEvaluate\_in\_SSB are defined in Table 8.1.2.2-4 for FR1 (deactivated PSCell).

TEvaluate\_out\_SSB and TEvaluate\_in\_SSB are defined in Table 8.1.2.2-4 for FR1 (deactivated PSCell).

TEvaluate\_out\_SSB and TEvaluate\_in\_SSB are defined in Table 8.1.2.2-5 for FR2 (deactivated PSCell) with scaling factor N=8 for FR2-1 and N=12 for FR2-2.

When concurrent gaps are configured,

- P value for an RLM-RS resource to be measured is defined as

- Ntotal / Noutside\_MG in FR1

- Psharing factor \* Ntotal / Noutside\_MG in FR2 with Navailable = 0

- Ntotal / Navailable in FR2 with Navailable > 0

- For a window W of duration max(TL1, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE measurement gaps and per-FR measurement gaps within the same FR as serving cell, and starting at the beginning of any RLM-RS resource occasion:

- Ntotal is the total number of RLM-RS resource occasions within the window, including those overlapped with measurement gap occasions or SMTC occasions within the window, and

- Noutside\_MG is the number of RLM-RS resource occasions that are not overlapped with any measurement gap occasion within the window W

- Navailable is the number of RLM-RS resource occasions that are not overlapped with any measurement gap occasion nor any SMTC occasion within the window W

- TL1 is periodicity of the target RLM-RS.

Otherwise, for a UE not supporting *concurrentMeasGap-r17* or when concurrent gaps are not configured,

For FR1,

- , when in the monitored cell there are GAPs configured for intra-frequency, inter-frequency or inter-RAT measurements, and these GAPs are overlapping with some but not all occasions of the SSB; and

- P = 1 when in the monitored cell there are no GAPs overlapping with any occasion of the SSB.

For FR2

- , when RLM-RS resource is not overlapped with GAP and the RLM-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod).

- P is Psharing factor, when the RLM-RS resource is not overlapped with GAP and RLM-RS resource is fully overlapped with SMTC period (TSSB = TSMTCperiod).

- , when the RLM-RS resource is partially overlapped with GAP and the RLM-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with [measurement gap] and

- TSMTCperiod ≠ xRP or

- TSMTCperiod = xRP and TSSB < 0.5\*TSMTCperiod

- , when the RLM-RS is partially overlapped with GAP and the RLM-RS is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with [measurement gap] and TSMTCperiod = xRP and TSSB = 0.5 × TSMTCperiod

- , when the RLM-RS resource is partially overlapped with GAP and the RLM-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is partially or fully overlapped with [measurement gap]

- , when the RLM-RS resource is partially overlapped with GAP and the RLM-RS resource is fully overlapped with SMTC occasion (TSSB = TSMTCperiod) and SMTC occasion is partially overlapped with GAP (TSMTCperiod < xRP)

where,

- Psharing factor = 1, if the RLM-RS resource outside gap is

- not overlapped with the SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol before each consecutive SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol after each consecutive SSB symbols indicated by *SSB-ToMeasure*, given that *SSB-ToMeasure* is configured, where the *SSB-ToMeasure* is the union set of *SSB-ToMeasure* from all the configured measurement objects merged on the same serving carrier, and,

- not overlapped by the RSSI symbols indicated by *ss-RSSI-Measurement* and 1 data symbol before each RSSI symbol indicated by *ss-RSSI-Measurement* and 1 data symbol after each RSSI symbol indicated by *ss-RSSI-Measurement*, given that *ss-RSSI-Measurement* is configured.

- Psharing factor = 3, otherwise.

- If the high layer in TS 38.331 [2] signaling of *smtc2*is present, TSMTCperiod follows *smtc2*; Otherwise TSMTCperiod follows *smtc1.* TSMTCperiod is the shortest SMTC period among all CCs in the same FR2 band, provided the SMTC offset of all CCs in FR2 have the same offset.

- When a measurement gap is configured and the measurement gap is not NCSG,

- an RLM-RS resource or an SMTC occasion is considered to be overlapped with the GAP if it overlaps a measurement gap occasion, and

- xRP = MGRP

- Otherwise,when NCSG measurement gap is configured,

- an RLM-RS resource or an SMTC occasion is considered to be overlapped with the GAP if

- it overlaps the VIL1 or VIL2 of NCSG, or

- it overlaps the ML of NCSG in FR2, and there exists a target carrier to be measured within NCSG that is intra-frequency carrier or inter-frequency carrier in the same band as the serving cell, or inter-frequency carrier in different band as the serving cell and UE does not support IBM between the target carrier and the serving cell,

- and

- xRP = VIRP

- If the UE is configured with Pre-MG, an RLM-RS resource or an SMTC occasion is only considered to be overlapped by the Pre-MG if the Pre-MG is activated.

- When concurrent gaps are configured, an RLM-RS or an SMTC occasion is not considered as overlapped by a gap occasion if the gap occasion is dropped according to 9.1.8.

If the high layer in TS 38.331 [2] signaling of *smtc2*is present, TSMTCperiod follows *smtc2*; Otherwise TSMTCperiod follows *smtc1.*

Longer evaluation period would be expected if the combination of RLM-RS resource, SMTC occasion and GAP configurations does not meet previous conditions

For either an FR1 or FR2 serving cell, longer evaluation period would be expected during the period Tidentify\_CGI when the UE is requested to decode an NR CGI.

For either an FR1 or FR2 serving cell, longer evaluation period would be expected during the period Tidentify\_CGI,E-UTRAN when the UE is requested to decode an LTE CGI.

Table 8.1.2.2-1: Evaluation period TEvaluate\_out\_SSB and TEvaluate\_in\_SSB for FR1

|  |  |  |
| --- | --- | --- |
| Configuration | TEvaluate\_out\_SSB (ms) | TEvaluate\_in\_SSB (ms) |
| no DRX | Max(200, Ceil(10 × P) × TSSB) | Max(100, Ceil(5 × P) × TSSB) |
| DRX cycle≤320ms | Max(200, Ceil(15 × P) × Max(TDRX,TSSB)) | Max(100, Ceil(7.5 × P) × Max(TDRX,TSSB)) |
| DRX cycle>320ms | Ceil(10 × P) × TDRX | Ceil(5 × P) × TDRX |
| NOTE: TSSB is the periodicity of the SSB configured for RLM. TDRX is the DRX cycle length. | | |

Table 8.1.2.2-2: Evaluation period TEvaluate\_out\_SSB and TEvaluate\_in\_SSB for FR2

|  |  |  |
| --- | --- | --- |
| Configuration | TEvaluate\_out\_SSB (ms) | TEvaluate\_in\_SSB (ms) |
| no DRX | Max(200, Ceil(10 × P × N) × TSSB) | Max(100, Ceil(5 × P × N) × TSSB) |
| DRX cycle≤320ms | Max(200, Ceil(15 × P × N) × Max(TDRX,TSSB)) | Max(100, Ceil(7.5 × P × N) × Max(TDRX,TSSB)) |
| DRX cycle>320ms | Ceil(10 × P × N) × TDRX | Ceil(5 × P × N) × TDRX |
| NOTE: TSSB is the periodicity of the SSB configured for RLM. TDRX is the DRX cycle length. | | |

Table 8.1.2.2-3: Evaluation period TEvaluate\_out\_SSB and TEvaluate\_in\_SSB for FR2 power class 6 UE configured with *highSpeedMeasFlagFR2-r17*

|  |  |  |
| --- | --- | --- |
| Configuration | TEvaluate\_out\_SSB (ms) | TEvaluate\_in\_SSB (ms) |
| no DRX | Max(200, Ceil(10 × P × N Note2) × TSSB) | Max(100, Ceil(5 × P × N Note2) × TSSB) |
| DRX cycle≤80ms | Max(200, Ceil(15 × P × N Note2) × Max(TDRX,TSSB)) | Max(100, Ceil(7.5 × P × N Note2) × Max(TDRX,TSSB)) |
| NOTE 1: TSSB is the periodicity of the SSB configured for RLM. TDRX is the DRX cycle length.  NOTE 2: scaling factor N=2 when *highSpeedMeasFlagFR2-r17* is configured to set1 or scaling factor N=6 when *highSpeedMeasFlagFR2-r17* is configured to set2. | | |

Table 8.1.2.2-4: Evaluation period TEvaluate\_out\_SSB and TEvaluate\_in\_SSB for FR1(deactivated PSCell)

|  |  |  |
| --- | --- | --- |
| Configuration | TEvaluate\_out\_SSB (ms) | TEvaluate\_in\_SSB (ms) |
| no DRX | Ceil(10 × P) × measCyclePSCell | Ceil(5 × P) × measCyclePSCell |
| DRX cycle≤ 320ms | Ceil(15 × P) × Max(TDRX, measCyclePSCell) | Ceil(7.5 × P) × Max(TDRX, measCyclePSCell) |
| DRX cycle> 320ms | Ceil(10 × P) × Max(TDRX, measCyclePSCell) | Ceil(5 × P) × Max(TDRX, measCyclePSCell) |
| NOTE: TDRX is the DRX cycle length of SCG. measCyclePSCell is the measurement cycle length of the deactivated PSCell. | | |

Table 8.1.2.2-5: Evaluation period TEvaluate\_out\_SSB and TEvaluate\_in\_SSB for FR2(deactivated PSCell)

|  |  |  |
| --- | --- | --- |
| Configuration | TEvaluate\_out\_SSB (ms) | TEvaluate\_in\_SSB (ms) |
| no DRX | Ceil(10 × P× N) × measCyclePSCell | Ceil(5 × P× N) × measCyclePSCell |
| DRX cycle≤ 320 ms | Ceil(15 × P× N) × Max(TDRX, measCyclePSCell) | Ceil(7.5 × P× N) × Max(TDRX, measCyclePSCell) |
| DRX cycle> 320 ms | Ceil(10 × P× N) × Max(TDRX, measCyclePSCell) | Ceil(5 × P× N) × Max(TDRX, measCyclePSCell) |
| NOTE: TDRX is the DRX cycle length of SCG. measCyclePSCell is the measurement cycle length of the deactivated PSCell. | | |

#### 8.1.2.3 Measurement restrictions for SSB based RLM

The UE is required to be capable of measuring SSB for RLM without measurement gaps. The UE is required to perform the SSB measurements with measurement restrictions as described in the following scenarios.

For FR1, when the SSB for RLM is in the same OFDM symbol as CSI-RS for RLM, BFD, CBD or L1-RSRP measurement,

- If SSB and CSI-RS have same SCS, UE shall be able to measure the SSB for RLM without any restriction;

- If SSB and CSI-RS have different SCS,

- If UE supports *simultaneousRxDataSSB-DiffNumerology*, UE shall be able to measure the SSB for RLM without any restriction;

- If UE does not support *simultaneousRxDataSSB-DiffNumerology*, UE is required to measure one of but not both SSB for RLM and CSI-RS. Longer measurement period for SSB based RLM is expected, and no requirements are defined

For FR2, when the SSB for RLM measurement on one CC is in the same OFDM symbol as CSI-RS for RLM, BFD, CBD or L1-RSRP measurement on the same CC or different CCs in the same band, UE is required to measure one of but not both SSB for RLM and CSI-RS. Longer measurement period for SSB based RLM is expected, and no requirements are defined.

For FR2, there is no measurement restriction allowed when the network configures mixed numerology between SSB for RLM measurement on one FR2 band and CSI-RS for RLM, BFD, CBD, L1-RSRP or L1-SINR measurement on the other FR2 band, provided that UE is capable of independent beam management on this FR2 band pair.

#### 8.1.2.4 Minimum requirement of SSB based radio link monitoring for UE fulfilling relaxed measurement criteria

This clause contains minimum requirements for relaxed radio link monitoring based on SSB.

UE shall be able to evaluate whether the downlink radio link quality on the configured RLM-RS resource estimated over the last TEvaluate\_out\_SSB\_Relax [ms] period becomes worse than the threshold Qout\_SSB within TEvaluate\_out\_SSB\_Relax [ms] evaluation period.

TEvaluate\_out\_SSB\_Relax is defined in Table 8.1.2.4-1 for FR1.

TEvaluate\_out\_SSB\_Relax is defined in Table 8.1.2.4-2 for FR2 with scaling factor N=8.

The value of P is defined in clause 8.1.2.2.

Longer evaluation period would be expected if the combination of RLM-RS resource, SMTC occasion and measurement gap configurations does not meet previous conditions.

For either an FR1 or FR2 serving cell, longer evaluation period would be expected during the period Tidentify\_CGI when the UE is requested to decode an NR CGI.

For either an FR1 or FR2 serving cell, longer evaluation period would be expected during the period Tidentify\_CGI,E-UTRAN when the UE is requested to decode an LTE CGI.

Table 8.1.2.4-1: Evaluation period TEvaluate\_out\_SSB\_Relax for FR1

|  |  |
| --- | --- |
| Configuration | TEvaluate\_out\_SSB\_Relax (ms) |
| Max(TDRX,TSSB) ≤80ms | Max(200× K3 NOTE3, Ceil(15 × K1NOTE2 × P) × Max(TDRX,TSSB)) |
| 80ms < Max(TDRX,TSSB) ≤160ms | Ceil(15 × P) × Max(TDRX,TSSB) |
| NOTE 1: TSSB is the periodicity of the SSB configured for RLM. TDRX is the DRX cycle length and no longer than 80ms.  NOTE 2: K1 = 4 for Max(TDRX,TSSB) ≤40ms and K1 = 2 for 40ms<Max(TDRX,TSSB) ≤80ms.  NOTE 3: K3 = K1, if K1 ≤ 2; otherwise K3 = 1. | |

Table 8.1.2.4-2: Evaluation period TEvaluate\_out\_SSB\_Relax for FR2

|  |  |
| --- | --- |
| Configuration | TEvaluate\_out\_SSB\_Relax (ms) |
| Max(TDRX,TSSB) ≤80ms | Max(200× K4 NOTE3, Ceil(15 × K2 NOTE2 × P × N) × Max(TDRX,TSSB)) |
| 80ms < Max(TDRX,TSSB) ≤160ms | Ceil(15 × P × N) × Max(TDRX,TSSB) |
| NOTE 1: TSSB is the periodicity of the SSB configured for RLM. TDRX is the DRX cycle length and no longer than 80ms.  NOTE 2: K2 = 2.  NOTE 3: K4 = K2, if K2 ≤ 2; otherwise K4 = 1. | |

### 8.1.3 Requirements for CSI-RS based radio link monitoring

#### 8.1.3.1 Introduction

The requirements in this clause apply for each CSI-RS based RLM-RS resource configured for PCell, PSCell or deactivated PSCell, provided that the CSI-RS configured for RLM is actually transmitted within UE active DL BWP during the entire evaluation period specified in clause 8.1.3.2. UE is not expected to perform radio link monitoring measurements on the CSI-RS configured as RLM-RS if the CSI-RS is not in the active TCI state of any CORESET configured in the UE active BWP.

Table 8.1.3.1-1: PDCCH transmission parameters for out-of-sync evaluation

|  |  |
| --- | --- |
| Attribute | Value for BLER Configuration #0 |
| DCI format | 1-0 |
| Number of control OFDM symbols | 2 |
| Aggregation level (CCE) | 8 |
| Ratio of hypothetical PDCCH RE energy to average CSI-RS RE energy | 4dB |
| Ratio of hypothetical PDCCH DMRS energy to average CSI-RS RE energy | 4dB |
| Bandwidth (PRBs) | 48 |
| Sub-carrier spacing (kHz) | SCS of the active DL BWP |
| DMRS precoder granularity | REG bundle size |
| REG bundle size | 6 |
| CP length | Normal |
| Mapping from REG to CCE | Distributed |

Table 8.1.3.1-2: PDCCH transmission parameters for in-sync evaluation

|  |  |
| --- | --- |
| Attribute | Value for BLER Configuration #0 |
| DCI payload size | 1-0 |
| Number of control OFDM symbols | 2 |
| Aggregation level (CCE) | 4 |
| Ratio of hypothetical PDCCH RE energy to average CSI-RS RE energy | 0dB |
| Ratio of hypothetical PDCCH DMRS energy to average CSI-RS RE energy | 0dB |
| Bandwidth (PRBs) | 48 |
| Sub-carrier spacing (kHz) | SCS of the active DL BWP |
| DMRS precoder granularity | REG bundle size |
| REG bundle size | 6 |
| CP length | Normal |
| Mapping from REG to CCE | Distributed |

#### 8.1.3.2 Minimum requirement

UE shall be able to evaluate whether the downlink radio link quality on the configured RLM-RS resource estimated over the last TEvaluate\_out\_CSI-RS ms period becomes worse than the threshold Qout\_CSI-RS within TEvaluate\_out\_CSI-RS ms evaluation period.

UE shall be able to evaluate whether the downlink radio link quality on the configured RLM-RS resource estimated over the last TEvaluate\_in\_CSI-RS ms period becomes better than the threshold Qin\_CSI-RS within TEvaluate\_in\_CSI-RS ms evaluation period.

- TEvaluate\_out\_CSI-RS and TEvaluate\_in\_CSI-RS are defined in Table 8.1.3.2-1 for FR1.

- TEvaluate\_out\_CSI-RS and TEvaluate\_in\_CSI-RS are defined in Table 8.1.3.2-2 for FR2 with scaling factor N=1.

- TEvaluate\_out\_CSI-RS and TEvaluate\_in\_CSI-RS are defined in Table 8.1.3.2-3 for FR1 (deactivated PSCell).

- TEvaluate\_out\_CSI-RS and TEvaluate\_in\_CSI-RS are defined in Table 8.1.3.2-4 for FR2 (deactivated PSCell) with scaling factor N=1.

The requirements of TEvaluate\_out\_CSI-RS and TEvaluate\_in\_CSI-RS apply provided that the CSI-RS for RLM is not in a resource set configured with repetition ON. The requirements do not apply when the CSI-RS resource in the active TCI state of CORESET is the same CSI-RS resource for RLM and the TCI state information of the CSI-RS resource is not given, wherein the TCI state information means QCL Type-D to SSB for L1-RSRP or CSI-RS with repetition ON.

When concurrent gaps are configured,

- P value for an RLM-RS resource to be measured is defined as

- Ntotal / Noutside\_MG in FR1

- Psharing factor \* Ntotal / Noutside\_MG in FR2 with Navailable = 0

- Ntotal / Navailable in FR2 with Navailable > 0

- For a window W of duration max(TL1, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE measurement gaps and per-FR measurement gaps within the same FR as serving cell, and starting at the beginning of any RLM-RS resource occasion:

- Ntotal is the total number of RLM-RS resource occasions within the window, including those overlapped with measurement gap occasions or SMTC occasions within the window, and

- Noutside\_MG is the number of RLM-RS resource occasions that are not overlapped with any measurement gap occasion within the window W

- Navailable is the number of RLM-RS resource occasions that are not overlapped with any measurement gap occasion nor any SMTC occasion within the window W

- TL1 is periodicity of the target RLM-RS.Otherwise, for a UE not supporting *concurrentMeasGap-r17* or when concurrent gaps are not configured,

For FR1,

- , when in the monitored cell there are GAPs configured for intra-frequency, inter-frequency or inter-RAT measurements, and these GAPs] are overlapping with some but not all occasions of the CSI-RS; and

- P=1 when in the monitored cell there are no GAPs overlapping with any occasion of the CSI-RS.

For FR2,

- P=1, when the RLM-RS resource is not overlapped with measurement gap and also not overlapped with SMTC occasion.

- , when the RLM-RS resource is partially overlapped with GAP and the RLM-RS resource is not overlapped with SMTC occasion (TCSI-RS < xRP)

- , when the RLM-RS resource is not overlapped with GAP and the RLM-RS resource is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod).

- P = Psharing factor, when the RLM-RS resource is not overlapped with GAP and RLM-RS resource is fully overlapped with SMTC occasion (TCSI-RS = TSMTCperiod).

- , when the RLM-RS resource is partially overlapped with GAP and the RLM-RS resource is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is not overlapped with GAP and

- TSMTCperiod ≠ xRP or

- TSMTCperiod = xRP and TCSI-RS < 0.5 × TSMTCperiod

- , when the RLM-RS resource is partially overlapped with measurement gap and the RLM-RS resource is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is not overlapped with GAP and TSMTCperiod = xRP and TCSI-RS = 0.5 × TSMTCperiod

- , when the RLM-RS resource is partially overlapped with GAP and the RLM-RS resource is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is partially or fully overlapped with GAP

- , when the RLM-RS resource is partially overlapped with measurement gap and the RLM-RS resource is fully overlapped with SMTC occasion (TCSI-RS = TSMTCperiod) and SMTC occasion is partially overlapped with measurement gap (TSMTCperiod < xRP)

where,

- Psharing factor = 1, if the RLM-RS resource outside gap is

- not overlapped with the SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol before each consecutive SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol after each consecutive SSB symbols indicated by *SSB-ToMeasure*, given that *SSB-ToMeasure* is configured, where the *SSB-ToMeasure* is the union set of *SSB-ToMeasure* from all the configured measurement objects merged on the same serving carrier, and,

- not overlapped by the RSSI symbols indicated by *ss-RSSI-Measurement* and 1 data symbol before each RSSI symbol indicated by *ss-RSSI-Measurement* and 1 data symbol after each RSSI symbol indicated by *ss-RSSI-Measurement*, given that *ss-RSSI-Measurement* is configured.

- Psharing factor = 3, otherwise.

- If the high layer in TS 38.331 [2] signaling of *smtc2*is present, TSMTCperiod follows *smtc2*; Otherwise TSMTCperiod follows *smtc1.* TSMTCperiod is the shortest SMTC period among all CCs in the same FR2 band, provided the SMTC offset of all CCs in FR2 have the same offset.

- When a measurement gap is configured and the measurement gap is not NCSG,

- an RLM-RS resource or an SMTC occasion is considered to be overlapped with the GAP if it overlaps a measurement gap occasion, and

- xRP = MGRP

- Otherwise, when NCSG measurement gap is configured,

- an RLM-RS resource or an SMTC occasion is considered to be overlapped with the GAP if

- it overlaps the VIL1 or VIL2 of NCSG, or

- it overlaps the ML of NCSG in FR2, and there exists a target carrier to be measured within NCSG that is intra-frequency carrier or inter-frequency carrier in the same band as the serving cell, or inter-frequency carrier in different band as the serving cell and UE does not support IBM between the target carrier and the serving cell,

- and

- xRP = VIRP

If the UE is configured with Pre-MG, an RLM-RS resource or an SMTC occasion is only considered to be overlapped by the Pre-MG if the Pre-MG is activated.

When concurrent gaps are configured, an RLM-RS or an SMTC occasion is not considered to be overlapped by a gap occasion if the gap occasion is dropped according to 9.1.8.

If the high layer in TS 38.331 [2] signaling of *smtc2*is present, TSMTCperiod follows *smtc2*; Otherwise TSMTCperiod follows *smtc1.*

Note: The overlap between CSI-RS for RLM and SMTC means that CSI-RS based RLM is within the SMTC window duration.

Longer evaluation period would be expected if the combination of RLM-RS resource, SMTC occasion and GAP configurations does not meet previous conditions.

For either an FR1 or FR2 serving cell, longer evaluation period would be expected during the period Tidentify\_CGI when the UE is requested to decode an NR CGI.

For either an FR1 or FR2 serving cell, longer evaluation period would be expected during the period Tidentify\_CGI,E-UTRAN when the UE is requested to decode an LTE CGI.

The values of Mout and Min used in Table 8.1.3.2-1, Table 8.1.3.2-2, Table 8.1.3.2-3 and Table 8.1.3.2-4 are defined as:

- Mout = 20 and Min = 10, if the CSI-RS resource configured for RLM is transmitted with higher layer CSI-RS parameter *density* [6, clause 7.4.1] set to 3 and over the bandwidth ≥ 24 PRBs.

Table 8.1.3.2-1: Evaluation period TEvaluate\_out\_CSI-RS and TEvaluate\_in\_CSI-RS for FR1

|  |  |  |
| --- | --- | --- |
| Configuration | TEvaluate\_out\_CSI-RS (ms) | TEvaluate\_in\_CSI-RS (ms) |
| no DRX | Max(200, Ceil(Mout×P)×TCSI-RS) | Max(100, Ceil(Min×P) × TCSI-RS) |
| DRX ≤ 320ms | Max(200, Ceil(1.5×Mout×P)× Max(TDRX, TCSI-RS)) | Max(100, Ceil(1.5×Min×P)× Max(TDRX, TCSI-RS)) |
| DRX > 320ms | Ceil(Mout×P) × TDRX | Ceil(Min×P) × TDRX |
| NOTE: TCSI-RS is the periodicity of the CSI-RS resource configured for RLM. The requirements in this table apply for TCSI-RS equal to 5 ms, 10ms, 20 ms or 40 ms. TDRX is the DRX cycle length. | | |

Table 8.1.3.2-2: Evaluation period TEvaluate\_out\_CSI-RS and TEvaluate\_in\_CSI-RS for FR2

|  |  |  |
| --- | --- | --- |
| Configuration | TEvaluate\_out\_CSI-RS (ms) | TEvaluate\_in\_CSI-RS (ms) |
| no DRX | Max(200, Ceil(Mout×P×N)×TCSI-RS) | Max(100, Ceil(Min×P×N) × TCSI-RS) |
| DRX ≤ 320ms | Max(200, Ceil(1.5×Mout×P×N)× Max(TDRX, TCSI-RS)) | Max(100, Ceil(1.5×Min×P×N)× Max(TDRX, TCSI-RS)) |
| DRX > 320ms | Ceil(Mout×P×N) × TDRX | Ceil(Min×P×N) × TDRX |
| NOTE: TCSI-RS is the periodicity of the CSI-RS resource configured for RLM. The requirements in this table apply for TCSI-RS equal to 5 ms, 10 ms, 20 ms or 40 ms. TDRX is the DRX cycle length. | | |

Table 8.1.3.2-3: Evaluation period TEvaluate\_out\_CSI-RS and TEvaluate\_in\_CSI-RS for FR1 (deactivated PSCell)

|  |  |  |
| --- | --- | --- |
| Configuration | TEvaluate\_out\_CSI-RS (ms) | TEvaluate\_in\_CSI-RS (ms) |
| no DRX | Ceil(Mout×P) × measCyclePSCell | Ceil(Min×P) × measCyclePSCell |
| DRX ≤ 320ms | Ceil(1.5 ×Mout×P) × Max(TDRX, measCyclePSCell) | Ceil(1.5 ×Min×P) × Max(TDRX, measCyclePSCell) |
| DRX > 320ms | Ceil(Mout×P) × Max(TDRX, measCyclePSCell) | Ceil(Min×P) × Max(TDRX, measCyclePSCell) |
| NOTE: TDRX is the DRX cycle length of SCG. measCyclePSCell is the measurement cycle length of the deactivated PSCell. | | |

Table 8.1.3.2-4: Evaluation period TEvaluate\_out\_CSI-RS and TEvaluate\_in\_CSI-RS for FR2 (deactivated PSCell)

|  |  |  |
| --- | --- | --- |
| Configuration | TEvaluate\_out\_CSI-RS (ms) | TEvaluate\_in\_CSI-RS (ms) |
| no DRX | Ceil(Mout×P×N) × measCyclePSCell | Ceil(Min×P×N) × measCyclePSCell |
| DRX ≤ 320ms | Ceil(1.5 × Mout×P×N) × Max(TDRX, measCyclePSCell) | Ceil(1.5 × Min×P×N) × Max(TDRX, measCyclePSCell) |
| DRX > 320ms | Ceil(Mout×P×N) × Max(TDRX, measCyclePSCell) | Ceil(Min×P×N) × Max(TDRX, measCyclePSCell) |
| NOTE: TDRX is the DRX cycle length of SCG. measCyclePSCell is the measurement cycle length of the deactivated PSCell. | | |

#### 8.1.3.3 Measurement restrictions for CSI-RS based RLM

The UE is required to be capable of measuring CSI-RS for RLM without measurement gaps. The UE is required to perform the CSI-RS measurements with measurement restrictions as described in the following clauses.

For both FR1 and FR2, when the CSI-RS for RLM is in the same OFDM symbol as SSB for RLM, BFD, CBD or L1-RSRP measurement, UE is not required to receive CSI-RS for RLM in the PRBs that overlap with an SSB.

For FR1, when the SSB for RLM, BFD, CBD, or L1-RSRP measurement is within the active BWP and has same SCS than CSI-RS for RLM, the UE shall be able to perform CSI-RS measurement without restrictions.

For FR1, when the SSB for RLM, BFD, CBD or L1-RSRP measurement is within the active BWP and has different SCS than CSI-RS for RLM, the UE shall be able to perform CSI-RS measurement with restrictions according to its capabilities:

- If the UE supports *simultaneousRxDataSSB-DiffNumerology* the UE shall be able to perform CSI-RS for RLM measurement without restrictions.

- If the UE does not support *simultaneousRxDataSSB-DiffNumerology*, UE is required to measure one of but not both CSI-RS for RLM and SSB. Longer measurement period for CSI-RS based RLM is expected, and no requirements are defined.

For FR1, when the CSI-RS for RLM is in the same OFDM symbol as another CSI-RS for RLM, BFD, CBD or L1-RSRP measurement, UE shall be able to measure the CSI-RS for RLM without any restriction.

For FR2, when the CSI-RS for RLM measurement on one CC is in the same OFDM symbol as SSB for RLM, BFD, or L1-RSRP measurement on the same CC or different CCs in the same band, or in the same symbol as SSB for CBD measurement on the same CC or different CCs in the same band when beam failure is detected, UE is required to measure one of but not both CSI-RS for RLM and SSB. Longer measurement period for CSI-RS based RLM is expected, and no requirements are defined.

For FR2, when the CSI-RS for RLM measurement on one CC is in the same OFDM symbol as another CSI-RS for RLM, BFD, CBD or L1-RSRP measurement on the same CC or different CCs in the same band,

- In the following cases, UE is required to measure one of but not both CSI-RS for RLM and the other CSI-RS. Longer measurement period for CSI-RS based RLM is expected, and no requirements are defined.

- The CSI-RS for RLM or the other CSI-RS in a resource set configured with repetition ON, or

- The other CSI-RS is configured in q1 and beam failure is detected, or

- The two CSI-RS-es are not QCL-ed w.r.t. QCL-TypeD, or the QCL information is not known to UE,

- Otherwise, UE shall be able to measure the CSI-RS for RLM without any restriction.

#### 8.1.3.4 Minimum requirement of CSI-RS based radio link monitoring for UE fulfilling relaxed measurement criteria

This clause contains minimum requirements for relaxed radio link monitoring based on CSI-RS.

UE shall be able to evaluate whether the downlink radio link quality on the configured RLM-RS resource estimated over the last TEvaluate\_out\_CSI-RS\_Relax [ms] period becomes worse than the threshold Qout\_CSI-RS within TEvaluate\_out\_CSI-RS\_Relax [ms] evaluation period.

TEvaluate\_out\_CSI-RS\_Relax is defined in Table 8.1.3.4-1 for FR1.

TEvaluate\_out\_CSI-RS\_Relax is defined in Table 8.1.3.4-2 for FR2 with scaling factor N=1.

The value of P is defined in clause 8.1.3.2.

Longer evaluation period would be expected if the combination of RLM-RS resource, SMTC occasion and measurement gap configurations does not meet previous conditions.

For either an FR1 or FR2 serving cell, longer evaluation period would be expected during the period Tidentify\_CGI when the UE is requested to decode an NR CGI.

For either an FR1 or FR2 serving cell, longer evaluation period would be expected during the period Tidentify\_CGI,E-UTRAN when the UE is requested to decode an LTE CGI.

The values of Mout used in Table 8.1.3.4-1 and Table 8.1.3.4-2 are defined as:

- Mout = 20, if the CSI-RS resource configured for RLM is transmitted with higher layer CSI-RS parameter *density* [6, clause 7.4.1] set to 3 and over the bandwidth ≥ 24 PRBs.

Table 8.1.3.4-1: Evaluation period TEvaluate\_out\_CSI-RS\_Relax for FR1

|  |  |
| --- | --- |
| Configuration | TEvaluate\_out\_CSI-RS\_Relax (ms) |
| Max(TDRX, TCSI-RS) ≤ 80 ms | Max(200 × K3 NOTE3, Ceil(1.5 × Mout × P × K1 NOTE2) × Max(TDRX, TCSI-RS) NOTE1) |
| NOTE1: TCSI-RS is the periodicity of the CSI-RS resource configured for RLM. The requirements in this table apply for TCSI-RS equal to 5 ms, 10ms, 20 ms or 40 ms. TDRX is the DRX cycle length and no longer than 80ms.  NOTE2: K1 = 2 for 40 ms < MAX(TDRX, TCSI-RS) ≤ 80 ms, K1 = 4 for MAX(TDRX, TCSI-RS) ≤ 40 ms  NOTE3: K3 = K1, if K1 ≤ 2; K3 = 1 otherwise. | |

Table 8.1.3.4-2: Evaluation period TEvaluate\_out\_CSI-RS\_Relax for FR2

|  |  |
| --- | --- |
| Configuration | TEvaluate\_out\_CSI-RS\_Relax (ms) |
| Max(TDRX, TCSI-RS) ≤ 80 ms | Max(200 × K4 NOTE3, Ceil(1.5 × Mout × P × N × K2 NOTE2) × Max(TDRX, TCSI-RS) NOTE1) |
| NOTE1: TCSI-RS is the periodicity of the CSI-RS resource configured for RLM. The requirements in this table apply for TCSI-RS equal to 5 ms, 10 ms, 20 ms or 40 ms. TDRX is the DRX cycle length and no longer than 80ms.  NOTE2: K2 = 2.  NOTE3: K4 = K2, if K2 ≤ 2; K4 = 1 otherwise. | |

### 8.1.4 Minimum requirement at transitions

When the UE transitions between DRX and no DRX or when DRX cycle periodicity changes, for each RLM-RS resource, for a duration of time equal to the evaluation period corresponding to the second mode after the transition occurs, the UE shall use an evaluation period that is no less than the minimum of evaluation period corresponding to the first mode and the second mode. Subsequent to this duration, the UE shall use an evaluation period corresponding to the second mode for each RLM-RS resource. This requirement shall be applied to both out-of-sync evaluation and in-sync evaluation of the monitored cell.

When the UE transitions from a first configuration of RLM resources to a second configuration of RLM resources that is different from the first configuration, for each RLM resource present in the second configuration, for a duration of time equal to the evaluation period corresponding to the second configuration after the transition occurs, the UE shall use an evaluation period that is no less than the minimum of evaluation periods corresponding to the first configuration and the second configuration. Subsequent to this duration, the UE shall use an evaluation period corresponding to the second configuration for each RLM resource present in the second configuration. This requirement shall be applied to both out-of-sync evaluation and in-sync evaluation of the monitored cell.

When the UE transitions from a first configuration of active TCI state of the CORESET to a second configuration of active TCI state of the CORESET, for each CSI-RS for RLM present in the second configuration, the UE shall use an evaluation period corresponding to the second configuration from the time of transition. This requirement shall be applied to both out-of-sync evaluation and in-sync evaluation of the monitored cell.

### 8.1.5 Minimum requirement for UE turning off the transmitter

The transmitter power of the UE in the monitored cell shall be turned off within 40ms after expiry of T310 timer as specified in TS 38.331 [2].

### 8.1.6 Minimum requirement for L1 indication

When the downlink radio link quality on all the configured RLM-RS resources is worse than Qout, layer 1 of the UE shall send an out-of-sync indication for the cell to the higher layers. A layer 3 filter shall be applied to the out-of-sync indications as specified in TS 38.331 [2].

When the downlink radio link quality on at least one of the configured RLM-RS resources is better than Qin, layer 1 of the UE shall send an in-sync indication for the cell to the higher layers. A layer 3 filter shall be applied to the in-sync indications as specified in TS 38.331 [2].

The out-of-sync and in-sync evaluations for the configured RLM-RS resources shall be performed as specified in clause 5 in TS 38.213 [3]. Two successive indications from layer 1 shall be separated by at least TIndication\_interval.

When DRX is not used TIndication\_interval is max(10ms, TRLM-RS,M), where TRLM-RS,M is the shortest periodicity of all configured RLM-RS resources for the monitored cell, which corresponds to TSSB specified in clause 8.1.2 if the RLM-RS resource is SSB, or TCSI-RS specified in clause 8.1.3 if the RLM-RS resource is CSI-RS.

In case DRX is used, TIndication\_interval is Max(10ms, 1.5 × DRX\_cycle\_length, 1.5 × TRLM-RS,M)) if DRX cycle\_length is less than or equal to 320ms, and TIndication\_interval is DRX\_cycle\_length if DRX cycle\_length is greater than 320ms. Upon start of T310 timer as specified in TS 38.331 [2], the UE shall monitor the configured RLM-RS resources for recovery using the evaluation period and layer 1 indication interval corresponding to the no DRX mode until the expiry or stop of T310 timer.

For deactivated PSCell, when DRX is not used TIndication\_interval is Max (10ms, *measCyclePSCell*). In case DRX is used, TIndication\_interval is Max(10ms, 1.5 × DRX\_cycle\_length, 1.5 × *measCyclePSCell*)) if DRX cycle\_length is less than or equal to 320ms, and TIndication\_interval is Max (DRX\_cycle\_length, *measCyclePSCell*) if DRX cycle\_length is greater than 320ms.

### 8.1.7 Scheduling availability of UE during radio link monitoring

When the reference signal to be measured for RLM has different subcarrier spacing than PDSCH/PDCCH or is on frequency range 2, there are restrictions on the scheduling availability as described in the following clauses.

#### 8.1.7.1 Scheduling availability of UE performing radio link monitoring with a same subcarrier spacing as PDSCH/PDCCH on FR1

There are no scheduling restrictions due to radio link monitoring performed with a same subcarrier spacing as PDSCH/PDCCH on FR1.

#### 8.1.7.2 Scheduling availability of UE performing radio link monitoring with a different subcarrier spacing than PDSCH/PDCCH on FR1

For UEs which support *simultaneousRxDataSSB-DiffNumerology* [14] there are no restrictions on scheduling availability due to radio link monitoring based on SSB as RLM-RS. For UEs which do not support *simultaneousRxDataSSB-DiffNumerology* [14] the following restrictions apply due to radio link monitoring based on SSB as RLM -RS.

- The UE is not expected to transmit PUCCH, PUSCH or SRS or receive PDCCH, PDSCH or CSI-RS for tracking or CSI-RS for CQI on SSB symbols to be measured for radio link monitoring.

When intra-band carrier aggregation in FR1 is performed, the scheduling restrictions on FR1 serving PCell or PSCell applies to all serving cells in the same band on the symbols that fully or partially overlap with the restricted symbols. When inter-band carrier aggregation within FR1 is performed, there are no scheduling restrictions on FR1 serving cell(s) in the bands due to radio link monitoring performed on FR1 serving PCell or PSCell in different bands.

#### 8.1.7.3 Scheduling availability of UE performing radio link monitoring on FR2

The following scheduling restriction applies due to radio link monitoring on an FR2 serving PCell and/or PSCell.

- If the RLM-RS is CSI-RS which is type-D QCLed with active TCI state for PDCCH or PDSCH, and the CSI-RS is not in a CSI-RS resource set with repetition ON,

- There are no scheduling restrictions due to radio link monitoring based on the CSI-RS.

- Otherwise

- For FR2-1 or the RLM-RS is not using 480 kHz SCS or 960 kHz SCS on FR2-2, the UE is not expected to transmit PUCCH, PUSCH or SRS or receive PDCCH, PDSCH or CSI-RS for tracking or CSI-RS for CQI on RLM-RS symbols to be measured for radio link monitoring.

- For FR2-2 and the RLM-RS is using 480 kHz SCS or 960 kHz SCS, the UE is not expected to transmit PUCCH, PUSCH or SRS or receive PDCCH, PDSCH or CSI-RS for tracking or CSI-RS for CQI on RLM-RS symbols to be measured for radio link monitoring, and on one data symbol before each RLM-RS symbol to be measured and one data symbol after each RLM-RS symbol to be measured.

When intra-band carrier aggregation in FR2 is performed, the scheduling restrictions on FR2 serving PCell or PSCell applies to all serving cells in the same band on the symbols that fully or partially overlap with restricted symbols.

When inter-band carrier aggregation in FR2 is performed, there are no scheduling restrictions on FR2 serving cell(s) in the bands for the following cases, provided that UE is capable of independent beam management on this FR2 band pair:

- when performing radio link monitoring performed on FR2 serving PCell or PSCell in different bands,

- the UE is configured with same or different numerology between SSB on one FR2 band and data on the other FR2 band.

For FR2, if following conditions are met,

- UE has been notified about system information update through paging,

- The gap between UE’s reception of PDCCH that UE monitors in the Type2-PDCCH CSS set and that notifies system information update, and the PDCCH that UE monitors in the Type0-PDCCH CSS set, is greater than 2 slots,

For the SSB for RLM and CORESET for RMSI scheduling multiplexing patterns 3, UE is expected to receive the PDCCH that UE monitors in the Type0-PDCCH CSS set, and the corresponding PDSCH, on SSB symbols to be measured for RLM; and

For the SSB for RLM and CORESET for RMSI scheduling multiplexing patterns 2, UE is expected to receive PDSCH that corresponds to the PDCCH that UE monitors in the Type0-PDCCH CSS set, on SSB symbols to be measured for RLM.

#### 8.1.7.4 Scheduling availability of UE performing radio link monitoring on FR1 or FR2 in case of FR1-FR2 inter-band CA and NR-DC

There are no scheduling restrictions on FR1 serving cell(s) due to radio link monitoring performed on FR2 serving PCell and/or PSCell.

There are no scheduling restrictions on FR2 serving cell(s) due to radio link monitoring performed on FR1 serving PCell and/or PSCell.

## 8.1A Radio Link Monitoring with CCA on Target Frequency

### 8.1A.1 Introduction

The requirements in clause 8.1A apply for radio link monitoring on a carrier frequency with CCA for cells:

- PCell in SA NR operation mode,

- PSCell in EN-DC operation mode.

- PSCell in NR-DC operation mode.

The UE shall monitor the downlink radio link quality based on the reference signal configured as RLM-RS resource(s) in order to detect the downlink radio link quality of the PCell and PSCell as specified in TS 38.213 [3]. The configured RLM-RS resources can be all SSBs, or all CSI-RSs, or a mix of SSBs and CSI-RSs. UE is not required to perform RLM outside the active DL BWP.

On each RLM-RS resource, the UE shall estimate the downlink radio link quality and compare it to the thresholds Qout,CCA and Qin,CCA for the purpose of monitoring downlink radio link quality of the cell.

The threshold Qout,CCA is defined as the level at which the downlink radio link cannot be reliably received and shall correspond to the out-of-sync block error rate (BLERout,CCA) as defined in Table 8.1A.1-1. For SSB based radio link monitoring, Qout\_SSB,CCA is derived based on the hypothetical PDCCH transmission parameters listed in Table 8.1A.2.1-1.

The threshold Qin,CCA is defined as the level at which the downlink radio link quality can be received with significantly higher reliability than at Qout,CCA and shall correspond to the in-sync block error rate (BLERin) as defined in Table 8.1A.1-1. For SSB based radio link monitoring, Qin\_SSB,CCA is derived based on the hypothetical PDCCH transmission parameters listed in Table 8.1A.2.1-2.

The out-of-sync block error rate (BLERout,CCA) and in-sync block error rate (BLERin,CCA) are determined from the network configuration via parameter *rlmInSyncOutOfSyncThreshold* signalled by higher layers. When UE is not configured with *rlmInSyncOutOfSyncThreshold* from the network, UE determines out-of-sync and in-sync block error rates from Configuration #0 in Table 8.1A.1-1 as default. All requirements in clause 8.1A are applicable for BLER Configuration #0 in Table 8.1A.1-1.

Table 8.1A.1-1: Out-of-sync and in-sync block error rates

|  |  |  |
| --- | --- | --- |
| Configuration | BLERout,CCA | BLERin,CCA |
| 0 | 10% | 2% |

UE shall be able to monitor up to NRLM RLM-RS resources of the same or different types in each corresponding carrier frequency range, depending on a maximum number Lmax of SSBs per half frame according to TS 38.213 [3], where NRLM is specified in Table 8.1A.1-2, and meet the requirements as specified in clause 8.1A. UE is not required to meet the requirements in clause 8.1A if RLM-RS is not configured and no TCI state for PDCCH is activated.

Table 8.1A.1-2: Maximum number of RLM-RS resources NRLM

|  |  |  |
| --- | --- | --- |
| Carrier frequency range of PCell/PSCell | Lmax | Maximum number of RLM-RS resources, NRLM |
| FR1 | 8 | 4 |
| FR2-2 | 64 | 8 |

In the requirements of clause 8.1A, the term RLM-RS SSB occasion not available at the UE refers to when the RLM-RS SSB is configured by gNB in a cell on a carrier frequency subject to CCA, but the first two successive candidate SSB positions for the same SSB index within the set of configured RLM-RS resources are not available at the UE due to DL CCA failures at gNB during the corresponding evaluation period; otherwise the RLM-RS SSB is considered as available at the UE.

The requirements in clause 8.1A apply for any *channelAccessMode* configuration [TS 38.331, 2].

### 8.1A.2 Requirements for SSB Based Radio Link Monitoring

#### 8.1A.2.1 Introduction

The requirements in this clause apply for each SSB based RLM-RS resource configured for PCell or PSCell, provided that the SSB configured for RLM are actually configured to be transmitted within UE active DL BWP during the entire evaluation period specified in clause 8.1A.2.2 but occasionally may not be transmitted due to CCA operation.

Table 8.1A.2.1-1: PDCCH transmission parameters for out-of-sync evaluation

|  |  |
| --- | --- |
| Attribute | Value for BLER Configuration #0 |
| DCI format | 1-0 |
| Number of control OFDM symbols | 2 |
| Aggregation level (CCE) | 8 |
| Ratio of hypothetical PDCCH RE energy to average SSS RE energy | 4 dB |
| Ratio of hypothetical PDCCH DMRS energy to average SSS RE energy | 4 dB |
| Bandwidth (PRBs) | 24 |
| Sub-carrier spacing (kHz) | SCS of the active DL BWP |
| DMRS precoder granularity | REG bundle size |
| REG bundle size | 6 |
| CP length | Normal |
| Mapping from REG to CCE | Distributed |

Table 8.1A.2.1-2: PDCCH transmission parameters for in-sync evaluation

|  |  |
| --- | --- |
| Attribute | Value for BLER Configuration #0 |
| DCI payload size | 1-0 |
| Number of control OFDM symbols | 2 |
| Aggregation level (CCE) | 4 |
| Ratio of hypothetical PDCCH RE energy to average SSS RE energy | 0dB |
| Ratio of hypothetical PDCCH DMRS energy to average SSS RE energy | 0dB |
| Bandwidth (PRBs) | 24 |
| Sub-carrier spacing (kHz) | SCS of the active DL BWP |
| DMRS precoder granularity | REG bundle size |
| REG bundle size | 6 |
| CP length | Normal |
| Mapping from REG to CCE | Distributed |

#### 8.1A.2.2 Minimum Requirement

UE shall be able to evaluate whether the downlink radio link quality on the configured RLM-RS resource estimated over the last TEvaluate\_out\_SSB,CCA [ms] period becomes worse than the threshold Qout\_SSB,CCA within TEvaluate\_out\_SSB,CCA [ms] evaluation period.

UE shall be able to evaluate whether the downlink radio link quality on the configured RLM-RS resource estimated over the last TEvaluate\_in\_SSB,CCA [ms] period becomes better than the threshold Qin\_SSB,CCA within TEvaluate\_in\_SSB,CCA [ms] evaluation period. During the in-sync evaluation procedure, layer 1 of the UE shall not send any in-sync indication for the cell to the higher layers when Lin exceeds Lin,max, where Lin and Lin,max are defined in Table 8.1A.2.2-1.

TEvaluate\_out\_SSB,CCA and TEvaluate\_in\_SSB,CCA are defined in Table 8.1A.2.2-1 for FR1.

TEvaluate\_out\_SSB,CCA and TEvaluate\_in\_SSB,CCA are defined in Table 8.1A.2.2-2 for FR2-2 with scaling factor N = 12.

When concurrent gaps are configured,

- P value for an RLM-RS resource to be measured is defined as Ntotal / Noutside\_MG

- For a window W of duration max(TL1, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE measurement gap and per-FR measurement gap within the same FR as serving cell, and starting at the beginning of any RLM-RS resource occasion:

- Ntotal is the total number of RLM-RS resource occasions within the window, including those overlapped with measurement gap occasions within the window, and

- Noutside\_MG is the number of RLM-RS resource occasions that are not overlapped with any measurement gap occasion within the window W

Otherwise, for a UE not supporting *concurrentMeasGap-r17* or when concurrent gaps are not configured,

For FR1,

- , when in the monitored cell there are GAPs configured for intra-frequency, inter-frequency or inter-RAT measurements, and these GAPs are overlapping with some but not all occasions of the SSB RLM-RS resources; and

- P=1 when in the monitored cell there are no GAPs overlapping with any occasion of the SSB RLM-RS resources.

When a measurement gap is configured and the measurement gap is not NCSG,

- an RLM-RS resource is considered to be overlapped with the GAP f it overlaps a measurement gap occasion, and

- xRP = MGRP

Otherwise, when NCSG measurement gap is configured,

- an RLM-RS resource is considered to be overlapped with the GAP if it overlaps the VIL1 or VIL2 of NCSG, and

- xRP = VIRP

If the UE is configured with Pre-MG, an RLM-RS resource is only considered to be overlapped by the Pre-MG if the Pre-MG is activated.

When concurrent gaps are configured, an RLM-RS is not considered to be overlapped by a gap occasion if the gap occasion is dropped according to 9.1.8.

For FR2-2,

- , when RLM-RS resource is not overlapped with measurement gap and the RLM-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod).

- P is Psharing factor, when the RLM-RS resource is not overlapped with measurement gap and RLM-RS resource is fully overlapped with SMTC period (TSSB = TSMTCperiod).

- , when the RLM-RS resource is partially overlapped with measurement gap and the RLM-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and

- TSMTCperiod ≠ MGRP or

- TSMTCperiod = MGRP and TSSB < 0.5\*TSMTCperiod

- , when the RLM-RS is partially overlapped with measurement gap and the RLM-RS is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and TSMTCperiod = MGRP and TSSB = 0.5 × TSMTCperiod

- , when the RLM-RS resource is partially overlapped with measurement gap and the RLM-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is partially or fully overlapped with measurement gap

- , when the RLM-RS resource is partially overlapped with measurement gap and the RLM-RS resource is fully overlapped with SMTC occasion (TSSB = TSMTCperiod) and SMTC occasion is partially overlapped with measurement gap (TSMTCperiod < MGRP)

- Psharing factor = 1, if the RLM-RS resource outside measurement gap is

* not overlapped with the SSB symbols indicated by *SSB-ToMeasure* and K data symbol before each consecutive SSB symbols indicated by *SSB-ToMeasure* and K data symbol after each consecutive SSB symbols indicated by *SSB-ToMeasure*, given that *SSB-ToMeasure* is configured, where the *SSB-ToMeasure* is the union set of *SSB-ToMeasure* from all the configured measurement objects merged on the same serving carrier, and K is defined in clause 9.2.5.3.3, and,
* not overlapped by the RSSI symbols indicated by *ss-RSSI-Measurement* and K data symbol before each RSSI symbol indicated by *ss-RSSI-Measurement* and K data symbol after each RSSI symbol indicated by *ss-RSSI-Measurement*, given that *ss-RSSI-Measurement* is configured, and K is defined in clause 9.2.5.3.3.

- Psharing factor = 3, otherwise.

where,

If the high layer in TS 38.331 [2] signaling of *smtc2*is present, TSMTCperiod follows *smtc2*; Otherwise TSMTCperiod follows *smtc1.* TSMTCperiod is the shortest SMTC period among all CCs in the same FR2-2 band, provided the SMTC offset of all CCs in FR2-2 have the same offset.

Longer evaluation period would be expected if the combination of RLM-RS resource, SMTC occasion and GAP configurations does not meet previous conditions.

Table 8.1A.2.2-1: Evaluation period TEvaluate\_out\_SSB,CCA and TEvaluate\_in\_SSB,CCA for FR1

|  |  |  |  |
| --- | --- | --- | --- |
| Configuration | TEvaluate\_out\_SSB,CCA (ms) | | TEvaluate\_in\_SSB,CCA (ms) |
|  | RLM-RS SSB Es/IotNote4 ≥-7 dB | RLM-RS SSB Es/Iot Note4 <-7 dB |  |
| no DRX | Max(200, Ceil(17\*P)\*TSSB) | Max(200, Ceil(24\*P)\*TSSB) | Max(100, Ceil((5+Lin)\*P)\*TSSB) |
| DRX cycle≤320 | Max(200, Ceil(1.5\*15\*P)\*Max(TDRX,TSSB)) | Max(200, Ceil(1.5\*20\*P)\*Max(TDRX,TSSB)) | Max(100, Ceil(1.5\*(5+Lin)\*P)\*Max(TDRX,TSSB)) |
| DRX cycle>320 | Ceil(13\*P)\*TDRX | Ceil(16\*P)\*TDRX | Ceil((5+Lin)\*P)\*TDRX |
| NOTE 1: TSSB is the periodicity of the SSB configured for RLM. TDRX is the DRX cycle length.  NOTE 2: When DRX is not configured, Lin is the number of RLM-RS SSB occasions which are not available at the UE during TEvaluate\_in\_SSB,CCA, where Lin ≤ Lin,max. When DRX is configured, Lin is the number of DRX cycles in which at least one RLM-RS SSB occasion is not available at the UE during TEvaluate\_in\_SSB,CCA, where Lin ≤ Lin,max. The UE is not required to determine the availability of SSB occasions more frequent than  Once per Max(10ms, P \* TSSB) if no DRX is used,  Once per Max(10ms, Ceil(1.5 \* P) \* Max(TDRX, TSSB)) if DRX cycle ≤ 320ms,  Once per P \* TDRX if DRX cycle > 320ms.  NOTE 3: Lin,max=7 for Max(TDRX,TSSB) ≤ 40 assuming TDRX=0 for non-DRX case,  Lin,max=5 for 40<Max(TDRX,TSSB)≤320,  Lin,max=3 for TDRX>320.  NOTE 4: RLM-RS SSB Es/Iot is the averaged Es/Iot over the most recent previous out-of-sync evaluation period. | | | |

Table 8.1A.2.2-2: Evaluation period TEvaluate\_out\_SSB,CCA and TEvaluate\_in\_SSB,CCA for FR2-2

|  |  |  |
| --- | --- | --- |
| Configuration | TEvaluate\_out\_SSB,CCA (ms) | TEvaluate\_in\_SSB,CCA (ms) |
|  |  |
| no DRX | Max(200, Ceil([12]\*P\* N)\*TSSB) | Max(100, Ceil((5 +Lin)\*P\* N)\*TSSB) |
| DRX cycle≤320 | Max(200, Ceil(1.5\*[10]\*P\* N)\*Max(TDRX,TSSB)) | Max(100, Ceil(1.5\*(5 +Lin)\*P\* N)\*Max(TDRX,TSSB)) |
| DRX cycle>320 | Ceil([10]\*P\* N)\*TDRX | Ceil((5+Lin)\*P\* N)\*TDRX |
| NOTE 1: TSSB is the periodicity of the SSB configured for RLM. TDRX is the DRX cycle length.  NOTE 2: When DRX is not configured, Lin is the number of RLM-RS SSB occasions groups which are not available at the UE during TEvaluate\_in\_SSB,CCA, where Lin ≤ Lin,max. A RLM-RS SSB occasions group consists of N consecutive RLM-RS SSB occasions, and the RLM-RS SSB occasions group is not available at the UE when at least one RLM-SSB occasion in the group is not transmitted by the gNB. When DRX is configured, Lin is the number of DRX cycles groups which are not available at the UE during TEvaluate\_in\_SSB,CCA, where Lin ≤ Lin,max. A DRX group consists of N DRX cycles, and the DRX group is not available when there is at least one DRX in which at least one RLM-RS SSB occasion is not available. The UE is not required to determine the availability of SSB occasions more frequent than once per DRX cycle length, when configured with DRX.  NOTE 3: Lin,max=7 for Max(TDRX,TSSB) ≤ 40 assuming TDRX=0 for non-DRX case,  Lin,max=5 for 40<Max(TDRX,TSSB)≤320,  Lin,max=3 for TDRX>320. | | |

8.1A.2.3 Measurement Restrictions for SSB based RLM

The UE is required to be capable of measuring SSB for RLM without measurement gaps. The UE is required to perform the SSB measurements with measurement restrictions as described in the following clauses.

For FR1, when the SSB for RLM is in the same OFDM symbol as CSI-RS for RLM, BFD, CBD or L1-RSRP measurement,

- If SSB and CSI-RS have same SCS, UE shall be able to measure the SSB for RLM without any restriction;

- If SSB and CSI-RS have different SCS,

- If UE supports *simultaneousRxDataSSB-DiffNumerology*, UE shall be able to measure the SSB for RLM without any restriction;

- If UE does not support *simultaneousRxDataSSB-DiffNumerology*, UE is required to measure SSB for RLM.

For FR2-2, when the SSB for RLM measurement on one CC is in the same OFDM symbol as CSI-RS for RLM, BFD, CBD or L1-RSRP measurement on the same CC or different CCs in the same band, UE is required to measure one of but not both SSB for RLM and CSI-RS. Longer measurement period for SSB based RLM is expected, and no requirements are defined.

### 8.1A.3 Minimum requirement at transitions

When the UE transitions between DRX and no DRX or when DRX cycle periodicity changes, for each RLM-RS resource, for a duration of time equal to the evaluation period corresponding to the second mode after the transition occurs, the UE shall use an evaluation period that is no less than the minimum of evaluation period corresponding to the first mode and the second mode. Subsequent to this duration, the UE shall use an evaluation period corresponding to the second mode for each RLM-RS resource. This requirement shall be applied to both out-of-sync evaluation and in-sync evaluation of the monitored cell.

When the UE transitions from a first configuration of RLM resources to a second configuration of RLM resources that is different from the first configuration, for each RLM resource present in the second configuration, for a duration of time equal to the evaluation period corresponding to the second configuration after the transition occurs, the UE shall use an evaluation period that is no less than the minimum of evaluation periods corresponding to the first configuration and the second configuration. Subsequent to this duration, the UE shall use an evaluation period corresponding to the second configuration for each RLM resource present in the second configuration. This requirement shall be applied to both out-of-sync evaluation and in-sync evaluation of the monitored cell.

### 8.1A.4 Minimum requirement for UE turning off the transmitter

The transmitter power of the UE in the monitored cell shall be turned off within 40ms after expiry of T310 timer as specified in TS 38.331 [2]. The UE shall not perform CCA procedure on any of the serving carrier frequencies with CCA after the expiry of T310.

### 8.1A.5 Minimum requirement for L1 indication

When the downlink radio link quality on all the configured RLM-RS resources is worse than Qout,CCA, layer 1 of the UE shall send an out-of-sync indication for the cell to the higher layers. A layer 3 filter shall be applied to the out-of-sync indications as specified in TS 38.331 [2].

When the downlink radio link quality on at least one of the configured RLM-RS resources is better than Qin,CCA, layer 1 of the UE shall send an in-sync indication for the cell to the higher layers. A layer 3 filter shall be applied to the in-sync indications as specified in TS 38.331 [2].

The out-of-sync and in-sync evaluations for the configured RLM-RS resources shall be performed as specified in clause 5 in TS 38.213 [3]. Two successive indications from layer 1 shall be separated by at least TIndication\_interval,CCA.

When DRX is not used TIndication\_interval,CCA is max(10ms, TRLM-RS,M), where TRLM,M is the shortest periodicity of all configured RLM-RS resources for the monitored cell, which corresponds to TSSB specified in clause 8.1A.2 if the RLM-RS resource is SSB.

In case DRX is used, TIndication\_interval,CCA is Max(10ms, 1.5 × DRX\_cycle\_length, 1.5 × TRLM-RS,M)) if DRX cycle\_length is less than or equal to 320ms, and TIndication\_interval,CCA is DRX\_cycle\_length if DRX cycle\_length is greater than 320ms. Upon start of T310 timer as specified in TS 38.331 [2], the UE shall monitor the configured RLM-RS resources for recovery using the evaluation period and layer 1 indication interval corresponding to the no DRX mode until the expiry or stop of T310 timer.

### 8.1A.6 Scheduling availability of UE during radio link monitoring

When the reference signal to be measured for RLM on a carrier frequency with CCA has different subcarrier spacing than PDSCH/PDCCH, there are restrictions on the scheduling availability as described in the following clauses.

8.1A.6.1 Scheduling availability of UE performing radio link monitoring with the same subcarrier spacing as PDSCH/PDCCH on FR1

There are no scheduling restrictions due to radio link monitoring performed with a same subcarrier spacing as PDSCH/PDCCH on FR1.

8.1A.6.2 Scheduling availability of UE performing radio link monitoring with a different subcarrier spacing than PDSCH/PDCCH on FR1

For UEs which support *simultaneousRxDataSSB-DiffNumerology* [14] there are no restrictions on scheduling availability due to radio link monitoring based on SSB as RLM-RS. For UEs which do not support *simultaneousRxDataSSB-DiffNumerology* [14] the following restrictions apply due to radio link monitoring based on SSB as RLM -RS.

- The UE is not expected to transmit PUCCH, PUSCH or SRS or receive PDCCH, PDSCH or CSI-RS for tracking or CSI-RS for CQI on SSB symbols to be measured for radio link monitoring.

When intra-band carrier aggregation is performed, the scheduling restrictions on PCell or PSCell applies to all serving cells in the same band on the symbols that fully or partially overlap with the restricted symbols.

#### 8.1A.6.3 Scheduling availability of UE performing radio link monitoring on FR2-2

The following scheduling restriction applies due to radio link monitoring on an FR2-2 serving PCell and/or PSCell.

- If the RLM-RS is CSI-RS which is type-D QCLed with active TCI state for PDCCH or PDSCH, and the CSI-RS is not in a CSI-RS resource set with repetition ON,

- There are no scheduling restrictions due to radio link monitoring based on the CSI-RS.

- Otherwise

- When the RLM-RS is using 120 KHz SCS, the UE is not expected to transmit PUCCH, PUSCH or SRS or receive PDCCH, PDSCH or CSI-RS for tracking or CSI-RS for CQI on RLM-RS symbols to be measured for radio link monitoring.

- When the RLM-RS is using 480 kHz SCS or 960 kHz SCS, the UE is not expected to transmit PUCCH, PUSCH or SRS or receive PDCCH, PDSCH or CSI-RS for tracking or CSI-RS for CQI on RLM-RS resource symbols to be measured for radio link monitoring, and on one data symbol before each RLM-RS symbol to be measured and one data symbol after each RLM-RS symbol to be measured.

When intra-band carrier aggregation in FR2-2 is performed, the scheduling restrictions on FR2-2 serving PCell or PSCell applies to all serving cells in the same band on the symbols that fully or partially overlap with restricted symbols.

For FR2-2, if following conditions are met,

- UE has been notified about system information update through paging,

- The gap between UE’s reception of PDCCH that UE monitors in the Type2-PDCCH CSS set and that notifies system information update, and the PDCCH that UE monitors in the Type0-PDCCH CSS set, is greater than 2 slots,

For the SSB for RLM and CORESET for RMSI scheduling multiplexing patterns 3, UE is expected to receive the PDCCH that UE monitors in the Type0-PDCCH CSS set, and the corresponding PDSCH, on SSB symbols to be measured for RLM; and

For the SSB for RLM and CORESET for RMSI scheduling multiplexing patterns 2, UE is expected to receive PDSCH that corresponds to the PDCCH that UE monitors in the Type0-PDCCH CSS set, on SSB symbols to be measured for RLM.

#### 8.1A.6.4 Scheduling availability of UE performing radio link monitoring on FR1 or FR2-2 in case of FR1-FR2-2 inter-band CA and NR-DC

There are no scheduling restrictions on FR1 serving cell(s) due to radio link monitoring performed on FR2-2 serving PCell and/or PSCell.

There are no scheduling restrictions on FR2-2 serving cell(s) due to radio link monitoring performed on FR1 serving PCell and/or PSCell.

## 8.1B Radio Link Monitoring for RedCap

### 8.1B.1 Introduction

The requirements in clause 8.1B apply for radio link monitoring on UE with reduced capabilites:

- PCell in SA NR operation mode,

The UE shall monitor the downlink radio link quality based on the reference signal configured as RLM-RS resource(s) in order to detect the downlink radio link quality of the PCell as specified in TS 38.213 [3]. The configured RLM-RS resources can be all SSBs, or all CSI-RSs, or a mix of SSBs and CSI-RSs. UE is not required to perform RLM outside the active DL BWP. The SSB and SMTC in this section applies for both CD-SSB and NCD-SSB if it is not additional specified.

On each RLM-RS resource, the UE shall estimate the downlink radio link quality and compare it to the thresholds Qout,RedCap and Qin,RedCap for the purpose of monitoring downlink radio link quality of the cell.

The threshold Qout,RedCap is defined as the level at which the downlink radio link cannot be reliably received and shall correspond to the out-of-sync block error rate (BLERout) as defined in Table 8.1B.1-1. For SSB based radio link monitoring, Qout\_SSB,RedCap is derived based on the hypothetical PDCCH transmission parameters listed in Table 8.1B.2.1-1. For CSI-RS based radio link monitoring, Qout\_CSI-RS,RedCap is derived based on the hypothetical PDCCH transmission parameters listed in Table 8.1B.3.1-1.

The threshold Qin,RedCap is defined as the level at which the downlink radio link quality can be received with significantly higher reliability than at Qout,RedCap and shall correspond to the in-sync block error rate (BLERin,RedCap) as defined in Table 8.1B.1-1. For SSB based radio link monitoring, Qin\_SSB,RedCap is derived based on the hypothetical PDCCH transmission parameters listed in Table 8.1B.2.1-2. For CSI-RS based radio link monitoring, Qin\_CSI-RS,RedCap is derived based on the hypothetical PDCCH transmission parameters listed in Table 8.1B.3.1-2.

The out-of-sync block error rate (BLERout,RedCap) and in-sync block error rate (BLERin,RedCap) are determined from the network configuration via parameter *rlmInSyncOutOfSyncThreshold* signalled by higher layers. When UE is not configured with *rlmInSyncOutOfSyncThreshold* from the network, UE determines out-of-sync and in-sync block error rates from Configuration #0 in Table 8.1B.1-1 by default. All requirements in clause 8.1B are applicable for BLER Configuration #0 in Table 8.1B.1-1.

Table 8.1B.1-1: Out-of-sync and in-sync block error rates for RedCap UE

|  |  |  |
| --- | --- | --- |
| Configuration | BLERout,RedCap | BLERin,RedCap |
| 0 | 10% | 2% |

UE shall be able to monitor up to NRLM RLM-RS resources of the same or different types in each corresponding carrier frequency range, depending on a maximum number  of SSBs per half frame according to TS 38.213 [3], where NRLM is specified in Table 8.1B.1-2 according TS 38.213 [3], and meet the requirements as specified in clause 8.1B. UE is not required to meet the requirements in clause 8.1B if RLM-RS is not configured and no TCI state for PDCCH is activated.

Table 8.1B.1-2: Maximum number of RLM-RS resources NRLM for RedCap UE

|  |  |  |
| --- | --- | --- |
| Carrier frequency range of PCell |  | Maximum number of RLM-RS resources, NRLM |
| FR1, ≤ 3 GHzNote | 4 | 2 |
| FR1, > 3 GHzNote | 8 | 4 |
| FR2 | 64 | 8 |
| NOTE: For unpaired spectrum operation with Case C - 30 kHz SCS, 3GHz is replaced by 1.88GHz, as specified in clause 4.1 in TS 38.213 [3]. | | |

### 8.1B.2 Requirements for SSB based radio link monitoring

#### 8.1B.2.1 Introduction

The requirements in this clause apply for each SSB based RLM-RS resource configured for PCell, provided that the SSB configured for RLM is actually transmitted within UE active DL BWP during the entire evaluation period specified in clause 8.1B.2.2.

Table 8.1B.2.1-1: PDCCH transmission parameters for out-of-sync evaluation for RedCap UE

|  |  |
| --- | --- |
| Attribute | Value for BLER Configuration #0 |
| DCI format | 1-0 |
| Number of control OFDM symbols | 2 |
| Aggregation level (CCE) | 16; for RedCap UE with 1Rx branch.  8; for RedCap UE with 2Rx branches. |
| Ratio of hypothetical PDCCH RE energy to average SSS RE energy | 4dB |
| Ratio of hypothetical PDCCH DMRS energy to average SSS RE energy | 4dB |
| Bandwidth (PRBs) | 48; for RedCap UE with 1Rx branch.  24; for RedCap UE with 2Rx branches. |
| Sub-carrier spacing (kHz) | SCS of the active DL BWP |
| DMRS precoder granularity | REG bundle size |
| REG bundle size | 6 |
| CP length | Normal |
| Mapping from REG to CCE | Distributed |
| Note: SCS = 60KHz is not applicable for FR1. | |

Table 8.1B.2.1-2: PDCCH transmission parameters for in-sync evaluation for RedCap UE

|  |  |
| --- | --- |
| Attribute | Value for BLER Configuration #0 |
| DCI payload size | 1-0 |
| Number of control OFDM symbols | 2 |
| Aggregation level (CCE) | 8; for RedCap UE with 1Rx branch.  4; for RedCap UE with 2Rx branches. |
| Ratio of hypothetical PDCCH RE energy to average SSS RE energy | 0dB |
| Ratio of hypothetical PDCCH DMRS energy to average SSS RE energy | 0dB |
| Bandwidth (PRBs) | 48; for RedCap UE with 1Rx branch.  24; for RedCap UE with 2Rx branches. |
| Sub-carrier spacing (kHz) | SCS of the active DL BWP |
| DMRS precoder granularity | REG bundle size |
| REG bundle size | 6 |
| CP length | Normal |
| Mapping from REG to CCE | Distributed |
| Note: SCS = 60KHz is not applicable for FR1. | |

#### 8.1B.2.2 Minimum requirement

UE shall be able to evaluate whether the downlink radio link quality on the configured RLM-RS resource estimated over the last TEvaluate\_out\_SSB,RedCap [ms] period becomes worse than the threshold Qout\_SSB,RedCap within TEvaluate\_out\_SSB,RedCap [ms] evaluation period.

UE shall be able to evaluate whether the downlink radio link quality on the configured RLM-RS resource estimated over the last TEvaluate\_in\_SSB,RedCap [ms] period becomes better than the threshold Qin\_SSB,RedCap within TEvaluate\_in\_SSB,RedCap [ms] evaluation period.

TEvaluate\_out\_SSB,RedCap and TEvaluate\_in\_SSB,RedCap are defined in Table 8.1B.2.2-1 and Table 8.1B.2.2-3 for FR1 for UE with 2Rx RedCap and 1Rx RedCap, respectively.

TEvaluate\_out\_SSB,RedCap and TEvaluate\_in\_SSB,RedCap are defined in Table 8.1B.2.2-2 and for FR2 with scaling factor N=8 for 2Rx RedCap.

For FR1,

- , when in the monitored cell there are measurement gaps configured for intra-frequency, inter-frequency or inter-RAT measurements, and these measurement gaps are overlapping with some but not all occasions of the SSB; and

- P = 1 when in the monitored cell there are no measurement gaps overlapping with any occasion of the SSB.

For FR2,

- , when RLM-RS resource is not overlapped with measurement gap and the RLM-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod).

- P is Psharing factor, when the RLM-RS resource is not overlapped with measurement gap and RLM-RS resource is fully overlapped with SMTC period (TSSB = TSMTCperiod).

- , when the RLM-RS resource is partially overlapped with measurement gap and the RLM-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and

- TSMTCperiod ≠ MGRP or

- TSMTCperiod = MGRP and TSSB < 0.5\*TSMTCperiod

- , when the RLM-RS is partially overlapped with measurement gap and the RLM-RS is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and TSMTCperiod = MGRP and TSSB = 0.5 × TSMTCperiod

- , when the RLM-RS resource is partially overlapped with measurement gap and the RLM-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is partially or fully overlapped with measurement gap

- , when the RLM-RS resource is partially overlapped with measurement gap and the RLM-RS resource is fully overlapped with SMTC occasion (TSSB = TSMTCperiod) and SMTC occasion is partially overlapped with measurement gap (TSMTCperiod < MGRP)

- Psharing factor = 1, if the RLM-RS resource outside measurement gap is

* not overlapped with the SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol before each consecutive SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol after each consecutive SSB symbols indicated by *SSB-ToMeasure*, given that *SSB-ToMeasure* is configured, where the *SSB-ToMeasure* is the union set of *SSB-ToMeasure* from all the configured measurement objects merged on the same serving carrier, and,
* not overlapped by the RSSI symbols indicated by *ss-RSSI-Measurement* and 1 data symbol before each RSSI symbol indicated by *ss-RSSI-Measurement* and 1 data symbol after each RSSI symbol indicated by *ss-RSSI-Measurement*, given that *ss-RSSI-Measurement* is configured.

- Psharing factor = 3, otherwise.

where,

If the high layer in TS 38.331 [2] signaling of *smtc2*is present, TSMTCperiod follows *smtc2*; Otherwise TSMTCperiod follows *smtc1.*

If the high layer in TS 38.331 [2] signaling of *smtc2*is present, TSMTCperiod follows *smtc2*; Otherwise TSMTCperiod follows *smtc1.*

Longer evaluation period would be expected if the combination of RLM-RS resource, SMTC occasion and measurement gap configurations does not meet previous conditions.

For either an FR1 or FR2 serving cell, longer evaluation period would be expected during the period Tidentify\_CGI when the UE is requested to decode an NR CGI.

For either an FR1 or FR2 serving cell, longer evaluation period would be expected during the period Tidentify\_CGI,E-UTRAN when the UE is requested to decode an LTE CGI.

Table 8.1B.2.2-1: Evaluation period TEvaluate\_out\_SSB,RedCap and TEvaluate\_in\_SSB,RedCap for FR1 for 2Rx RedCap UE

|  |  |  |
| --- | --- | --- |
| Configuration | TEvaluate\_out\_SSB,RedCap (ms) | TEvaluate\_in\_SSB,RedCap (ms) |
| no DRX | Max(200, Ceil(10 × P) × TSSB) | Max(100, Ceil(5 × P) × TSSB) |
| DRX cycle≤320ms | Max(200, Ceil(15 × P) × Max(TDRX,TSSB)) | Max(100, Ceil(7.5 × P) × Max(TDRX,TSSB)) |
| DRX cycle>320ms | Ceil(10 × P) × TDRX | Ceil(5 × P) × TDRX |
| NOTE: TSSB is the periodicity of the SSB configured for RLM. TDRX is the DRX cycle length. | | |

Table 8.1B.2.2-2: Evaluation period TEvaluate\_out\_SSB,RedCap and TEvaluate\_in\_SSB,RedCap for FR2 for 2Rx RedCap UE

|  |  |  |
| --- | --- | --- |
| Configuration | TEvaluate\_out\_SSB,RedCap (ms) | TEvaluate\_in\_SSB,RedCap (ms) |
| no DRX | Max(200, Ceil(10 × P × N) × TSSB) | Max(100, Ceil(5 × P × N) × TSSB) |
| DRX cycle≤320ms | Max(200, Ceil(15 × P × N) × Max(TDRX,TSSB)) | Max(100, Ceil(7.5 × P × N) × Max(TDRX,TSSB)) |
| DRX cycle>320ms | Ceil(10 × P × N) × TDRX | Ceil(5 × P × N) × TDRX |
| NOTE: TSSB is the periodicity of the SSB configured for RLM. TDRX is the DRX cycle length. | | |

Table 8.1B.2.2-3: Evaluation period TEvaluate\_out\_SSB,RedCap and TEvaluate\_in\_SSB,RedCap for FR1 for 1Rx RedCap UE

|  |  |  |
| --- | --- | --- |
| Configuration | TEvaluate\_out\_SSB,RedCap (ms) | TEvaluate\_in\_SSB,RedCap (ms) |
| no DRX | Max(400, Ceil(20 × P) × TSSB) | Max(100, Ceil(5 × P) × TSSB) |
| DRX cycle≤320ms | Max(400, Ceil(30 × P) × Max(TDRX,TSSB)) | Max(100, Ceil(7.5 × P) × Max(TDRX,TSSB)) |
| DRX cycle>320ms | Ceil(20 × P) × TDRX | Ceil(5 × P) × TDRX |
| NOTE: TSSB is the periodicity of the SSB configured for RLM. TDRX is the DRX cycle length. | | |

#### 8.1B.2.3 Measurement restrictions for SSB based RLM

The UE is required to be capable of measuring SSB for RLM without measurement gaps. The UE is required to perform the SSB measurements with measurement restrictions as described in the following scenarios.

For FR1, when the SSB for RLM is in the same OFDM symbol as CSI-RS for RLM, BFD, CBD or L1-RSRP measurement,

- If SSB and CSI-RS have same SCS, UE shall be able to measure the SSB for RLM without any restriction;

- If SSB and CSI-RS have different SCS,

- If UE supports *simultaneousRxDataSSB-DiffNumerology*, UE shall be able to measure the SSB for RLM without any restriction;

- If UE does not support *simultaneousRxDataSSB-DiffNumerology*, UE is required to measure one of but not both SSB for RLM and CSI-RS. Longer measurement period for SSB based RLM is expected, and no requirements are defined.

For FR2, when the SSB for RLM measurement is in the same OFDM symbol as CSI-RS for RLM, BFD, CBD or L1-RSRP measurement, UE is required to measure one of but not both SSB for RLM and CSI-RS. Longer measurement period for SSB based RLM is expected, and no requirements are defined.

### 8.1B.3 Requirements for CSI-RS based radio link monitoring

#### 8.1B.3.1 Introduction

The requirements in this clause apply for each CSI-RS based RLM-RS resource configured for PCell, provided that the CSI-RS configured for RLM is actually transmitted within UE active DL BWP during the entire evaluation period specified in clause 8.1B.3.2. UE is not expected to perform radio link monitoring measurements on the CSI-RS configured as RLM-RS if the CSI-RS is not in the active TCI state of any CORESET configured in the UE active BWP.

Table 8.1B.3.1-1: PDCCH transmission parameters for out-of-sync evaluation for RedCap UE

|  |  |
| --- | --- |
| Attribute | Value for BLER Configuration #0 |
| DCI format | 1-0 |
| Number of control OFDM symbols | 2 |
| Aggregation level (CCE) | 16; for RedCap UE with 1Rx branch.  8; for RedCap UE with 2Rx branches. |
| Ratio of hypothetical PDCCH RE energy to average CSI-RS RE energy | 4dB |
| Ratio of hypothetical PDCCH DMRS energy to average CSI-RS RE energy | 4dB |
| Bandwidth (PRBs) | 48 |
| Sub-carrier spacing (kHz) | SCS of the active DL BWP |
| DMRS precoder granularity | REG bundle size |
| REG bundle size | 6 |
| CP length | Normal |
| Mapping from REG to CCE | Distributed |
| Note: SCS = 60KHz is not applicable for FR1. | |

Table 8.1B.3.1-2: PDCCH transmission parameters for in-sync evaluation for RedCap UE

|  |  |
| --- | --- |
| Attribute | Value for BLER Configuration #0 |
| DCI payload size | 1-0 |
| Number of control OFDM symbols | 2 |
| Aggregation level (CCE) | 8; for RedCap UE with 1Rx branch.  4; for RedCap UE with 2Rx branches. |
| Ratio of hypothetical PDCCH RE energy to average CSI-RS RE energy | 0dB |
| Ratio of hypothetical PDCCH DMRS energy to average CSI-RS RE energy | 0dB |
| Bandwidth (PRBs) | 48 |
| Sub-carrier spacing (kHz) | SCS of the active DL BWP |
| DMRS precoder granularity | REG bundle size |
| REG bundle size | 6 |
| CP length | Normal |
| Mapping from REG to CCE | Distributed |
| Note: SCS = 60KHz is not applicable for FR1. | |

#### 8.1B.3.2 Minimum requirement

UE shall be able to evaluate whether the downlink radio link quality on the configured RLM-RS resource estimated over the last TEvaluate\_out\_CSI-RS,RedCap ms period becomes worse than the threshold Qout\_CSI-RS,RedCap within TEvaluate\_out\_CSI-RS,RedCap ms evaluation period.

UE shall be able to evaluate whether the downlink radio link quality on the configured RLM-RS resource estimated over the last TEvaluate\_in\_CSI-RS,RedCap ms period becomes better than the threshold Qin\_CSI-RS,RedCap within TEvaluate\_in\_CSI-RS,RedCap ms evaluation period.

- TEvaluate\_out\_CSI-RS,RedCap and TEvaluate\_in\_CSI-RS,RedCap are defined in Table 8.1B.3.2-1 and Table 8.1B.3.2-3 for FR1 for RedCap 2Rx RedCap and 1Rx RedCap, respectively.

- TEvaluate\_out\_CSI-RS,RedCap and TEvaluate\_in\_CSI-RS,RedCap are defined in Table 8.1B.3.2-2 for FR2 with scaling factor N=1 for 2 Rx RedCap.

The requirements of TEvaluate\_out\_CSI-RS,RedCap and TEvaluate\_in\_CSI-RS,RedCap apply provided that the CSI-RS for RLM is not in a resource set configured with repetition ON. The requirements do not apply when the CSI-RS resource in the active TCI state of CORESET is the same CSI-RS resource for RLM and the TCI state information of the CSI-RS resource is not given, wherein the TCI state information means QCL Type-D to SSB for L1-RSRP or CSI-RS with repetition ON.

For FR1,

- , when in the monitored cell there are measurement gaps configured for intra-frequency, inter-frequency or inter-RAT measurements, and these measurement gaps are overlapping with some but not all occasions of the CSI-RS; and

- P=1 when in the monitored cell there are no measurement gaps overlapping with any occasion of the CSI-RS.

For FR2,

- P=1, when the RLM-RS resource is not overlapped with measurement gap and also not overlapped with SMTC occasion.

- , when the RLM-RS resource is partially overlapped with measurement gap and the RLM-RS resource is not overlapped with SMTC occasion (TCSI-RS < MGRP)

- , when the RLM-RS resource is not overlapped with measurement gap and the RLM-RS resource is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod).

- P = Psharing factor, when the RLM-RS resource is not overlapped with measurement gap and RLM-RS resource is fully overlapped with SMTC occasion (TCSI-RS = TSMTCperiod).

- , when the RLM-RS resource is partially overlapped with measurement gap and the RLM-RS resource is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and

- TSMTCperiod ≠ MGRP or

- TSMTCperiod = MGRP and TCSI-RS < 0.5 × TSMTCperiod

- , when the RLM-RS resource is partially overlapped with measurement gap and the RLM-RS resource is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and TSMTCperiod = MGRP and TCSI-RS = 0.5 × TSMTCperiod

- , when the RLM-RS resource is partially overlapped with measurement gap and the RLM-RS resource is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is partially or fully overlapped with measurement gap

- , when the RLM-RS resource is partially overlapped with measurement gap and the RLM-RS resource is fully overlapped with SMTC occasion (TCSI-RS = TSMTCperiod) and SMTC occasion is partially overlapped with measurement gap (TSMTCperiod < MGRP)

- Psharing factor = 1, if the RLM-RS resource outside measurement gap is

- not overlapped with the SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol before each consecutive SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol after each consecutive SSB symbols indicated by *SSB-ToMeasure*, given that *SSB-ToMeasure* is configured, where the *SSB-ToMeasure* is the union set of *SSB-ToMeasure* from all the configured measurement objects merged on the same serving carrier, and,

- not overlapped by the RSSI symbols indicated by *ss-RSSI-Measurement* and 1 data symbol before each RSSI symbol indicated by *ss-RSSI-Measurement* and 1 data symbol after each RSSI symbol indicated by *ss-RSSI-Measurement*, given that *ss-RSSI-Measurement* is configured.

- Psharing factor = 3, otherwise.

where,

If the high layer in TS 38.331 [2] signaling of *smtc2*is present, TSMTCperiod follows *smtc2*; Otherwise TSMTCperiod follows *smtc1.*

If the high layer in TS 38.331 [2] signaling of *smtc2*is present, TSMTCperiod follows *smtc2*; Otherwise TSMTCperiod follows *smtc1.*

Note: The overlap between CSI-RS for RLM and SMTC means that CSI-RS based RLM is within the SMTC window duration.

Longer evaluation period would be expected if the combination of RLM-RS resource, SMTC occasion and measurement gap configurations does not meet previous conditions.

For either an FR1 or FR2 serving cell, longer evaluation period would be expected during the period Tidentify\_CGI when the UE is requested to decode an NR CGI.

For either an FR1 or FR2 serving cell, longer evaluation period would be expected during the period Tidentify\_CGI,E-UTRAN when the UE is requested to decode an LTE CGI.

The values of Mout,RedCap and Min,RedCap used in Table 8.1B.3.2-1 and Table 8.1B.3.2-2 for UE with 2Rx are defined as:

- Mout,RedCap = 20 and Min,RedCap = 10, if the CSI-RS resource configured for RLM is transmitted with higher layer CSI-RS parameter *density* [6, clause 7.4.1] set to 3 and over the bandwidth ≥ 24 PRBs.

The values of Mout,RedCap and Min,RedCap used in Table 8.1B.3.2-3 for RedCap UE with 1Rx are defined as:

- Mout,RedCap = 40 and Min,RedCap = 10, if the CSI-RS resource configured for RLM is transmitted with higher layer CSI-RS parameter *density* [6, clause 7.4.1] set to 3 and over the bandwidth ≥ 24 PRBs.

Table 8.1B.3.2-1: Evaluation period TEvaluate\_out\_CSI-RS,RedCap and TEvaluate\_in\_CSI-RS,RedCap for FR1 for 2Rx RedCap UE

|  |  |  |
| --- | --- | --- |
| Configuration | TEvaluate\_out\_CSI-RS,RedCap (ms) | TEvaluate\_in\_CSI-RS,RedCap (ms) |
| no DRX | Max(200, Ceil(Mout,RedCap×P)×TCSI-RS) | Max(100, Ceil(Min,RedCap×P) × TCSI-RS) |
| DRX ≤ 320ms | Max(200, Ceil(1.5×Mout,RedCap ×P)× Max(TDRX, TCSI-RS)) | Max(100, Ceil(1.5×Min,RedCap×P)× Max(TDRX, TCSI-RS)) |
| DRX > 320ms | Ceil(Mout,RedCap ×P) × TDRX | Ceil(Min,RedCap ×P) × TDRX |
| NOTE: TCSI-RS is the periodicity of the CSI-RS resource configured for RLM. The requirements in this table apply for TCSI-RS equal to 5 ms, 10ms, 20 ms or 40 ms. TDRX is the DRX cycle length. | | |

Table 8.1B.3.2-2: Evaluation period TEvaluate\_out\_CSI-RS,RedCap and TEvaluate\_in\_CSI-RS,RedCap for FR2 for 2Rx RedCap UE

|  |  |  |
| --- | --- | --- |
| Configuration | TEvaluate\_out\_CSI-RS,RedCap (ms) | TEvaluate\_in\_CSI-RS,RedCap (ms) |
| no DRX | Max(200, Ceil(Mout,RedCap×P×N)×TCSI-RS) | Max(100, Ceil(Min,RedCap×P×N) × TCSI-RS) |
| DRX ≤ 320ms | Max(200, Ceil(1.5×Mout,RedCap×P×N)× Max(TDRX, TCSI-RS)) | Max(100, Ceil(1.5×Min,RedCap×P×N)× Max(TDRX, TCSI-RS)) |
| DRX > 320ms | Ceil(Mout,RedCap×P×N) × TDRX | Ceil(Min,RedCap×P×N) × TDRX |
| NOTE: TCSI-RS is the periodicity of the CSI-RS resource configured for RLM. The requirements in this table apply for TCSI-RS equal to 5 ms, 10 ms, 20 ms or 40 ms. TDRX is the DRX cycle length. | | |

Table 8.1B.3.2-3: Evaluation period TEvaluate\_out\_CSI-RS,RedCap and TEvaluate\_in\_CSI-RS,RedCap for FR1 for 1Rx RedCap UE

|  |  |  |
| --- | --- | --- |
| Configuration | TEvaluate\_out\_CSI-RS,RedCap (ms) | TEvaluate\_in\_CSI-RS,RedCap (ms) |
| no DRX | Max(400, Ceil(Mout,RedCap×P)×TCSI-RS) | Max(100, Ceil(Min,RedCap×P) × TCSI-RS) |
| DRX ≤ 320ms | Max(400, Ceil(1.5×Mout,RedCap ×P)× Max(TDRX, TCSI-RS)) | Max(100, Ceil(1.5×Min,RedCap×P)× Max(TDRX, TCSI-RS)) |
| DRX > 320ms | Ceil(Mout,RedCap ×P) × TDRX | Ceil(Min,RedCap ×P) × TDRX |
| NOTE: TCSI-RS is the periodicity of the CSI-RS resource configured for RLM. The requirements in this table apply for TCSI-RS equal to 5 ms, 10ms, 20 ms or 40 ms. TDRX is the DRX cycle length. | | |

#### 8.1B.3.3 Measurement restrictions for CSI-RS based RLM

The UE is required to be capable of measuring CSI-RS for RLM without measurement gaps. The UE is required to perform the CSI-RS measurements with measurement restrictions as described in the following clauses.

For both FR1 and FR2, when the CSI-RS for RLM is in the same OFDM symbol as SSB for RLM, BFD, CBD or L1-RSRP measurement, UE is not required to receive CSI-RS for RLM in the PRBs that overlap with an SSB.

For FR1, when the SSB for RLM, BFD, CBD, or L1-RSRP measurement is within the active BWP and has same SCS than CSI-RS for RLM, the UE shall be able to perform CSI-RS measurement without restrictions.

For FR1, when the SSB for RLM, BFD, CBD or L1-RSRP measurement is within the active BWP and has different SCS than CSI-RS for RLM, the UE shall be able to perform CSI-RS measurement with restrictions according to its capabilities:

- If the UE supports *simultaneousRxDataSSB-DiffNumerology* the UE shall be able to perform CSI-RS for RLM measurement without restrictions.

- If the UE does not support *simultaneousRxDataSSB-DiffNumerology*, UE is required to measure one of but not both CSI-RS for RLM and SSB. Longer measurement period for CSI-RS based RLM is expected, and no requirements are defined.

For FR1, when the CSI-RS for RLM is in the same OFDM symbol as another CSI-RS for RLM, BFD, CBD or L1-RSRP measurement, UE shall be able to measure the CSI-RS for RLM without any restriction.

For FR2, when the CSI-RS for RLM is in the same OFDM symbol as SSB for RLM, BFD, or L1-RSRP measurement, or in the same symbol as SSB for CBD when beam failure is detected, UE is required to measure one of but not both CSI-RS for RLM and SSB. Longer measurement period for CSI-RS based RLM is expected, and no requirements are defined.

For FR2, when the CSI-RS for RLM measurement is in the same OFDM symbol as another CSI-RS for RLM, BFD, CBD or L1-RSRP measurement,

- In the following cases, UE is required to measure one of but not both CSI-RS for RLM and the other CSI-RS. Longer measurement period for CSI-RS based RLM is expected, and no requirements are defined.

- The CSI-RS for RLM or the other CSI-RS in a resource set configured with repetition ON, or

- The other CSI-RS is configured in q1 and beam failure is detected, or

- The two CSI-RS-es are not QCL-ed w.r.t. QCL-TypeD, or the QCL information is not known to UE,

- Otherwise, UE shall be able to measure the CSI-RS for RLM without any restriction.

### 8.1B.4 Minimum requirement at transitions

When the UE transitions between RLM CD-SSB resource and RLM NCD-SSB resource during one evaluation period, the UE is allowed to restart the ongoing evaluation using the second SSB type after BWP switching. Subsequent to this duration, the UE shall use an evaluation period corresponding to the second SSB type for each RLM-RS resource.

The requirements in clause 8.1.4 shall also apply except the scenarios described above.

### 8.1B.5 Minimum requirement for UE turning off the transmitter

The requirements in clause 8.1.5 shall apply.

### 8.1B.6 Minimum requirement for L1 indication

When the downlink radio link quality on all the configured RLM-RS resources is worse than Qout,RedCap, layer 1 of the UE shall send an out-of-sync indication for the cell to the higher layers. A layer 3 filter shall be applied to the out-of-sync indications as specified in TS 38.331 [2].

When the downlink radio link quality on at least one of the configured RLM-RS resources is better than Qin,RedCap, layer 1 of the UE shall send an in-sync indication for the cell to the higher layers. A layer 3 filter shall be applied to the in-sync indications as specified in TS 38.331 [2].

The out-of-sync and in-sync evaluations for the configured RLM-RS resources shall be performed as specified in clause 5 in TS 38.213 [3]. Two successive indications from layer 1 shall be separated by at least TIndication\_interval,RedCap.

When DRX is not used for RedCap UEs, TIndication\_interval,RedCap is max(10ms, TRLM-RS,M), where TRLM,M is the shortest periodicity of all configured RLM-RS resources for the monitored cell, which corresponds to TSSB specified in clause 8.1B.2 if the RLM-RS resource is SSB, or TCSI-RS specified in clause 8.1B.3 if the RLM-RS resource is CSI-RS.

In case DRX is used for RedCap UEs, TIndication\_interval,RedCap is Max(10ms, 1.5 × DRX\_cycle\_length, 1.5 × TRLM-RS,M)) if DRX cycle\_length is less than or equal to 320ms, and TIndication\_interval is DRX\_cycle\_length if DRX cycle\_length is greater than 320ms. Upon start of T310 timer as specified in TS 38.331 [2], the UE shall monitor the configured RLM-RS resources for recovery using the evaluation period and layer 1 indication interval corresponding to the no DRX mode until the expiry or stop of T310 timer.

When DRX is not used for HD-FDD RedCap UEs, TIndication\_interval,RedCap is max(10ms, TRLM-RS,M), where TRLM,M is the shortest periodicity of all configured RLM-RS resources for the monitored cell, which corresponds to TSSB specified in clause 8.1B.2 if the RLM-RS resource is SSB, or TCSI-RS specified in clause 8.1B.3 if the RLM-RS resource is CSI-RS, under the following condition

- For each RLM-RS configuration, at least one RLM-RS sample must fall with DL occasion within an indication period.

In case DRX is used for HD-FDD RedCap UEs, TIndication\_interval,RedCap is Max(10ms, 1.5 × DRX\_cycle\_length, 1.5 × TRLM-RS,M)) if DRX cycle\_length is less than or equal to 320ms, and TIndication\_interval is DRX\_cycle\_length if DRX cycle\_length is greater than 320ms, under the following condition

- For each RLM-RS configuration, at least one RLM-RS sample must fall with DL occasion within an indication period.

### 8.1B.7 Scheduling availability of UE during radio link monitoring

The requirements in clause 8.1.7 shall apply.

#### 8.1B.7.1 Scheduling availability of UE performing radio link monitoring with a same subcarrier spacing as PDSCH/PDCCH on FR1

The requirements in clause 8.1.7.1 shall apply.

#### 8.1B.7.2 Scheduling availability of UE performing radio link monitoring with a different subcarrier spacing than PDSCH/PDCCH on FR1

For UEs which support *simultaneousRxDataSSB-DiffNumerology* [14] there are no restrictions on scheduling availability due to radio link monitoring based on SSB as RLM-RS. For UEs which do not support *simultaneousRxDataSSB-DiffNumerology* [14] the following restrictions apply due to radio link monitoring based on SSB as RLM -RS.

- The UE is not expected to transmit PUCCH, PUSCH or SRS or receive PDCCH, PDSCH or CSI-RS for tracking or CSI-RS for CQI on SSB symbols to be measured for radio link monitoring.

#### 8.1B.7.3 Scheduling availability of UE performing radio link monitoring on FR2

The following scheduling restriction applies due to radio link monitoring on an FR2 serving PCell.

- If the RLM-RS is CSI-RS which is type-D QCLed with active TCI state for PDCCH or PDSCH, and the CSI-RS is not in a CSI-RS resource set with repetition ON,

- There are no scheduling restrictions due to radio link monitoring based on the CSI-RS.

- Otherwise

- The UE is not expected to transmit PUCCH, PUSCH or SRS or receive PDCCH, PDSCH or CSI-RS for tracking or CSI-RS for CQI on RLM-RS symbols to be measured for radio link monitoring.

For FR2, if following conditions are met,

- UE has been notified about system information update through paging,

- The gap between UE’s reception of PDCCH that UE monitors in the Type2-PDCCH CSS set and that notifies system information update, and the PDCCH that UE monitors in the Type0-PDCCH CSS set, is greater than 2 slots,

For the SSB for RLM and CORESET for RMSI scheduling multiplexing patterns 3, UE is expected to receive the PDCCH that UE monitors in the Type0-PDCCH CSS set, and the corresponding PDSCH, on SSB symbols to be measured for RLM; and

For the SSB for RLM and CORESET for RMSI scheduling multiplexing patterns 2, UE is expected to receive PDSCH that corresponds to the PDCCH that UE monitors in the Type0-PDCCH CSS set, on SSB symbols to be measured for RLM.

## 8.1C Radio Link Monitoring for Satellite Access

### 8.1C.1 Introduction

The requirements in clause 8.1C apply for radio link monitoring on PCell and the UE is configured with only PCell, which is served by satellite access node (SAN).The UE shall monitor the downlink radio link quality based on the reference signal configured as RLM-RS resource(s) in order to detect the downlink radio link quality of the PCell as specified in TS 38.213 [3]. The configured RLM-RS resources can be all SSBs, or all CSI-RSs, or a mix of SSBs and CSI-RSs. UE is not required to perform RLM outside the active DL BWP.

On each RLM-RS resource, the UE shall estimate the downlink radio link quality and compare it to the thresholds Qout and Qin for the purpose of monitoring downlink radio link quality of the cell.

The threshold Qout is defined as the level at which the downlink radio link cannot be reliably received and shall correspond to the out-of-sync block error rate (BLERout) as defined in Table 8.1C.1-1. For SSB based radio link monitoring, Qout\_SSB is derived based on the hypothetical PDCCH transmission parameters listed in Table 8.1C.2.1-1. For CSI-RS based radio link monitoring, Qout\_CSI-RS is derived based on the hypothetical PDCCH transmission parameters listed in Table 8.1C.3.1-1.

The threshold Qin is defined as the level at which the downlink radio link quality can be received with significantly higher reliability than at Qout and shall correspond to the in-sync block error rate (BLERin) as defined in Table 8.1C.1-1. For SSB based radio link monitoring, Qin\_SSB is derived based on the hypothetical PDCCH transmission parameters listed in Table 8.1C.2.1-2. For CSI-RS based radio link monitoring, Qin\_CSI-RS is derived based on the hypothetical PDCCH transmission parameters listed in Table 8.1C.3.1-2.

The out-of-sync block error rate (BLERout) and in-sync block error rate (BLERin) are determined from the network configuration via parameter *rlmInSyncOutOfSyncThreshold* signalled by higher layers. When UE is not configured with *rlmInSyncOutOfSyncThreshold* from the network, UE determines out-of-sync and in-sync block error rates from Configuration #0 in Table 8.1C.1-1 by default. All requirements in clause 8.1C are applicable for BLER Configuration #0 in Table 8.1C.1-1.

Table 8.1C.1-1: Out-of-sync and in-sync block error rates

|  |  |  |
| --- | --- | --- |
| Configuration | BLERout | BLERin |
| 0 | 10% | 2% |

UE shall be able to monitor up to NRLM RLM-RS resources of the same or different types in each corresponding carrier frequency range, depending on a maximum number  of SSBs per half frame according to TS 38.213 [3], where NRLM is specified in Table 8.1C.1-2 according TS 38.213 [3], and meet the requirements as specified in clause 8.1C. UE is not required to meet the requirements in clause 8.1C if RLM-RS is not configured and no TCI state for PDCCH is activated.

Table 8.1C.1-2: Maximum number of RLM-RS resources NRLM

|  |  |  |
| --- | --- | --- |
| Carrier frequency range of PCell |  | Maximum number of RLM-RS resources, NRLM |
| FR1, ≤ 3 GHzNote | 4 | 2 |
| FR1, > 3 GHzNote | 8 | 4 |
|  |  |  |
| NOTE: For unpaired spectrum operation with Case C - 30 kHz SCS, 3GHz is replaced by 1.88GHz, as specified in clause 4.1 in TS 38.213 [3]. | | |

### 8.1C.2 Requirements for SSB based radio link monitoring

#### 8.1C.2.1 Introduction

The requirements in this clause apply for each SSB based RLM-RS resource configured for PCell, provided that the SSB configured for RLM is actually transmitted within UE active DL BWP during the entire evaluation period specified in clause 8.1C.2.2.

Table 8.1C.2.1-1: PDCCH transmission parameters for out-of-sync evaluation

|  |  |
| --- | --- |
| Attribute | Value for BLER Configuration #0 |
| DCI format | 1-0 |
| Number of control OFDM symbols | 2 |
| Aggregation level (CCE) | 8 |
| Ratio of hypothetical PDCCH RE energy to average SSS RE energy | 4dB |
| Ratio of hypothetical PDCCH DMRS energy to average SSS RE energy | 4dB |
| Bandwidth (PRBs) | 24 |
| Sub-carrier spacing (kHz) | SCS of the active DL BWP |
| DMRS precoder granularity | REG bundle size |
| REG bundle size | 6 |
| CP length | Normal |
| Mapping from REG to CCE | Distributed |

Table 8.1C.2.1-2: PDCCH transmission parameters for in-sync evaluation

|  |  |
| --- | --- |
| Attribute | Value for BLER Configuration #0 |
| DCI payload size | 1-0 |
| Number of control OFDM symbols | 2 |
| Aggregation level (CCE) | 4 |
| Ratio of hypothetical PDCCH RE energy to average SSS RE energy | 0dB |
| Ratio of hypothetical PDCCH DMRS energy to average SSS RE energy | 0dB |
| Bandwidth (PRBs) | 24 |
| Sub-carrier spacing (kHz) | SCS of the active DL BWP |
| DMRS precoder granularity | REG bundle size |
| REG bundle size | 6 |
| CP length | Normal |
| Mapping from REG to CCE | Distributed |

#### 8.1C.2.2 Minimum requirement

UE shall be able to evaluate whether the downlink radio link quality on the configured RLM-RS resource estimated over the last TEvaluate\_out\_SSB [ms] period becomes worse than the threshold Qout\_SSB within TEvaluate\_out\_SSB [ms] evaluation period.

UE shall be able to evaluate whether the downlink radio link quality on the configured RLM-RS resource estimated over the last TEvaluate\_in\_SSB [ms] period becomes better than the threshold Qin\_SSB within TEvaluate\_in\_SSB [ms] evaluation period.

TEvaluate\_out\_SSB and TEvaluate\_in\_SSB are defined in Table 8.1C.2.2-1 for FR1.

P value for an RLM-RS resource to be measured is defined as

- Psharing factor \* Ntotal / Noutside\_MG with Navailable = 0

- Ntotal / Navailable with Navailable > 0

For a window W of duration max(TL1, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE measurement gaps, and starting at the beginning of any RLM-RS resource occasion:

- Ntotal is the total number of RLM-RS resource occasions within the window, including those overlapped with measurement gap occasions or SMTC occasions within the window W, and

- Noutside\_MG is the number of RLM-RS resource occasions that are not overlapped with any measurement gap occasion within the window W

- Navailable is

- the number of RLM-RS resource occasions that are not overlapped with any measurement gap occasion nor any SMTC occasion within the window W, if UE does not support *parallelMeasurementWithoutRestriction* and LEO satellites are measured for intra-frequency measurement, and

- same as Noutside\_MG, otherwise

- TL1 is periodicity of the target RLM-RS

- Psharing factor = 3.

Longer evaluation period would be expected if the combination of RLM-RS resource, SMTC occasion and measurement gap configurations does not meet previous conditions.

For an FR1 serving cell, longer evaluation period would be expected during the period Tidentify\_CGI when the UE is requested to decode an NR CGI.

Table 8.1C.2.2-1: Evaluation period TEvaluate\_out\_SSB and TEvaluate\_in\_SSB for FR1

|  |  |  |
| --- | --- | --- |
| Configuration | TEvaluate\_out\_SSB (ms) | TEvaluate\_in\_SSB (ms) |
| no DRX | Max(200, Ceil(10 ´ P) ´ TSSB) | Max(100, Ceil(5 ´ P) ´ TSSB) |
| DRX cycle≤320ms | Max(200, Ceil(15 ´ P) ´ Max(TDRX,TSSB)) | Max(100, Ceil(7.5 ´ P) ´ Max(TDRX,TSSB)) |
| DRX cycle>320ms | Ceil(10 ´ P) ´ TDRX | Ceil(5 ´ P) ´ TDRX |
| NOTE: TSSB is the periodicity of the SSB configured for RLM. TDRX is the DRX cycle length. | | |

#### 8.1C.2.3 Measurement restrictions for SSB based RLM

The UE is required to be capable of measuring SSB for RLM without measurement gaps. The UE is required to perform the SSB measurements with measurement restrictions as described in the following scenarios.

For FR1, when the SSB for RLM is in the same OFDM symbol as CSI-RS for RLM, BFD, CBD or L1-RSRP measurement,

- If SSB and CSI-RS have same SCS, UE shall be able to measure the SSB for RLM without any restriction;

- If SSB and CSI-RS have different SCS,

- If UE supports *simultaneousRxDataSSB-DiffNumerology*, UE shall be able to measure the SSB for RLM without any restriction;

- If UE does not support *simultaneousRxDataSSB-DiffNumerology*, UE is required to measure one of but not both SSB for RLM and CSI-RS. Longer measurement period for SSB based RLM is expected, and no requirements are defined.

### 8.1C.3 Requirements for CSI-RS based radio link monitoring

#### 8.1C.3.1 Introduction

The requirements in this clause apply for each CSI-RS based RLM-RS resource configured for PCell, provided that the CSI-RS configured for RLM is actually transmitted within UE active DL BWP during the entire evaluation period specified in clause 8.1C.3.2. UE is not expected to perform radio link monitoring measurements on the CSI-RS configured as RLM-RS if the CSI-RS is not in the active TCI state of any CORESET configured in the UE active BWP.

Table 8.1C.3.1-1: PDCCH transmission parameters for out-of-sync evaluation

|  |  |
| --- | --- |
| Attribute | Value for BLER Configuration #0 |
| DCI format | 1-0 |
| Number of control OFDM symbols | 2 |
| Aggregation level (CCE) | 8 |
| Ratio of hypothetical PDCCH RE energy to average CSI-RS RE energy | 4dB |
| Ratio of hypothetical PDCCH DMRS energy to average CSI-RS RE energy | 4dB |
| Bandwidth (PRBs) | 48 |
| Sub-carrier spacing (kHz) | SCS of the active DL BWP |
| DMRS precoder granularity | REG bundle size |
| REG bundle size | 6 |
| CP length | Normal |
| Mapping from REG to CCE | Distributed |

Table 8.1C.3.1-2: PDCCH transmission parameters for in-sync evaluation

|  |  |
| --- | --- |
| Attribute | Value for BLER Configuration #0 |
| DCI payload size | 1-0 |
| Number of control OFDM symbols | 2 |
| Aggregation level (CCE) | 4 |
| Ratio of hypothetical PDCCH RE energy to average CSI-RS RE energy | 0dB |
| Ratio of hypothetical PDCCH DMRS energy to average CSI-RS RE energy | 0dB |
| Bandwidth (PRBs) | 48 |
| Sub-carrier spacing (kHz) | SCS of the active DL BWP |
| DMRS precoder granularity | REG bundle size |
| REG bundle size | 6 |
| CP length | Normal |
| Mapping from REG to CCE | Distributed |

#### 8.1C.3.2 Minimum requirement

UE shall be able to evaluate whether the downlink radio link quality on the configured RLM-RS resource estimated over the last TEvaluate\_out\_CSI-RS ms period becomes worse than the threshold Qout\_CSI-RS within TEvaluate\_out\_CSI-RS ms evaluation period.

UE shall be able to evaluate whether the downlink radio link quality on the configured RLM-RS resource estimated over the last TEvaluate\_in\_CSI-RS ms period becomes better than the threshold Qin\_CSI-RS within TEvaluate\_in\_CSI-RS ms evaluation period.

- TEvaluate\_out\_CSI-RS and TEvaluate\_in\_CSI-RS are defined in Table 8.1C.3.2-1 for FR1.

The requirements of TEvaluate\_out\_CSI-RS and TEvaluate\_in\_CSI-RS apply provided that the CSI-RS for RLM is not in a resource set configured with repetition ON. The requirements do not apply when the CSI-RS resource in the active TCI state of CORESET is the same CSI-RS resource for RLM and the TCI state information of the CSI-RS resource is not given, wherein the TCI state information means QCL Type-D to SSB for L1-RSRP or CSI-RS with repetition ON.

P value for an RLM-RS resource to be measured is defined as

- Psharing factor \* Ntotal / Noutside\_MG with Navailable = 0

- Ntotal / Navailable with Navailable > 0

For a window W of duration max(TL1, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE measurement gaps, and starting at the beginning of any RLM-RS resource occasion:

- Ntotal is the total number of RLM-RS resource occasions within the window, including those overlapped with measurement gap occasions or SMTC occasions within the window W, and

- Noutside\_MG is the number of RLM-RS resource occasions that are not overlapped with any measurement gap occasion within the window W

- Navailable is

- the number of RLM-RS resource occasions that are not overlapped with any measurement gap occasion nor any SMTC occasion within the window W, if UE does not support *parallelMeasurementWithoutRestriction* and LEO satellites are measured for intra-frequency measurement, and

- same as Noutside\_MG, otherwise

- TL1 is periodicity of the target RLM-RS

- Psharing factor = 3.

Longer evaluation period would be expected if the combination of RLM-RS resource, SMTC occasion and measurement gap configurations does not meet previous conditions.

For an FR1 serving cell, longer evaluation period would be expected during the period Tidentify\_CGI when the UE is requested to decode an NR CGI.

The values of Mout and Min used in Table 8.1C.3.2-1 are defined as:

- Mout = 20 and Min = 10, if the CSI-RS resource configured for RLM is transmitted with higher layer CSI-RS parameter *density* [6, clause 7.4.1] set to 3 and over the bandwidth ≥ 24 PRBs.

Table 8.1C.3.2-1: Evaluation period TEvaluate\_out\_CSI-RS and TEvaluate\_in\_CSI-RS for FR1

|  |  |  |
| --- | --- | --- |
| Configuration | TEvaluate\_out\_CSI-RS (ms) | TEvaluate\_in\_CSI-RS (ms) |
| no DRX | Max(200, Ceil(Mout×P)×TCSI-RS) | Max(100, Ceil(Min×P) × TCSI-RS) |
| DRX ≤ 320ms | Max(200, Ceil(1.5×Mout×P)× Max(TDRX, TCSI-RS)) | Max(100, Ceil(1.5×Min×P)× Max(TDRX, TCSI-RS)) |
| DRX > 320ms | Ceil(Mout×P) × TDRX | Ceil(Min×P) × TDRX |
| NOTE: TCSI-RS is the periodicity of the CSI-RS resource configured for RLM. The requirements in this table apply for TCSI-RS equal to 5 ms, 10ms, 20 ms or 40 ms. TDRX is the DRX cycle length. | | |

#### 8.1C.3.3 Measurement restrictions for CSI-RS based RLM

The UE is required to be capable of measuring CSI-RS for RLM without measurement gaps. The UE is required to perform the CSI-RS measurements with measurement restrictions as described in the following clauses.

For FR1, when the CSI-RS for RLM is in the same OFDM symbol as SSB for RLM, BFD, CBD or L1-RSRP measurement, UE is not required to receive CSI-RS for RLM in the PRBs that overlap with an SSB.

For FR1, when the SSB for RLM, BFD, CBD, or L1-RSRP measurement is within the active BWP and has same SCS than CSI-RS for RLM, the UE shall be able to perform CSI-RS measurement without restrictions.

For FR1, when the SSB for RLM, BFD, CBD or L1-RSRP measurement is within the active BWP and has different SCS than CSI-RS for RLM, the UE shall be able to perform CSI-RS measurement with restrictions according to its capabilities:

- If the UE supports *simultaneousRxDataSSB-DiffNumerology* the UE shall be able to perform CSI-RS for RLM measurement without restrictions.

- If the UE does not support *simultaneousRxDataSSB-DiffNumerology*, UE is required to measure one of but not both CSI-RS for RLM and SSB. Longer measurement period for CSI-RS based RLM is expected, and no requirements are defined.

For FR1, when the CSI-RS for RLM is in the same OFDM symbol as another CSI-RS for RLM, BFD, CBD or L1-RSRP measurement, UE shall be able to measure the CSI-RS for RLM without any restriction.

### 8.1C.4 Minimum requirement at transitions

When the UE transitions between DRX and no DRX or when DRX cycle periodicity changes, for each RLM-RS resource, for a duration of time equal to the evaluation period corresponding to the second mode after the transition occurs, the UE shall use an evaluation period that is no less than the minimum of evaluation period corresponding to the first mode and the second mode. Subsequent to this duration, the UE shall use an evaluation period corresponding to the second mode for each RLM-RS resource. This requirement shall be applied to both out-of-sync evaluation and in-sync evaluation of the monitored cell.

When the UE transitions from a first configuration of RLM resources to a second configuration of RLM resources that is different from the first configuration, for each RLM resource present in the second configuration, for a duration of time equal to the evaluation period corresponding to the second configuration after the transition occurs, the UE shall use an evaluation period that is no less than the minimum of evaluation periods corresponding to the first configuration and the second configuration. Subsequent to this duration, the UE shall use an evaluation period corresponding to the second configuration for each RLM resource present in the second configuration. This requirement shall be applied to both out-of-sync evaluation and in-sync evaluation of the monitored cell.

When the UE transitions from a first configuration of active TCI state of the CORESET to a second configuration of active TCI state of the CORESET, for each CSI-RS for RLM present in the second configuration, the UE shall use an evaluation period corresponding to the second configuration from the time of transition. This requirement shall be applied to both out-of-sync evaluation and in-sync evaluation of the monitored cell.

### 8.1C.5 Minimum requirement for UE turning off the transmitter

The transmitter power of the UE in the monitored cell shall be turned off within 40ms after expiry of T310 timer as specified in TS 38.331 [2].

### 8.1C.6 Minimum requirement for L1 indication

When the downlink radio link quality on all the configured RLM-RS resources is worse than Qout, layer 1 of the UE shall send an out-of-sync indication for the cell to the higher layers. A layer 3 filter shall be applied to the out-of-sync indications as specified in TS 38.331 [2].

When the downlink radio link quality on at least one of the configured RLM-RS resources is better than Qin, layer 1 of the UE shall send an in-sync indication for the cell to the higher layers. A layer 3 filter shall be applied to the in-sync indications as specified in TS 38.331 [2].

The out-of-sync and in-sync evaluations for the configured RLM-RS resources shall be performed as specified in clause 5 in TS 38.213 [3]. Two successive indications from layer 1 shall be separated by at least TIndication\_interval.

When DRX is not used TIndication\_interval is max(10ms, TRLM-RS,M), where TRLM,M is the shortest periodicity of all configured RLM-RS resources for the monitored cell, which corresponds to TSSB specified in clause 8.1C.2 if the RLM-RS resource is SSB, or TCSI-RS specified in clause 8.1C.3 if the RLM-RS resource is CSI-RS.

In case DRX is used, TIndication\_interval is Max(10ms, 1.5 × DRX\_cycle\_length, 1.5 × TRLM-RS,M)) if DRX cycle\_length is less than or equal to 320ms, and TIndication\_interval is DRX\_cycle\_length if DRX cycle\_length is greater than 320ms. Upon start of T310 timer as specified in TS 38.331 [2], the UE shall monitor the configured RLM-RS resources for recovery using the evaluation period and layer 1 indication interval corresponding to the no DRX mode until the expiry or stop of T310 timer.

### 8.1C.7 Scheduling availability of UE during radio link monitoring

When the reference signal to be measured for RLM has different subcarrier spacing than PDSCH/PDCCH or is on frequency range 2, there are restrictions on the scheduling availability as described in the following clauses.

#### 8.1C.7.1 Scheduling availability of UE performing radio link monitoring with a same subcarrier spacing as PDSCH/PDCCH on FR1

There are no scheduling restrictions due to radio link monitoring performed with a same subcarrier spacing as PDSCH/PDCCH on FR1.

#### 8.1C.7.2 Scheduling availability of UE performing radio link monitoring with a different subcarrier spacing than PDSCH/PDCCH on FR1

For UEs which support *simultaneousRxDataSSB-DiffNumerology* [14] there are no restrictions on scheduling availability due to radio link monitoring based on SSB as RLM-RS. For UEs which do not support *simultaneousRxDataSSB-DiffNumerology* [14] the following restrictions apply due to radio link monitoring based on SSB as RLM -RS.

- The UE is not expected to transmit PUCCH, PUSCH or SRS or receive PDCCH, PDSCH or CSI-RS for tracking or CSI-RS for CQI on SSB symbols to be measured for radio link monitoring.

## 8.2 Interruption

### 8.2.1 EN-DC Interruption

#### 8.2.1.1 Introduction

This clause contains the requirements related to the interruptions on PSCell, and SCell, when

E-UTRA PCell transitions between active and non-active during DRX, or

E-UTRA PCell transitions from non-DRX to DRX, or

E-UTRA SCell in MCG or SCell in SCG is added or released, or

E-UTRA SCell in MCG or SCell(s) in SCG is activated or deactivated, or

measurements on SCC with deactivated SCell in either E-UTRA MCG or NR SCG, or

a supplementary UL carrier or an UL carrier is configured or de-configured, or

UL/DL active BWP is switched on PSCell or SCell in SCG, or

E-UTRA SCell in MCG or SCell(s) in SCG is directly activated and hibernated, or

E-UTRA SCell in MCG is hibernated, or

Multiple SCells in SCG are activated or deactivated, or

SCell dormancy switches, or

CQI/RRM measurement happens during SCell dormancy, or

UE-specific CBW is changed on PSCell or SCell in SCG, or

CGI reading of an NR neighbour cell with autonomous gaps, or

CGI reading of an E-UTRA neighbour cell with autonomous gaps.

NR SRS carrier based switching, or

E-UTRA SRS carrier based switching, or

NR SRS antenna port switching, or

UE dynamic Tx switches between two uplink carriers, or

SCell in SCG is activated based on aperiodic CSI-RS.

The requirements shall apply for E-UTRA-NR DC with an E-UTRA PCell.

This clause contains interruptions where victim cell is PSCell or SCell belonging to SCG. Requirements for interruptions requirements when the victim cell is E-UTRA PCell or E-UTRA SCell belonging to MCG are specified in TS 36.133 [15].

For a UE which does not support per-FR measurement gaps, interruptions to the PSCell or activated SCG SCells may be caused by EUTRA PCell, EUTRA SCells or SCells on any frequency range. For UE which support per-FR gaps, interruptions to the PSCell or activated SCG SCells may be caused by EUTRA PCell, EUTRA SCells or SCells on the same frequency range as the victim cell.

#### 8.2.1.2 Requirements

##### 8.2.1.2.1 Interruptions at transitions between active and non-active during DRX

Interruption on PSCell and the activated SCell if configured due to E-UTRA PCell transitions between active and non-active druing DRX when PSCell or SCell is in non-DRX are allowed with up to 1% probability of missed ACK/NACK when the configured E-UTRA PCell DRX cycle is less than 640 ms, and 0.625% probability of missed ACK/NACK is allowed when the configured E-UTRA PCell DRX cycle is 640 ms or longer. Each interruption shall not exceed X slot as defined in table 8.2.1.2.1-1.

Table 8.2.1.2.1-1: Interruption length X at transition between active and non-active during DRX

|  |  |  |  |
| --- | --- | --- | --- |
|  | NR Slot | Interruption length X (slots) | |
|  | length (ms) | Sync | Async |
| 0 | 1 | 1 | 2 |
| 1 | 0.5 | 1 | 2 |
| 2 | 0.25 | 3 | |
| 3 | 0.125 | 5 | |

When both E-UTRA PCell and PSCell are in DRX, no interruption is allowed.

##### 8.2.1.2.2 Interruptions at transitions from non-DRX to DRX

Interruption on PSCell and the activated SCell if configured due to E-UTRA PCell transitions from non-DRX to DRX when PSCell or SCell is in non-DRX shall not exceed X slot as defined in table 8.2.1.2.1-1.

When PSCell and the activated SCell are in DRX, no interruption due to E-UTRA PCell transitions from non-DRX to DRX is allowed.

##### 8.2.1.2.3 Interruptions at SCell addition/release

The requirements in this clause shall apply for the UE configured with PSCell.

When one E-UTRA SCell in MCG is added or released:

- the UE is allowed an interruption on any active serving cell in SCG:

- of up to X1 slot, if the active serving cell is not in the same band as any of the E-UTRA SCells being added or released, or

- of up to max{Y1 slot + TSMTC\_duration, 5ms} if the active serving cells are in the same band as any of the E-UTRA SCells being added or released, provided the cell specific reference signals from the active serving cells and the E-UTRA SCells being added or released are available in the same slot, where TSMTC\_duration is the longest SMTC duration among all above active serving cells in SCG;

Where X1 and Y1 are specified in Table 8.2.1.2.3-1.

When one SCell in SCG is added or released:

- the UE is allowed an interruption on any active serving cell in SCG:

- of up to X1 slot, if the active serving cell and the SCell being added or released are in a FR2 band pair and UE is capable of independent beam management on this FR2 band pair

- of up to X1 slot, if the active serving cell and the SCell being added or released are in a FR2 band pair and UE is capable of independent beam management on this FR2 band pair

or

- of up to Y1 slot + TSMTC\_duration if the active serving cells are in the same band as any of the SCells being added or released, provided the cell specific reference signals from the active serving cells and the SCells being added or released are available in the same slot, where, TSMTC\_duration is

- the longest SMTC duration among all above active serving cells in SCG and the SCell being added when one SCell is added. If SSB configuration (*absoluteFrequencySSB*) but no SMTC configuration is provided for the SCell being added, the SSB transmission periodicity is assumed to be 5ms and TSMTC duration for the SCell being added is x ms, where x = the number of consecutive subframes containing all SSBs in one SSB burst transmitted by the SCell being added. If no SSB configuration (*absoluteFrequencySSB*) nor SMTC configuration is provided for the SCell being added, TSMTC duration for the SCell being added is 0 ms;

- the longest SMTC duration among all above active serving cells in SCG when one SCell is released.

Where X1 and Y1 are specified in Table 8.2.1.2.3-2.

Table 8.2.1.2.3-1: Interruption length X1 and Y1 at E-UTRA SCell addition/Release

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | NR Slot length | Interruption length X1 (slots) | | Interruption length Y1 (slots) | |
|  | (ms) | Sync | Async | Sync | Async |
| 0 | 1 | 1 | 2 | 1 | 2 |
| 1 | 0.5 | 2 | 3 | 2 | 3 |
| 2 | 0.25 | 5 | | 4 | 5 |
| 3 | 0.125 | 9 | | N/A | - N/A |

Table 8.2.1.2.3-2: Interruption length X1 and Y1 at SCell addition/Release

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | NR Slot length (ms) of victim cell | Interruption length X1 (slots) | | Interruption length Y1 (slots) |
| 0 | 1 | 1 | | 1 |
| 1 | 0.5 | 2 | | 2 |
| 2 | 0.25 | Both aggressor cell and victim cell are on FR2 | 4 | 4 |
|  |  | Either aggressor cell or victim cell is on FR1 | 5 |  |
| 3 | 0.125 | Aggressor cell is on FR2 | 8 | 8 |
|  |  | Aggressor cell is on FR1 | 9 |  |

##### 8.2.1.2.4 Interruptions at SCell activation/deactivation

The requirements in this clause shall apply for the UE configured with PSCell and one SCell.

When one E-UTRA SCell in MCG is activated from deactivated or dormant state, or deactivated from activated or dormant state:

- the UE is allowed an interruption on any active serving cell in SCG:

- of up to X2 slot, if the active serving cell is not in the same band as any of the E-UTRA SCells being activated or deactivated, or

- of up to max{Y2 slot + TSMTC\_duration, 5ms} if the active serving cells are in the same band as any of the E-UTRA SCells being activated or deactivated, provided the cell specific reference signals from the active serving cells and the E-UTRA SCells being activated or deactivated are available in the same slot, where TSMTC\_duration is the longest SMTC duration among all above active serving cells in SCG.

Where X2 and Y2 are specified in Table 8.2.1.2.4-1.

When one SCell in SCG is activated or deactivated:

- an interruption on any serving cell in SCG:

- of up to X2 slot, if the active serving cell and the SCell being activated or deactivated are in a FR1 band pair or in a FR1+FR2 band pair.

- of up to X2 slot, if the active serving cells and the SCells being activated or deactivated are in a FR2 band pair and UE is capable of independent beam management on this FR2 band pair.

or

- of up to Y2 slot + TSMTC\_duration if the active serving cells are in the same band as any of the SCells being activated or deactivated, provided the cell specific reference signals from the active serving cells and the SCells being activated or deactivated are available in the same slot, where, TSMTC\_duration is

- the longest SMTC duration among all above active serving cells in SCG and the SCell being activated when one SCell is activated. If SSB configuration (*absoluteFrequencySSB*) but no SMTC configuration is provided for the SCell being activated, the SSB transmission periodicity is assumed to be 5ms and TSMTC duration for the SCell being activated is x ms, where x = the number of consecutive subframes containing all SSBs in one SSB burst transmitted by the SCell being activated. If no SSB configuration (*absoluteFrequencySSB*) nor SMTC configuration is provided for the SCell being activated, TSMTC duration for the SCell being activated is 0ms;

- the longest SMTC duration among all above active serving cells in SCG when one SCell is deactivated.

Where X2 and Y2 are specified in Table 8.2.1.2.4-2.

Table 8.2.1.2.4-1: Interruption length X2 and Y2 at E-UTRA SCell activation/deactivation

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | NR Slot length | nterruption length X2 (slots) | | Interruption length Y2 (slots) | |
|  | (ms) | Sync | Async | Sync | Async |
| 0 | 1 | 1 | 2 | 1 | 2 |
| 1 | 0.5 | 1 | 2 | 1 | 2 |
| 2 | 0.25 | 3 | | 2 | 3 |
| 3 | 0.125 | 5 | | N/A | N/A |

Table 8.2.1.2.4-2: Interruption length X2 and Y2 at SCell activation/deactivation

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | NR Slot length (ms) of victim cell | Interruption length X2 (slots) | | Interruption length Y2 (slots) |
| 0 | 1 | 1 | | 1 |
| 1 | 0.5 | 1 | | 1 |
| 2 | 0.25 | Both aggressor cell and victim cell are on FR2 | 2 | 2 |
|  |  | Either aggressor cell or victim cell is on FR1 | 3 |  |
| 3 | 0.125 | Aggressor cell is on FR2 | 4 | 4 |
|  |  | Aggressor cell is on FR1 | 5 |  |

##### 8.2.1.2.5 Interruptions during measurements on SCC

###### 8.2.1.2.5.1 Interruptions during measurements on deactivated NR SCC

Interruption on PSCell and other activated NR SCell(s) during measurement on the deactivated NR SCC shall meet requirements in clause 8.2.2.2.3, where the term PCell in clause 8.2.2.2.3 shall be deemed to be replaced with PSCell.

###### 8.2.1.2.5.2 Interruptions during measurements on deactivated E-UTRAN SCC

When one E-UTRA SCell in MCG is deactivated, the UE is allowed due to measurements on the E-UTRA SCC with the deactivated E-UTRA SCell:

- an interruption on PSCell or any activated SCell with up to 0.5% probability of missed ACK/NACK when any of the configured *measCycleSCell* [15] for the deactivated E-UTRA SCellsis 640 ms or longer.

- an interruption on PSCell or any activated SCell with up to 0.5% probability of missed ACK/NACK regardless of the configured *measCycleSCell* [15]for the deactivated E-UTRA SCells if indicated by the network using IE *allowInterruptions* [15].

Each interruption shall not exceed

- X3 slot, if the PSCell or activated SCell is not in the same band as the E-UTRA deactivated SCC being measured, or

- Y3 slot + SMTC duration, if the PSCell or activated SCell is in the same band as the E-UTRA deactivated SCC being measured, provided the cell specific reference signals from the PSCell or activated SCell and the E-UTRA deactivated SCC being measured are available in the same slot.

Table 8.2.1.2.5.2-1: Interruption length X3 and Y3 at measurements on deactivated E-UTRA SCC

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | NR Slot length | Interruption length X3 (slots) | | Interruption length Y3 (slots) | |
|  | (ms) | Sync | Async | Sync | Async |
| 0 | 1 | 1 | 2 | 1 | 2 |
| 1 | 0.5 | 1 | 2 | 1 | 2 |
| 2 | 0.25 | 3 | | 2 | 3 |
| 3 | 0.125 | 5 | | N/A | N/A |

###### 8.2.1.2.5.3 Interruptions during CQI measurements on dormant E-UTRAN SCell

When one E-UTRA SCell in MCG is dormant, the UE is allowed due to CQI measurements on the dormant E-UTRA SCell:

- an interruption on PSCell or any activated SCell with up to 0.5% probability of missed ACK/NACK.

Each interruption shall not exceed

- X3 slot, if the PSCell or activated SCell is not in the same band as the E-UTRA dormant SCell being measured, or

- Y3 slot + SMTC duration, if the PSCell or activated SCell is in the same band as the E-UTRA dormant SCell being measured, provided the cell specific reference signals from the PSCell or activated SCell and the E-UTRA dormant SCell being measured are available in the same slot.

Where X3 and Y3 are defined in Table 8.2.1.2.5.2-1.

###### 8.2.1.2.5.4 Interruptions during RRM measurements on dormant E-UTRAN SCC

When one E-UTRA SCell in MCG is dormant, the UE is allowed due to RRM measurements on the E-UTRA SCC with the dormant E-UTRA SCell:

- an interruption on PSCell or any activated SCell with up to 0.5% probability of missed ACK/NACK.

Each interruption shall not exceed

- X3 slot, if the PSCell or activated SCell is not in the same band as the E-UTRA dormant SCC being measured, or

- Y3 slot + SMTC duration, if the PSCell or activated SCell is in the same band as the E-UTRA dormant SCC being measured, provided the cell specific reference signals from the PSCell or activated SCell and the E-UTRA dormant SCC being measured are available in the same slot.

Where X3 and Y3 are defined in Table 8.2.1.2.5.2-1.

##### 8.2.1.2.6 Interruptions at UL carrier RRC reconfiguration

The requirements in this clause shall apply when a supplementary UL carrier or an UL carrier is configured or de-configured in NR non-standalone operation as defined in TS 38.331 [2].

When an UL carrier or supplementary UL carrier is configured or de-configured, an interruption of up to X4 slot, is allowed during the RRC reconfiguration procedure [2] on E-UTRA PCell, all activated E-UTRA SCells, PSCell and all activated SCells within the same FR as the reconfigured uplink carrier. The interruption is for both uplink and downlink of E-UTRA PCell, all activated E-UTRA SCells, PSCell and all activated SCells within the same FR as the configured or de-configured UL.

Table 8.2.1.2.6-1: Interruption length X4 at UL carrier RRC reconfiguration

|  |  |  |  |
| --- | --- | --- | --- |
|  | NR Slot  length (ms) | Interruption length X4 (slots) | |
|  |  | Sync | Async |
| 0 | 1 | 1 | 2 |
| 1 | 0.5 | 2 | 3 |
| 2 | 0.25 | 5 | |
| 3 | 0.125 | 9 | |

##### 8.2.1.2.7 Interruptions due to Active BWP switching Requirement

The requirements for DCI-based BWP switch, timer-based BWP switch or UL BWP switch triggered by consistent uplink CCA failures in this clause apply to the case that the BWP switch is performed on a single CC or multiple CCs.

When either of the DCI-based, timer-based or RRC-based downlink BWP switch and/or uplink BWP switch occur on multiple CCs simultaneously or over partially overlapping period, the interruption requirements described in this clause apply for each BWP switch.

When UE receives a DCI indicating UE to switch its active BWP involving changes in any of the parameters listed in Table 8.2.1.2.7-2, the UE is allowed to cause interruption of up to X slot to other active serving cells if the UE is not capable of per-FR gap, or if the BWP switching involves SCS changing. When the BWP switch imposes changes in any of the parameters listed in Table 8.2.1.2.7-2 and the UE is capable of per-FR gap, the UE is allowed to cause interruption of up to X slot to other active serving cells in the same frequency range wherein the UE is performing BWP switching. X is defined in Table 8.2.1.2.7-1. The starting time of interruption is only allowed within the BWP switching delay TBWPswitchDelay as defined in clause 8.6.2 when BWP switch occurs on a single CC. The starting time of interruption caused by each BWP switch is only allowed within the BWP switch delay TMultipleBWPswitchDelay +Y as defined in clause 8.6.2A.1 when BWP switch occurs on multiple CCs. Interruptions are not allowed during BWP switch involving any other parameter change.

When a BWP timer *bwp-InactivityTimer* defined in TS 38.331 [2] expires, UE is allowed to cause interruption of up to X slot to other active serving cells due to switching its active BWP involving changes in any of the parameters listed in Table 8.2.1.2.7-2 if the UE is not capable of per-FR gap, or if the BWP switching involves SCS changing. When the BWP switch imposes changes in any of the parameters listed in Table 8.2.1.2.7-2 and the UE is capable of per-FR gap, the UE is allowed to cause interruption of up to X slot to other active serving cells in the same frequency range wherein the UE is performing BWP switching. X is defined in Table 8.2.1.2.7-1. The starting time of interruption is only allowed within the BWP switching delay TBWPswitchDelay as defined in clause 8.6.2 when BWP switch occurs on a single CC. The starting time of interruption caused by each BWP switch is only allowed within the BWP switch delay TMultipleBWPswitchDelay as defined in clause 8.6.2B.1 when BWP switch occurs on multiple CCs simultaneously or TMultipleBWPswitchDelayTotal as defined in clause 8.6.2B.2 when BWP switch occurs on multiple CCs over partially overlapping time period. Interruptions are not allowed during BWP switch involving any other parameter change.

When UE receives an RRC reconfiguration that only requests UE to switch its active BWP on one single CC, the UE is allowed to cause interruption of up to X slot to other active serving cells due to switching its active BWP involving changes in any of the parameters listed in Table 8.2.1.2.7-2 if the UE is not capable of per-FR gap, or if the BWP switching involves SCS changing. When the BWP switch imposes changes in any of the parameters listed in Table 8.2.1.2.7-2 and the UE is capable of per-FR gap, the UE is allowed to cause interruption of up to X slot to other active serving cells in the same frequency range wherein the UE is performing BWP switching. X is defined in Table 8.2.1.2.7-1. The interruption is only allowed within the delay TRRCprocessingDelay + TBWPswitchDelayRRC defined in clause 8.6.3 when BWP switch occurs on a single CC. The interruption is only allowed within the delay TRRCprocessingDelay + TBWPswitchDelayRRC + DRRC\*(N-1) as defined in clause 8.6.3A when BWP switch occurs on multiple CCs.

When UL BWP switch is triggered by consistent uplink CCA failures [7], the UE is allowed to cause interruption of up to X slot to other active serving cells due to switching its active UL BWP involving changes in any of the parameters listed in Table 8.2.1.2.7-2 if the UE is not capable of per-FR gap, or if the UL BWP switching involves SCS changing. When the UL BWP switch imposes changes in any of the parameters listed in Table 8.2.1.2.7-2 and the UE is capable of per-FR gap, the UE is allowed to cause interruption of up to X slot to other active serving cells in the same frequency range wherein the UE is performing UL BWP switching. X is defined in Table 8.2.1.2.7-1. The starting time of interruption is only allowed within the UL BWP switching delay TBWPswitchDelay as defined in clause 8.6.2. Interruptions are not allowed during UL BWP switch involving other parameter change.

Table 8.2.1.2.7-1: interruption length X

|  |  |  |
| --- | --- | --- |
|  | NR Slot length (ms) | Interruption length X (slots) |
| 0 | 1 | 1 |
| 1 | 0.5 | 1 |
| 2 | 0.25 | 3 |
| 3 | 0.125 | 5 |
| Note1: void | | |

Table 8.2.1.2.7-2: Parameters which cause interruption other than SCS

|  |  |
| --- | --- |
| Parameters | Comment |
| *locationAndBandwidth* | From TS 38.331 [2] |
| *nrofSRS-Ports* |  |
| *maxMIMO-Layers-r16* |  |

##### 8.2.1.2.8 Interruptions at direct SCell activation and hibernation

###### 8.2.1.2.8.1 Interruptions during direct SCell activation and hibernation of E-UTRA SCell

When one E-UTRA SCell in MCG is directly activated and hibernated:

- the UE is allowed an interruption on any active serving cell in SCG:

- of up to X1 slots, if the active serving cell is not in the same band as any of the E-UTRA SCells being directly activated or hibernated, or

- of up to max{Y1 slots + TSMTC\_duration, 5ms} if the active serving cells are in the same band as any of the E-UTRA SCells being directly activated or hibernated, provided the cell specific reference signals from the active serving cells and the E-UTRA SCells being directly activated or hibernated are available in the same slot, where TSMTC\_duration is the longest SMTC duration among all above active serving cells in MCG Where X1 and Y1 are specified in Table 8.2.1.2.3-1.

###### 8.2.1.2.8.2 Interruptions during direct SCell activation

When one or multiple SCell(s) in SCG are directly activated at SCell addition:

- the UE is allowed an interruption on any active serving cell in SCG:

- of up to X1 slot, if the active serving cell is not in the same band as the SCell being directly activated, or

- of up to max{Y1 slot + TSMTC\_duration, 5ms} if the active serving cells are in the same band as the SCell being directly activated, provided the cell specific reference signals from the active serving cells and the SCell being directly activated are available in the same slot, where TSMTC\_duration is the longest SMTC duration among all above active serving cells in SCG.

Where X1 and Y1 are specified in Table 8.2.1.2.3-2.

##### 8.2.1.2.9 Interruptions at SCell hibernation

When one E-UTRA SCell in MCG is hibernated:

- the UE is allowed an interruption on any active serving cell in SCG:

- of up to X2 slots, if the active serving cell is not in the same band as any of the E-UTRA SCells being hibernated, or

- of up to max{Y2 slots + TSMTC\_duration, 5ms} if the active serving cells are in the same band as any of the E-UTRA SCells being hibernated, provided the cell specific reference signals from the active serving cells and the E-UTRA SCells being hibernated are available in the same slot, where TSMTC\_duration is the longest SMTC duration among all above active serving cells in MCG.

Where X2 and Y2 are specified in Table 8.2.1.2.4-1.

##### 8.2.1.2.10 Interruptions at SCell activation/deactivation with multiple downlink SCells

The requirements in this clause shall apply for the UE configured with PSCell and up to 6 downlink SCell(s).

When multiple SCells in SCG are activated or deactivated by one single MAC CE command:

- an interruption on any serving cell in SCG is specified as in clause 8.2.1.2.4.

##### 8.2.1.2.11 Interruptions due to UE-specific CBW change

When UE receives an RRC reconfiguration that changes *offsetToCarrier* or *carrierBandwidth*, the UE is allowed to cause interruption of up to X slot to other active serving cells due to switching its CBW. X is defined in Table 8.2.1.2.11-1. The interruption is only allowed within the delay TRRCprocessingDelay + TCBWchangeDelayRRC defined in clause 8.7.

Table 8.2.1.2.11-1: interruption length X

|  |  |  |
| --- | --- | --- |
|  | NR Slot | Interruption length X (slots) |
|  | length (ms) |  |
| 0 | 1 | 1 |
| 1 | 0.5 | 1 |
| 2 | 0.25 | 3 |
| 3 | 0.125 | 5 |

##### 8.2.1.2.12 Interruptions at NR SRS carrier based switching

SRS transmission can be configured on a carrier not configured for PUCCH/PUSCH transmission. When a UE needs to transmit periodic, semi-persistent or aperiodic SRS on a carrier of a serving cell not configured for PUCCH/PUSCH transmission, the UE can perform carrier based switching to one or more carriers not configured for PUCCH/PUSCH transmission from a carrier with PUCCH/PUSCH transmission or from a carrier not configured for PUCCH/PUSCH transmission prior to transmitting SRS, provided that:

- switching is from a configured carrier to an active UL BWP of another activated carrier;

- the carrier of SCells not configured for PUCCH/PUSCH transmission to which SRS carrier based switching is performed is indicated by DCI SRS request field for aperiodic SRS transmission, or indicated by MAC-CE for semi-persistent SRS transmission, or configured via RRC for periodic SRS transmission;

- the serving cell, from which SRS carrier based switching is performed and whose UL transmission may therefore be interrupted, is indicated by srs-SwitchFromServCellIndex and srs-SwitchFromCarrier in TS38.331 [2];

- the SRS switching is not colliding with any other transmission with higher priority defined in TS 38.214 [26].

- the SRS switching is not colliding with any SSB/CSI-RS based L3 measurements and the measurements for RLM/BFD in SCG.

- for UE, which does not support simultaneous reception and transmission for inter-band TDD CA specified in TS 38.331 [2], and is compliant to the requirements for inter-band CA with uplink in one NR band and without simultaneous Rx/Tx specified in TS 38.101-3 [20], the SRS transmission are not simultaneously scheduled with DL SSB/CSI-RS for L3 or L1 measurements transmission on other carriers.

The UE shall not perform SRS carrier based switching if the above conditions cannot be met.

When SRS carrier based switching is performed between carriers, the UE is allowed interruptions on any active serving cell in SCG if UE is not capable of Per-FR gap, or on active serving cell(s) in SCG in FR1 if UE is capable of Per-FR gap, during the switching to the carrier of a serving cell in FR1 not configured for PUCCH/PUSCH transmission,

- with up to X1 slot as specified in Table 8.2.1.2.12-1.

When SRS carrier based switching is performed between carriers, the UE is allowed interruptions on any active serving cell in SCG if UE is not capable of Per-FR gap, or on active serving cell(s) in SCG in FR2 if UE is capable of Per-FR gap, during the switching to the carrier of a serving cell in FR2 not configured for PUCCH/PUSCH transmission,

- with up to X2 slot as specified in Table 8.2.1.2.12-2.

When SRS carrier based switching is performed between carriers, the UE is allowed interruptions on any active serving cell in SCG if UE is not capable of Per-FR gap, or on active serving cell(s) in SCG in FR1 if UE is capable of Per-FR gap, during the switching from the carrier of a serving cell in FR1 not configured for PUCCH/PUSCH transmission,

- with up to X1 slot as specified in Table 8.2.1.2.12-1.

When SRS carrier based switching is performed between carriers, the UE is allowed interruptions on any active serving cell in SCG if UE is not capable of Per-FR gap, or on active serving cell(s) in SCG in FR2 if UE is capable of Per-FR gap, during the switching from the carrier of a serving cell in FR2 not configured for PUCCH/PUSCH transmission,

- with up to X2 slot as specified in Table 8.2.1.2.12-2.

Table 8.2.1.2.12-1: Interruption length X1 (slot)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | NR Slot length | SRS carrier | Interruption length X1 (slots) | |
|  | (ms) of victim cell | switching time (us)Note 1 | Sub carrier spacing for agressor cell (kHz) | |
|  |  |  | 15 | 30 |
| 0 | 1 | ≤ 200 | 2 | 2 |
|  |  | 300, 500 | 2 | 2 |
|  |  | 900 | 3 | 3 |
| 1 | 0.5 | ≤ 200 | 3 | 2 |
|  |  | 300, 500 | 3 | 3 |
|  |  | 900 | 4 | 4 |
| 2 | 0.25 | ≤ 200 | 4 | 3 |
|  |  | 300, 500 | 5 | 4 |
|  |  | 900 | 7 | 6 |
| 3 | 0.125 | ≤ 200 | 7 | 5 |
|  |  | 300, 500 | 9 | 7 |
|  |  | 900 | 12 | 10 |
| Note1: NR SRS carrier switching time is UE capability indicated by higher layer parameter *SRS-SwitchingTimeNR*. | | | | |

Table 8.2.1.2.12-2: Interruption length X2 (slot)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | NR Slot | SRS carrier | Interruption length X2 (slots) | |
|  | length (ms) of victim cell | switching time (us) Note | Sub carrier spacing for agressor cell (kHz) | |
|  |  |  | 60 | 120 |
| 0 | 1 | ≤ 200 | 2 | 2 |
| 1 | 0.5 | ≤ 200 | 2 | 2 |
| 2 | 0.25 | ≤ 200 | 3 | 3 |
| 3 | 0.125 | ≤ 200 | 4 | 4 |
| Note1: NR SRS carrier switching time is UE capability indicated by higher layer parameter *SRS-SwitchingTimeNR*. | | | | |

For intra-band SRS carrier switching in FR1 or FR2, interruptions in Table 8.2.1.2.12-1 and in Table 8.2.1.2.12-2 based on SRS carrier switching time ≤ 200us shall apply. For inter-band SRS carrier switching in FR1, interruptions in Table 8.2.1.2.12-1 and in Table 8.2.1.2.12-2 shall apply.

##### 8.2.1.2.13 Interruptions at E-UTRA SRS carrier based switching

A PUSCH-less carrier of E-UTRA SCell is a TDD carrier without PUCCH/PUSCH configured. When a UE needs to transmit periodic or aperiodic SRS [23] and/or non-contention based PRACH on a PUSCH-less carrier of E-UTRA SCell, the UE can perform carrier based switching to one or more PUSCH-less carrier of E-UTRA SCells from a E-UTRA carrier with PUSCH or from another PUSCH-less E-UTRA carrier of SCell prior to transmitting SRS and/or PRACH, provided that:

- switching is from a configured E-UTRA carrier to another activated TDD E-UTRA carrier;

- the PUSCH-less carrier of E-UTRA SCells to which SRS carrier based switching is performed is indicated by DCI SRS request field for aperiodic SRS transmission or configured via RRC [15] for periodic SRS transmission;

- the E-UTRA serving cell, from which SRS carrier based switching is performed and whose UL transmission may therefore be interrupted, is indicated by srs-SwitchFromServCellIndex [15];

- the SRS switching is not colliding with any other transmission with higher priority defined in TS36.213 [26];

- the SRS switching is not colliding with PDCCH in subframe 0 and 5 as specified in TS36.213 [26];

- for UE, which does not support simultaneous reception and transmission for inter-band TDD CA specified in TS 36.331 [2], and is compliant to the requirements for inter-band CA with uplink in one E-UTRA band and without simultaneous Rx/Tx specified in TS 36.101 [25], the SRS or RACH transmission are not simultaneously scheduled with DL subframe #0 or DL subframe #5 on other E-UTRA carriers.

The UE shall not perform SRS carrier based switching if the above conditions cannot be met.

When SRS carrier based switching is performed between E-UTRA carriers, the UE is allowed interruptions on any active serving cell in SCG if UE is not capable of Per-FR gap, or on active serving cell(s) in SCG in FR1 if UE is capable of Per-FR gap, during the switching to the PUSCH-less carrier of a serving cell,

- with up to X3 slot as specified in Table 8.2.1.2.13-1.

When SRS carrier based switching is performed between E-UTRA carriers, the UE is allowed interruptions on any active serving cell in SCG if UE is not capable of Per-FR gap, or on active serving cell(s) in SCG in FR1 if UE is capable of Per-FR gap, during the switching from the PUSCH-less carrier of a serving cell,

- with up to X3 slot as specified in Table 8.2.1.2.13-1

Table 8.2.1.2.13-1: Interruption length X3 (slot)

|  |  |  |
| --- | --- | --- |
|  | NR Slot | Interruption length X3 |
|  | length (ms) | (slots) |
| 0 | 1 | 2 |
| 1 | 0.5 | 3 |
| 2 | 0.25 | 5 |
| 3 | 0.125 | 9 |

##### 8.2.1.2.14 DL Interruptions at switching between two uplink carriers

The DL interruption requirements at dynamic switching between two uplink carriers specified in this clause are applicable for an uplink band pair of an inter-band EN-DC configuration when the capability *uplinkTxSwitchingPeriod* is present, and is only applicable for uplink switching mechanism specified in clause 6.1.6 of TS 38.214 [26], where E-UTRA UL carrier is capable of one transmit antenna connector and NR UL carrier is capable of two transmit antenna connectors, and the two uplink carriers are in different bands with different carrier frequencies.

When dynamic switching between two uplink carriers is conducted, UE is allowed to cause DL interruption of X OFDM symbols in NR downlink carrier(s) as indicated by *uplinkTxSwitching-DL-Interruption* [2]. The DL interruption starts from the first OFDM symbol which fully or partially overlaps with the UL switching period located in NR carrier. The DL interruption lengths of X for NR carrier(s) are defined in Table 8.2.1.2.14-1.

No DL interruption is allowed in the NR downlink carrier(s) which is not indicated by *uplinkTxSwitching-DL-Interruption*. No DL interruption is allowed for some inter-band EN-DC configurations as specified in clause 5.5B.4 of TS 38.101-3 [20].

Table 8.2.1.2.14-1: DL interruption length on NR carrier(s) in the unit of OFDM symbols (X) for switching between two uplink carriers

|  |  |  |  |
| --- | --- | --- | --- |
|  | NR Slot length (ms) | Uplink Tx switching period Note1 | |
|  |  | 35us | 140us |
| 0 | 1 | 2 | 3 |
| 1 | 0.5 | 3 | 6 |
| 2 | 0.25 | 4 | 10 |
| Note 1: Uplink Tx switching period depends on UE capability *uplinkTxSwitchingPeriod.* | | | |

##### 8.2.1.2.15 Interruptions due to SCell dormancy

###### 8.2.1.2.15.1 Interruptions due to SCell dormancy switch

When one SCell in SCG is switched from dormancy to non-dormancy or from non-dormancy to dormancy [7] when UE is in DRX active time,

- the UE is allowed an interruption on active serving cell in SCG as defined in clause 8.2.1.2.7, except that the interruption is allowed regardless of which parameters change between the dormant BWP and the non-dormant BWP

- The starting time of interruption shall be within the dormancy switching delay as defined in clause 8.6.2.

When multiple SCells in SCG are switched from dormancy to non-dormancy or vice versa when the UE is in DRX active time, the interruption requirement described above applies for each BWP switch.

###### 8.2.1.2.15.2 Interruptions due to CQI measurements during SCell dormancy

When one or more SCells are in dormancy, the UE is for the purpose of CQI measurements on the dormant SCell(s) allowed to cause interruptions to non-dormant serving cell(s).

The rate of ACK/NACK feedback loss on any non-dormant serving cell resulting from CQI measurements on dormant SCells shall not exceed 0.5%.

###### 8.2.1.2.15.3 Interruptions due to RRM measurements during SCell dormancy

When one or more SCells are in dormancy, the UE is for the purpose of RRM measurements on the dormant SCell(s) allowed to cause interruptions to non-dormant serving cell(s).

The rate of ACK/NACK feedback loss on any non-dormant serving cell resulting from RRM measurements on dormant SCells shall not exceed 1.0%.

##### 8.2.1.2.16 Interruptions when identifying CGI of an NR cell with autonomous gaps

When a UE is identifying CGI of an NR cell with autonomous gaps, the UE is allowed interruptions on PSCell or any activated SCell:

- with up to K1 interruptions with interrupted slots up to interruption length X1 specified in Table 8.2.1.2.16-1 for each interruption during MIB decoding time period TMIB (ms) specified in clause 9.11.

- with up to L1 interruptions with interrupted slots up to interruption length Y1 specified in Table 8.2.1.2.16-1 for each interruption during SIB1 decoding time period TSIB1 (ms) specified in clause 9.11 for SSB and CORESET for RMSI scheduling multiplexing patterns 1.

- with up to L2 interruptions with interrupted slots up to interruption length Y2 specified in Table 8.2.1.2.16-1 for each interruption during SIB1 decoding time period TSIB1 (ms) specified in clause 9.11 for SSB and CORESET for RMSI scheduling multiplexing patterns 2 and 3.

Where:

- K1 = 6 for the target cell carrier frequency on FR1 and K1 = 25 for the target cell carrier frequency on FR2, and

- L1 = TSIB1/20, and

- L2 = TSIB1/TSMTC, where TSMTC is the periodicity of the SMTC occasion configured for the target cell carrier.

Table 8.2.1.2.16-1: Interruption length X1, Y1 and Y2 during measurements with autonomous gaps

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | NR Slot length (ms) of victim cell | Interruption length X1 (slots) | Interruption length Y1 (slots) | Interruption length Y2 (slots) |
| 0 | 1 | 6 | 7 | 6 |
| 1 | 0.5 | 12 | 13 | 10 |
| 2 | 0.25 | 24 | 25 | 19 |
| 3 | 0.125 | 48 | 49 | 37 |

##### 8.2.1.2.17 Interruptions when identifying CGI of an E-UTRA cell with autonomous gaps

When a UE is identifying CGI of an E-UTRA FDD cell or E-UTRA TDD cell with autonomous gaps, within time period

- Tidentify\_CGI, intra specified in clause 8.1.2.2.3, or clause 8.1.2.2.4 in TS 36.133 [15], or

- Tidentify\_CGI, inter specified in clause 8.1.2.3.5, or clause 8.1.2.3.6, or clause 8.1.2.3.7, or clause 8.1.2.3.6 in TS 36.133 [15], or

- Tidentify\_CGI, E-UTRA specified in clause 9.4.7.1

the UE shall be able to transmit at least the number of ACK/NACKs specified in Table 8.2.1.2.17-1 on PSCell or any activated SCell in the frequency range where autonomous gaps are used, provided that:

- there is continuous DL data allocation,

- no DRX cycle is used,

- no measurement gaps are configured,

- only one code word is transmitted in each slot,

- 2 slot ACK/NACK feedback is configured,

- 20 ms SMTC period is configured.

Table 8.2.1.2.17-1: Minimum number of ACK/NACKs transmitted by the UE

|  |  |  |
| --- | --- | --- |
| Minimum number of transmitted ACK/NACKs | Configuration of the serving cell in which the transmitted ACK/NACKs are counted | |
|  | Duplex mode configuration | SCS |
| 84 | FDD | 15 kHz |
| 193 | FDD | 30 kHz |
| 402 | FDD | 60 kHz |
| 28 | TDD Note 1 | 15 kHz |
| 81 | TDD Note 1 | 30 kHz |
| 159 | TDD Note 1 | 60 kHz |
| 233 | TDD Note 2 | 60 kHz |
| 491 | TDD Note 2 | 120 kHz |
| NOTE 1: TDD UL-DL configuration is as specified in Table A.3.3.1-1 of TS 38.101-1 [18].  NOTE 2: TDD UL-DL configuration is as specified in Table A.3.3.1-1 of TS 38.101-2 [19]. | | |

##### 8.2.1.2.18 Interruptions at NR SRS antenna port switching

The requirements in this clause are applicable to SRS antenna port switching on FR1 and SRS resource(s) is only configured within the last 6 symbols of a slot. For interruption caused by SRS antenna port switching, the victim cell is based on the entry number of the band indicated by *txSwitchImpactToRx* and/or *txSwitchWithAnotherBand* regardless of per-FR MG capability. An UL interruption is allowed on any of the serving cells as indicated in *txSwitchWithAnotherBand*, and a DL interruption is allowed on any of the serving cells as indicated in *txSwitchImpactToRx*.

The UE shall perform SRS antenna port switching only if the below conditions are met.

- the SRS switching is not colliding with any other UL transmission with higher priority defined in TS 38.214 [26] if the serving cell on which the higher priority transmission is performed is a victim cell based on *txSwitchWithAnotherBand* or is the same carrier on which SRS is transmitted.

- the SRS switching is not colliding with any NR measurements (i.e. SSB/CSI-RS based L1/L3 measurements) and the measurements for RLM/BFD/CBD if the serving cell on which the NR measurements and the measurements for RLM/BFD/CBD is performed is a victim cell based on *txSwitchImpactToRx* or is the same carrier on which SRS is transmitted.

No requirements are defined for SRS antenna port switching if aperiodic SRS switching is colliding with aperiodic L1-RSRP/L1-SINR measurements and the serving cell on which the aperiodic L1-RSRP/L1-SINR measurement is configured is indicated in *txSwitchImpactToRx* or is the same carrier on which aperiodic SRS is scheduled/configured.No requirements apply when SRS antenna port switching is colliding with E-UTRA measurement if the carrier on which the E-UTRA measurement is performed is indicated in *txSwitchImpactToRx* or is the same carrier on which SRS is scheduled/configured.When 1 SRS symbol is configured in a slot for SRS antenna switching and the aggressor and victim cells are synchronized, the interruption requirement in Table 8.2.1.2.18-1 applies. When 1 SRS symbol is configured in a slot for SRS antenna switching and the aggressor and victim cells are asynchronized, the interruption requirement in Table 8.2.1.2.18-2 applies. For the rest of SRS configurations, the interruption requirement in Table 8.2.1.2.18-3 applies.

Table 8.2.1.2.18-1: Interruption length in symbols when 1 SRS symbol is configured and aggressor and victim cells are synchronized

|  |  |  |  |
| --- | --- | --- | --- |
| **Victim cell SCS(kHz)** | **Aggressor cell SCS (kHz)** | | |
| **15** | **30** | **60** |
| 15 | 3 | 2 | 2 |
| 30 | 4 | 3 | 3 |
| 60 | 8 | 6 | 5 |
| 120 | 14 | 10 | 8 |

Table 8.2.1.2.18-2: Interruption length in slots when 1 SRS symbol is configured and aggressor and victim cells are asynchronized

|  |  |  |  |
| --- | --- | --- | --- |
| **Victim cell SCS(kHz)** | **Aggressor cell SCS (kHz)** | | |
| **15** | **30** | **60** |
| 15 | 2 | 2 | 2 |
| 30 | 2 | 2 | 2 |
| 60 | 2 | 2 | 2 |
| 120 | 2 | 2 | 2 |

Table 8.2.1.2.18-3: Interruption length in slots for rest of the SRS configurations for synchronized and asynchronized scenarios

|  |  |  |  |
| --- | --- | --- | --- |
| **Victim cell SCS(kHz)** | **Aggressor cell SCS (kHz)** | | |
| **15** | **30** | **60** |
| 15 | 2 | 2 | 2 |
| 30 | 2 | 2 | 2 |
| 60 | 3 | 2 | 2 |
| 120 | 5 | 3 | 3 |

##### 8.2.1.2.19 Interruptions at fast SCell activation

The requirements in this clause shall apply for the UE configured with PSCell and one SCell when aperiodic CSI-RS resources is configured for fast SCell activation.

When one SCell in SCG configured with aperiodic CSI-RS resources is configured for fast SCell activation is activated from deactivated, the UE is allowed:

- an interruption on any serving cell in SCG:

- of up to X2 slot, if the active serving cell and the SCell being activated are in a FR1 band pair or in a FR1+FR2 band pair.

- of up to X2 slot, if the active serving cells and the SCells being activated are in a FR2 band pair and UE is capable of independent beam management on this FR2 band pair.

or

- of up to Y2 slot +TATRS\_duration if the active serving cells are in the same band as any of the SCells being activated, when

- SCell to be activated is known and belongs to FR1, if the measurement period of the SCell being activated is larger than [2400ms], or

- SCell is unknown and belongs to FR1, and SCell is contiguous to an active serving cell in the same band

or

- of up to Y2 slot if the active serving cells are in the same band as any of the SCells being activated, when

- SCell to be activated is known and belongs to FR1, if the measurement period of the SCell being activated is equal to or smaller than [2400ms], or

- SCell to be activated belongs to FR2

Where:

- TATRS\_duration is CSI-RS burst for SCell activation where the CSI-RS burst is defined as four CSI-RS resources in two consecutive slots on the being activated SCell.

- X2 and Y2 are specified in Table 8.2.1.2.4-2.

##### 8.2.1.2.20 Interruptions due to PUCCH SCell activation/deactivation

When one SCell in SCG configured with PUCCH is activated or deactivated,

The UE is allowed an interruption on active serving cell in SCG as defined in clause 8.2.1.2.4.

- The starting time of interruption shall be within the delay as defined in clause 8.3.12.

- For inter-band CA, if the UE is not capable of *parallelTxPRACH-SRS-PUCCH-PUSCH*, additional interruption is allowed on SRS/PUCCH/PUSCH of active serving cells when colliding with RACH transmission on PUCCH SCell. . Interruption occurs on the symbols containing SRS/PUCCH/PUSCH, which overlap with the duration of the PRACH preamble [3] transmitted on the PUCCH SCell.

### 8.2.2 SA: Interruptions with Standalone NR Carrier Aggregation

#### 8.2.2.1 Introduction

This clause contains the requirements related to the interruptions on PCell and activated SCell if configured, when

up to 7 SCells are configured, de-configured, activated or deactivated, or

a supplementary UL carrier or an UL carrier is configured or de-configured, or

measurements on SCC with deactivated SCell in NR SCG, or

UL/DL BWP is switched on PCell or SCell, or

CGI reading of an NR neighbour cell with autonomous gaps, or

CGI reading of an E-UTRA neighbour cell with autonomous gaps.

UE-specific CBW is changed on PCell or SCell, or

NR SRS carrier based switching, or

NR SRS antenna port switching, or

UE dynamic Tx switches between two uplink carriers, or

SCell is activated based on aperiodic CSI-RS.

Note: interruptions at SCell addition/release, activation/deactivation and during measurements on SCC may not be required by all UEs.

The interruptions shall not interrupt RRC signalling or ACK/NACKs related to RRC reconfiguration procedure according to TS38.331 [2] for SCell addition/release or MAC control signalling according to TS37.340 [17] for SCell activation/deactivation command.

This clause additionally contains requirements related to interruptions at inter-frequency SFTD between PCell in FR1 and neighbour cell in FR2.

For a UE which does not support per-FR measurement gap, interruptions to the PCell and activated SCell may be caused by SCells on any frequency range. For a UE which supports per-FR gaps, interruptions to PCell and activated SCell may be caused by SCells on the same frequency range as the victim cell.

In addition to standalone NR carrier aggregation when no CCA is configured, the requirements in clause 8.2.2. and all subclauses of 8.2.2 apply when the UE is configured with

-A PCell not using CCA in downlink and one or more SCells using CCA in downlink or

-A PCell and one or more SCells using CCA in downlink

#### 8.2.2.2 Requirements

##### 8.2.2.2.1 Interruptions at SCell addition/release

When any number of SCells between one and 7 is added or released using the same *RRCConnectionReconfiguration* message as defined in TS 38.331 [2], the UE is allowed an interruption on any active serving cell during the RRC reconfiguration procedure as follows:

- an interruption on any active serving cell:

- of up to X1 slot, if the active serving cell and the SCell being added or released are in a FR1 band pair or in a FR1+FR2 band pair.

- of up to X1 slot, if the active serving cell and the SCell being added or released are in a FR2 band pair and UE is capable of independent beam management on this FR2 band pair.

Where X1 is specified in Table 8.2.2.2.1-1.

or

- of up to the duration shown in table 8.2.2.2.1-2, if the active serving cells are in the same band as any of the SCells being added or released, provided the cell specific reference signals from the active serving cells and the SCells being added or released are available in the same slot.

Table 8.2.2.2.1-1: Interruption length X1 for SCell addition/release for inter-band CA

|  |  |  |  |
| --- | --- | --- | --- |
|  | NR Slot length (ms) of victim cell | Interruption length X1 (slots) | |
| 0 | 1 | 1 | |
| 1 | 0.5 | 2 | |
| 2 | 0.25 | Both aggressor cell and victim cell are on FR2 | 4 |
|  |  | Either aggressor cell or victim cell is on FR1 | 5 |
| 3 | 0.125 | Aggressor cell is on FR2 | 8 |
|  |  | Aggressor cell is on FR1 | 9 |
| 5 | 0.03125 | Aggressor cell is on FR1 | 33 |
| 6 | 0.015625 | Aggressor cell is on FR1 | 65 |

Table 8.2.2.2.1-2: Interruption duration for SCell addition/release for intra-band CA

|  |  |  |
| --- | --- | --- |
|  | NR Slot length (ms) | Interruption length (slots) |
| 0 | 1 | 1 + TSMTC\_duration \* |
| 1 | 0.5 | 2 + TSMTC\_duration \* |
| 2 | 0.25 | 4 + TSMTC\_duration \* |
| 3 | 0.125 | 8 + TSMTC\_duration \* |
| 5 | 0.03125 | 32+ TSMTC\_duration \* |
| 6 | 0.015625 | 64+ TSMTC\_duration \* |
| NOTE 1: TSMTC\_duration measured in subframes is  - the longest SMTC duration among all above active serving cells and the SCell being added when one SCell is added. If SSB configuration (*absoluteFrequencySSB*) but no SMTC configuration is provided for the SCell being added, the SSB transmission periodicity is assumed to be 5ms and TSMTC duration for the SCell being added is x ms, where x = the number of consecutive subframes containing all SSBs in one SSB burst transmitted by the SCell being added. If no SSB configuration (*absoluteFrequencySSB*) nor SMTC configuration is provided for the SCell being added, TSMTC duration for the SCell being added is 0ms;  - the longest SMTC duration among all active serving cells in the same band when one SCell is released.  NOTE 2: is as defined in TS 38.211 [6]. | | |

##### 8.2.2.2.2 Interruptions at SCell activation/deactivation

When an intra-band SCell is activated or deactivated as defined in TS 37.340 [17], the UE is allowed

- an interruption on any active serving cell:

- of up to X2 slot, if the active serving cell and the SCell being activated or deactivated are in a FR1 band pair or in a FR1+FR2 band pair.

- of up to X2 slot, if the active serving cell and the SCell being activated or deactivated are in a FR2 band pair and UE is capable of independent beam management on this FR2 band pair.

Where X2 is specified in Table 8.2.2.2.2-1.

or

- of up to the duration shown in table 8.2.2.2.2-2, if the active serving cells are in the same band as any of the SCells being activated or deactivated provided the cell specific reference signals from the active serving cells and the SCells being activated or deactivated are available in the same slot.

Table 8.2.2.2.2-1: Interruption length X2 for SCell activation/deactivation for inter-band CA

|  |  |  |  |
| --- | --- | --- | --- |
|  | NR Slot length (ms) of victim cell | Interruption length X2 (slots) | |
| 0 | 1 |  | 1 |
| 1 | 0.5 |  | 1 |
| 2 | 0.25 | Both aggressor cell and victim cell are on FR2 | 2 |
|  |  | Either aggressor cell or victim cell is on FR1 | 3 |
| 3 | 0.125 | Aggressor cell is on FR2 | 4 |
|  |  | Aggressor cell is on FR1 | 5 |
| 5 | 0.03125 | Aggressor cell is on FR1 | 17 |
| 6 | 0.015625 | Aggressor cell is on FR1 | 33 |

Table 8.2.2.2.2-2: Interruption duration for SCell activation/deactivation for intra-band CA

|  |  |  |
| --- | --- | --- |
|  | NR Slot length (ms) | Interruption length (slots) |
| 0 | 1 | 1 + TSMTC\_duration \* |
| 1 | 0.5 | 1 + TSMTC\_duration \* |
| 2 | 0.25 | 2 + TSMTC\_duration \* |
| 3 | 0.125 | 4 + TSMTC\_duration \* |
| 5 | 0.03125 | 16+ TSMTC\_duration \* |
| 6 | 0.015625 | 32+ TSMTC\_duration \* |
| NOTE 1: TSMTC\_duration measured in subframes is  - the longest SMTC duration among all above active serving cells and the SCell being activated when one SCell is activated. If SSB configuration (*absoluteFrequencySSB*) but no SMTC configuration is provided for the SCell being activated, the SSB transmission periodicity is assumed to be 5ms and TSMTC duration for the SCell being activated is x ms, where x = the number of consecutive subframes containing all SSBs in one SSB burst transmitted by the SCell being activated. If no SSB configuration (*absoluteFrequencySSB*) nor SMTC configuration is provided for the SCell being activated, TSMTC duration for the SCell being activated is 0ms;  - the longest SMTC duration among all active servingNOTE 2: is as defined in TS 38.211 [6]. | | |

##### 8.2.2.2.3 Interruptions during measurements on deactivated SCC

Interruptions on PCell or activated SCell(s) due to measurements when an SCell is deactivated are allowed with up to 0.5% probability of missed ACK/NACK when the configured *measCycleSCell* [2] is 640 ms or longer.

* If the PCell or activated SCell(s) is not in the same band as the deactivated SCell, the UE is only allowed to cause interruptions on PCell or activated SCell(s) immediately before and immediately after an SMTC. Each interruption shall not exceed requirement in Table 8.2.2.2.2-1.

If the PCell or activated SCell(s) is in the same band as the deactivated SCell, the UE is only allowed to cause an interruption on PCell or activated SCell(s) no earlier than X slots before TSMTC\_duration and no later than X slots after TSMTC\_duration, provided the cell specific reference signals from the active serving cells and the deactivated SCell are available in the same slot, where X and TSMTC\_duration are given by Table 8.2.2.2.3-1. The interruption shall not exceed requirements in Table 8.2.2.2.3-1.

The interruption requirements in Table 8.2.2.2.3-1 are not applicable when a UE is configured with NCSG unless the SMTC on the deactivated SCC is fully non-overlapped with NCSG.

Table 8.2.2.2.3-1: Interruption duration for measurement on deactivated SCell for intra-band CA

|  |  |  |  |
| --- | --- | --- | --- |
|  | NR Slot length (ms) | X (slots) | Interruption length (slots) |
| 0 | 1 | 1 | 2 + TSMTC\_duration \* |
| 1 | 0.5 | 1 | 2 + TSMTC\_duration \* |
| 2 | 0.25 | 2 | 4 + TSMTC\_duration \* |
| 3 | 0.125 | 4 | 8 + TSMTC\_duration \* |
| 5 | 0.03125 | 16 | 32 + TSMTC\_duration \* |
| 6 | 0.015625 | 32 | 64 + TSMTC\_duration \* |
| NOTE 1: TSMTC\_duration measured in subframes is the longest SMTC duration among all above active serving cells and the deactivated SCell to be measured;  NOTE 2: is as defined in TS 38.211 [6]. | | | |

##### 8.2.2.2.4 Interruptions at UL carrier RRC reconfiguration

The requirements in this clause shall apply when a supplementary UL carrier or an UL carrier is configured or de-configured in NR standalone carrier aggregation as defined in TS 38.331 [2]. Further, the requirements in this clause are applicable to UE capable of independent beam management in FR2 inter-band CA and UE capable of FR2 intra-band CA and FR1.

When an UL carrier or supplementary UL carrier is configured or de-configured, an interruption of up to the duration shown in table 8.2.2.2.4-1, is allowed during the RRC reconfiguration procedure [2] on PCell and all activated SCells within the same FR as the reconfigured uplink carrier. The interruption is for both uplink and downlink of PCell and all the activated SCells within the same FR as the configured or de-configured UL.

Table 8.2.2.2.4-1: Interruption duration for UL carrier RRC reconfiguration

|  |  |  |
| --- | --- | --- |
|  | NR Slot length (ms) | Interruption length (slots) |
| 0 | 1 | 1 |
| 1 | 0.5 | 2 |
| 2 | 0.25 | 4 |
| 3 | 0.125 | 8 |
| 5 | 0.03125 | 32 |
| 6 | 0.015625 | 64 |

##### 8.2.2.2.5 Interruptions due to Active BWP switching Requirement

The requirements for DCI-based BWP switch, timer-based BWP switch or UL BWP switch triggered by consistent uplink CCA failures in this clause apply to the case that the BWP switch is performed on a single CC or multiple CCs.

When either of the DCI-based, timer-based or RRC-based downlink BWP switch and/or uplink BWP switch occur on multiple CCs simultaneously or over partially overlapping period, the interruption requirements described in this clause apply for each BWP switch. Further, the requirements in this clause are applicable to UE capable of independent beam management in FR2 inter-band CA and UE capable of FR2 intra-band CA and FR1.

When UE receives a DCI indicating UE to switch its active BWP involving changes in any of the parameters listed in Table 8.2.2.2.5-2, the UE is allowed to cause interruption of up to X slot to other active serving cells if the UE is not capable of per-FR gap, or if the BWP switching involves SCS changing. When the BWP switch imposes changes in any of the parameters listed in Table 8.2.2.2.5-2 and the UE is capable of per-FR gap the UE is allowed to cause interruption of up to X slot to other active serving cells in the same frequency range wherein the UE is performing BWP switching. X is defined in Table 8.2.2.2.5-1. The starting time of interruption is only allowed within the BWP switching delay TBWPswitchDelay as defined in clause 8.6.2 when BWP switch occurs on a single CC. The starting time of interruption caused by each BWP switch is only allowed within the BWP switch delay TMultipleBWPswitchDelay +Y as defined in clause 8.6.2A.1 when BWP switch occurs on multiple CCs. Interruptions are not allowed during BWP switch involving any other parameter change.

When a BWP timer *bwp-InactivityTimer* defined in TS 38.331 [2] expires, UE is allowed to cause interruption of up to X slot to other active serving cells due to switching its active BWP involving changes in any of the parameters listed in Table 8.2.2.2.5-2 if the UE is not capable of per-FR gap, or if the BWP switching involves SCS changing. When the BWP switch imposes changes in any of the parameters listed in Table 8.2.2.2.5-2 and the UE is capable of per-FR gap, the UE is allowed to cause interruption of up to X slot to other active serving cells in the same frequency range wherein the UE is performing BWP switching. X is defined in Table 8.2.2.2.5-1. The starting time of interruption is only allowed within the BWP switching delay TBWPswitchDelay as defined in clause 8.6.2 when BWP switch occurs on a single CC. The starting time of interruption caused by each BWP switch is only allowed within the BWP switch delay TMultipleBWPswitchDelay as defined in clause 8.6.2B.1 when BWP switch occurs on multiple CCs simultaneously or TMultipleBWPswitchDelayTotal as defined in clause 8.6.2B.2 when BWP switch occurs on multiple CCs over partially overlapping time period. Interruptions are not allowed during BWP switch involving any other parameter change.

When UE receives an RRC reconfiguration that only requests UE to switch its active BWP on one single CC, the UE is allowed to cause interruption of up to X slot to other active serving cells due to switching its active BWP involving changes in any of the parameters listed in Table 8.2.2.2.5-2 if the UE is not capable of per-FR gap, or if the BWP switching involves SCS changing. When the BWP switch imposes changes in any of the parameters listed in Table 8.2.2.2.5-2 and the UE is capable of per-FR gap, the UE is allowed to cause interruption of up to X slot to other active serving cells in the same frequency range wherein the UE is performing BWP switching. X is defined in Table 8.2.2.2.5-1. The interruption is only allowed within the delay TRRCprocessingDelay + TBWPswitchDelayRRC defined in clause 8.6.3 when BWP switch occurs on a single CC. The interruption is only allowed within the delay TRRCprocessingDelay + TBWPswitchDelayRRC + DRRC\*(N-1) as defined in clause 8.6.3A when BWP switch occurs on multiple CCs.

When UL BWP switch is triggered by consistent uplink CCA failures [7], UE is allowed to cause interruption of up to X slot to other active serving cells due to switching its active UL BWP involving changes in any of the parameters listed in Table 8.2.2.2.5-2 if the UE is not capable of per-FR gap, or if the BWP switching involves SCS changing. When the UL BWP switch imposes changes in any of the parameters listed in Table 8.2.2.2.5-2 and the UE is capable of per-FR gap, the UE is allowed to cause interruption of up to X slot to other active serving cells in the same frequency range wherein the UE is performing UL BWP switching. X is defined in Table 8.2.2.2.5-1. The starting time of interruption is only allowed within the UL BWP switching delay TBWPswitchDelay as defined in clause 8.6.2. Interruptions are not allowed during BWP switch involving other parameter change.

Table 8.2.2.2.5-1: Interruption length X

|  |  |  |
| --- | --- | --- |
|  | NR Slot | Interruption length X (slots) |
|  | length (ms) |  |
| 0 | 1 | 1 |
| 1 | 0.5 | 1 |
| 2 | 0.25 | 3 |
| 3 | 0.125 | 5 |
| 5 | 0.03125 | 17 |
| 6 | 0.015625 | 33 |
| Note1: void | | |

Table 8.2.2.2.5-2: Parameters which cause interruption other than SCS

|  |  |
| --- | --- |
| Parameters | Comment |
| *locationAndBandwidth* | From TS 38.331 [2] |
| *nrofSRS-Ports* |  |
| *maxMIMO-Layers-r16* |  |

##### 8.2.2.2.6 Interruptions at inter-frequency SFTD measurement

The requirements in this clause concern interruptions on PCell, as well as on activated SCells in MCG, when the UE is performing SFTD measurements on inter-frequency neighbour cell(s). The following requirements apply when no PSCell is configured.

For a UE with per-FR gap capability:

- for neighbour cell in FR1:

- the percentage of interrupted slots on uplink and downlink on FR1 serving cells during the SFTD measurement period Tmeasure\_SFTD1 specified in Clause 9.3.8 shall not exceed the percentages specified in Table 8.2.2.2.6-1. No interruption is allowed on FR2 serving cells.

- the length of each interruption on FR1 serving cells shall not exceed the number of slots specified in Table 8.2.2.2.6-2.

- for neighbour cell in FR2:

- the percentage of interrupted slots on uplink and downlink on FR2 serving cells during the SFTD measurement period Tmeasure\_SFTD1 specified in Clause 9.3.8 shall not exceed the percentages specified in Table 8.2.2.2.6-1. No interruption is allowed on FR1 serving cells.

- the length of each interruption on FR2 serving cells shall not exceed the number of slots specified in Table 8.2.2.2.6-2.

For a UE with per-UE gap capability:

- for neighbour cell in FR1 or FR2:

- the percentage of interrupted slots on uplink and downlink on FR1 and FR2 serving cells during the SFTD measurement period Tmeasure\_SFTD1 specified in Clause 9.3.8 shall not exceed the percentages specified in Table 8.2.2.2.6-1.

- the length of each interruption on FR1 and FR2 serving cells shall not exceed the number of slots specified in Table 8.2.2.2.6-2.

Table 8.2.2.2.6-1: Requirements on maximum percentage of interrupted slots in serving cell in inter-frequency SFTD

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| SFTD configuration | Serving cell µ | Neighbour cell SMTC periodicity | | | | | |
|  |  | 5ms | 10ms | 20ms | 40ms | 80ms | 160ms |
| With RSRP | 0 | 8.4% | 6.3% | 8.4% | 6.3% | 5.3% | 4.7% |
| report | 1 |  |  |  |  |  |  |
|  | 2 |  |  |  |  |  |  |
|  | 3 |  |  |  |  |  |  |
| Without RSRP | 0 | 11.4% | 8.6% | 7.9% | 6.8% | 6.3% | 6.0% |
| report | 1 |  |  |  |  |  |  |
|  | 2 |  |  |  |  |  |  |
|  | 3 |  |  |  |  |  |  |

Table 8.2.2.2.6-2: Interruption duration for FR1 serving cell in inter-frequency SFTD with neighbour cell in FR1

|  |  |  |
| --- | --- | --- |
|  | NR Slot length (ms) | Interruption length (slots) |
| 0 | 1 | 1 |
| 1 | 0.5 | 2 |
| 2 | 0.25 | 4 |
| 3 | 0.125 | 8 |

Table 8.2.2.2.6-3: Void

Table 8.2.2.2.6-4: Void

##### 8.2.2.2.7 Interruptions at SCell activation/deactivation with multiple downlink SCells

The requirements in this clause shall apply for the UE configured with PCell and up to 7 downlink SCell(s).

When multiple SCell is activated or deactivated by one single MAC CE command:

- an interruption on any active serving cell is specified as in clause 8.2.2.2.2:

##### 8.2.2.2.8 Interruptions due to UE-specific CBW change

When UE receives an RRC reconfiguration that changes *offsetToCarrier* or *carrierBandwidth*, the UE is allowed to cause interruption of up to X slot to other active serving cells due to switching its CBW. X is defined in Table 8.2.2.2.8-1. The interruption is only allowed within the delay TRRCprocessingDelay + TCBWchangeDelayRRC defined in clause 8.13.

Table 8.2.2.2.8-1: interruption length X

|  |  |  |
| --- | --- | --- |
|  | **NR Slot** | **Interruption length X (slots)** |
|  | **length (ms)** |  |
| 0 | 1 | 1 |
| 1 | 0.5 | 1 |
| 2 | 0.25 | 3 |
| 3 | 0.125 | 5 |
| 5 | 0.03125 | 17 |
| 6 | 0.015625 | 33 |

##### 8.2.2.2.9 Interruptions at NR SRS carrier based switching

SRS transmission can be configured on a carrier not configured for PUCCH/PUSCH transmission. When a UE needs to transmit periodic, semi-persistent or aperiodic SRS on a carrier of a serving cell not configured for PUCCH/PUSCH transmission, the UE can perform carrier based switching to one or more carriers not configured for PUCCH/PUSCH transmission from a carrier with PUCCH/PUSCH transmission or from a carrier not configured for PUCCH/PUSCH transmission prior to transmitting SRS, provided that:

- switching is from a configured carrier to another activated carrier;

- the carrier of SCells not configured for PUCCH/PUSCH transmission to which SRS carrier based switching is performed is indicated by DCI SRS request field for aperiodic SRS transmission, or indicated by MAC-CE for semi-persistent SRS transmission, or configured via RRC for periodic SRS transmission;

- the serving cell, from which SRS carrier based switching is performed and whose UL transmission may therefore be interrupted, is indicated by srs-SwitchFromServCellIndex and srs-SwitchFromCarrier in TS38.331 [2];

- the SRS switching is not colliding with any other transmission with higher priority defined in TS 38.214 [26].

- the SRS switching is not colliding with any SSB/CSI-RS based L3 measurements and the measurements for RLM/BFD.

- for UE, which does not support simultaneous reception and transmission for inter-band TDD CA specified in TS 38.331 [2], and is compliant to the requirements for inter-band CA with uplink in one NR band and without simultaneous Rx/Tx specified in TS 38.101-1 [18] for frequency range 1 and TS 38.101-2 [19] for frequency range 2, the SRS transmission are not simultaneously scheduled with DL SSB/CSI-RS for L3 or L1 measurements transmission on other carriers.

The UE shall not perform SRS carrier based switching if the above conditions cannot be met.

When SRS carrier based switching is performed between carriers, the UE is allowed interruptions on any active serving cell if UE is not capable of Per-FR gap, or on active serving cell(s) in FR1 if UE is capable of Per-FR gap, during the switching to the carrier of a serving cell in FR1 not configured for PUCCH/PUSCH transmission,

- with up to X1 slot as specified in Table 8.2.2.2.9-1.

When SRS carrier based switching is performed between carriers, the UE is allowed interruptions on any active serving cell if UE is not capable of Per-FR gap, or on active serving cell(s) in FR2 if UE is capable of Per-FR gap, during the switching to the carrier of a serving cell in FR2 not configured for PUCCH/PUSCH transmission,

- with up to X2 slot as specified in Table 8.2.2.2.9-2.

When SRS carrier based switching is performed between carriers, the UE is allowed interruptions on any active serving cell if UE is not capable of Per-FR gap, or on active serving cell(s) in FR1 if UE is capable of Per-FR gap, during the switching from the carrier of a serving cell in FR1 not configured for PUCCH/PUSCH transmission,

- with up to X1 slot as specified in Table 8.2.2.2.9-1.

When SRS carrier based switching is performed between carriers, the UE is allowed interruptions on any active serving cell if UE is not capable of Per-FR gap, or on active serving cell(s) in FR2 if UE is capable of Per-FR gap, during the switching from the carrier of a serving cell in FR2 not configured for PUCCH/PUSCH transmission,

- with up to X2 slot as specified in Table 8.2.2.2.9-2.

Table 8.2.2.2.9-1: Interruption length X1 (slot)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | NR Slot length | SRS carrier | Interruption length X1 (slots) | |
|  | (ms) of victim cell | switching time (us)Note 1 | Sub carrier spacing for agressor cell (kHz) | |
|  |  |  | 15 | 30 |
| 0 | 1 | ≤ 200 | 2 | 2 |
|  |  | 300, 500 | 2 | 2 |
|  |  | 900 | 2 | 2 |
| 1 | 0.5 | ≤ 200 | 3 | 2 |
|  |  | 300, 500 | 3 | 3 |
|  |  | 900 | 4 | 4 |
| 2 | 0.25 | ≤ 200 | 4 | 3 |
|  |  | 300, 500 | 5 | 4 |
|  |  | 900 | 7 | 6 |
| 3 | 0.125 | ≤ 200 | 7 | 5 |
|  |  | 300, 500 | 9 | 7 |
|  |  | 900 | 12 | 10 |
| 5 | 0.03125 | ≤ 200 | 22 | 15 |
|  |  | 300, 500 | 31 | 24 |
|  |  | 900 | 44 | 37 |
| 6 | 0.015625 | ≤ 200 | 42 | 28 |
|  |  | 300, 500 | 61 | 47 |
|  |  | 900 | 87 | 73 |
| Note1: NR SRS carrier switching time is UE capability indicated by higher layer parameter *SRS-SwitchingTimeNR*. | | | | |

Table 8.2.2.2.9-2: Interruption length X2 (slot)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **length (ms) of victim cell** | **switching time (us) Note 1** | **Sub carrier spacing for agressor cell (kHz)** | | | |
|  |  |  | **60** | **120** | **480** | **960** |
| 0 | 1 | ≤ 200 | 2 | 2 | 2 | 2 |
| 1 | 0.5 | ≤ 200 | 2 | 2 | 2 | 2 |
| 2 | 0.25 | ≤ 200 | 3 | 3 | 2 | 2 |
| 3 | 0.125 | ≤ 200 | 4 | 4 | 3 | 3 |
| 5 | 0.03125 | ≤ 200 | 11 | 10 | 8 | 8 |
| 6 | 0.015625 | ≤ 200 | 21 | 18 | 15 | 15 |
| Note1: NR SRS carrier switching time is UE capability indicated by higher layer parameter *SRS-SwitchingTimeNR*. | | | | | | |

For intra-band SRS carrier switching in FR1 or FR2, interruptions in Table 8.2.2.2.9-1 and in Table 8.2.2.2.9-2 based on SRS carrier switching time ≤ 200us shall apply. For inter-band SRS carrier switching in FR1, interruptions in Table 8.2.2.2.9-1 and in Table 8.2.2.2.9-2 shall apply.

##### 8.2.2.2.10 DL Interruptions at UE switching between two uplink carriers

The DL interruption requirements at dynamic switching between two uplink carreirs specified in this clause are applicable for an uplink band pair of an inter-band UL CA configuration in FR1 when the capability *uplinkTxSwitchingPeriod* is present, and is only applicable for uplink switching mechanism specified in clause 6.1.6 of TS 38.214 [26], where NR uplink carrier 1 is capable of one transmit antenna connector and NR uplink carrier 2 is capable of two transmit antenna connectors, and the two uplink carriers are in different bands with different carrier frequencies.

When dynamic switching between two uplink carriers is conducted, UE is allowed to cause DL interruption of X OFDM symbols in NR downlink carrier(s) as indicated by *uplinkTxSwitching-DL-Interruption* [2]. The DL interruption starts from the first OFDM symbol which fully or partially overlaps with the UL switching period located in either NR carrier 1 or carrier 2 as indicated in RRC signalling [2]. The DL interruption lengths of X are defined in Table 8.2.2.2.10-1.

No DL interruption is allowed in the NR downlink carrier(s) which is not indicated by *uplinkTxSwitching-DL-Interruption*. No DL interruption is allowed for some inter-band UL CA configurations as specified in clause 5.2A.2 of TS 38.101-1 [18].

Table 8.2.2.2.10-1: DL interruption length on NR carrier(s) in the unit of OFDM symbols (X) for switching between two uplink carriers

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | NR Slot length (ms) | Uplink Tx switching period Note1 | | |
|  |  | 35us | 140us | 210us |
| 0 | 1 | 2 | 3 | 4 |
| 1 | 0.5 | 3 | 6 | 7 |
| 2 | 0.25 | 4 | 10 | 14 |
| Note 1: Uplink Tx switching period depends on UE capability *uplinkTxSwitchingPeriod* | | | | |

##### 8.2.2.2.10A DL Interruptions at UE switching between two uplink carriers with two transmit antenna connectors

The DL interruption requirements at dynamic switching between two uplink carriers specified in this clause are applicable for an uplink band pair of an inter-band UL CA configuration when the capability *[uplinkTxSwitchingPeriod2T2T]* is present, and is only applicable for uplink switching mechanism specified in clause 6.1.6 of TS 38.214 [26], where NR UL carrier 1 is capable of two transmit antenna connectors and NR UL carrier 2 is capable of two transmit antenna connectors, and the two uplink carriers are in different bands with different carrier frequencies.

When dynamic switching between two uplink carriers is conducted, UE is allowed to cause DL interruption of X OFDM symbols in NR downlink carrier(s) as indicated by *uplinkTxSwitching-DL-Interruption* [2]. The DL interruption starts from the first OFDM symbol which fully or partially overlaps with the UL switching period located in either NR carrier 1 or carrier 2 as indicated in RRC signalling [2]. The DL interruption lengths of X are defined in Table 8.2.2.2.10A-1.

No DL interruption is allowed in the NR downlink carrier(s) which is not indicated by *uplinkTxSwitching-DL-Interruption*. No DL interruption is allowed for some inter-band UL CA configurations as specified in clause 5.2A.2 of TS 38.101-1 [18].

Table 8.2.2.2.10A -1: DL interruption length on NR carrier(s) in the unit of OFDM symbols (X) for switching between two uplink carriers

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | NR Slot length (ms) | Uplink Tx switching period Note1 | | |
|  |  | 35us | 140us | 210us |
| 0 | 1 | 2 | 3 | 4 |
| 1 | 0.5 | 3 | 6 | 7 |
| 2 | 0.25 | 4 | 10 | 14 |
| Note 1: Uplink Tx switching period depends on UE capability [*uplinkTxSwitchingPeriod2T2T]*. | | | | |

##### 8.2.2.2.10B DL Interruptions at UE switching between one uplink band with one transmit antenna connector and one uplink band with two transmit antenna connectors

The DL interruption requirements at dynamic switching between two uplink bands specified in this clause are applicable for an uplink band pair of an inter-band UL CA configuration when the capability *[uplinkTxSwitchingPeriod]* is present, and is only applicable for uplink switching mechanism specified in clause 6.1.6 of TS 38.214 [26], where NR UL carrier 1 in band A is capable of one transmit antenna connector, NR UL carrier 2 and carrier 3 in band B are capable of two transmit antenna connectors. NR UL carrier 2 and carrier 3 are two contiguous aggregated carriers, and band A and band B are different bands with different carrier frequencies.

When dynamic switching between two uplink bands is conducted, UE is allowed to cause DL interruption of X OFDM symbols in NR downlink carrier(s) as indicated by *uplinkTxSwitching-DL-Interruption* [2]. The DL interruption starts from the first OFDM symbol which fully or partially overlaps with the UL switching period located in either NR band A or band B as indicated in RRC signalling [2]. The DL interruption lengths of X are defined in Table 8.2.2.2.10-1.

No DL interruption is allowed in the NR downlink carrier(s) which is not indicated by *uplinkTxSwitching-DL-Interruption*. No DL interruption is allowed for some inter-band UL CA configurations as specified in clause 5.2A.2 of TS 38.101-1 [18].

##### 8.2.2.2.10C DL Interruptions at UE switching between two uplink bands with two transmit antenna connectors

The DL interruption requirements at dynamic switching between two uplink bands specified in this clause are applicable for an uplink band pair of an inter-band UL CA configuration when the capability *[uplinkTxSwitchingPeriod2T2T]* is present, and is only applicable for uplink switching mechanism specified in clause 6.1.6 of TS 38.214 [26], where NR UL carrier 1 in band A is capable of two transmit antenna connectors, NR UL carrier 2 and carrier 3 in band B are capable of two transmit antenna connectors. NR UL carrier 2 and carrier 3 are two contiguous aggregated carriers, and band A and band B are different bands with different carrier frequencies.

When dynamic switching between two uplink bands is conducted, UE is allowed to cause DL interruption of X OFDM symbols in NR downlink carrier(s) as indicated by *uplinkTxSwitching-DL-Interruption* [2]. The DL interruption starts from the first OFDM symbol which fully or partially overlaps with the UL switching period located in either NR band A or band B as indicated in RRC signalling [2]. The DL interruption lengths of X are defined in Table 8.2.2.2.10A -1.

No DL interruption is allowed in the NR downlink carrier(s) which is not indicated by *uplinkTxSwitching-DL-Interruption*. No DL interruption is allowed for some inter-band UL CA configurations as specified in clause 5.2A.2 of TS 38.101-1 [18].

##### 8.2.2.2.11 Interruptions at direct SCell activation

When one or multiple SCell(s) are directly activated at SCell addition,

- the UE is allowed an interruption on any active serving cell:

- of up to the duration shown in Table 8.2.2.2.1-1, if the active serving cell is not in the same band as the SCell being directly activated, or

- of up to the duration shown in Table 8.2.2.2.1-2, if the active serving cells are in the same band as the SCell being activated provided the cell specific reference signals from the active serving cells and the SCell being activated are available in the same slot.

##### 8.2.2.2.12 Interruptions due to SCell dormancy

###### 8.2.2.2.12.1 Interruptions due to SCell dormancy switch

When one SCell in MCG is switched from dormancy to non-dormancy or from non-dormancy to dormancy [7] when UE is in DRX active time,

- the UE is allowed an interruption on active serving cell in MCG as defined in clause 8.2.2.2.5, except that the interruption is allowed regardless of which parameters change between the dormant BWP and the non-dormant BWP

- The starting time of interruption shall be within the dormancy switching delay as defined in clause 8.6.2.

When multiple SCells in MCG are switched from dormancy to non-dormancy or vice versa when the UE is in DRX active time, the interruption requirement described above applies for each BWP switch.

###### 8.2.2.2.12.2 Interruptions due to CQI measurements during SCell dormancy

When one or more SCells are in dormancy, the UE is for the purpose of CQI measurements on the dormant SCell(s) allowed to cause interruptions to non-dormant serving cell(s).

The rate of ACK/NACK feedback loss on any non-dormant serving cell resulting from CQI measurements on dormant SCells shall not exceed 0.5%.

###### 8.2.2.2.12.3 Interruptions due to RRM measurements during SCell dormancy

When one or more SCells are in dormancy, the UE is for the purpose of RRM measurements on the dormant SCell(s) allowed to cause interruptions to non-dormant serving cell(s).

The rate of ACK/NACK feedback loss on any non-dormant serving cell resulting from RRM measurements on dormant SCells shall not exceed 1.0%.

##### 8.2.2.2.13 Interruptions at transitions between active and non-active during DRX

For the UEs that are capable of *secondaryDRX-Group*[14] in FR1+FR2 CA, when two DRX groups are configured each group of serving cells, no interruption is allowed for UEs supporting either per UE or per FR gaps.

##### 8.2.2.2.14 Interruptions when identifying CGI of an NR cell with autonomous gaps

When a UE is identifying CGI of an NR cell with autonomous gaps, the UE is allowed interruptions on PCell or any activated SCell:

- with up to K1 interruptions with interrupted slots up to interruption length X1 specified in Table 8.2.2.2.14-1 for each interruption during MIB decoding time period TMIB (ms) specified in clause 9.11.

- with up to L1 interruptions with interrupted slots up to interruption length Y1 specified in Table 8.2.2.2.14-1 for each interruption during SIB1 decoding time period TSIB1 (ms) specified in clause 9.11 for SSB and CORESET for RMSI scheduling multiplexing patterns 1.

- with up to L2 interruptions with interrupted slots up to interruption length Y2 specified in Table 8.2.2.2.14-1 for each interruption during SIB1 decoding time period TSIB1 (ms) specified in clause 9.11 for SSB and CORESET for RMSI scheduling multiplexing patterns 2 and 3.

Where:

- K1 = 6 for the target cell carrier frequency on FR1 and K1 = 25 for the target cell carrier frequency on FR2, and

- L1 = TSIB1/20and

- L2 = TSIB1/TSMTC, where TSMTC is the periodicity of the SMTC occasion configured for the target cell carrier.

Table 8.2.2.2.14-1: Interruption length X1, Y1 and Y2 during measurements with autonomous gaps

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | NR Slot length (ms) of victim cell | Interruption length X1 (slots) | Interruption length Y1 (slots) | Interruption length Y2 (slots) |
| 0 | 1 | 6 | 7 | 6 |
| 1 | 0.5 | 12 | 13 | 10 |
| 2 | 0.25 | 24 | 25 | 19 |
| 3 | 0.125 | 48 | 49 | 37 |

##### 8.2.2.2.15 Interruptions when identifying CGI of an E-UTRA cell with autonomous gaps

When a UE is identifying CGI of an E-UTRA FDD cell or E-UTRA TDD cell with autonomous gaps, within time period Tidentify\_CGI, E-UTRA specified in clause 9.4.7.1, the UE shall be able to transmit at least the number of ACK/NACKs specified in Table 8.2.2.2.15-1 on PCell or any activated SCell in the frequency range where autonomous gaps are used, provided that:

- there is continuous DL data allocation,

- no DRX cycle is used,

- no measurement gaps are configured,

- only one code word is transmitted in each slot,

- 2 slot ACK/NACK feedback is configured,

- 20 ms SMTC period is configured.

Table 8.2.2.2.15-1: Minimum number of ACK/NACKs transmitted by the UE during Tidentify\_CGI, E-UTRA

|  |  |  |
| --- | --- | --- |
| Minimum number of transmitted ACK/NACKs | SCS | |
|  | Duplex mode configuration | SCS |
|  | Duplex mode configuration | SCS |
| 84 | FDD | 15 kHz |
| 193 | FDD | 30 kHz |
| 402 | FDD | 60 kHz |
| 28 | TDD Note 1 | 15 kHz |
| 81 | TDD Note 1 | 30 kHz |
| 159 | TDD Note 1 | 60 kHz |
| 233 | TDD Note 2 | 60 kHz |
| 491 | TDD Note 2 | 120 kHz |
| NOTE 1: TDD UL-DL configuration is as specified in Table A.3.3.1-1 of TS 38.101-1 [18].  NOTE 2: TDD UL-DL configuration is as specified in Table A.3.3.1-1 of TS 38.101-2 [19]. | | |

##### 8.2.2.2.16 Interruptions at NR SRS antenna port switching

The requirements in this clause are applicable to SRS antenna port switching on FR1 and SRS resource(s) is only configured within the last 6 symbols of a slot. For interruption caused by SRS antenna port switching, the victim cell is based on the entry number of the band indicated by *txSwitchImpactToRx* and/or *txSwitchWithAnotherBand* regardless of per-FR MG capability. An UL interruption is allowed on any of the serving cells as indicated in *txSwitchWithAnotherBand*, and a DL interruption is allowed on any of the serving cells as indicated in *txSwitchImpactToRx*.

The UE shall perform SRS antenna port switching only if the below conditions are met.

- the SRS switching is not colliding with any other UL transmission with higher priority defined in TS 38.214 [26] if the serving cell on which the higher priority transmission is performed is a victim cell based on *txSwitchWithAnotherBand* or is the same carrier on which SRS is transmitted.

- the SRS switching is not colliding with any NR measurements (i.e. SSB/CSI-RS based L1/L3 measurements) and the measurements for RLM/BFD/CBD if the serving cell on which the NR measurements and the measurements for RLM/BFD/CBD is performed is a victim cell based on *txSwitchImpactToRx* or is the same carrier on which SRS is transmitted.

No requirements are defined for SRS antenna port switching if aperiodic SRS switching is colliding with aperiodic L1-RSRP/L1-SINR measurements and the serving cell on which the aperiodic L1-RSRP/L1-SINR measurement is configured is indicated in *txSwitchImpactToRx* or is the same carrier on which aperiodic SRS is scheduled/configured.

When 1 SRS symbol is configured in a slot for SRS antenna switching and the aggressor and victim cells are synchronized, the interruption requirement in Table 8.2.2.2.16-1 applies. When 1 SRS symbol is configured in a slot for SRS antenna switching and the aggressor and victim cells are asynchronized, the interruption requirement in Table 8.2.2.2.16-2 applies. For the rest of SRS configurations, the interruption requirement in Table 8.2.2.2.16-3 applies.

**Table 8.2.2.2.16-1: Interruption length in symbols when 1 SRS symbol is configured and aggressor and victim cells are synchronized**

|  |  |  |  |
| --- | --- | --- | --- |
| **Victim cell SCS(kHz)** | **Aggressor cell SCS (kHz)** | | |
| **15** | **30** | **60** |
| 15 | 3 | 2 | 2 |
| 30 | 4 | 3 | 3 |
| 60 | 8 | 6 | 5 |
| 120 | 14 | 10 | 8 |

**Table 8.2.2.2.16.2: Interruption length in slots when 1 SRS symbol is configured and aggressor and victim cells are asynchronized**

|  |  |  |  |
| --- | --- | --- | --- |
| **Victim cell SCS(kHz)** | **Aggressor cell SCS (kHz)** | | |
| **15** | **30** | **60** |
| 15 | 2 | 2 | 2 |
| 30 | 2 | 2 | 2 |
| 60 | 2 | 2 | 2 |
| 120 | 2 | 2 | 2 |

**Table 8.2.2.2.16-3: Interruption length in slots for rest of the SRS configurations for synchronised and asynchronized scenarios**

|  |  |  |  |
| --- | --- | --- | --- |
| **Victim cell SCS(kHz)** | **Aggressor cell SCS (kHz)** | | |
| **15** | **30** | **60** |
| 15 | 2 | 2 | 2 |
| 30 | 2 | 2 | 2 |
| 60 | 3 | 2 | 2 |
| 120 | 5 | 3 | 3 |

##### 8.2.2.2.17 Interruptions at fast SCell activation

The requirements in this clause shall apply for the UE configured with PCell and one SCell when aperiodic CSI-RS resources is configured for fast SCell activation.

When one SCell in MCG configured with aperiodic CSI-RS resources is configured for fast SCell activation is activated from deactivated, the UE is allowed:

- an interruption on any active serving cell:

- of up to X2 slot, if the active serving cell and the SCell being activated are in a FR1 band pair or in a FR1+FR2 band pair.

- of up to X2 slot, if the active serving cell and the SCell being activated are in a FR2 band pair and UE is capable of independent beam management on this FR2 band pair.

- Where X2 is specified in Table 8.2.2.2.2-1.

or

- of up to Y2 slot +TATRS\_duration, if the active serving cells are in the same band as any of the SCells being activated, when

- SCell to be activated is known and belongs to FR1, if the measurement period of the SCell being activated is larger than [2400ms], or

- SCell is unknown and belongs to FR1, and SCell is contiguous to an active serving cell in the same band

or

- of up to Y2 slot if the active serving cells are in the same band as any of the SCells being activated, when

- SCell to be activated is known and belongs to FR1, if the measurement period of the SCell being activated is equal to or smaller than [2400ms], or

- SCell to be activated belongs to FR2

Where:

- TATRS\_duration is CSI-RS burst for SCell activation where the CSI-RS burst is defined as four CSI-RS resources in two consecutive slots on the being activated SCell.

- Y2 are specified in Table 8.2.1.2.4-2.

##### 8.2.2.2.18 Interruptions due to PUCCH SCell activation/deactivation

When one SCell configured with PUCCH is activated or deactivated,

- The UE is allowed an interruption on active serving cell as defined in clause 8.2.2.2.2.

- The starting time of interruption shall be within the delay as defined in clause 8.3.12.

- For inter-band CA, if the UE is not capable of *parallelTxPRACH-SRS-PUCCH-PUSCH*, additional interruption is allowed on SRS/PUCCH/PUSCH of active serving cells when colliding with RACH transmission on PUCCH SCell. Interruption occurs on the symbols containing SRS/PUCCH/PUSCH, which overlap with the duration of the PRACH preamble [3] transmitted on the PUCCH SCell.

### 8.2.3 NE-DC Interruptions

#### 8.2.3.1 Introduction

This clause contains the requirements related to the interruptions on PCell and SCell, when

E-UTRA PSCell transitions between active and non-active during DRX, or

E-UTRA PSCell transitions from non-DRX to DRX, or

E-UTRA PSCell/SCell in SCG or SCell in MCG is added or released, or

E-UTRA PSCell/SCell in SCG or SCell(s) in MCG is activated or deactivated, or

measurements on SCC with deactivated SCell in either E-UTRA SCG or NR MCG or

PUSCH/PUCCH carrier configuration and deconfiguration in NR MCG, or

UL/DL BWP is switched on PCell or SCell in MCG, or

UE-specific CBW is changed on PCell or SCell in MCG, or

CGI reading of an NR neighbour cell with autonomous gaps, or

CGI reading of an E-UTRA neighbour cell with autonomous gaps.

NR SRS carrier based switching, or

E-UTRA SRS carrier based switching, or

NR SRS antenna port switching.

SCell in NR MCG is activated based on aperiodic CSI-RS.

The requirements shall apply for NE-DC with an NR PCell.

This clause contains interruptions where victim cell is PCell or SCell belonging to MCG. Requirements for interruptions requirements when the victim cell is E-UTRA PSCell or E-UTRA SCell belonging to SCG are specified in TS 36.133 [15].

For a UE which does not support per-FR measurement gap, interruptions to the PCell, E-UTRA PSCell or activated MCG SCells may be caused by EUTRA PSCell, EUTRA SCells or SCells on any frequency range. For UE which support per-FR gap, interruptions to the PCell, E-UTRA PSCell or activated MCG SCells may be caused by EUTRA PSCell, EUTRA SCells or SCells on the same frequency range as the victim cell.

#### 8.2.3.2 Requirements

##### 8.2.3.2.1 Interruptions at transitions between active and non-active during DRX

Interruption on PCell and the activated SCell if configured due to E-UTRA PSCell transitions between active and non-active druing DRX when PCell or SCell is in non-DRX are allowed with up to 1% probability of missed ACK/NACK when the configured E-UTRA PSCell DRX cycle is less than 640 ms, and 0.625% probability of missed ACK/NACK is allowed when the configured E-UTRA PCell DRX cycle is 640 ms or longer. Each interruption shall not exceed X slot as defined in table 8.2.3.2.1-1.

Table 8.2.3.2.1-1: Interruption length X at transition between active and non-active during DRX

|  |  |  |  |
| --- | --- | --- | --- |
|  | NR slot length (ms) | Interruption length X (slots) | |
|  |  | Sync | Async |
| 0 | 1 | 1 | 2 |
| 1 | 0.5 | 1 | 2 |
| 2 | 0.25 | 3 | |
| 3 | 0.125 | 5 | |

When both PCell and E-UTRA PSCell are in DRX, no interruption is allowed.

##### 8.2.3.2.2 Interruptions at transitions from non-DRX to DRX

Interruption on PCell and the activated SCell if configured due to E-UTRA PSCell transitions from non-DRX to DRX when PCell or SCell is in non-DRX shall not exceed X slots as defined in table 8.2.3.2.1-1.

##### 8.2.3.2.3 Interruptions at PSCell/SCell addition/release

The requirements in this clause shall apply for the UE configured with E-UTRA PSCell.

When one E-UTRA PSCell/SCell in SCG is added or released:

- the UE is allowed an interruption on any active serving cell in MCG:

- of up to X1 slots, if the active serving cell is not in the same band as any of the E-UTRA PSCell/SCells being added or released, or

- of up to max{Y1 slots + TSMTC\_duration, 5ms} if the active serving cells are in the same band as any of the E-UTRA PSCell/SCells being added or released, provided the cell specific reference signals from the active serving cells and the E-UTRA PSCell/SCells being added or released are available in the same slot, where TSMTC\_duration is the longest SMTC duration among all above activated serving cells in MCG;

Where X1 and Y1 are specified in Table 8.2.3.2.3-1.

When one SCell in MCG is added or released:

- the UE is allowed an interruption on any activated serving cell in MCG:

- of up to X1 slots, if the active serving cell and the SCell being added or released are in a FR1 band pair or in a FR1+FR2 band pair.

- of up to X1 slot, if the active serving cell and the SCell being added or released are in a FR2 band pair and UE is capable of independent beam management on this FR2 band pair.

or

- of up to Y1 slots + TSMTC\_duration if the active serving cells are in the same band as any of the SCells being added or released, provided the cell specific reference signals from the active serving cells and the SCells being added or released are available in the same slot, where, TSMTC\_duration is

- the longest SMTC duration among all above active serving cells in MCG and the SCell being added when one SCell is added. If SSB configuration (*absoluteFrequencySSB*) but no SMTC configuration is provided for the SCell being added, the SSB transmission periodicity is assumed to be 5ms and TSMTC duration for the SCell being added is x ms, where x = the number of consecutive subframes containing all SSBs in one SSB burst transmitted by the SCell being added. If no SSB configuration (*absoluteFrequencySSB*) nor SMTC configuration is provided for the SCell being added, TSMTC duration for the SCell being added is 0ms;

- the longest SMTC duration among all above active serving cells in MCG when one SCell is released.

Where X1 and Y1 are specified in Table 8.2.3.2.3-2.

Table 8.2.3.2.3-1: Interruption length X1 and Y1 at E-UTRA PSCell/SCell addition/release

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | NR Slot length | Interruption length X1 (slots) | | Interruption length Y1 (slots) | |
|  | (ms) | Sync | Async | Sync | Async |
| 0 | 1 | 1 | 2 | 1 | 2 |
| 1 | 0.5 | 2 | 3 | 2 | 3 |
| 2 | 0.25 | 5 | | 4 | 5 |
| 3 | 0.125 | 9 | | N/A | N/A |

Table 8.2.3.2.3-2: Interruption length X1 and Y1 at SCell addition/Release

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | NR Slot length (ms) of victim cell | Interruption length X1 (slots) | | Interruption length Y1 (slots) |
| 0 | 1 | 1 | | 1 |
| 1 | 0.5 | 2 | | 2 |
| 2 | 0.25 | Both aggressor cell and victim cell are on FR2 | 4 | 4 |
|  |  | Either aggressor cell or victim cell is on FR1 | 5 |  |
| 3 | 0.125 | Aggressor cell is on FR2 | 8 | 8 |
|  |  | Aggressor cell is on FR1 | 9 |  |

##### 8.2.3.2.4 Interruptions at SCell activation/deactivation

The requirements in this clause shall apply for the UE configured with E-UTRA PSCell and one SCell.

When one E-UTRA SCell in SCG is activated from deactivated or dormant state, or deactivated from activated or dormant state:

- the UE is allowed an interruption on any active serving cell in MCG:

- of up to X2 slots, if the active serving cell is not in the same band as any of the SCells being activated or deactivated, or

- of up to max{Y2 slots + TSMTC\_duration, 5ms} if the active serving cells are in the same band as any of the E-UTRA SCells being activated or deactivated, provided the cell specific reference signals from the active serving cells and the E-UTRA SCells being activated or deactivated are available in the same slot, where TSMTC\_duration is the longest SMTC duration among all above active serving cells in MCG.

Where X2 and Y2 are specified in Table 8.2.3.2.4-1.

When one SCell in MCG is activated or deactivated:

- the UE is allowed an interruption on any serving cell in MCG:

- of up to X2 slots, if the active serving cell is not in the same band as any of the SCells being activated or deactivated, or

- of up to Y2 slots + TSMTC\_duration if the active serving cells are in the same band as any of the SCells being activated or deactivated, provided the cell specific reference signals from the active serving cells and the SCells being activated or deactivated are available in the same slot, where, TSMTC\_duration is

- the longest SMTC duration among all above active serving cells in MCG and the SCell being activated when one SCell is activated, If SSB configuration (*absoluteFrequencySSB*) but no SMTC configuration is provided for the SCell being activated, the SSB transmission periodicity is assumed to be 5ms and TSMTC duration for the SCell being activated is x ms, where x = the number of consecutive subframes containing all SSBs in one SSB burst transmitted by the SCell being activated. If no SSB configuration (*absoluteFrequencySSB*) nor SMTC configuration is provided for the SCell being activated, TSMTC duration for the SCell being activated is 0ms;

- the longest SMTC duration among all above active serving cells in MCG when one SCell is deactivated.

Where X2 and Y2 are specified in Table 8.2.3.2.4-2.

Table 8.2.3.2.4-1: Interruption length X2 and Y2 at E-UTRA SCell activation/deactivation

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | NR Slot length (ms) | Interruption length X2 (slots) | | Interruption length Y2 (slots) | |
|  |  | Sync | Async | Sync | Async |
| 0 | 1 | 1 | 2 | 1 | 2 |
| 1 | 0.5 | 1 | 2 | 1 | 2 |
| 2 | 0.25 | 3 | | 2 | 3 |
| 3 | 0.125 | 5 | | N/A | N/A |

Table 8.2.3.2.4-2: Interruption length X2 and Y2 at SCell activation/deactivation

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | NR Slot length (ms) of victim cell | Interruption length X2 (slots) | | Interruption length Y2 (slots) |
| 0 | 1 | 1 | | 1 |
| 1 | 0.5 | 1 | | 1 |
| 2 | 0.25 | Both aggressor cell and victim cell are on FR2 | 2 | 2 |
|  |  | Either aggressor cell or victim cell is on FR1 | 3 |  |
| 3 | 0.125 | Aggressor cell is on FR2 | 4 | 4 |
|  |  | Aggressor cell is on FR1 | 5 |  |

##### 8.2.3.2.5 Interruptions during measurements on SCC

###### 8.2.3.2.5.1 Interruptions during measurements on deactivated NR SCC

Interruption on PCell and other activated SCell(s) during measurement on the deactivated NR SCC shall meet requirements in clause 8.2.2.2.3.

###### 8.2.3.2.5.2 Interruptions during measurements on deactivated E-UTRAN SCC

When one E-UTRA SCell in SCG is deactivated, the UE is allowed due to measurements on the E-UTRA SCC with the deactivated E-UTRA SCell:

- an interruption on PCell or any activated SCell with up to 0.5% probability of missed ACK/NACK when any of the configured *measCycleSCell* [15] for the deactivated E-UTRA SCellsis 640 ms or longer.

- an interruption on PCell or any activated SCell with up to 0.5% probability of missed ACK/NACK regardless of the configured *measCycleSCell* [15]for the deactivated E-UTRA SCells if indicated by the network using IE *allowInterruptions* [15].

Each interruption shall not exceed

- X3 slots, if the PCell or activated SCell is not in the same band as the E-UTRA deactivated SCC being measured, or

- Y3 slots + SMTC duration, if the PCell or activated SCell is in the same band as the E-UTRA deactivated SCC being measured, provided the cell specific reference signals from the PCell or activated SCell and the E-UTRA deactivated SCC being measured are available in the same slot.

Where X3 and Y3 are specified in Table 8.2.3.2.5-1

Table 8.2.3.2.5-1: Interruption length X3 and Y3 at measurements on deactivated E-UTRA SCC

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | NR Slot length | Interruption length X3 (slots) | | Interruption length Y3 (slot) | |
|  | (ms) | Sync | Async | Sync | Async |
| 0 | 1 | 1 | 2 | 1 | 2 |
| 1 | 0.5 | 1 | 2 | 1 | 2 |
| 2 | 0.25 | 3 | | 2 | 3 |
| 3 | 0.125 | 5 | | N/A | N/A |

###### 8.2.3.2.5.3 Interruptions during CQI measurements on dormant E-UTRAN SCC

When one E-UTRA SCell in SCG is dormant, the UE is allowed due to CQI measurements on the dormant E-UTRA SCell:

- an interruption on PCell or any activated SCell with up to 0.5% probability of missed ACK/NACK.

Each interruption shall not exceed

- X3 slots, if the PCell or activated SCell is not in the same band as the E-UTRA dormant SCell being measured, or

- Y3 slots + SMTC duration, if the PCell or activated SCell is in the same band as the E-UTRA dormant SCell being measured, provided the cell specific reference signals from the PSCell or activated SCell and the E-UTRA dormant SCell being measured are available in the same slot.

Where X3 and Y3 are defined in Table 8.2.3.2.5.2-1.

###### 8.2.3.2.5.4 Interruptions during RRM measurements on dormant E-UTRAN SCC

When one E-UTRA SCell in SCG is dormant, the UE is allowed due to RRM measurements on the E-UTRA SCC with the dormant E-UTRA SCell:

- an interruption on PCell or any activated SCell with up to 0.5% probability of missed ACK/NACK.

Each interruption shall not exceed

- X3 slots, if the PCell or activated SCell is not in the same band as the E-UTRA dormant SCC being measured, or

- Y3 slots + SMTC duration, if the PCell or activated SCell is in the same band as the E-UTRA dormant SCC being measured, provided the cell specific reference signals from the PSCell or activated SCell and the E-UTRA dormant SCC being measured are available in the same slot.

Where X3 and Y3 are defined in Table 8.2.3.2.5.2-1.

##### 8.2.3.2.6 Interruptions at UL carrier RRC reconfiguration

The requirements in this clause shall apply when a supplementary UL carrier or an UL carrier is configured or de-configured in NE-DC.

When an UL carrier or supplementary UL carrier is configured or deconfigured, an interruption of up to X4 slot as specified in Table 8.2.3.2.6-1, is allowed during the RRC reconfiguration procedure in TS 38.331 [2] on PCell, all activated SCells within the same FR as the reconfigured uplink carrier. The interruption is for both uplink and downlink of PCell, all activated E-UTRA SCells, E-UTRA PSCell and all activated SCells within the same FR as the configured or de-configured UL.

Table 8.2.3.2.6-1: Interruption length X4 at UL carrier RRC reconfiguration

|  |  |  |  |
| --- | --- | --- | --- |
|  | NR Slot length (ms) | Interruption length X4 (slots) | |
|  |  | Sync | Async |
| 0 | 1 | 1 | 2 |
| 1 | 0.5 | 2 | 3 |
| 2 | 0.25 | 5 | |
| 3 | 0.125 | 9 | |

##### 8.2.3.2.7 Interruptions due to Active BWP switching Requirement

The requirements for DCI-based BWP switch , timer-based BWP switch or UL BWP switch triggered by consistent uplink CCA failures in this clause apply to the case that the BWP switch is performed on a single CC or multiple CCs.

When either of the DCI-based, timer-based or RRC-based downlink BWP switch and/or uplink BWP switch occur on multiple CCs simultaneously or over partially overlapping period, the interruption requirements described in this clause apply for each BWP switch.

When UE receives a DCI indicating the UE to switch its active BWP, or when a BWP timer *bwp-InactivityTimer* defined in TS 38.331 [2] expires, or when the UE receives an RRC command indicating the UE to switch its active BWP or when UL BWP switch is triggered by consistent uplink CCA failures, the UE is allowed an interruption on PCell and any activated SCells as defined in clause 8.2.2.2.5.

##### 8.2.3.2.8 Interruptions at direct SCell activation and hibernation

8.2.3.2.8.1 Interruptions during direct SCell activation and hibernation of E-UTRA SCell

When one E-UTRA SCell in SCG is directly activated and hibernated:

- the UE is allowed an interruption on any active serving cell in MCG:

- of up to X1 slot, if the active serving cell is not in the same band as any of the E-UTRA SCells being directly activated or hibernated, or

- of up to max{Y1 slot + TSMTC\_duration, 5ms} if the active serving cells are in the same band as any of the E-UTRA SCells being directly activated or hibernated, provided the cell specific reference signals from the active serving cells and the E-UTRA SCells being directly activated or hibernated are available in the same slot, where TSMTC\_duration is the longest SMTC duration among all above active serving cells in MCG.

Where X1 and Y1 are specified in Table 8.2.3.2.3-1.

8.2.3.2.8.2 Interruptions during direct SCell activation

When one or multiple SCell(s) in MCG are directly activated at SCell addition:

- the UE is allowed an interruption on any active serving cell in MCG:

- of up to X1 slot, if the active serving cell is not in the same band as the SCell being directly activated, or

- of up to max{Y1 slot + TSMTC\_duration, 5ms} if the active serving cells are in the same band as the SCell being directly activated, provided the cell specific reference signals from the active serving cells and the SCell being directly activated are available in the same slot, where TSMTC\_duration is the longest SMTC duration among all above active serving cells in MCG.

Where X1 and Y1 are specified in Table 8.2.3.2.3-2.

##### 8.2.3.2.9 Interruptions at SCell hibernation

When one E-UTRA SCell in SCG is hibernated:

- the UE is allowed an interruption on any active serving cell in MCG:

- of up to X2 slot, if the active serving cell is not in the same band as any of the E-UTRA SCells being hibernated, or

- of up to max{Y2 slot + TSMTC\_duration, 5ms} if the active serving cells are in the same band as any of the E-UTRA SCells being hibernated, provided the cell specific reference signals from the active serving cells and the E-UTRA SCells being hibernated are available in the same slot, where TSMTC\_duration is the longest SMTC duration among all above active serving cells in MCG.

Where X2 and Y2 are specified in Table 8.2.3.2.4-1.

##### 8.2.3.2.10 Interruptions at SCell activation/deactivation with multiple downlink SCells

The requirements in this clause shall apply for the UE configured with E-UTRA PSCell and up to 6 downlink SCell(s).

When multiple SCells in MCG are activated or deactivated by one single MAC CE command:

- an interruption on any serving cell in MCG is specified as in clause 8.2.3.2.4.

##### 8.2.3.2.11 Interruptions at NR SRS carrier based switching

SRS transmission can be configured on a carrier not configured for PUCCH/PUSCH transmission. When a UE needs to transmit periodic, semi-persistent or aperiodic SRS on a carrier of a serving cell not configured for PUCCH/PUSCH transmission, the UE can perform carrier based switching to one or more carriers not configured for PUCCH/PUSCH transmission from a carrier with PUCCH/PUSCH transmission or from a carrier not configured for PUCCH/PUSCH transmission prior to transmitting SRS, provided that:

- switching is from a configured carrier to another activated carrier;

- the carrier of SCells not configured for PUCCH/PUSCH transmission to which SRS carrier based switching is performed is indicated by DCI SRS request field for aperiodic SRS transmission, or indicated by MAC-CE for semi-persistent SRS transmission, or configured via RRC for periodic SRS transmission;

- the serving cell, from which SRS carrier based switching is performed and whose UL transmission may therefore be interrupted, is indicated by srs-SwitchFromServCellIndex and srs-SwitchFromCarrier in TS38.331 [2];

- the SRS switching is not colliding with any other transmission with higher priority defined in TS 38.214 [26].

- the SRS switching is not colliding with any SSB/CSI-RS based L3 measurements and the measurements for RLM/BFD in MCG.- for UE, which does not support simultaneous reception and transmission for inter-band TDD CA specified in TS 38.331 [2], and is compliant to the requirements for inter-band CA with uplink in one NR band and without simultaneous Rx/Tx specified in TS 38.101-3 [20], the SRS transmission are not simultaneously scheduled with DL SSB/CSI-RS for L3 or L1 measurements transmission on other carriers.

The UE shall not perform SRS carrier based switching if the above conditions cannot be met.

When SRS carrier based switching is performed between carriers, the UE is allowed interruptions on any active serving cell in MCG if UE is not capable of Per-FR gap, or on active serving cell(s) in MCG in FR1 if UE is capable of Per-FR gap, during the switching to the carrier of a serving cell in FR1 not configured for PUCCH/PUSCH transmission,

- with up to X1 slot as specified in Table 8.2.3.2.11-1.

When SRS carrier based switching is performed between carriers, the UE is allowed interruptions on any active serving cell in MCG if UE is not capable of Per-FR gap, or on active serving cell(s) in MCG in FR2 if UE is capable of Per-FR gap, during the switching to the carrier of a serving cell in FR2 not configured for PUCCH/PUSCH transmission,

- with up to X2 slot as specified in Table 8.2.3.2.11-2.

When SRS carrier based switching is performed between carriers, the UE is allowed interruptions on any active serving cell in MCG if UE is not capable of Per-FR gap, or on active serving cell(s) in MCG in FR1 if UE is capable of Per-FR gap, during the switching from the carrier of a serving cell in FR1 not configured for PUCCH/PUSCH transmission,

- with up to X1 slot as specified in Table 8.2.3.2.11-1.

When SRS carrier based switching is performed between carriers, the UE is allowed interruptions on any active serving cell in MCG if UE is not capable of Per-FR gap, or on active serving cell(s) in MCG in FR2 if UE is capable of Per-FR gap, during the switching from the carrier of a serving cell in FR2 not configured for PUCCH/PUSCH transmission,

- with up to X2 slot as specified in Table 8.2.3.2.11-2.

Table 8.2.3.2.11-1: Interruption length X1 (slot)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | NR Slot length | SRS carrier | Interruption length X1 (slots) | |
|  | (ms) of victim cell | switching time (us)Note 1 | Sub carrier spacing for agressor cell (kHz) | |
|  |  |  | 15 | 30 |
| 0 | 1 | ≤ 200 | 2 | 2 |
|  |  | 300, 500 | 2 | 2 |
|  |  | 900 | 3 | 3 |
| 1 | 0.5 | ≤ 200 | 3 | 2 |
|  |  | 300, 500 | 3 | 3 |
|  |  | 900 | 4 | 4 |
| 2 | 0.25 | ≤ 200 | 4 | 3 |
|  |  | 300, 500 | 5 | 4 |
|  |  | 900 | 7 | 6 |
| 3 | 0.125 | ≤ 200 | 7 | 5 |
|  |  | 300, 500 | 9 | 7 |
|  |  | 900 | 12 | 10 |
| Note1: NR SRS carrier switching time is UE capability indicated by higher layer parameter *SRS-SwitchingTimeNR*. | | | | |

Table 8.2.3.2.11-2: Interruption length X2 (slot)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | NR Slot | SRS carrier | Interruption length X2 (slots) | |
|  | length (ms) of victim cell | switching time (us) Note 1 | Sub carrier spacing for agressor cell (kHz) | |
|  |  |  | 60 | 120 |
| 0 | 1 | ≤ 200 | 2 | 2 |
| 1 | 0.5 | ≤ 200 | 2 | 2 |
| 2 | 0.25 | ≤ 200 | 3 | 3 |
| 3 | 0.125 | ≤ 200 | 4 | 4 |
| Note1: NR SRS carrier switching time is UE capability indicated by higher layer parameter *SRS-SwitchingTimeNR*. | | | | |

For intra-band SRS carrier switching in FR1 or FR2, interruptions in Table 8.2.3.2.11-1 and in Table 8.2.3.2.11-2 based on SRS carrier switching time ≤ 200us shall apply. For inter-band SRS carrier switching in FR1, interruptions in Table 8.2.3.2.11-1 and in Table 8.2.3.2.11-2 shall apply.

##### 8.2.3.2.12 Interruptions at E-UTRA SRS carrier based switching

A PUSCH-less carrier of E-UTRA SCell is a TDD carrier without PUCCH/PUSCH configured. When a UE needs to transmit periodic or aperiodic SRS [23] and/or non-contention based PRACH on a PUSCH-less E-UTRA carrier of SCell, the UE can perform carrier based switching to one or more PUSCH-less carrier of E-UTRA SCells from a E-UTRA carrier with PUSCH or from another PUSCH-less E-UTRA carrier of SCell prior to transmitting SRS and/or PRACH, provided that:

- switching is from a configured E-UTRA carrier to another activated TDD carrier;

- the PUSCH-less carrier of E-UTRA SCells to which SRS carrier based switching is performed is indicated by DCI SRS request field for aperiodic SRS transmission or configured via RRC [15] for periodic SRS transmission;

- the E-UTRA serving cell, from which SRS carrier based switching is performed and whose UL transmission may therefore be interrupted, is indicated by srs-SwitchFromServCellIndex [15];

- the SRS switching is not colliding with any other transmission with higher priority defined in TS36.213 [TBD];

- the SRS switching is not colliding with PDCCH in subframe 0 and 5 as specified in TS36.213 [TBD];

- for UE, which does not support simultaneous reception and transmission for inter-band TDD CA specified in TS 36.331 [2], and is compliant to the requirements for inter-band CA with uplink in one E-UTRA band and without simultaneous Rx/Tx specified in TS 36.101 [25], the SRS or RACH transmission are not simultaneously scheduled with DL subframe #0 or DL subframe #5 on other E-UTRA carriers.

The UE shall not perform SRS carrier based switching if the above conditions cannot be met.

When SRS carrier based switching is performed between E-UTRA carriers, the UE is allowed interruptions on any active serving cell in MCG if UE is not capable of Per-FR gap, or on active serving cell(s) in MCG in FR1 if UE is capable of Per-FR gap, during the switching to the PUSCH-less carrier of a serving cell,

- with up to X2 slot as specified in Table 8.2.3.2.12-1.

When SRS carrier based switching is performed between E-UTRA carriers, the UE is allowed interruptions on any active serving cell in MCG if UE is not capable of Per-FR gap, or on active serving cell(s) in MCG in FR1 if UE is capable of Per-FR gap, during the switching from the PUSCH-less carrier of a serving cell,

- with up to X2 slot as specified in Table 8.2.3.2.12-1

Table 8.2.3.2.12-1: Interruption length X2 (slot)

|  |  |  |
| --- | --- | --- |
|  | NR Slot | Interruption length X2 |
|  | length (ms) | (slots) |
| 0 | 1 | 2 |
| 1 | 0.5 | 3 |
| 2 | 0.25 | 5 |
| 3 | 0.125 | 9 |

##### 8.2.3.2.13 Interruptions due to SCell dormancy

8.2.3.2.13.1 Interruptions due to SCell dormancy switch

When one SCell in MCG is switched from dormancy to non-dormancy or from non-dormancy to dormancy [7] when UE is in DRX active time,

- the UE is allowed an interruption on active serving cell in MCG as defined in clause 8.2.3.2.7, except that the interruption is allowed regardless of which parameters change between the dormant BWP and the non-dormant BWP

- The starting time of interruption shall be within the dormancy switching delay as defined in clause 8.6.2.

When multiple SCells in MCG are switched from dormancy to non-dormancy or vice versa when the UE is in DRX active time, the interruption requirement described above applies for each BWP switch.

8.2.3.2.13.2 Interruptions due to CQI measurements during SCell dormancy

When one or more SCells are in dormancy, the UE is for the purpose of CQI measurements on the dormant SCell(s) allowed to cause interruptions to non-dormant serving cell(s).

The rate of ACK/NACK feedback loss on any non-dormant serving cell resulting from CQI measurements on dormant SCells shall not exceed 0.5%.

8.2.3.2.13.3 Interruptions due to RRM measurements during SCell dormancy

When one or more SCells are in dormancy, the UE is for the purpose of RRM measurements on the dormant SCell(s) allowed to cause interruptions to non-dormant serving cell(s).

The rate of ACK/NACK feedback loss on any non-dormant serving cell resulting from RRM measurements on dormant SCells shall not exceed 1.0%.

##### 8.2.3.2.14 Interruptions when identifying CGI of an NR cell with autonomous gaps

When a UE is identifying CGI of an NR cell with autonomous gaps, the UE is allowed interruptions on PCell or any activated SCell:

- with up to K1 interruptions with interrupted slots up to interruption length X1 specified in Table 8.2.3.2.14-1 for each interruption during MIB decoding time period TMIB (ms) specified in clause 9.11.

- with up to L1 interruptions with interrupted slots up to interruption length Y1 specified in Table 8.2.3.2.14-1 for each interruption during SIB1 decoding time period TSIB1 (ms) specified in clause 9.11 for SSB and CORESET for RMSI scheduling multiplexing patterns 1.

- with up to L2 interruptions with interrupted slots up to interruption length Y2 specified in Table 8.2.3.2.14-1 for each interruption during SIB1 decoding time period TSIB Where:

- K1 = 6 for the target cell carrier frequency on FR1 and K1 = 25 for the target cell carrier frequency on FR2, and

- L1 = TSIB1/20, and

- L2 = TSIB1/TSMTC, where TSMTC is the periodicity of the SMTC occasion configured for the target cell carrier.

Table 8.2.3.2.14-1: Interruption length X1, Y1 and Y2 during measurements with autonomous gaps

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | NR Slot length (ms) of victim cell | Interruption length X1 (slots) | Interruption length Y1 (slots) | Interruption length Y2 (slots) |
| 0 | 1 | 6 | 7 | 6 |
| 1 | 0.5 | 12 | 13 | 10 |
| 2 | 0.25 | 24 | 25 | 19 |
| 3 | 0.125 | 48 | 49 | 37 |

##### 8.2.3.2.15 Interruptions when identifying CGI of an E-UTRA cell with autonomous gaps

When a UE is identifying CGI of an E-UTRA FDD cell or E-UTRA TDD cell with autonomous gaps, within time period

- Tidentify\_CGI, intra specified in clause 8.1.2.2.3, or clause 8.1.2.2.4 in TS 36.133 [15], or

- Tidentify\_CGI, inter specified in clause 8.1.2.3.5, or clause 8.1.2.3.6, or clause 8.1.2.3.7, or clause 8.1.2.3.6 in TS 36.133 [15], or

- Tidentify\_CGI, E-UTRA specified in clause 9.4.7.1

the UE shall be able to transmit at least the number of ACK/NACKs specified in Table 8.2.3.2.15-1 on PCell or any activated SCell in the frequency range where autonomous gaps are used, provided that:

- there is continuous DL data allocation,

- no DRX cycle is used,

- no measurement gaps are configured,

- only one code word is transmitted in each slot,

- 2 slot ACK/NACK feedback is configured,

- 20 ms SMTC period is configured.

Table 8.2.3.2.15-1: Minimum number of ACK/NACKs transmitted by the UE

|  |  |  |
| --- | --- | --- |
| Minimum number of transmitted ACK/NACKs | Configuration of the serving cell in which the transmitted ACK/NACKs are counted | |
|  | Duplex mode configuration | SCS |
| 84 | FDD | 15 kHz |
| 193 | FDD | 30 kHz |
| 402 | FDD | 60 kHz |
| 28 | TDD Note 1 | 15 kHz |
| 81 | TDD Note 1 | 30 kHz |
| 159 | TDD Note 1 | 60 kHz |
| 233 | TDD Note 2 | 60 kHz |
| 491 | TDD Note 2 | 120 kHz |
| NOTE 1: TDD UL-DL configuration is as specified in Table A.3.3.1-1 of TS 38.101-1 [18].  NOTE 2: TDD UL-DL configuration is as specified in Table A.3.3.1-1 of TS 38.101-2 [19]. | | |

8.2.3.2.16 Interruptions at NR SRS antenna port switching

The requirements in this clause are applicable to SRS antenna port switching on FR1 and SRS resource(s) is only configured within the last 6 symbols of a slot. For interruption caused by SRS antenna port switching, the victim cell is based on the entry number of the band indicated by *txSwitchImpactToRx* and/or *txSwitchWithAnotherBand* regardless of per-FR MG capability. An UL interruption is allowed on any of the serving cells as indicated in *txSwitchWithAnotherBand*, and a DL interruption is allowed on any of the serving cells as indicated in *txSwitchImpactToRx*.

The UE shall perform SRS antenna port switching only if the below conditions are met.

- the SRS switching is not colliding with any other UL transmission with higher priority defined in TS 38.214 [26] if the serving cell on which the higher priority transmission is performed is a victim cell based on *txSwitchWithAnotherBand* or is the same carrier on which SRS is transmitted.

- the SRS switching is not colliding with any NR measurements (i.e. SSB/CSI-RS based L1/L3 measurements) and the measurements for RLM/BFD/CBD if the serving cell on which the NR measurements and the measurements for RLM/BFD/CBD is performed is a victim cell based on *txSwitchImpactToRx* or is the same carrier on which SRS is transmitted.

No requirements are defined for SRS antenna port switching if aperiodic SRS switching is colliding with aperiodic L1-RSRP/L1-SINR measurements and the serving cell on which the aperiodic L1-RSRP/L1-SINR measurement is configured is indicated in *txSwitchImpactToRx* or is the same carrier on which aperiodic SRS is scheduled/configured.

No requirements apply when SRS antenna port switching is colliding with E-UTRA measurement if the carrier on which the E-UTRA measurement is performed is indicated in *txSwitchImpactToRx* or is the same carrier on which SRS is scheduled/configured.

When 1 SRS symbol is configured in a slot for SRS antenna switching and the aggressor and victim cells are synchronized, the interruption requirement in Table 8.2.3.2.16-1 applies. When 1 SRS symbol is configured in a slot for SRS antenna switching and the aggressor and victim cells are asynchronized, the interruption requirement in Table 8.2.3.2.16-2 applies. For the rest of SRS configurations, the interruption requirement in Table 8.2.3.2.16-3 applies.

Table 8.2.3.2.16-1: Interruption length in symbols when 1 SRS symbol is configured and aggressor and victim cells are synchronized

|  |  |  |  |
| --- | --- | --- | --- |
| **Victim cell SCS(kHz)** | **Aggressor cell SCS (kHz)** | | |
| **15** | **30** | **60** |
| 15 | 3 | 2 | 2 |
| 30 | 4 | 3 | 3 |
| 60 | 8 | 6 | 5 |
| 120 | 14 | 10 | 8 |

Table 8.2.3.2.16-2: Interruption length in slots when 1 SRS symbol is configured and aggressor and victim cells are asynchronized

|  |  |  |  |
| --- | --- | --- | --- |
| **Victim cell SCS(kHz)** | **Aggressor cell SCS (kHz)** | | |
| **15** | **30** | **60** |
| 15 | 2 | 2 | 2 |
| 30 | 2 | 2 | 2 |
| 60 | 2 | 2 | 2 |
| 120 | 2 | 2 | 2 |

Table 8.2.3.2.16-3: Interruption length in slots for rest of the SRS configurations for synchronised and asynchronized scenarios

|  |  |  |  |
| --- | --- | --- | --- |
| **Victim cell SCS(kHz)** | **Aggressor cell SCS (kHz)** | | |
| **15** | **30** | **60** |
| 15 | 2 | 2 | 2 |
| 30 | 2 | 2 | 2 |
| 60 | 3 | 2 | 2 |
| 120 | 5 | 3 | 3 |

##### 8.2.3.2.17 Interruptions at fast SCell activation

The requirements in this clause shall apply for the UE configured with E-UTRA PSCell and one SCell in MCG when aperiodic CSI-RS resources is configured for fast SCell activation.

When one SCell in MCG configured with aperiodic CSI-RS resources is configured for fast SCell activation is activated from deactivated, the UE is allowed:

- the UE is allowed an interruption on any serving cell in MCG:

- of up to X2 slots, if the active serving cell is not in the same band as any of the SCells being activated, or

- of up to Y2 slots + TATRS\_duration if the active serving cells are in the same band as any of the SCells being activated, when

- SCell to be activated is known and belongs to FR1, if the measurement period of the SCell being activated is larger than [2400ms], or

- SCell is unknown and belongs to FR1, and SCell is contiguous to an active serving cell in the same band

- of up to Y2 slot if the active serving cells are in the same band as any of the SCells being activated, when

- SCell to be activated is known and belongs to FR1, if the measurement period of the SCell being activated is equal to or smaller than [2400ms], or

- SCell to be activated belongs to FR2

Where

- TATRS\_duration is CSI-RS burst for SCell activation where the CSI-RS burst is defined as four CSI-RS resources in two consecutive slots on the being activated SCell.

- X2 and Y2 are specified in Table 8.2.3.2.4-2.

##### 8.2.3.2.18 Interruptions due to UE-specific CBW change

The requirements in clause 8.2.1.2.11 apply for this clause.

##### 8.2.3.2.19 Interruptions due to PUCCH SCell activation/deactivation

When one SCell in MCG configured with PUCCH is activated or deactivated,

The UE is allowed an interruption on active serving cell in MCG as defined in clause 8.2.3.2.4.

- The starting time of interruption shall be within the delay as defined in clause 8.3.12.

- For inter-band CA, if the UE is not capable of *parallelTxPRACH-SRS-PUCCH-PUSCH*, additional interruption is allowed on SRS/PUCCH/PUSCH of active serving cells when colliding with RACH transmission on PUCCH SCell. Interruption occurs on the symbols containing SRS/PUCCH/PUSCH, which overlap with the duration of the PRACH preamble [3] transmitted on the PUCCH SCell.

### 8.2.4 NR-DC: Interruptions

#### 8.2.4.1 Introduction

This clause contains the requirements related to the interruptions on PCell, PSCell and activated SCell if configured, when

up to 1 SCell in FR1 and up to 7 SCell(s) in FR2 are configured, deconfigured, activated or deactivated or,

a supplementary UL carrier or an UL carrier is configured or de-configured, or

measurements on SCC with deactivated SCell in NR SCG, or

measurements on the deactivated PSCell in NR SCG, or

UL/DL BWP is switched on PCell, PSCell or SCell,

UE-specific CBW is changed on PCell, PSCell or SCell, or

transitions between active and non-active during DRX, or

transitions from non-DRX to DRX, or

CGI reading of an NR neighbour cell with autonomous gaps, or

CGI reading of an E-UTRA neighbour cell with autonomous gaps.

NR SRS carrier based switching, or

NR SRS antenna port switching.

RLM/BFD Measurement on deactivatd NR PSCell, or

NR SCell is activated based on aperiodic CSI-RS.

Note: interruptions at SCell addition/release, activation/deactivation and during measurements on SCC may not be required by all UEs.

The interruptions shall not interrupt RRC signalling or ACK/NACKs related to RRC reconfiguration procedure [2] for SCell addition/release or MAC control signalling [17] for SCell activation/deactivation command.

The requirements shall apply for NR-DC with an NR PCell, PSCell or SCell.

For a UE which does not support per-FR measurement gap, interruptions to the PCell and activated SCell may be caused by SCells on any frequency range. For a UE which supports per-FR gaps, interruptions to PCell, PSCell and activated SCell may be caused by SCells on the same frequency range as the victim cell.

#### 8.2.4.2 Requirements

##### 8.2.4.2.1 Interruptions at PSCell/SCell addition/release

When PSCell or one or more SCells is added or released using the same *RRCConnectionReconfiguration* message as defined in TS 38.331 [2], the UE is allowed an interruption on any activated serving cell during the RRC reconfiguration procedure as follows:

- an interruption on any active serving cell:

- of up to the duration shown in table 8.2.4.2.1-1, if the active serving cell is not in the same band as the PSCell or SCell being added or released, where the requriements for Sync apply for synchronous NR-DC, and for asynchronous NR-DC if the active serving cell is in the same CG as the PSCell or SCell being added or released, and the requriements for Async apply for asynchronous NR-DC if the active serving cell is not in the same CG as the PSCell or SCell being added or released, or

- of up to the duration shown in table 8.2.4.2.1-2, if the active serving cells are in the same band as the SCell being added or released, provided the cell specific reference signals from the active serving cells and the SCell being added or released are available in the same slot.

Table 8.2.4.2.1-1: Interruption duration for PSCell/SCell addition/release for inter-band DC/CA

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | NR Slot length (ms) | Interruption length (slots) | | |
|  | of victim cell | Sync | | Async |
| 0 | 1 | 1 | | 2 |
| 1 | 0.5 | 2 | | 3 |
| 2 | 0.25 | Both aggressor cell and victim cell are on FR2 | 4 | 5 |
|  |  | Either aggressor cell or victim cell is on FR1 | 5 |  |
| 3 | 0.125 | Aggressor cell is on FR2 | 8 | 9 |
|  |  | Aggressor cell is on FR1 | 9 |  |
| 5 | 0.03125 | Aggressor cell is on FR1 | 33 | 33 |
| 6 | 0.015625 | Aggressor cell is on FR1 | 65 | 65 |

Table 8.2.4.2.1-2: Interruption duration for SCell addition/release for intra-band DC/CA

|  |  |  |
| --- | --- | --- |
|  | NR Slot length (ms) | Interruption length (slots) |
| 0 | 1 | 1 + TSMTC\_duration \* |
| 1 | 0.5 | 2 + TSMTC\_duration \* |
| 2 | 0.25 | 4 + TSMTC\_duration \* |
| 3 | 0.125 | 8 + TSMTC\_duration \* |
| 5 | 0.03125 | 32+ TSMTC\_duration \* |
| 6 | 0.015625 | 64+ TSMTC\_duration \* |
| NOTE 1: TSMTC\_duration measured in subframes is  - the longest SMTC duration among all above activeserving cells and the SCell being added when one SCell is added. If SSB configuration (*absoluteFrequencySSB*) but no SMTC configuration is provided for the SCell being added, the SSB transmission periodicity is assumed to be 5ms and TSMTC duration for the SCell being added is x ms, where x = the number of consecutive subframes containing all SSBs in one SSB burst transmitted by the SCell being added. If no SSB configuration (*absoluteFrequencySSB*) nor SMTC configuration is provided for the SCell being added, TSMTC duration for the SCell being added is 0ms;  - the longest SMTC duration among all active serving cells in the same band when one SCell is released.  NOTE 2: is as defined in TS 38.211 [6]. | | |

##### 8.2.4.2.2 Interruptions at SCell activation/deactivation

When a SCell is activated or deactivated as defined in TS 37.340 [17], the UE is allowed

- an interruption on any active serving cell:

- of up to the duration shown in table 8.2.4.2.2-1, if the active serving cell is not in the same band as any of the SCells being activated or deactivated, where the requriements for Sync apply for synchronous NR-DC, and for asynchronous NR-DC if the active serving cell is in the same CG as all the SCells being activated, and the requriements for Async apply for asynchronous NR-DC if the active serving cell is not in the same CG as any of the SCells being activated, or

- of up to the duration shown in table 8.2.4.2.2-2, if the active serving cells are in the same band as any of the SCells being activated or deactivated provided the cell specific reference signals from the active serving cells and the SCells being activated or deactivated are available in the same slot.

Table 8.2.4.2.2-1: Interruption duration for SCell activation/deactivation for inter-band DC/CA

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | NR Slot length | Interruption length (slots) | | |
|  | (ms) of victim cell | Sync | | Async |
| 0 | 1 | 1 | | 2 |
| 1 | 0.5 | 1 | | 2 |
| 2 | 0.25 | Both aggressor cell and victim cell are on FR2 | 2 | 3 |
|  |  | Either aggressor cell or victim cell is on FR1 | 3 |  |
| 3 | 0.125 | Aggressor cell is on FR2 | 4 | 5 |
|  |  | Aggressor cell is on FR1 | 5 |  |
| 5 | 0.03125 | Aggressor cell is on FR1 | 17 | 17 |
| 6 | 0.015625 | Aggressor cell is on FR1 | 33 | 33 |

Table 8.2.4.2.2-2: Interruption duration for SCell activation/deactivation for intra-band DC/CA

|  |  |  |
| --- | --- | --- |
|  | NR Slot length (ms) | Interruption length (slots) |
| 0 | 1 | 1 + TSMTC\_duration \* |
| 1 | 0.5 | 1 + TSMTC\_duration \* |
| 2 | 0.25 | 2 + TSMTC\_duration \* |
| 3 | 0.125 | 4 + TSMTC\_duration \* |
| 5 | 0.03125 | 16+ TSMTC\_duration \* |
| 6 | 0.015625 | 32+ TSMTC\_duration \* |
| NOTE 1: TSMTC\_duration measured in subframes is  - the longest SMTC duration among all above active serving cells and the SCell being activated when one SCell is activated. If SSB configuration (*absoluteFrequencySSB*) but no SMTC configuration is provided for the SCell being activated, the SSB transmission periodicity is assumed to be 5ms and TSMTC duration for the SCell being activated is x ms, where x = the number of consecutive subframes containing all SSBs in one SSB burst transmitted by the SCell being activated. If no SSB configuration (*absoluteFrequencySSB*) nor SMTC configuration is provided for the SCell being activated, TSMTC duration for the SCell being activated is 0ms;  - the longest SMTC duration among all active serving cells in the same band when one SCell is deactivated.  NOTE 2: is as defined in TS 38.211 [6]. | | |

##### 8.2.4.2.3 Interruptions during measurements on SCC

Interruption on PCell, PSCell and other activated SCell(s) during measurement on the deactivated NR SCC shall meet requirements in clause 8.2.2.2.3, where the term PCell in clause 8.2.2.2.3 shall be deemed to be replaced with SpCell.

##### 8.2.4.2.4 Interruptions at UL carrier RRC reconfiguration

The requirements in this clause shall apply when a supplementary UL carrier or an UL carrier is configured or de-configured in NR-DC as defined in TS 38.331 [2].

When an UL carrier or supplementary UL carrier is configured or de-configured, an interruption of up to the duration shown in table 8.2.4.2.4-1, is allowed during the RRC reconfiguration procedure in TS38.331 [2] on all the other activated serving cells within the same FR as the reconfigured uplink carrier. The interruption is for both uplink and downlink of all the other serving cells within the same FR as the configured or de-configured UL.

Table 8.2.4.2.4-1: Interruption duration for UL carrier RRC reconfiguration

|  |  |  |
| --- | --- | --- |
|  | NR Slot length (ms) | Interruption length (slots) |
| 0 | 1 | 1 |
| 1 | 0.5 | 2 |
| 2 | 0.25 | 4 |
| 3 | 0.125 | 8 |
| 5 | 0.03125 | 32 |
| 6 | 0.015625 | 64 |

##### 8.2.4.2.5 Interruptions due to Active BWP switching Requirement

The requirements for DCI-based BWP switch, timer-based BWP switch or UL BWP switch triggered by consistent uplink CCA failures in this clause apply to the case that the BWP switch is performed on a single CC or multiple CCs.

When either of the DCI-based, timer-based or RRC-based downlink BWP switch and/or uplink BWP switch occur on multiple CCs simultaneously or over partially overlapping period, the interruption requirements described in this clause apply for each BWP switch.

When UE receives a DCI indicating the UE to switch its active BWP, or when a BWP timer bwp-InactivityTimer defined in TS 38.331 [2] expires, or when the UE receives an RRC command indicating the UE to switch its active BWP or when UL BWP switch is triggered by consistent uplink CCA failures,, the UE is allowed to cause an interruption on any other serving cells as defined in clause 8.2.2.2.5. In addition to what is defined in 8.2.2.5, when RRC-based BWP switch occurs on multiple CCs over partially overlapping period, the interruption is only allowed within the delay TRRCprocessingDelay + TWaiting + TBWPswitchDelayRRC + DRRC\*(M-1) as defined in clause 8.6.3A.3. Besides, in asynchronous scenario the UE is allowed an additional interrupt of 1 slot length.

##### 8.2.4.2.6 Interruptions at transitions between active and non-active during DRX

When PCell is in non-DRX and PSCell is in DRX, interruptions on PCell and the activated SCell in MCG if configured due to transitions from active to non-active and from non-active to active during PSCell DRX are allowed with up to 1% probability of missed ACK/NACK when the configured PSCell DRX cycle is less than 640 ms, and 0.625% probability of missed ACK/NACK is allowed when the configured PSCell DRX cycle is 640 ms or longer. Each interruption shall not exceed X slot as defined in table 8.2.4.2.6-1.

When PSCell is in non-DRX and PCell is in DRX, interruptions on PSCell on the activated SCell in SCG if configured due to transitions from active to non-active and from non-active to active during PCell DRX are allowed with up to 1 % probability of missed ACK/NACK when the configured PCell DRX cycle is less than 640 ms, and 0.625% probability of missed ACK/NACK is allowed when the configured PCell DRX cycle is 640 ms or longer. Each interruption shall not exceed X slot as defined in table 8.2.4.2.6-1.

Table 8.2.4.2.6-1: Interruption length X at transition between active and non-active during DRX

|  |  |  |  |
| --- | --- | --- | --- |
|  | NR Slot length (ms) | Interruption length X (slots) | |
|  |  | Sync | Async |
| 0 | 1 | 1 | 2 |
| 1 | 0.5 | 1 | 2 |
| 2 | 0.25 | 3 | |
| 3 | 0.125 | 5 | |
| 5 | 0.03125 | 17 | |
| 6 | 0.015625 | 33 | |

When both PCell and PSCell are in DRX, no interruption is allowed.

##### 8.2.4.2.7 Interruptions at transitions from non-DRX to DRX

Interruption on PCell and the activated SCell in MCG if configured due to PSCell transitions from non-DRX to DRX when PCell is in non-DRX shall not exceed X slots as defined in table 8.2.4.2.6-1.

Interruption on PSCell and the activated SCell in SCG if configured due to PCell transitions from non-DRX to DRX when PSCell is in non-DRX shall not exceed X slots as defined in table 8.2.4.2.6-1.

##### 8.2.4.2.8 Interruptions at SCell activation/deactivation with multiple downlink SCells

The requirements in this clause shall apply for the UE configured with NR-DC and up to 1 downlink SCell in FR1 and up to 7 downlink SCell(s) in FR2.

When multiple SCell are activated or deactivated by one single MAC CE command in MCG or SCG:

- an interruption on any serving cell in MCG or SCG is specified as in clause 8.2.4.2.2.

When multiple SCell are activated or deactivated in both MCG and SCG by two MAC CE commands respectively:

- an interruption on any serving cell in MCG is specified as in clause 8.2.4.2.2, and

- an interruption on any serving cell in SCG is specified as in clause 8.2.4.2.2.

##### 8.2.4.2.9 Interruptions at NR SRS carrier based switching

SRS transmission can be configured on a carrier not configured for PUCCH/PUSCH transmission. When a UE needs to transmit periodic, semi-persistent or aperiodic SRS on a carrier of a serving cell not configured for PUCCH/PUSCH transmission, the UE can perform carrier based switching to one or more carriers not configured for PUCCH/PUSCH transmission from a carrier with PUCCH/PUSCH transmission or from a carrier not configured for PUCCH/PUSCH transmission prior to transmitting SRS, provided that:

- switching is from a configured carrier to another activated carrier;

- the carrier of SCells not configured for PUCCH/PUSCH transmission to which SRS carrier based switching is performed is indicated by DCI SRS request field for aperiodic SRS transmission, or indicated by MAC-CE for semi-persistent SRS transmission, or configured via RRC for periodic SRS transmission;

- the serving cell, from which SRS carrier based switching is performed and whose UL transmission may therefore be interrupted, is indicated by srs-SwitchFromServCellIndex and srs-SwitchFromCarrier in TS38.331 [2];

- the SRS switching is not colliding with any other transmission with higher priority defined in TS 38.214 [26].

- the SRS switching is not colliding with any SSB/CSI-RS based L3 measurements and the measurements for RLM/BFD in the same CG.- for UE, which does not support simultaneous reception and transmission for inter-band TDD CA specified in TS 38.331 [2], and is compliant to the requirements for inter-band CA with uplink in one NR band and without simultaneous Rx/Tx specified in TS 38.101-3 [20], the SRS transmission are not simultaneously scheduled with DL SSB/CSI-RS for L3 or L1 measurements transmission on other carriers.

The UE shall not perform SRS carrier based switching if the above conditions cannot be met.

When SRS carrier based switching is performed between carriers, the UE is allowed interruptions on any active serving cell if UE is not capable of Per-FR gap, or on active serving cell(s) in FR1 if UE is capable of Per-FR gap, during the switching to the carrier of a serving cell in FR1 not configured for PUCCH/PUSCH transmission,

- with up to X1 slot as specified in Table 8.2.4.2.9-1.

When SRS carrier based switching is performed between carriers, the UE is allowed interruptions on any active serving cell if UE is not capable of Per-FR gap, or on active serving cell(s) in FR2 if UE is capable of Per-FR gap, during the switching to the carrier of a serving cell in FR2 not configured for PUCCH/PUSCH transmission,

- with up to X2 slot as specified in Table 8.2.4.2.9-2.

When SRS carrier based switching is performed between carriers, the UE is allowed interruptions on any active serving cell if UE is not capable of Per-FR gap, or on active serving cell(s) in FR1 if UE is capable of Per-FR gap, during the switching from the carrier of a serving cell in FR1 not configured for PUCCH/PUSCH transmission,

- with up to X1 slot as specified in Table 8.2.4.2.9-1.

When SRS carrier based switching is performed between carriers, the UE is allowed interruptions on any active serving cell if UE is not capable of Per-FR gap, or on active serving cell(s) in FR2 if UE is capable of Per-FR gap, during the switching from the carrier of a serving cell in FR2 not configured for PUCCH/PUSCH transmission,

- with up to X2 slot as specified in Table 8.2.4.2.9-2.

Table 8.2.4.2.9-1: Interruption length X1 (slot)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | NR Slot length | SRS carrier | Interruption length X1 (slots) | |
|  | (ms) of victim cell | switching time (us)Note 1 | Sub carrier spacing for agressor cell (kHz) | |
|  |  |  | 15 | 30 |
| 0 | 1 | ≤ 200 | 2 | 2 |
|  |  | 300, 500 | 2 | 2 |
|  |  | 900 | 3 | 3 |
| 1 | 0.5 | ≤ 200 | 3 | 2 |
|  |  | 300, 500 | 3 | 3 |
|  |  | 900 | 4 | 4 |
| 2 | 0.25 | ≤ 200 | 4 | 3 |
|  |  | 300, 500 | 5 | 4 |
|  |  | 900 | 7 | 6 |
| 3 | 0.125 | ≤ 200 | 7 | 5 |
|  |  | 300, 500 | 9 | 7 |
|  |  | 900 | 12 | 10 |
| 5 | 0.03125 | ≤ 200 | 22 | 15 |
|  |  | 300, 500 | 31 | 24 |
|  |  | 900 | 44 | 37 |
| 6 | 0.015625 | ≤ 200 | 42 | 28 |
|  |  | 300, 500 | 61 | 47 |
|  |  | 900 | 87 | 73 |
| Note1: NR SRS carrier switching time is UE capability indicated by higher layer parameter *SRS-SwitchingTimeNR*. | | | | |

Table 8.2.4.2.9-2: Interruption length X2 (slot)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **NR Slot** | **SRS carrie** | **Interruption length X2 (slots)** | | | |
|  | **length (ms) of victim cell** | **switching time (us) Note 1** | **Sub carrier spacing for agressor cell (kHz)** | | | |
|  |  |  | **60** | **120** | **480** | **960** |
| 0 | 1 | ≤ 200 | 2 | 2 | 2 | 2 |
| 1 | 0.5 | ≤ 200 | 2 | 2 | 2 | 2 |
| 2 | 0.25 | ≤ 200 | 3 | 3 | 2 | 2 |
| 3 | 0.125 | ≤ 200 | 4 | 4 | 3 | 3 |
| 5 | 0.03125 | ≤ 200 | 11 | 10 | 8 | 8 |
| 6 | 0.015625 | ≤ 200 | 21 | 18 | 15 | 15 |
| Note1: NR SRS carrier switching time is UE capability indicated by higher layer parameter *SRS-SwitchingTimeNR*. | | | | | | |

For intra-band SRS carrier switching in FR1or FR2, interruptions in Table 8.2.2.2.9-1 and in Table 8.2.2.2.9-2 based on SRS carrier switching time ≤ 200us shall apply. For inter-band SRS carrier switching in FR1, interruptions in Table 8.2.2.2.9-1 and in Table 8.2.2.2.9-2 shall apply.

##### 8.2.4.2.10 Interruptions at direct SCell activation

When one or multiple SCell(s) are directly activated at SCell addition:

- the UE is allowed an interruption on any active serving cell:

- of up to the duration shown in Table 8.2.4.2.1-1, if the active serving cell is not in the same band as the SCell being directly activated, where the requriements for Sync apply for synchronous NR-DC, and for asynchronous NR-DC if the active serving cell is in the same CG as the SCell being directly activated, and the requriements for Async apply for asynchronous NR-DC if the active serving cell is not in the same CG as the SCell being directly activated, or

- of up to the duration shown in Table 8.2.4.2.1-2, if the active serving cells are in the same band as the SCell being directly activated provided the cell specific reference signals from the active serving cells and the SCell being directly activated are available in the same slot.

##### 8.2.4.2.11 Interruptions when identifying CGI of an NR cell with autonomous gaps

When a UE is identifying CGI of an NR cell with autonomous gaps, the UE is allowed interruptions on PCell, PSCell or any activated SCell:

- with up to K1 interruptions with interrupted slots up to interruption length X1 specified in Table 8.2.4.2.11-1 for each interruption during MIB decoding time period TMIB (ms) specified in clause 9.11.

- with up to L1 interruptions with interrupted slots up to interruption length Y1 specified in Table 8.2.4.2.11-1 for each interruption during SIB1 decoding time period TSIB1 (ms) specified in clause 9.11 for SSB and CORESET for RMSI scheduling multiplexing patterns 1.

- with up to L2 interruptions with interrupted slots up to interruption length Y2 specified in Table 8.2.4.2.11-1 for each interruption during SIB1 decoding time period TSIB1 (ms) specified in clause 9.11 for SSB and CORESET for RMSI scheduling multiplexing patterns 2 and 3.

Where:

- K1 = 6 for the target cell carrier frequency on FR1 and K1 = 25 for the target cell carrier frequency on FR2, and

- L1 = TSIB1/20, and

- L2 = TSIB1/TSMTC, where TSMTC is the periodicity of the SMTC occasion configured for the target cell carrier.

Table 8.2.4.2.11-1: Interruption length X1, Y1 and Y2 during measurements with autonomous gaps

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | NR Slot length (ms) of victim cell | Interruption length X1 (slots) | Interruption length Y1 (slots) | Interruption length Y2 (slots) |
| 0 | 1 | 6 | 7 | 6 |
| 1 | 0.5 | 12 | 13 | 10 |
| 2 | 0.25 | 24 | 25 | 19 |
| 3 | 0.125 | 48 | 49 | 37 |
| 5 | 0.03125 | 192 | 193 | 145 |
| 6 | 0.015625 | 384 | 385 | 289 |

##### 8.2.4.2.12 Interruptions when identifying CGI of an E-UTRA cell with autonomous gaps

When a UE is identifying CGI of an E-UTRA FDD cell or E-UTRA TDD cell with autonomous gaps, within time period Tidentify\_CGI, E-UTRA specified in clause 9.4.7.1, the UE shall be able to transmit at least the number of ACK/NACKs specified in Table 8.2.4.2.12-1 on PCell, PSCell or any activated SCell in the frequency range where autonomous gaps are used, provided that:

- there is continuous DL data allocation,

- no DRX cycle is used,

- no measurement gaps are configured,

- only one code word is transmitted in each slot,

- 2 slot ACK/NACK feedback is configured,

- 20 ms SMTC period is configured.

Table 8.2.4.2.12-1: Minimum number of ACK/NACKs transmitted by the UE during Tidentify\_CGI, E-UTRA

|  |  |  |
| --- | --- | --- |
| Minimum number of transmitted ACK/NACKs | Configuration of the serving cell in which the transmitted ACK/NACKs are counted | |
|  | Duplex mode configuration | SCS |
| 84 | FDD | 15 kHz |
| 193 | FDD | 30 kHz |
| 402 | FDD | 60 kHz |
| 28 | TDD Note 1 | 15 kHz |
| 81 | TDD Note 1 | 30 kHz |
| 159 | TDD Note 1 | 60 kHz |
| 233 | TDD Note 2 | 60 kHz |
| 491 | TDD Note 2 | 120 kHz |
| NOTE 1: TDD UL-DL configuration is as specified in Table A.3.3.1-1 of TS 38.101-1 [18].  NOTE 2: TDD UL-DL configuration is as specified in Table A.3.3.1-1 of TS 38.101-2 [19]. | | |

##### 8.2.4.2.13 Interruptions due to SCell dormancy

8.2.4.2.13.1 Interruptions due to SCell dormancy switch

When one SCell in MCG or SCG is switched from dormancy to non-dormancy or from non-dormancy to dormancy [7] when UE is in DRX active time,

- the UE is allowed an interruption on active serving cell in MCG and SCG as defined in clause 8.2.4.2.5, except that the interruption is allowed regardless of which parameters change between the dormant BWP and the non-dormant BWP

- The starting time of interruption shall be within the dormancy switching delay as defined in clause 8.6.2.

When multiple SCells in MCG or SCG are switched from dormancy to non-dormancy or vice versa when the UE is in DRX active time, the interruption requirement described above applies for each BWP switch.

8.2.4.2.13.2 Interruptions due to CQI measurements during SCell dormancy

When one or more SCells are in dormancy, the UE is for the purpose of CQI measurements on the dormant SCell(s) allowed to cause interruptions to non-dormant serving cell(s).

The rate of ACK/NACK feedback loss on any non-dormant serving cell resulting from CQI measurements on dormant SCells shall not exceed 0.5%.

8.2.4.2.13.3 Interruptions due to RRM measurements during SCell dormancy

When one or more SCells are in dormancy, the UE is for the purpose of RRM measurements on the dormant SCell(s) allowed to cause interruptions to non-dormant serving cell(s).

The rate of ACK/NACK feedback loss on any non-dormant serving cell resulting from RRM measurements on dormant SCells shall not exceed 1.0%.

##### 8.2.4.2.14 Interruptions at NR SRS antenna port switching

The requirements in this clause are applicable to SRS antenna port switching on FR1 and SRS resource(s) is only configured within the last 6 symbols of a slot. For interruption caused by SRS antenna port switching, the victim cell is based on the entry number of the band indicated by *txSwitchImpactToRx* and/or *txSwitchWithAnotherBand* regardless of per-FR MG capability. An UL interruption is allowed on any of the serving cells as indicated in *txSwitchWithAnotherBand*, and a DL interruption is allowed on any of the serving cells as indicated in *txSwitchImpactToRx*..

The UE shall perform SRS antenna port switching only if the below conditions are met.

- the SRS switching is not colliding with any other UL transmission with higher priority defined in TS 38.214 [26] if the serving cell on which the higher priority transmission is performed is a victim cell based on *txSwitchWithAnotherBand* or is the same carrier on which SRS is transmitted.

- the SRS switching is not colliding with any NR measurements (i.e. SSB/CSI-RS based L1/L3 measurements) and the measurements for RLM/BFD/CBD if the serving cell on which the NR measurements and the measurements for RLM/BFD/CBD is performed is a victim cell based on *txSwitchImpactToRx* or is the same carrier on which SRS is transmitted.

No requirements are defined for SRS antenna port switching if aperiodic SRS switching is colliding with aperiodic L1-RSRP/L1-SINR measurements and the serving cell on which the aperiodic L1-RSRP/L1-SINR measurement is configured is indicated in *txSwitchImpactToRx* or is the same carrier on which aperiodic SRS is scheduled/configured.

When 1 SRS symbol is configured in a slot for SRS antenna switching and the aggressor and victim cells are synchronized, the interruption requirement in Table 8.2.4.2.14-1 applies. When 1 SRS symbol is configured in a slot for SRS antenna switching and the aggressor and victim cells are asynchronized, the interruption requirement in Table 8.2.4.2.14-2 applies. For the rest of SRS configurations, the interruption requirement in Table 8.2.4.2.14-3 applies.

Table 8.2.4.2.14-1: Interruption length in symbols when 1 SRS symbol is configured and aggressor and victim cells are synchronized

|  |  |  |  |
| --- | --- | --- | --- |
| **Victim cell SCS(kHz)** | **Aggressor cell SCS (kHz)** | | |
| **15** | **30** | **60** |
| 15 | 3 | 2 | 2 |
| 30 | 4 | 3 | 3 |
| 60 | 8 | 6 | 5 |
| 120 | 14 | 10 | 8 |

Table 8.2.4.2.14-2: Interruption length in slots when 1 SRS symbol is configured and aggressor and victim cells are asynchronized

|  |  |  |  |
| --- | --- | --- | --- |
| **Victim cell SCS(kHz)** | **Aggressor cell SCS (kHz)** | | |
| **15** | **30** | **60** |
| 15 | 2 | 2 | 2 |
| 30 | 2 | 2 | 2 |
| 60 | 2 | 2 | 2 |
| 120 | 2 | 2 | 2 |

Table 8.2.4.2.14-3: Interruption length in slots for rest of the SRS configurations for synchronised and asynchronized scenarios

|  |  |  |  |
| --- | --- | --- | --- |
| **Victim cell SCS(kHz)** | **Aggressor cell SCS (kHz)** | | |
| **15** | **30** | **60** |
| 15 | 2 | 2 | 2 |
| 30 | 2 | 2 | 2 |
| 60 | 3 | 2 | 2 |
| 120 | 5 | 3 | 3 |

##### 8.2.4.2.15 Interruptions at fast SCell activation

The requirements in this clause shall apply for the UE configured with one SCell when aperiodic CSI-RS resources is configured for fast SCell activation.

When one SCell in MCG or SCG is activated from deactivated, and aperiodic CSI-RS resources is configured for fast SCell activation, the UE is allowed.

- an interruption on any active serving cell:

- of up to the duration shown in table 8.2.4.2.2-1, if the active serving cell is not in the same band as the SCell being activated, where the requriements for Sync apply for synchronous NR-DC, and for asynchronous NR-DC if the active serving cell is in the same CG as the SCell being activated, and the requriements for Async apply for asynchronous NR-DC if the active serving cell is not in the same CG as the SCell being activated, or

- of up to Y2 slots + TATRS\_duration if the active serving cells are in the same band as the SCell being activated, when

- SCell to be activated is known and belongs to FR1, if the measurement period of the SCell being activated is larger than [2400ms], or

- SCell is unknown and belongs to FR1, and SCell is contiguous to an active serving cell in the same band

- of up to Y2 slot if the active serving cells are in the same band as any of the SCells being activated, when

- SCell to be activated is known and belongs to FR1, if the measurement period of the SCell being activated is equal to or smaller than [2400ms], or

- SCell to be activated belongs to FR2

Where

- TATRS\_duration is CSI-RS burst for SCell activation where the CSI-RS burst is defined as four CSI-RS resources in two consecutive slots on the being activated SCell.

- Y2 are specified in Table 8.2.3.2.4-2.

##### 8.2.4.2.16 Interruptions at SCG activation/deactivation

When SCG is activated or deactivated using an *RRCConnectionReconfiguration* message as defined in TS 38.331 [2], the UE is allowed an interruption on any activated serving cell in MCG during the RRC reconfiguration procedure as follows:

- an interruption on any active serving cell in MCG:

- of up to the duration shown in table 8.2.4.2.16-1, if the active serving cell is not in the same band as the PSCell being activated or deactivated, where the requriements for Sync apply for synchronous NR-DC. The requriements for Async apply for asynchronous NR-DC.

Table 8.2.4.2.16-1: Interruption duration for SCG activation/deactivation for inter-band DC/CA

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | NR Slot length (ms) | Interruption length (slots) | | |
|  | of victim cell | Sync | | Async |
| 0 | 1 | [1] | | [2] |
| 1 | 0.5 | [2] | | [3] |
| 2 | 0.25 | Both aggressor cell and victim cell are on FR2 | [4] | [5] |
|  |  | Either aggressor cell or victim cell is on FR1 | [5] |  |
| 3 | 0.125 | Aggressor cell is on FR2 | [8] | [9] |
|  |  | Aggressor cell is on FR1 | [9] |  |

##### 8.2.4.2.17 Interruptions due to RRM measurements on deactivated SCG

If the UE is not configured with RLM or BFD on the deactivated PSCell, interruptions on PCell or activated SCell(s) due to measurements on the deactivated PSCell are allowed with up to 0.5% probability of missed ACK/NACK feedback when the configured *measCyclePSCell* is 640ms or longer. The UE is only allowed to cause interruptions on PCell or activated SCell(s) immediately before and immediately after an SMTC. Each interruption shall not exceed requirement in Table 8.2.2.2.2-1.

If the UE is configured with RLM or BFD on the deactivated PSCell, the rate of ACK/NACK feedback loss on any active serving cell resulting from RRM measurements on the deactivated PSCell shall not exceed 1.0%.

##### 8.2.4.2.18 Interruptions during RLM/BFD measurements on deactivated PScell

When PSCell is configured with *bfd-and-RLM* with value *true*, if NR PScell is deactivated, the UE is for the purpose RLM/BFD measurements on the deactivated PSCell allowed to cause interruptions to activated serving cell(s) which can either be Pcell or Scell in MCG.

The rate of ACK/NACK feedback loss on any activated serving cell resulting from RLM/BFD measurements on deactivated PSCell shall not exceed 0.5%.

##### 8.2.4.2.19 Interruptions due to UE-specific CBW change

The requirements in clause 8.2.2.2.8 apply for this clause.

#### 8.2.4.2A Void

##### 8.2.4.2A.1 Void

##### 8.2.4.2A.2 Void

##### 8.2.4.2A.3 Void

## 8.3 SCell Activation and Deactivation Delay

### 8.3.1 Introduction

This clause defines requirements for the delay within which the UE shall be able to activate a deactivated SCell and deactivate an activated SCell in EN-DC, or in standalone NR carrier aggregation, or in NE-DC, or in NR-DC.

The requirements shall apply for EN-DC, standalone NR carrier aggregation, NE-DC, and NR-DC.

### 8.3.2 SCell Activation Delay Requirement for Deactivated SCell

The requirements in this clause shall apply for the UE configured with one downlink SCell in EN-DC, or in standalone NR carrier aggregation or in NE-DC or in NR-DC and when one SCell is being activated.

The delay within which the UE shall be able to activate the deactivated SCell depends upon the specified conditions.

Upon receiving SCell activation command in slot *n*, the UE shall be capable to transmit valid CSI report and apply actions related to the activation command for the SCell being activated no later than in slot , where:

THARQ (in ms) is the timing between DL data transmission and acknowledgement as specified in TS 38.213 [3]

Tactivation\_time is the SCell activation delay in millisecond.

If the SCell is known and belongs to FR1, Tactivation\_time is:

- TFirstSSB+ 5ms, if the measurement period of the SCell being activated is equal to or smaller than 2400ms.

- TFirstSSB\_MAX + Trs + 5ms, if the measurement period of the SCell being activated is larger than 2400ms.

If the SCell is unknown and belongs to FR1, and if one of the following conditions is met

- ‘ssb-PositionInBurst’ indicates only one SSB is being actually transmitted, or

- ‘ssb-PositionInBurst’ indicates multiple SSBs and TCI indication is provided in same MAC PDU with SCell activation,

provided that the side condition Ês/Iot ≥ -2dB is fulfilled, Tactivation\_time is:

- TFirstSSB\_MAX + TSMTC\_MAX + Trs + 5ms, if the following conditions are met,

- the SCell is contiguous to an active serving cell in the same band, and

- its *ssb-PositionInBurst* is same as the one of contiguous FR1 active serving cell, and

- its SMTC offset is same as the one of contiguous FR1 active serving cell, and

- its RTD with contiguous FR1 active serving cell is smaller than or equal to 260ns with respect to the to-be-activated SCell’s SSB numerology, and its reception power difference with contiguous FR1 active serving cell is smaller than or equal to 6dB;

- TFirstSSB\_MAX + TSMTC\_MAX + 2\*Trs + 5ms, otherwise.

otherwise, provided that the side condition Ês/Iot ≥ -2dB is fulfilled, Tactivation\_time is:

- 6ms + TFirstSSB\_MAX + TSMTC\_MAX + Trs + TL1-RSRP,measure + TL1-RSRP,report + THARQ + max(Tuncertainty\_MAC + TFineTiming + 2ms, Tuncertainty\_SP), if semi-persistent CSI-RS is used for CSI reporting,

- 3ms + TFirstSSB\_MAX + TSMTC\_MAX + Trs + TL1-RSRP,measure + TL1-RSRP,report + max(THARQ + Tuncertainty\_MAC + 5ms + TFineTiming, Tuncertainty\_RRC + TRRC\_delay), if periodic CSI-RS is used for CSI reporting.

- However, when the following conditions are fulfilled, no activation requirement will be applied for this unknown SCell:

- the SCell is contiguous to an active serving cell in the same band, and

- A single SSB is used in the unknown SCell; or multiple SSBs are used in the SCell and TCI state indication for PDCCH is provided by the same MAC PDU used for SCell activation; and

- its *ssb-PositionInBurst* is same as the one of contiguous FR1 active serving cell, and

- its SMTC offset is same as the one of contiguous FR1 active serving cell

- its RTD with contiguous FR1 active serving cell is larger than 260ns with respect to the to-be-activated SCell’s SSB numerology, or its reception power difference with contiguous FR1 active serving cell is larger than 6dB;

If the SCell being activated belongs to FR1 and if there is at least one active serving cell contiguous to the SCell on that FR1 band, if the UE is not provided with SSB configuration (*absoluteFrequencySSB*) nor SMTC configuration for the target SCell, Tactivation\_time is 3 ms for UE supporting *scellWithoutSSB*, provided

- The RTD between the target SCell and the contiguous active serving cell is within within ±260ns, and

- The difference of the reception power with the contiguous active serving cell is <= 6dB, and

- The RS(s) of SCell being activated is (are) QCL-TypeA with TRS(s) of the SCell being activated, and the TRS(s) of the SCell being activated is (are) further QCL-TypeC with SSB(s) of any active serving cell that is contiguous to the SCell being activated on that FR1 band.

If the SCell being activated belongs to FR2 and if there is at least one active serving cell on that FR2 band, then Tactivation\_time is TFirstSSB+ 5ms provided:

- The UE is provided with SMTC for the target SCell, and

- The SSBs in the serving cell(s) and the SSBs in the SCell fulfil the condition defined in clause 3.6.3,

- The parameter ssb-PositionsInBurst is same for the serving cell(s) and the SCell.

- SSB is in the same half-frame on the SCell and the contiguous FR2 active serving cell

If the SCell being activated belongs to FR2 and if there is at least one active serving cell on that FR2 band, if the UE supporting *scellWithoutSSB* is not provided with any SMTC for the target SCell, Tactivation\_time is 3 ms, provided

- the RS (s) of SCell being activated is (are) QCL-TypeD with RS (s) of one active serving cell on that FR2 band.

If the SCell being activated belongs to FR2 and if there is no active serving cell on that FR2 band provided that PCell or PSCell is in FR1 or in FR2:

If the target SCell is known to UE and semi-persistent CSI-RS is used for CSI reporting, then Tactivation\_time is:

- 3ms + max(Tuncertainty\_MAC + TFineTiming + 2ms, Tuncertainty\_SP), where Tuncertainty\_MAC=0 and Tuncertainty\_SP=0 if UE receives the SCell activation command, semi-persistent CSI-RS activation command and TCI state activation command at the same time.

If the target SCell is known to UE and periodic CSI-RS is used for CSI reporting, then Tactivation\_time is:

- max(Tuncertainty\_MAC + 5ms + TFineTiming, Tuncertainty\_RRC + TRRC\_delay-THARQ), where Tuncertainty\_MAC=0 if UE receives the SCell activation command and TCI state activation commands at the same time.

If the PCell/PSCell and the target SCell are configured as FR1-FR2-1 CA or if the PCell/PSCell and the target SCell are in a FR2-1 band pair with independent beam management, and the target SCell is unknown to UE and semi-persistent CSI-RS is used for CSI reporting, provided that the side condition Ês/Iot ≥ -2dB is fulfilled, then Tactivation\_time is:

- 6ms + TFirstSSB\_MAX + 15\*TSMTC\_MAX + 8\*Trs + TL1-RSRP, measure + TL1-RSRP, report + THARQ + max(Tuncertainty\_MAC + TFineTiming + 2ms, Tuncertainty\_SP).

If the PCell/PSCell and the target SCell are configured as FR1-FR2-2 CA or if the PCell/PSCell and the target SCell are in a FR2-2 band pair with independent beam management, and the target SCell is unknown to UE and semi-persistent CSI-RS is used for CSI reporting, provided that the side condition Ês/Iot ≥ -2dB is fulfilled, then Tactivation\_time is:

- 6ms + TFirstSSB\_MAX + 23\*TSMTC\_MAX + 12\*Trs + TL1-RSRP, measure + TL1-RSRP, report + THARQ + max(Tuncertainty\_MAC + TFineTiming + 2ms, Tuncertainty\_SP).

If the PCell/PSCell and the target SCell are configured as FR1-FR2-1 CA or if the PCell/PSCell and the target SCell are in a FR2-1 band pair with independent beam management, and the target SCell is unknown to UE and periodic CSI-RS is used for CSI reporting, provided that the side condition Ês/Iot ≥ -2dB is fulfilled, then Tactivation\_time is:

- 3ms + TFirstSSB\_MAX + 15\*TSMTC\_MAX + 8\*Trs + TL1-RSRP, measure + TL1-RSRP, report + max {(THARQ + Tuncertainty\_MAC + 5ms + TFineTiming), (Tuncertainty\_RRC + TRRC\_delay)}.

If the PCell/PSCell and the target SCell are configured as FR1-FR2-2 CA or if the PCell/PSCell and the target SCell are in a FR2-2 band pair with independent beam management, and the target SCell is unknown to UE and periodic CSI-RS is used for CSI reporting, provided that the side condition Ês/Iot ≥ -2dB is fulfilled, then Tactivation\_time is:

- 3ms + TFirstSSB\_MAX + 23\*TSMTC\_MAX + 12\*Trs + TL1-RSRP, measure + TL1-RSRP, report + max {(THARQ + Tuncertainty\_MAC + 5ms + TFineTiming), (Tuncertainty\_RRC + TRRC\_delay)}.

where,

TSMTC\_MAX:

- In FR1, in case of intra-band SCell activation, TSMTC\_MAX is the longer SMTC periodicity between active serving cells and SCell being activated provided the cell specific reference signals from the active serving cells and the SCells being activated or released are available in the same slot; in case of inter-band SCell activation, TSMTC\_MAX is the SMTC periodicity of SCell being activated.

- In FR2, in case of intra-band SCell activation, TSMTC\_MAX is the longer SMTC periodicity between active serving cells and SCell being activated provided that in Rel-15 only support FR2 intra-band CA; in case of FR2 inter-band SCell activation, TSMTC\_MAX is the SMTC periodicity of SCell being activated.

- TSMTC\_MAX is bounded to a minimum value of 10ms.

Trs is the SMTC periodicity of the SCell being activated if the UE has been provided with an SMTC configuration for the SCell in SCell addition message, otherwise Trs is the SMTC configured in the measObjectNR having the same SSB frequency and subcarrier spacing. If the measObjectNRs having the same SSB frequency and subcarrier spacing configured by MN and SN have different SMTC, Trs is the periodicity of one of the SMTC which is up to UE implementation. If the UE is not provided SMTC configuration or measurement object on this frequency, the requirement which involves Trs is applied with Trs = 5ms assuming the SSB transmission periodicity is 5ms. There are no requirements if the SSB transmission periodicity is not 5ms

TFirstSSB: is the time to the end of the first complete SSB burst indicated by the SMTC, or within 5ms if SMTC is not configured, after slot n + .

TFirstSSB\_MAX: Is the time to the end of the first complete SSB burst indicated by the SMTC, or within 5ms if SMTC is not configured, after slot n + , further fulfilling:

- In FR1, in case of intra-band SCell activation, the occasion when all active serving cells and SCells being activated or released are transmitting SSB bursts in the same slot; in case of inter-band SCell activation, the first occasion when the SCell being activated is transmitting SSB burst.

- In FR2, the occasion when all active serving cells and SCells being activated or released are transmitting SSB bursts in the same slot.

TFineTiming is the time period between UE finish processing the last activation command for PDCCH TCI, PDSCH TCI (when applicable) and the timing of first complete available SSB corresponding to the TCI state.

TL1-RSRP, measure is L1-RSRP measurement delay TL1-RSRP\_Measurement\_Period\_SSB msor TL1-RSRP\_Measurement\_Period\_CSI-RS based on applicability as defined in clause 9.5 assuming M=1 and TReport=0.

TL1-RSRP, report is delay of acquiring CSI reporting resources.

Tuncertainty\_MAC is the time period between reception of the last activation command for PDCCH TCI, PDSCH TCI (when applicable) relative to

- SCell activation command for known case;

- First valid L1-RSRP reporting for unknown case.

Tuncertainty\_RRC is the time period between reception of the RRC configuration message for TCI of periodic CSI-RS for CQI reporting (when applicable) relative to

- SCell activation command for known case;

- First valid L1-RSRP reporting for unknown case.

Tuncertainty\_SP is the time period between reception of the activation command for semi-persistent CSI-RS resource set for CQI reporting relative to

- SCell activation command for known case;

- First valid L1-RSRP reporting for unknown case.

TRRC\_delay is the RRC procedure delay as specified in TS38.331 [2].

Longer delays for RRM measurement requirements, and in case of FR2 also SSB based RLM/BFD/CBD/L1-RSRP measurement requirements, can be expected during the cell detection time for unknown SCell activation.

When *absoluteFrequencySSB* is not configured in *DownlinkConfigCommon* for target SCell but SMTC for target SCell is configured, no requirement would be applied.

TCSI\_reporting is the delay (in ms) including uncertainty in acquiring the first available downlink CSI reference resource, UE processing time for CSI reporting and uncertainty in acquiring the first available CSI reporting resources as specified in TS 38.331 [2].

SCell in FR1 is known if it has been meeting the following conditions:

- During the period equal to max(5\*measCycleSCell,  5\*DRX cycles) for FR1 before the reception of the SCell activation command:

- the UE has sent a valid measurement report for the SCell being activated and

- the SSB measured remains detectable according to the cell identification conditions specified in clause 9.2 and 9.3.

- the SSB measured during the period equal to max(5\*measCycleSCell, 5\*DRX cycles) also remains detectable during the SCell activation delay according to the cell identification conditions specified in clause 9.2 and 9.3.

Otherwise SCell in FR1 is unknown.

For the first SCell activation in FR2 bands, the SCell is known if it has been meeting the following conditions:

- During the period equal to 4s for UE supporting power class 1/5 and 3s for UE supporting power class 2/3/4 before UE receives the last activation command for PDCCH TCI, PDSCH TCI (when applicable) and semi-persistent CSI-RS for CQI reporting (when applicable):

- the UE has sent a valid L3-RSRP measurement report with SSB index

- SCell activation command is received after L3-RSRP reporting and no later than the time when UE receives MAC-CE command for TCI activation

- During the period from L3-RSRP reporting to the valid CQI reporting, the reported SSBs with indexes remain detectable according to the cell identification conditions specified in clauses 9.2 and 9.3, and the TCI state is selected based on one of the latest reported SSB indexes.

Otherwise, the first SCell in FR2 band is unknown. The requirement for unknown SCell applies provided that the activation commands for PDCCH TCI, PDSCH TCI (when applicable), semi-persistent CSI-RS for CQI reporting (when applicable), and configuration message for TCI of periodic CSI-RS for CQI reporting (when applicable) are based on the latest valid L1-RSRP reporting.

If the UE has been provided with higher layer in TS 38.331 [2] signaling of *smtc2*prior to the activation command, TSMTC\_Scell follows *smtc1* or *smtc2* according to the physical cell ID of the target cell being activated. TSMTC\_MAX follows *smtc1* or *smtc2* according to the physical cell IDs of the target cells being activated and the active serving cells.

In addition to CSI reporting defined above, UE shall also apply other actions related to the activation command specified in TS 38.331 [2] for a SCell at the first opportunities for the corresponding actions once the SCell is activated.

The starting point of an interruption window on spCell or any activated SCell, as specified in clause 8.2, shall not occur before slot n+1+ and not occur after slot slot n+1+, where NR slot length is with respect to the numerology used in the SCell being activated, and TX is:

- 0, if Tactivation\_time is 3ms;

- TFirstSSB, for any scenario where Tactivation\_time includes TFirstSSB;

- TFirstSSB\_MAX, for any scenario where Tactivation\_time includes TFirstSSB\_MAX;

- Tuncertainty\_MAC +TFineTiming, for any scenario where Tactivation\_time includes only TFineTiming and no TFirstSSB\_MAX.

The length of the interruption window may be different for different victim cells, and depends on the applicable scenario and on the frequency band relation between the aggressor cell and the victim cell.

The requirements in this clause and requriements on interruption due to SCell activation in clause 8.2 apply provided that the SSB of the to-be-activated SCell is within the first active DL BWP of the Scell.

Starting from the slot specified in clause 4.3 of TS 38.213 [3] (timing for secondary Cell activation/deactivation) and until the UE has completed the SCell activation, the UE shall report out of range if the UE has available uplink resources to report CQI for the SCell.

Starting from the slot specified in clause 4.3 of TS 38.213 [3] (timing for secondary Cell activation/deactivation) and until the UE has completed a first L1-RSRP measurement, the UE shall report lowest valid L1 SS-RSRP range if the UE has available uplink resources to report L1-RSRP for the SCell.

### 8.3.3 SCell Deactivation Delay Requirement for Activated SCell

The requirements in this clause shall apply for the UE configured with one downlink SCell in EN-DC, or in standalone NR carrier aggregation, or in NE-DC, or in NR-DC.

Upon receiving SCell deactivation command in slot *n*, the UE shall accomplish the deactivation actions for the SCell being deactivated no later than in slot *n +*. The starting point of an interruption window on spCell or any activated SCell, as specified in clause 8.2, shall not occur before slot n+1+ and not occur after slot n+1+, where NR slot length is with respect to the numerology used in the SCell being deactivated.

Upon expiry of the *sCellDeactivationTimer* in slot *n*, the UE shall accomplish the deactivation actions for the SCell being deactivated no later than in slot *n +*. The starting point of an interruption window on spCell or any activated SCell, as specified in clause 8.2, shall not occur before slot n+1 and not occur after slot n+1+, where NR slot length is with respect to the numerology used in the SCell being deactivated.

The length of the interruption window may be different for different victim cells, and depends on the applicable scenario and on the frequency band relation between the aggressor cell and the victim cell.

### 8.3.4 Direct SCell Activation at SCell addition

The requirements in this clause apply for UE being configured in the RRC reconfiguration message, TS 38.331 [2], with one SCell for which the parameter *sCellState* is set to *activated*. If the RRC reconfiguration message for direct SCell activation also configures PSCell addition or PSCell change, the direct SCell activation delay may be longer than the requirements defined in this clause.

If the RRC reconfiguration message for direct SCell activation also configures TCI state information, the requirements in section 8.3.2 based on that TCI state activation command is received at the same time as SCell activation command shall apply.

The UE shall configure the SCell in activated state upon successful completion of the RRC reconfiguration procedure within the specified delay. The UE shall be capable to transmit valid CSI report and apply actions for the directly activated SCell no later than in slot ,

where:

- Slot n is the last slot overlapping with the PDSCH containing the RRC reconfiguration message,

- Ndirect = TRRC\_Process + T1 + Tactivation\_time + TCSI\_Reporting - 3ms for the cases specified in clause 8.3.2 that TCI state is not indicated within Tactivation\_time; otherwise, Ndirect = TRRC\_Process + T1 + THARQ + Tactivation\_time + TCSI\_Reporting

*-* TRRC\_Process: RRC procedure delay as specified in clause 11.2 of TS 36.331 [16] if the corresponding RRC message is embedded in E-UTRA RRC message, otherwise it is the RRC procedure delay defined in clause 12 of TS 38.331 [2],

*-* T1: Delay from slot until the transmission of *RRCReconfigurationComplete* message,

Note: *T1* is UE implementation dependent.

*THARQ* (in ms) is the timing between DL data transmission and acknowledgement as specified in TS 38.213 [3],

If the SCell is known and belongs to FR1, *TCSI\_Reporting* is specified in clause 8.3.2 and *Tactivation\_time* is defined as:

- TFirstSSB+ 5ms, if the measurement period of the SCell being activated is equal to or smaller than 2400ms.

- TFirstSSB\_MAX + Trs + 5ms, if measurement period of the SCell being activated is larger than 2400ms.

where,

the measurement period in Table 9.2.5.2-1 applies if the target SCell was in an intra-frequency layer corresponding to an activated SCell;

the measurement period in Table 9.2.5.2-3 applies if the target SCell was in an intra-frequency layer corresponding to a deactivated SCell;

the measurement period in Table 9.3.5-1 applies if the target SCell was in an inter-frequency layer.

*-* Otherwise, Tactivation\_time and TCSI\_Reporting are specified in clause 8.3.2, where the following definitions of TFirstSSB and TFirstSSB\_MAX shall override the existing ones:

- TFirstSSB: the time to the end of the first complete SSB burst indicated by the SMTC after slot n +

- TFirstSSB\_MAX: the time to the end of the first complete SSB burst indicated by the SMTC after slot n +

- In FR1, in case of intra-band SCell activation, the occasion when all active serving cells and SCells being activated or released are transmitting SSB bursts in the same slot; in case of inter-band SCell activation, the first occasion when the SCell being activated is transmitting SSB burst.

- In FR2, the occasion when all active serving cells and SCells being activated or released are transmitting SSB bursts in the same slot.

In addition to CSI reporting defined above, UE shall also apply other actions related to the activation command specified in TS38.321 [7] for an SCell at the first opportunities for the corresponding actions once the SCell is activated.

The SCell is known provided the following conditions are met for the SCell:

- During the last 5 seconds before the reception of the direct SCell configuration command:

- the UE has sent a valid measurement report for the SCell being directly activated, and

- the SSB measured remains detectable according to the cell identification conditions specified in sections 9.2 and 9.3,

- the SSB measured during the period equal to [5] seconds also remains detectable during the SCell activation delay according to the cell identification conditions specified in clause 9.2 and 9.3.

Otherwise, the SCell is unknown.

The UE may be allowed to cause interruptions to serving cells on other component carriers during an interruption window, as specified in clause 8.2. The starting point of an interruption window on spCell or any activated SCell shall not occur before slot *n*+1, and shall not occur after slot *n+*1+, where NR slot length is with respect to the numerology of the SCell being activated, and *TX* is:

- *TFirstSSB*, for any scenario where *Tactivation\_time*includes *TFirstSSB*;

- *TFirstSSB\_MAX*, for any scenario where *Tactivation\_time*includes *TFirstSSB\_MAX*;

- *Tuncertainty\_MAC +TFineTiming*, for any scenario where *Tactivation\_time*includes *TFineTiming*.

The length of the interruption window may be different for different victim cells, and depends on the applicable scenario and on the frequency band relation between the aggressor cell and the victim cell.

Starting from the slot until the UE has completed the direct SCell activation, the UE shall report CQI index = 0 (out of range) if the UE has available uplink resources to report CQI for the SCell.

### 8.3.5 Direct SCell Activation at Handover

The requirements in this clause apply for UE being configured in the RRC reconfiguration message, TS 38.331 [2], for handover with one SCell for which the parameter *sCellState* is set to *activated*.

The UE shall configure the SCell in activated state upon successful completion of the RRC reconfiguration procedure within the specified delay. The UE shall be capable to transmit valid CSI report and apply actions for the directly activated SCell no later than in slot ,

Where:

- Slot n is the last slot overlapping with the PDSCH containing RRC reconfiguration message.

- Ndirect = TRRC\_process + Tinterrupt + T2 + T3 + Tactivation\_time + TCSI\_Reporting - 3ms for the cases specified in clause 8.3.2 that TCI state is not indicated within Tactivation\_time; otherwise, Ndirect = TRRC\_process + Tinterrupt + T2 + T3 + THARQ +Tactivation\_time + TCSI\_Reporting

- TRRC\_Process: RRC procedure delay as specified in clause 11.2 of TS 36.331 [16] if the corresponding RRC message is embedded in E-UTRA RRC message, otherwise it is the RRC procedure delay defined in clause 12 of TS 38.331 [2],

- Tinterrupt: Interruption time during handover as specified in clause 6.1.1,

- T2: Delay from slot until UE has obtained a valid TA command for the target PCell,

- T3: Delay for applying the received TA for uplink transmission in the target PCell, and greater than or equal to k+1 slot, where k is defined in clause 4.2 in TS 38.213,

- *THARQ* (in ms) is the timing between DL data transmission and acknowledgement as specified in TS 38.213 [3],

*-* If the SCell is known and belongs to FR1, *TCSI\_Reporting* is specified in clause 8.3.2 and *Tactivation\_time* is defined as:

- TFirstSSB+ 5ms, if the measurement period of the SCell being activated is equal to or smaller than [2400ms].

- TFirstSSB\_MAX + Trs + 5ms, if measurement period of the SCell being activated is larger than [2400ms].

where,

the measurement period in Table 9.2.5.2-1 applies if the target SCell was in an intra-frequency layer corresponding to an activated SCell;

the measurement period in Table 9.2.5.2-3 applies if the target SCell was in an intra-frequency layer corresponding to a deactivated SCell;

the measurement period in Table 9.3.5-1 applies if the target SCell was in an inter-frequency layer.

- Otherwise, *Tactivation\_time* and *TCSI\_Reporting* are specified in clause 8.3.2, where the following definitions of *TFirstSSB* and *TFirstSSB\_MAX*shall override the existing ones:

- TFirstSSB: the time to the end of the first complete SSB burst indicated by the SMTC after slot n +

- TFirstSSB\_MAX: the time to the end of the first complete SSB burst indicated by the SMTC after slot n +

- In FR1, in case of intra-band SCell activation, the occasion when all active serving cells and SCells being activated or released are transmitting SSB bursts in the same slot; in case of inter-band SCell activation, the first occasion when the SCell being activated is transmitting SSB burst.

- In FR2, the occasion when all active serving cells and SCells being activated or released are transmitting SSB bursts in the same slot.

In addition to CSI reporting defined above, UE shall also apply other actions related to the activation command specified in TS 38.321 [7] for an SCell at the first opportunities for the corresponding actions once the SCell is activated.

The SCell is known provided the following conditions are met for the SCell:

- During the last 5 seconds before the reception of the direct SCell configuration command:

- the UE has sent a valid measurement report for the SCell being directly activated, and

- the SSB measured remains detectable according to the cell identification conditions specified in sections 9.2 and 9.3,

- the SSB measured during the period equal to [5] seconds also remains detectable during the SCell activation delay according to the cell identification conditions specified in clause 9.2 and 9.3.

Otherwise, the SCell is unknown.

The UE may be allowed to cause interruptions to PCell during an interruption window, as specified in clause 8.2. The starting point of an interruption window on PCell shall not occur before slot *n*+1+, and not occur after slot *n*+1+, where NR slot length is with respect to the numerology of the SCell being activated, and *TX* is:

- *TFirstSSB*, for any scenario where *Tactivation\_time*includes *TFirstSSB*;

- *TFirstSSB\_MAX*, for any scenario where *Tactivation\_time*includes *TFirstSSB\_MAX*;

- *Tuncertainty\_MAC +TFineTiming*, for any scenario where *Tactivation\_time*includes *TFineTiming*.

The length of the interruption window depends on the frequency band relation between the aggressor SCell and the victim PCell.

Starting from the slot and until the UE has completed the direct SCell activation, the UE shall report CQI index = 0 (out of range) if the UE has available uplink resources to report CQI for the SCell.

8.3.6 Direct SCell Activation at RRCResume

The requirements in this clause apply for UE being configured in the RRC reconfiguration message in TS38.331 [2] for RRC Resume with one SCell for which the parameter *sCellState* is set to *activated*.

The requirements in clause 8.3.4 shall apply, except that the definition of *T1* shall be deemed to be replaced with

*T1*: Delay from slot until the transmission of RRCResumeComplete message,

### 8.3.7 SCell Activation Delay Requirement for Deactivated SCell with Multiple Downlink SCells

The requirements in this clause shall apply for the UE configured with more than one SCells.

In EN-DC, NE-DC, standalone NR, or in one CG of NR-DC, the requirements in this clause shall apply when the following conditions are met:

- UE only receives one single MAC command for multiple SCell activation within the activation period defined in this clause

- in each single CG, there are no other SCell activation, deactivation, addition or release before activation is completed for all the SCells activated by the single MAC CE in this clause, and

- in EN-DC and NE-DC, there are no E-UTRAN SCell activation, deactivation, addition or release before multiple SCell activation is completed in this clause, and

- any to-be-activated unknown SCell has active serving cell(s) or known to-be-activated SCell(s) on the same band

In two CGs of NR-DC, the requirements in this clause shall apply when the following conditions are met:

- UE receives one MAC command per CG for multiple SCell activation within the activation period defined in this clause, and

- UE supports per-FR measurement gap capability, and

- any to-be-activated unknown SCell has active serving cell(s) or known to-be-activated SCell(s) on the same band

The delay within which the UE shall be able to activate the deactivated SCell with other downlink to-be-activated SCell(s) depends upon the specified conditions.

Upon receiving SCell activation command in slot *n* for more than one SCell, for each of the to-be-activated SCell, the UE shall be capable to transmit valid CSI report and apply actions related to the activation command for the SCell being activated no later than in slot , where:

THARQ (in ms) is the timing between DL data transmission and acknowledgement as specified in TS 38.213 [3]

Tactivation\_time\_multiple\_scells is the target SCell activation delay in millisecond in multiple SCell activation scenario.

If the SCell is known and belongs to FR1 and the measurement period of the SCell being activated is equal to or smaller than [2400ms], Tactivation\_time\_multiple\_scells is:

- TFirstSSB\_MAX\_multiple\_scells + Trs + 5ms, if on the same band UE also has at least one parallel to-be-activated SCell which is FR1 known Scell with the measurement period larger than [2400ms] but does not have any parallel to-be-activated SCell which is FR1 unknown SCell.

- TFirstSSB\_MAX\_multiple\_scells + TSMTC\_MAX\_multiple\_scells + Trs + 5ms, if on the same band UE also has at least one parallel to-be-activated SCell which is FR1 unknown Scell

- otherwise, TFirstSSB\_MAX\_multiple\_scells + 5ms.

If the SCell is known and belongs to FR1 and the measurement period of the SCell being activated is larger than [2400ms], Tactivation\_time\_multiple\_scells is:

- TFirstSSB\_MAX\_multiple\_scells + TSMTC\_MAX\_multiple\_scells + Trs + 5ms, if on the same band UE also has at least one parallel to-be-activated SCell which is FR1 unknown Scell

- otherwise, TFirstSSB\_MAX\_multiple\_scells + Trs + 5ms

If the SCell is unknown and belongs to FR1, provided that the side condition Ês/Iot ≥ -2dB is fulfilled, Tactivation\_time\_multiple\_scells is:

- TFirstSSB\_MAX\_multiple\_scells + TSMTC\_MAX\_multiple\_scells+Trs +5ms, if the SCell is not counted in N1

- The activation delay may be longer if SSB is not in the same half-frame on the SCell and the contiguous FR1 known cell or contiguous FR1 active serving cell

otherwise

- if the following conditions are met

- ‘ssb-PositionInBurst’ indicates only one SSB is being actually transmitted, or

- ‘ssb-PositionInBurst’ indicates multiple SSBs and TCI indication is provided in same MAC PDU with SCell activation,

- Tactivation\_time\_multiple\_scells is:

- TFirstSSB\_MAX\_multiple\_scells + TSMTC\_MAX\_multiple\_scells+Trs\*N1 +Trs +5ms,

- Otherwise:

Tactivation\_time\_multiple\_scells is:

- 6ms + TFirstSSB\_MAX\_multiple\_scells + TSMTC\_MAX\_multiple\_scells + Trs\*N1 + TL1-RSRP,measure + TL1-RSRP,report + THARQ + max(Tuncertainty\_MAC\_multiple\_scells + TFineTiming + 2ms, Tuncertainty\_SP\_multiple\_scells), if semi-persistent CSI-RS is used for CSI reporting,

- 3ms + TFirstSSB\_MAX\_multiple\_scells + TSMTC\_MAX\_multiple\_scells + Trs\*N1 + TL1-RSRP,measure + TL1-RSRP,report + max(THARQ + Tuncertainty\_MAC\_multiple\_scells + 5ms + TFineTiming, Tuncertainty\_RRC\_multiple\_scells + TRRC\_delay), if periodic CSI-RS is used for CSI reporting.

If the SCell being activated belongs to FR1 and if there is at least one active serving cell contiguous to the SCell on that FR1 band, if the UE is not provided with SSB configuration (*absoluteFrequencySSB*) nor SMTC configuration for the target SCell, Tactivation\_time\_multiple\_scells is same as single SCell activation delay requirement as defined in clause 8.3.2.

If the SCell being activated belongs to FR2 and if there is at least one active serving cell on that FR2 band, then Tactivation\_time\_multiple\_scells is same as single SCell activation delay requirement as defined in clause 8.3.2.

If the SCell being activated belongs to FR2 and if there is at least one active serving cell on that FR2 band, if the UE is not provided with any SMTC for the target SCell, Tactivation\_time\_multiple\_scells is same as single SCell activation delay requirement as defined in clause 8.3.2

If the SCell being activated belongs to FR2 and if there is no active serving cell on that FR2 band provided that PCell or PSCell is FR1:

If the target SCell is known to UE and semi-persistent CSI-RS is used for CSI reporting, then Tactivation\_time\_multiple\_scells is same as single SCell activation delay requirement as defined in clause 8.3.2.

If the target SCell is known to UE and periodic CSI-RS is used for CSI reporting, then Tactivation\_time\_multiple\_scells is same as single SCell activation delay requirement as defined in clause 8.3.2.

If the target SCell is unknown to UE and semi-persistent CSI-RS is used for CSI reporting, provided that the side condition Ês/Iot ≥ -2dB is fulfilled, then Tactivation\_time\_multiple\_scells is:

- 3 ms + max(Tuncertainty\_MAC\_multiple\_scells +TFineTiming + 2ms, Tuncertainty\_SP\_multiple\_scells), if on the same band UE also has at least one parallel to-be-activated SCell which is FR2 known Scell. Tuncertainty\_MAC\_multiple\_scells =0 and Tuncertainty\_SP\_multiple\_scells =0 if UE receives the SCell activation command, semi-persistent CSI-RS activation command and TCI state activation commands at the same time.

If the target SCell is unknown to UE and periodic CSI-RS is used for CSI reporting, provided that the side condition Ês/Iot ≥ -2dB is fulfilled, then Tactivation\_time\_multiple\_scells is:

- max(Tuncertainty\_MAC\_multiple\_scells + 5ms + TFineTiming, Tuncertainty\_RRC\_multiple\_scells + TRRC\_delay-THARQ), if on the same band UE also has at least one parallel to-be-activated SCell which is FR2 known Scell . Tuncertainty\_MAC\_multiple\_scells =0 if UE receives the SCell activation command and TCI state activation commands at the same time.

The requirements for FR2 unknown SCells apply provided that the parameter *ssb-PositionsInBurst* is same for the SCell and the known serving cell on the same FR2 band. The activation delay FR2 unknown SCell may be longer if SSB is not in the same half-frame on the SCell and the contiguous FR2 known cell.

Where,

N1 is the number counting for parallel FR1 unknown to-be-activated SCell(s) only except the ones which fulfilled the following conditions:

- contiguous to an active serving cell in the same band, or to a known SCell in the same band being activated by the same MAC PDU, and

- A single SSB is used in the unknown SCell; or multiple SSBs are used in the unknown SCell and TCI state indication for PDCCH is provided by the same MAC PDU used for SCell activation; and

- its *ssb-PositionInBurst* is same as the one of contiguous FR1 known cell or contiguous FR1 active serving cell, and

- its RTD with contiguous FR1 known cell or contiguous FR1 active serving cell is smaller than or equal to 260ns with respect to the to-be-activated SCell’s SSB numerology and its reception power difference with contiguous FR1 known cell or contiguous FR1 active serving cell is smaller than or equal to 6dB, and

- its SMTC offset is same as the one of contiguous FR1 known cell or contiguous FR1 active serving cell

However, when the following conditions are fulfilled, no activation requirement will be applied for this unknown SCell and other SCells being activated and counted in N1:

- contiguous to an active serving cell in the same band, or to a known SCell in the same band being activated by the same MAC PDU, and

- A single SSB is used in the unknown SCell; or multiple SSBs are used in the unknown SCell and TCI state indication for PDCCH is provided by the same MAC PDU used for SCell activation; and

- its *ssb-PositionInBurst* is same as the one of FR1 known cell or FR1 active serving cell, and

- its RTD with contiguous FR1 known cell or contiguous FR1 active serving cell is larger than 260ns with respect to the to-be-activated SCell’s SSB numerology or its reception power difference with contiguous FR1 known cell or contiguous FR1 active serving cell is larger than 6dB, and

- its SMTC offset is same as the one of FR1 known cell or FR1 active serving cell

TSMTC\_MAX\_multiple\_scells:

- In FR1, in case of intra-band SCell activation, TSMTC\_MAX\_multiple\_scells is the longest SMTC periodicity between active serving cells and SCells being activated on the same band provided the cell specific reference signals from the active serving cells and the SCells being activated or released are available in the same slot; in case of inter-band SCell activation, TSMTC\_MAX\_multiple\_scells is the longest SMTC periodicity of SCells being activated on the same band.

- In FR2, TSMTC\_MAX\_multiple\_scells is the longest SMTC periodicity between active serving cells and SCell(s) being activated in FR2 intra-band CA.

- TSMTC\_MAX\_multiple\_scells is bounded to a minimum value of 10ms.

TFirstSSB\_MAX\_multiple\_scells: is the time to the end of the first complete SSB burst indicated by the SMTC after slot n + , further fulfilling:

- In FR1, in case of intra-band SCell activation, the occasion when all active serving cells and SCells being activated or released are transmitting SSB bursts in the same slot; in case of inter-band SCell activation, the first occasion when the SCells being activated are transmitting SSB burst.

- In FR2, the occasion when all active serving cells and SCells being activated or released are transmitting SSB bursts in the same slot.

Tuncertainty\_MAC\_multiple\_scells is the time period between reception of the activation command for PDCCH TCI, PDSCH TCI (when applicable) and SCell activation command of this unknown SCell.

Tuncertainty\_SP\_multiple\_scells is the time period between reception of the activation command for semi-persistent CSI-RS resource set for CQI reporting and SCell activation command of this unknown SCell.

Tuncertainty\_RRC\_multiple\_scells is the time period between reception of the RRC configuration message for TCI of periodic CSI-RS for CQI reporting (when applicable) and SCell activation command of this unknown SCell.

Trs, TFineTiming, and TRRC\_delay is defined in clause 8.3.2.

Longer delays for RRM measurement requirements, and in case of FR2 also SSB based RLM/BFD/CBD/L1-RSRP measurement requirements, can be expected during the cell detection time for unknown SCell activation.

The condition of known SCell in FR1 or FR2 is defined in clause 8.3.2.

If the UE has been provided with higher layer in TS 38.331 [2] signaling of *smtc2*prior to the activation command, TSMTC\_Scell follows *smtc1* or *smtc2* according to the physical cell ID of the target cell being activated. TSMTC\_MAX\_multiple\_scell follows *smtc1* or *smtc2* according to the physical cell IDs of the target cells being activated and the active serving cells.

The starting point and the end-point of an interruption window on PCell or any activated SCell in MCG for NR standalone mode, or on PSCell or any activated SCell in SCG for EN-DC mode is same as single SCell activation requirement in clause 8.3.2.

Starting from the slot specified in clause 4.3 of TS 38.213 [3] (timing for secondary Cell activation/deactivation) and until the UE has completed the SCell activation, the UE shall report out of range if the UE has available uplink resources to report CQI for the SCell.

Upon receiving SCell activation command in slot *n,* if the start of the first complete SSB used in the *TX* in the different bands which have SCells being activated after *n*+ are not aligned on time domain among

- SCells in different bands being activated by the same MAC CE if UE does not support per FR gap, or

* SCells in different FR1 bands being activated by the same MAC CE if UE supports per FR gap,

additional interruptions may be expected for the activated serving cells, where

- The number of additional interruptions is no more than the number of FR1 bands which have both SCell being activated for which the activation requirements involve *TFirstSSB\_MAX* *multiple\_scells* with *Trs* and the active serving cell, and

- In each interruption occasion, the interruption length is defined in clause 8.2.2.2.2, and

- Longer activation delay may be expected for multiple SCell activation under one MAC CE with multiple interruptions, and

- *TX* is:

- TFirstSSB, for any scenario where Tactivation\_time multiple\_scells includes TFirstSSB;

- TFirstSSB\_MAX multiple\_scells, for any scenario where Tactivation\_time multiple\_scells includes TFirstSSB\_MAX multiple\_scells;

- Tuncertainty\_MAC+TFineTiming or Tuncertainty\_MAC multiple\_scells+TFineTiming, for any scenario where Tactivation\_time multiple\_scells includes TFineTiming.

Otherwise, no additional interruption is expected due to activation of multiple SCells.

Starting from slot *n* + THARQ + 3 ms where slot *n* is the slot where SCell activation command is received (as specified in clause 4.3 of TS 38.213 [3]) and until the SCell activation completion at UE, after at least one CSI-RS transmission occasion for the channel measurement and reporting (specified in clause 5.2.2.5 of TS 38.214 [26]), the UE shall report out of range if the UE has available uplink resources to report CQI for the SCell.

Starting from the slot specified in clause 4.3 of TS 38.213 [3] (timing for secondary Cell activation/deactivation) and until the UE has completed a first L1-RSRP measurement, the UE shall report lowest valid L1 SS-RSRP range if the UE has available uplink resources to report L1-RSRP for the SCell.

### 8.3.8 SCell Deactivation Delay Requirement for Activated SCell with Multiple Downlink SCells

The requirements in this clause shall apply for the UE configured with multiple downlink SCells in EN-DC, or in standalone NR carrier aggregation, or in NE-DC, or in NR-DC, provided that,

- in each single CG, there are no other SCell activation, deactivation, addition or release before deactivation is completed for all the SCells deactivated by the single MAC CE in this clause, and

- in EN-DC and NE-DC, there are no E-UTRAN SCell activation, deactivation, addition or release before multiple SCell deactivation is completed in this clause, and

- in EN-DC, NE-DC, NR-DC and standalone NR, UE only receives one single MAC command for multiple SCell deactivation within the deactivation period defined in this clause, or, in NR-DC, per-FR measurement gap capable UE receives one MAC command per CG for multiple SCell deactivation within the deactivation period defined in this clause

Upon receiving SCell deactivation command in slot *n*, the UE shall accomplish the deactivation actions for the SCell being deactivated within the same delay as specified in clause 8.3.3.

The starting point and the end-point of an interruption window on PCell or any activated SCell in MCG for NR standalone mode, or on PSCell or any activated SCell in SCG for EN-DC mode is same as single SCell activation requirement in clause 8.3.3.

### 8.3.9 Direct SCell Activation of Multiple Downlink SCells at SCell addition

The requirements in this clause apply for UE being configured in the RRC reconfiguration message, TS 38.331 [2], with 2 SCells for which the parameter *sCellState* is set to *activated*.

In EN-DC, NE-DC, stand-alone NR, or in one CG of NR-DC, the requirements in this clause shall apply when the following conditions are met:

- UE only receives one RRC reconfiguration message for direct activation of SCells within the activation period defined in this clause,

- in each single CG, there are no other SCell activation, deactivation, addition or release before direct activation is completed for all the SCells activated by the single RRC reconfiguration message in this clause, and

- in EN-DC and NE-DC, there are no E-UTRAN SCell activation, deactivation, addition or release before the direct SCell activation of multiple SCells in this clause is completed.

In two CGs of NR-DC, the requirements in this clause shall apply when the following conditions are met:

- UE receives one RRC message per CG for direct activation of SCells within the activation period defined in this clause,

- UE supports per-FR measurement gap capability, and

- any to-be-activated unknown SCell has active serving cell(s) or known to-be-activated SCell(s) on the same band.

The UE shall configure the SCells in activated state upon successful completion of the RRC reconfiguration procedure within the specified delay. The UE shall be capable to transmit valid CSI report and apply actions for the directly activated SCell no later than in slot ,

where:

- Slot n is the last slot overlapping with the PDSCH containing the RRC reconfiguration message.

- Ndirect\_multiple\_scells = TRRC\_Process + T1 + Tactivation\_time\_multiple\_scells + TCSI\_Reporting - 3ms for the cases specified in clause 8.3.7 that TCI state is not indicated within Tactivation\_time; otherwise, Ndirect\_multiple\_scells = TRRC\_Process + T1 + THARQ + Tactivation\_time\_multiple\_scells + TCSI\_Reporting

*- T1* and *TRRC\_Process* are specified in clause 8.3.4,

*- THARQ* (in ms) is the timing between DL data transmission and acknowledgement as specified in TS 38.213 [3],

*- Tactivation\_time\_multiple\_scells* and *TCSI\_Reporting* are specified in clause 8.3.7, where the following definition of *TFirstSSB*, *TFirstSSB\_MAX*, and *TFirstSSB\_MAX\_multiple\_scells*shall override the existing ones:

*- TFirstSSB* and *TFirstSSB\_MAX*: as specified in clause 8.3.4,

- *TFirstSSB\_MAX\_multiple\_scells*: the time to the end of the first complete SSB burst indicated by the SMTC after slot *n +* , further fulfilling:

- In FR1, in case of intra-band SCell activation, the occasion when all active serving cells and SCells being activated or released are transmitting SSB bursts in the same slot; in case of inter-band SCell activation, the first occasion when the SCells being activated are transmitting SSB burst.

- In FR2, the occasion when all active serving cells and SCells being activated or released are transmitting SSB bursts in the same slot.

In addition to CSI reporting defined above, UE shall also apply other actions related to the activation command specified in TS38.321 [7] for an SCell at the first opportunities for the corresponding actions once the SCell is activated.

The UE may be allowed to cause interruptions to serving cells on other component carriers during an interruption window, as specified in clause 8.2. The starting point of an interruption window on spCell or any activated SCell shall not occur before slot *n*+1+, and shall not occur after slot *n+*1+, where NR slot length is with respect to the numerology of the SCell being activated, and *TX* is:

- *TFirstSSB*, for any scenario where *Tactivation\_time\_multiple\_scells*includes *TFirstSSB*;

- *TFirstSSB\_MAX*, for any scenario where *Tactivation\_time\_multiple\_scells*includes *TFirstSSB\_MAX*;

- *TFirstSSB\_MAX\_multiple\_scell*, for any scenario where *Tactivation\_time\_multiple\_scells*includes *TFirstSSB\_MAX\_multiple\_scells*;

- *Tuncertainty\_MAC +TFineTiming*, for any scenario where *Tactivation\_time\_multiple\_scells*includes *TFineTiming.*

The length of the interruption window may be different for different victim cells, and depends on the applicable scenario and on the frequency band relation between the aggressor cell and the victim cell.

Starting from the slot until the UE has completed the direct SCell activation, the UE shall report CQI index = 0 (out of range) if the UE has available uplink resources to report CQI for the SCells.

### 8.3.10 Direct SCell Activation of Multiple Downlink SCells at Handover

The requirements in this clause apply for UE being configured in the RRC reconfiguration message, TS 38.331 [2], for handover with 2 SCells for which the parameter *sCellState* is set to *activated*.

In MCG of NE-DC, MCG of NR-DC, or in stand-alone NR, the requirements in this clause shall apply when the following conditions are met:

- UE does not receive any RRC reconfiguration message for direct activation of SCells within the activation period defined in this clause,

- there is no other SCell activation, deactivation, addition or release before direct activation is completed for all the SCells activated by the single RRC reconfiguration message in this clause, and

- in NE-DC, there is no E-UTRAN SCell activation, deactivation, addition or release before the direct activation of SCells in this clause is completed.

The UE shall configure the SCells in activated state upon successful completion of the RRC reconfiguration procedure within the specified delay. The UE shall be capable to transmit valid CSI report and apply actions for the directly activated SCells no later than in slot where:

- Slot n is the last slot overlapping with the PDSCH containing the RRC reconfiguration message,

- Ndirect\_multiple\_scells = TRRC\_process + Tinterrupt + T2 + T3 + Tactivation\_time\_multiple\_scells + TCSI\_Reporting - 3ms for the cases specified in clause 8.3.7 that TCI state is not indicated within Tactivation\_time; otherwise, Ndirect\_multiple\_scells = TRRC\_process + Tinterrupt + T2 + T3 + THARQ + Tactivation\_time\_multiple\_scells + TCSI\_Reporting

- *TRRC\_Process, Tinterrupt,T2*, and *T3* are specified in clause 8.3.5,

*- THARQ* (in ms) is the timing between DL data transmission and acknowledgement as specified in TS 38.213 [3],

*- Tactivation\_time\_multiple\_scells* and *TCSI\_Reporting* are specified in clause 8.3.7, where the following definitions of *TFirstSSB*, *TFirstSSB\_MAX*, and *TFirstSSB\_MAX\_multiple\_scells* shall override the existing ones:

- *TFirstSSB*, *TFirstSSB\_MAX*: as specified in clause 8.3.5,

- TFirstSSB\_MAX\_multiple\_scell: the time to the end of the first complete SSB burst indicated by the SMTC after slot n +, further fulfilling:

- In FR1, in case of intra-band SCell activation, the occasion when all active serving cells and SCells being activated or released are transmitting SSB bursts in the same slot; in case of inter-band SCell activation, the first occasion when the SCells being activated are transmitting SSB burst.

- In FR2, the occasion when all active serving cells and SCells being activated or released are transmitting SSB bursts in the same slot.

In addition to CSI reporting defined above, UE shall also apply other actions related to the activation command specified in TS 38.321 [7] for an SCell at the first opportunities for the corresponding actions once the SCell is activated.

The UE may be allowed to cause interruptions to PCell during an interruption window, as specified in clause 8.2. The starting point of an interruption window on PCell shall not occur before slot *n*+1+, and not occur after slot *n*+1+, where NR slot length is with respect to the numerology of the SCell being activated, and *TX* is:

- *TFirstSSB*, for any scenario where *Tactivation\_time\_multiple\_scells*includes *TFirstSSB*;

- *TFirstSSB\_MAX*, for any scenario where Tactivation\_time\_multiple\_scells includes TFirstSSB\_MAX;

- *TFirstSSB\_MAX\_multiple\_scell*, for any scenario where *Tactivation\_time\_multiple\_scells*includes *TFirstSSB\_MAX\_multiple\_scells*;

- *Tuncertainty\_MAC +TFineTiming*, for any scenario where *Tactivation\_time\_multiple\_scells*includes *TFineTiming*.

The length of the interruption window depends on the frequency band relation between the aggressor SCell and the victim PCell.

Starting from the slot and until the UE has completed the direct SCell activation, the UE shall report CQI index = 0 (out of range) if the UE has available uplink resources to report CQI for the SCells.

8.3.11 Direct SCell Activation of Multiple Downlink SCells at RRC Resume

The requirements in this clause apply for UE being configured in the RRC reconfiguration message in TS38.331 [2] for RRC Resume with 2 SCells for which the parameter *sCellState* is set to *activated*.

The requirements in clause 8.3.9 shall apply, except that the definition of *T1* shall be replaced by the corresponding definition in clause 8.3.6.

### 8.3.12 SCell Activation Delay Requirement for Deactivated PUCCH SCell

The requirements in this clause shall apply for the UE configured with one downlink SCell and when PUCCH is configured for the SCell being activated.

If the UE has a valid TA for transmitting on an SCell then the UE shall be capable to transmit valid CSI report and apply actions related to the activation command for the SCell being activated on the PUCCH SCell no later than in slot n+,

Where:

- A TA is considered to be valid provided that the *TimeAlignmentTimer* [2] associated with the TAG containing the PUCCH SCell is running.

- THARQ (in ms) is the timing between DL data transmission and acknowledgement as specified in TS 38.213 [3].

- Tactivation\_time is the SCell activation delay in millisecond as specified in section 8.3.2 except the definition of Tuncertainty\_MAC is replaced with:

- Tuncertainty\_MAC is the time period between reception of the last activation command for PDCCH TCI, PDSCH TCI (when applicable), UL spatial relation (for FR2) relative to

- SCell activation command for known case;

- First valid L1-RSRP reporting for unknown case.

- TCSI\_reporting is the delay (in ms) as specified in clause 8.3.2.

- Ttarget\_PL-RS is the periodicity of the target pathloss reference signal determined during PUCCH SCell activation.

- [X] sample measurement time is introduced when PL-RS of target PUCCH SCell is known

- FFS under what condition the [X] = 0 or [X] = 5If the UE does not have a valid TA for transmitting on an SCell then the UE shall be capable to perform downlink actions related to the SCell activation command as specified in [7] for the SCell being activated on the PUCCH SCell no later than in slot n+, and shall be capable to perform uplink actions related to the SCell activation command as specified in [7] for the SCell being activated on the PUCCH SCell no later than in slot and shall transmit valid CSI report for the SCell being activated on the PUCCH SCell no later than in slot , where:

Tdelay\_PUCCH\_SCell = Tactivation\_time + max ((TFirst\_available\_CSI + TCSI\_processing), (T1+T2+T3), [X]\*Ttarget\_PL-RS) + TCSI\_reporting\_after

Where:

- Tactivation\_time is the SCell activation delay in millisecond as specified in section 8.3.2 except the definition of Tuncertainty\_MAC is replaced with:

- Tuncertainty\_MAC is the time period between reception of the last activation command for PDCCH TCI, PDSCH TCI (when applicable), UL spatial relation (when applicable in FR2) relative to

- SCell activation command for known case;

- First valid L1-RSRP reporting for unknown case.

- Ttarget\_PL-RS is the periodicity of the target pathloss reference signal determined during PUCCH SCell activation.

- [X] sample measurement time is introduced when PL-RS of target PUCCH SCell is known

- FFS under what condition the [X] = 0 or [X] = 5

- TFirst\_available\_CSI is the delay uncertainty (in ms) in acquiring the first available downlink CSI reference resource.

- TCSI\_processing is the UE processing time for CSI reporting.

- TCSI\_reporting\_after is the delay uncertainty (in ms) in acquiring the first available CSI reporting resources after T3

- T1 is the delay uncertainty in acquiring the first available PDCCH triggered PRACH occasion in the PUCCH SCell after the slot n+.

- T1 is up to the summation of a delay uncertainty for reception of PDCCH order, SSB to PRACH occasion association period and 10 ms, where SSB to PRACH occasion association period is defined in the table 8.1-1 of TS 38.213

- T2 is the delay from slot n+until UE has obtained a valid TA command for the target PUCCH Scell being activated. Slot n is the slot where the UE receives PUCCH SCell activation command.

- T3 is the delay for applying the received TA for uplink transmission on target PUCCH SCell being activated, as specified in clause 4.2 in TS 38.213.

The pathloss reference signal is known for known PUCCH SCell during activation if the following conditions are met during the period between the last transmission of the RS resource used for L3 RSRP measurement reporting and the completion of PUCCH SCell activation, where the RS resource is the target pathloss reference signal or QCLed (with Type D) to the target pathloss reference signal:

-The PUCCH SCell activation command is received within 1280 ms upon the last transmission of the RS resource used for L3 measurement reporting

- The target pathloss reference signal determination is based on the latest L3 RSRP measurement reporting

- The target pathloss reference signal remains detectable during the PUCCH SCell activation period

- SNR of the target pathloss reference signal≥-3dB

- The associated SSBs with the target pathloss reference signal remain detectable during the PUCCH SCell activation period

- SNR of the associated SSB ≥-3dB

The pathloss reference signal is known for unknown PUCCH SCell during activation if the following conditions are met during the period between the last transmission of the RS resource used for L1-RSRP measurement reporting and the completion of PUCCH SCell activation, where the RS resource is the target pathloss reference signal or QCLed (with Type D) to the target pathloss reference signal.

- The PUCCH SCell activation command is received within 1280 ms upon the last transmission of the RS resource used for L1-RSRP measurement reporting

- The target pathloss reference signal determination is based on the latest L1-RSRP measurement reporting

- The target pathloss reference signal remains detectable during the PUCCH SCell activation period

- SNR of the target pathloss reference signal≥-3dB

- The associated SSBs with the target pathloss reference signal remain detectable during the PUCCH SCell activation period

- SNR of the associated SSB ≥-3dB

Otherwise, the pathloss reference signal is unknown.

The above delay requirement shall apply provided that:

- The target pathloss reference signal determined during PUCCH SCell activation is known otherwise longer activation time is expected if the pathloss reference signal is unknown; and

- The RA on PUCCH SCell is not interrupted by the RA on PCell otherwise additional delay to activate the SCell is expected; and

- No SRS carrier based switching or SRS antenna port switching occurs during the SCell activation procedure otherwise the PUCCH SCell activation delay can be extended.

The starting point and the end-point of an interruption window on PCell or any activated SCell in MCG for NR standalone mode, or on PSCell or any activated SCell in SCG for EN-DC mode is the same as the interruption in single SCell activation requirement in clause 8.3.2.

In addition to the interruption due to RF retuning during PUCCH SCell activation, if the UE is not capable of *parallelTxPRACH-SRS-PUCCH-PUSCH*, the UE shall transmit PRACH on PUCCH SCell and is allowed to drop or cause interruption to SRS or PUCCH or PUSCH transmission on the SpCell or on any activated SCell. Otherwise, UE is not allowed to drop or cause any interruption to SRS or PUCCH or PUSCH transmission on SpCell or on any activated SCell.

For unknown PUCCH SCell activation in FR2, the requirement only apply when UE supports CSI reporting cross PUCCH group capability , and UE is configured with CSI reporting via SpCell. For unknown PUCCH SCell activation in FR1, the requirement only applies when UE supports CSI reporting cross PUCCH group capability, and UE is configured with CSI reporting via SpCell, if ‘ssb-PositionInBurst’ indicates multiple SSBs but TCI state indication is not provided in same MAC PDU with SCell activation.

The requirement for unknown SCell applies provided that the PDCCH order (when applicable) and the activation commands for TCI, UL spatial relation and PL-RS (when applicable) are based on the latest valid L1-RSRP reporting via Primary PUCCH group.

### 8.3.13 SCell activation delay Requirement for Deactivated PUCCH SCell with Multiple SCells

#### 8.3.13.1 Introduction

The requirements in this clause shall apply for the UE configured with multiple deactivated downlink SCells and PUCCH is configured for a SCell, and when PUCCH SCell with downlink SCell(s) are activated by one MAC command.

For EN-DC, NE-DC, and standalone NR, the requirements in this clause shall apply when the following conditions are met:

- UE only receives one single MAC command for multiple SCell activation within the activation period defined in this clause

- in each single CG, there are no other SCell activation, deactivation, addition or release before activation is completed for all the SCells activated by the single MAC CE in this clause, and

- in EN-DC and NE-DC, there are no E-UTRAN SCell activation, deactivation, addition or release before multiple SCell activation is completed in this clause, and

- any to-be-activated unknown non-PUCCH SCell in a different band from to-be-activated PUCCH SCell has active serving cell(s) or known to-be-activated non-PUCCH SCell(s) on the same band.

- All DL SCells being activated in the secondary PUCCH group are unknown if PUCCH SCell being activated is unknown.

Upon receiving SCell activation command in slot *n* for more than one SCell and one among the multiple SCells is PUCCH SCell, the UE shall be able to transmit valid CSI report on PUCCH SCell and apply actions related to the SCell activation command as specified in [7] for the PUCCH SCell being activated no later than in slot *n*+ Tactivate\_total\_PUCCH\_SCell. The UE shall be capable to transmit valid CSI report of other SCell no later than in slot n+ Tactivate\_total\_other\_SCell.

Where:

- Tactivate\_total\_PUCCH\_SCell is ,

- Tactivate\_total\_other\_SCell is

Where:

Tdelay\_multiple\_SCells\_other\_SCell is the SCell activation delay for other SCell when the other SCell is activated with multiple SCells and is given by Tactivation\_time\_multiple\_scells +TCSI\_Reporting.

Tdelay\_multiple\_SCells\_PUCCH\_SCell is the SCell activation delay for a PUCCH SCell when PUCCH SCell is activated with other SCells and is given by:

- If UE has a Valid TA for transmitting on PUCCH SCell,

- A TA is considered to be valid provided that the *TimeAlignmentTimer* [2] associated with the TAG containing the PUCCH SCell is running.

Tdelay\_multiple\_SCells\_PUCCH\_SCell = Tactivation\_time\_multiple\_scells + Tmeas + TCSI\_Reporting

- If UE do not have valid TA for PUCCH SCell,

Tdelay\_multiple\_SCells\_PUCCH\_SCell = Tactivation\_time\_multiple\_scells + max ((TFirst\_available\_CSI + TCSI\_processing), (T1+T2+T3), Tmeas) + TCSI\_reporting\_after

Where:

- Tactivation\_time\_multiple\_scells is the target SCell activation delay in millisecond in multiple SCell activation scenario as specified in section 8.3.7.

- Tmeas equals to 5 times of the periodicity of PL-RS resource when PL-RS of target PUCCH SCell is known

- TCSI\_Reporting is the delay (in ms) including uncertainty in acquiring the first available downlink CSI reference resource, UE processing time for CSI reporting and uncertainty in acquiring the first available CSI reporting resources as specified in TS 38.331 [2]. If the CSI for a other SCell is reported to PUCCH SCell, CSI reporting delay may include uncertainty of waiting for PUCCH SCell activation completion.

- Tfirst\_available\_CSI: the delay uncertainty in acquiring the first available downlink CSI reference resources for secondary PUCCH group.

- TCSI\_processing: the UE processing time for CSI reporting of secondary group PUCCH SCells.

- TCSI\_reporting\_after the delay uncertainty in acquiring the first available CSI reporting resource after T3

- T1 is the delay uncertainty in acquiring the first available PDCCH triggered PRACH occasion in the PUCCH SCell after Tactivation\_time\_multiple\_scells.

- T1 is up to the summation of a delay uncertainty for reception of PDCCH order, SSB to PRACH occasion association period and 10 ms, where SSB to PRACH occasion association period is defined in the table 8.1-1 of TS 38.213

- T2 is the delay from slot n + (THARQ + Tactivation\_time\_multiple\_scells + T1)/NR slot length until UE has obtained a valid TA command for the target PUCCH SCell being activated. Slot n is the slot where the UE receives PUCCH SCell activation command.

- T3 is the delay for applying the received TA for uplink transmission on target PUCCH SCell being activated, and greater than or equal to k+1 slot, where k is defined in clause 4.2 in TS 38.213.The starting point and the endpoint of an interruption window on PCell or any activated SCell in MCG for NR standalone mode, or on PSCell or any activated SCell in SCG for EN-DC mode is same as single SCell activation requirement in clause 8.3.2.

Starting from slot n + THARQ + 3 ms where n is the slot where SCell activation command is received (as specified in clause 4.3 of TS 38.213 [3]) and until the SCell activation completion at UE, after at least one CSI-RS transmission occasion for the channel measurement and reporting (specified in clause 5.2.2.5 of TS 38.214 [26]), the UE shall report out of range if the UE has available uplink resources to report CQI for the SCell.

In addition to the interruption due to RF retuning during multiple SCell activation, if the UE is not capable of *parallelTxPRACH-SRS-PUCCH-PUSCH* for inter-band CA, then the UE shall transmit PRACH on PUCCH SCell and is allowed to drop or cause interruption to SRS or PUCCH or PUSCH transmission on the SpCell or on any activated SCell. Otherwise, UE is not allowed to drop or cause any interruption of SRS or PUCCH or PUSCH transmission on SpCell or on any activated SCell.

Upon receiving SCell activation command in slot *n,* if the start of the first complete SSB used in the *TX* in the different bands which have SCells being activated after *n*+ are not aligned on time domain among

- SCells in different bands being activated by the same MAC CE if UE does not support per FR gap, or

- SCells in different FR1 bands being activated by the same MAC CE if UE supports per FR gap,

additional interruptions may be expected for the activated serving cells, where

- The number of additional interruptions is no more than the number of FR1 bands which have both SCell being activated for which the activation requirements involve *TFirstSSB\_MAX* *multiple\_scells* with *Trs* and the active serving cell, and

- In each interruption occasion, the interruption length is defined in clause 8.2.2.2.2, and

- Longer activation delay may be expected for multiple SCell activation under one MAC CE with multiple interruptions, and

- *TX* is:

- TFirstSSB, for any scenario where Tactivation\_time multiple\_scells includes TFirstSSB;

- TFirstSSB\_MAX multiple\_scells, for any scenario where Tactivation\_time multiple\_scells includes TFirstSSB\_MAX multiple\_scells;

- Tuncertainty\_MAC+TFineTiming or Tuncertainty\_MAC multiple\_scells+TFineTiming, for any scenario where Tactivation\_time multiple\_scells includes TFineTiming.

Otherwise, no additional interruption is expected due to activation of multiple SCells.

[Starting from the slot specified in clause 4.3 of TS 38.213 [3] (timing for secondary Cell activation/deactivation) and until the UE has completed a first L1-RSRP measurement, the UE shall report lowest valid L1 SS-RSRP range if the UE has available uplink resources to report L1-RSRP for the SCell.]

### 8.3.14 SCell Deactivation Delay Requirement for Activated PUCCH SCell

The requirements in this clause shall apply for the UE configured with one SCell configured with PUCCH in EN-DC, or in standalone NR carrier aggregation, or in NE-DC.

Upon receiving PUCCH SCell deactivation command in slot *n*, the UE shall accomplish the deactivation actions for the PUCCH SCell being deactivated no later than in slot *n +*. The starting point of an interruption window on spCell or any activated SCell, as specified in clause 8.2, shall not occur before slot n+1+ and not occur after slot n+1+, where NR slot length is with respect to the numerology used in the PUCCH SCell being deactivated.

The length of the interruption window may be different for different victim cells, and depends on the applicable scenario and on the frequency band relation between the aggressor cell and the victim cell.

### 8.3.15 SCell Deactivation Delay Requirement for Activated PUCCH SCell with Multiple Downlink SCells

The requirements in this clause shall apply for the UE configured with multiple downlink SCells and one SCell configured with PUCCH in EN-DC, or in standalone NR carrier aggregation, or in NE-DC, provided that,

- in each single CG, there are no other SCell activation, deactivation, addition or release before deactivation is completed for all the SCells deactivated by the single MAC CE in this clause, and

- in EN-DC and NE-DC, there are no E-UTRAN SCell activation, deactivation, addition or release before multiple SCell deactivation is completed in this clause, and

- in EN-DC, NE-DC and standalone NR, UE only receives one single MAC command for multiple SCell deactivation within the deactivation period defined in this clause

Upon receiving SCell deactivation command in slot *n*, the UE shall accomplish the deactivation actions for the SCells (including one SCell configured with PUCCH) being deactivated within the same delay as specified in clause 8.3.12.

The starting point and the end-point of an interruption window on PCell or any activated SCell in MCG for NR standalone mode, or on PSCell or any activated SCell in SCG for EN-DC mode is same as single SCell activation requirement in clause 8.3.12.

### 8.3.16 Fast SCell Activation Delay Requirement for Deactivated SCell

Aperiodic CSI-RS resources can be configured for fast SCell activation. The requirements in this clause shall apply for the UE configured with one downlink SCell in EN-DC, or in standalone NR carrier aggregation or in NE-DC or in NR-DC and when one SCell is being activated. The requirements in this clause shall apply for the UE provided with aperiodic CSI-RS resources for SCell activation for the target SCell.

Note: If UE is allocated A-TRS for fast Scell activation, the UE is not required to use the SSB of the target Scell.

The delay within which the UE shall be able to activate the deactivated SCell depends upon the specified conditions.

Upon receiving SCell activation command in slot *n*, the UE shall be capable to transmit valid CSI report and apply actions related to the activation command for the SCell being activated no later than in slot , where:

THARQ (in ms) is the timing between DL data transmission and acknowledgement as specified in TS 38.213 [3]

Tactivation\_time is the SCell activation delay in millisecond.

If the SCell is known and belongs to FR1, Tactivation\_time is:

- TFirstATRS+ 5ms, if the measurement period of the SCell being activated is equal to or smaller than [2400ms].

- TFirstATRS + Tgap + TATRS + 5ms, if the measurement period of the SCell being activated is larger than [2400ms].

Note: The RSs on the activated serving cell in the same band are not required to be transmitted in the same slot as the temporary RS.

Note: UE may report inaccurate non-zero CQI for any activated Cell and being activated SCell during the fast SCell activation procedure only if the RSs on the activated serving cell in the same band are not transmitted in the same slot as the aperiodic CSI-RS for fast SCell activation.

If the SCell is unknown and belongs to FR1, and SCell is contiguous to an active serving cell in the same band, provided that the side condition Ês/Iot ≥ -2dB is fulfilled, Tactivation\_time is:

- TFirstATRS + Tgap + TATRS + 5ms, if the following conditions are met,

- the SCell is contiguous to an active serving cell in the same band, and

- its *ssb-PositionInBurst* is same as the one of contiguous FR1 active serving cell, and

- its SMTC offset is same as the one of contiguous FR1 active serving cell, and

- its RTD with contiguous FR1 active serving cell is smaller than or equal to 260ns with respect to the to-be-activated SCell’s SSB numerology, and its reception power difference with contiguous FR1 active serving cell is smaller than or equal to 6dB;

Note: The RSs on the activated serving cell in the same band are not required to be transmitted in the same slot as the temporary RS.

Note: UE may report inaccurate non-zero CQI for any activated SCell and being activated SCell during the fast SCell activation procedure only if the RSs on the activated serving cell in the same band are not transmitted in the same slot as the aperiodic CSI-RS for fast SCell activation.

If the SCell being activated belongs to FR2 and if there is at least one active serving cell on that FR2 band, then Tactivation\_time is TFirstATRS+ 5ms provided:

- The UE is provided with aperiodic CSI-RS resources for SCell activation for the target SCell, and

- The SSBs in the serving cell(s) and the SSBs in the SCell being activated fulfil the condition defined in clause 3.6.3,

- The parameter *ssb-PositionsInBurst* is same for the serving cell(s) and the SCell.

- SSB is in the same half-frame on the SCell and the contiguous FR2 active serving cell

If the SCell being activated belongs to FR2 and if there is no active serving cell on that FR2 band provided that PCell or PSCell is in FR1 or in FR2, and assuming PDCCH TCI and PDSCH TCI (when applicable) are associated with the triggered aperiodic CSI-RS resources for fast SCell activation, and when the following conditions are fulfillied:

- One of the candidate TCI states configured in TCI-StatesPDCCH-ToAddList has the same QCL source of the triggered A-TRS,

- The QCL source of CSI-RS for CQI reporting is the same as the triggered A-TRS,

- The TCI state for PDCCH/PDSCH is the same as A-TRS remain unchanged during SCell activation,

- If the target SCell belongs to FR2 is known to UE and semi-persistent CSI-RS is used for CSI reporting, then Tactivation\_time is:

- 3ms + max(TFirstATRS + 2ms, Tuncertainty\_SP), where Tuncertainty\_SP=0 if UE receives the SCell activation command and semi-persistent CSI-RS activation command at the same time.

- If the target SCell belongs to FR2 is known to UE and periodic CSI-RS is used for CSI reporting, then Tactivation\_time is:

- max(TFirstATRS + 5ms, Tuncertainty\_RRC + TRRC\_delay-THARQ).

where,

TFirstATRS: is the time to the end of the first complete CSI-RS burst for SCell activation after slot n + , where the CSI-RS burst is defined as four CSI-RS resources in two consecutive slots.

TATRS is the CSI-RS burst for SCell activation where the CSI-RS burst is defined as four CSI-RS resources in two consecutive slots.

Tgap is a gap length between two aperiodic CSI-RS bursts,

- at least 2 slots for 15kHz and 30kHz

- at least 3 slots for 60kHz

Tuncertainty\_RRC is the time period between reception of the RRC configuration message for TCI of periodic CSI-RS for CQI reporting (when applicable) relative to SCell activation command.

Tuncertainty\_SP is the time period between reception of the activation command for semi-persistent CSI-RS resource set for CQI reporting relative to SCell activation command for known case.

TRRC\_delay is the RRC procedure delay as specified in TS38.331 [2].

TCSI\_reporting is the delay (in ms) including uncertainty in acquiring the first available downlink CSI reference resource, UE processing time for CSI reporting and uncertainty in acquiring the first available CSI reporting resources as specified in TS 38.331 [2].

SCell in FR1 is known if it has been meeting the following conditions:

- During the period equal to max(5\*measCycleSCell,  5\*DRX cycles) for FR1 before the reception of the SCell activation command:

- the UE has sent a valid measurement report for the SCell being activated and

- the SSB measured remains detectable according to the cell identification conditions specified in clause 9.2 and 9.3.

- the SSB measured during the period equal to max(5\*measCycleSCell, 5\*DRX cycles) also remains detectable during the SCell activation delay according to the cell identification conditions specified in clause 9.2 and 9.3.

Otherwise SCell in FR1 is unknown.

For the first SCell activation in FR2 bands, the SCell is known if it has been meeting the following conditions:

- During the period equal to 4s for UE supporting power class 1/5 and 3s for UE supporting power class 2/3/4 before UE receives the last activation command for PDCCH TCI, PDSCH TCI (when applicable) and semi-persistent CSI-RS for CQI reporting (when applicable):

- the UE has sent a valid L3-RSRP measurement report with SSB index

- SCell activation command is received after L3-RSRP reporting and no later than the time when UE receives MAC-CE command for TCI activation

- During the period from L3-RSRP reporting to the valid CQI reporting, the reported SSBs with indexes remain detectable according to the cell identification conditions specified in clauses 9.2 and 9.3, and the TCI state is selected based on one of the latest reported SSB indexes.

Otherwise, the first SCell in FR2 band is unknown.

In addition to CSI reporting defined above, UE shall also apply other actions related to the activation command specified in TS 38.331 [2] for a SCell at the first opportunities for the corresponding actions once the SCell is activated.

The starting point of an interruption window on spCell or any activated SCell, as specified in clause 8.2, shall not occur before slot n+1+ and not occur after slot slot n+1+, where NR slot length is with respect to the numerology used in the SCell being activated, and TX is:

- TFirstATRS, for any scenario where Tactivation\_time includes TFirstATRS;

The length of the interruption window may be different for different victim cells, and depends on the applicable scenario and on the frequency band relation between the aggressor cell and the victim cell.

The requirements in this clause and requriements on interruption due to SCell activation in clause 8.x apply provided that the SSB and A-TRS of the to-be-activated SCell is within the first active DL BWP of the Scell.

Starting from slot *n* + THARQ + 3 ms where slot *n* is the slot where SCell activation command is received (as specified in clause 4.3 of TS 38.213 [3]) and until the SCell activation completion at UE, after at least one CSI-RS transmission occasion for the channel measurement and reporting (specified in clause 5.2.2.5 of TS 38.214 [26]), the UE shall report out of range if the UE has available uplink resources to report CQI for the SCell.

## 8.3A SCell Activation and Deactivation Delay in Carriers with CCA

### 8.3A.1 Introduction

This clause defines requirements for the delay within which the UE shall be able to activate a deactivated SCell operating with CCA and deactivate an activated SCell operating with CCA in EN-DC or in standalone NR carrier aggregation.

In the requirements of clause 8.3A, the term SMTC occasion not available at the UE refers to when the SMTC contains SSBs configured by gNB in a cell on a carrier frequency subject to CCA, but the first two successive candidate SSB positions for the same SSB index within the discovery burst transmission window are not available at the UE due to DL CCA failures at gNB during the corresponding period; otherwise the SMTC occasion is considered as available at the UE.

In the requirements of clause 8.3A, the term CSI-RS occasion not available at the UE due to DL CCA failures referes to when the CSI-RS is configured by gNB for the UE but not available at the UE due to DL CCA failures at gNB during the corresponding period.

The requirements shall apply for EN-DC and standalone NR carrier aggregation.

### 8.3A.2 SCell Activation Delay Requirement for Deactivated SCell

The requirements in this clause shall apply for the UE configured with one downlink SCell operating with CCA in EN-DC or in standalone NR carrier aggregation and when one SCell operating with CCA is being activated but none of the RRC parameters *CO-DurationPerCell-r16*, *SlotFormatIndicator*, and *CSI-RS-ValidationWith-DCI-r16* is configured and all of the CSI reporting resources for being-activated SCell are available.

The delay within which the UE shall be able to activate the deactivated SCell depends upon the specified conditions.

Upon receiving SCell activation command in slot *n*, the UE shall be capable to transmit valid CSI report and apply actions related to the activation command for the SCell being activated no later than in slot n + (THARQ + Tactivation\_time\_withCCA + TCSI\_reporting\_withCCA)/*NR\_slot\_length*, where:

- THARQ (in ms) is the timing between DL data transmission and acknowledgement as specified in TS 38.213 [3]. In the event of UE not being able to transmit the acknowledgment due to UL CCA failures: THARQ is extended to also include the time to all next HARQ feedback transmission and retransmission opportunities, until the time of its successful transmission, as specified in TS 38.213 [3]; no extension of THARQ due to UL CCA failures is allowed for Type 2C UL channel access procedure as defined in TS 37.213 [57].

- Tactivation\_time\_withCCA is the SCell activation delay in millisecond.

- If the SCell is known and belongs to FR1, Tactivation\_time\_withCCA is:

- TFirstSSB + L1\*Trs + 5ms, if the measurement period of the SCell being activated is equal to or smaller than 2400ms.

- TFirstSSB\_MAX + L2,1\*TSMTC\_MAX + (1 +L2,2)\*Trs + 5ms, if the measurement period of the SCell being activated is larger than 2400ms.

- If the SCell is unknown and belongs to FR1, provided that the side condition Ês/Iot ≥ -2 dB is fulfilled and the SCell can be successfully detected in one attempt, Tactivation\_time\_withCCA is:

- TFirstSSB\_MAX + (1 + L3,1)\*TSMTC\_MAX + (2 + L3,2)\*Trs + 5ms.- If the SCell being activated belongs to FR2-2 and if there is at least one active serving cell on that FR2-2 band, if the UE supporting *scellWithoutSSB* is not provided with any SMTC for the target SCell, Tactivation\_time\_withCCA is 3 ms, provided

- the RS (s) of SCell being activated is (are) QCL-TypeD with RS (s) of one active serving cell on that FR2-2 band.

- If the SCell being activated belongs to FR2-2 and if there is no active serving cell on that FR2-2 band provided that PCell or PSCell is in FR1 or in FR2-2:

- If the target SCell is known to UE and semi-persistent CSI-RS is used for CSI reporting, then Tactivation\_time\_withCCA is:

- 3ms + max(Tuncertainty\_MAC + TFineTiming + 2ms, Tuncertainty\_SP), where Tuncertainty\_MAC=0 and Tuncertainty\_SP=0 if UE receives the SCell activation command, semi-persistent CSI-RS activation command and TCI state activation command at the same time.

- If the target SCell is known to UE and periodic CSI-RS is used for CSI reporting, then Tactivation\_time is:

- max(Tuncertainty\_MAC + 5ms + TFineTiming, Tuncertainty\_RRC + TRRC\_delay-THARQ), where Tuncertainty\_MAC=0 if UE receives the SCell activation command and TCI state activation commands at the same time.

- If the PCell/PSCell and the target SCell are configured as FR1-FR2-2 CA or if the PCell/PSCell and the target SCell are in a FR2-2 band pair with independent beam management, and the target SCell is unknown to UE and semi-persistent CSI-RS is used for CSI reporting, provided that the side condition Ês/Iot ≥ -2dB is fulfilled, then Tactivation\_time\_withCCA is:

- 6ms + TFirstSSB\_MAX + (23+[N\*L4,1])\*TSMTC\_MAX + (12+[ N \*L4,2])\*Trs + TL1-RSRP, measure + TL1-RSRP, report + THARQ + max(Tuncertainty\_MAC + TFineTiming + 2ms, Tuncertainty\_SP).

- If the PCell/PSCell and the target SCell are configured as FR1-FR2-2 CA or if the PCell/PSCell and the target SCell are in a FR2-2 band pair with independent beam management, and the target SCell is unknown to UE and periodic CSI-RS is used for CSI reporting, provided that the side condition Ês/Iot ≥ -2dB is fulfilled, then Tactivation\_time\_withCCA is:

- 3ms + TFirstSSB\_MAX + (23+[ N\*L5,1])\*TSMTC\_MAX + (12+[ N \*L5,2])\*Trs + TL1-RSRP, measure + TL1-RSRP, report + max {(THARQ + Tuncertainty\_MAC + 5ms + TFineTiming), (Tuncertainty\_RRC + TRRC\_delay)}.

Where,

TSMTC\_MAX:

- In case of intra-band SCell activation, TSMTC\_MAX is the longest SMTC periodicity between active serving cells and SCell being activated provided the cell specific reference signals from the active serving cells and the SCells being activated or released are available in the same slot;

- In case of inter-band SCell activation, TSMTC\_MAX is the SMTC periodicity of SCell being activated;

- TSMTC\_MAX is bounded to a minimum value of 10ms.

Trs is the SMTC periodicity of the SCell being activated if the UE has been provided with an SMTC configuration for the SCell in SCell addition message, otherwise Trs is the SMTC configured in the measObjectNR having the same SSB frequency and subcarrier spacing. If the UE is not provided SMTC configuration or measurement object on this frequency, the requirement which involves Trs is applied with Trs = 5ms assuming the SSB transmission periodicity is 5ms. There are no requirements if the SSB transmission periodicity is not 5ms

TFirstSSB: is the time to the end of the first complete configured SSB burst indicated by the SMTC after slot n + (THARQ+3ms)/*NR\_slot\_length*

TFirstSSB\_MAX: is the time to the end of first complete configured SSB burst indicated by the SMTC after slot n + (THARQ+3ms)/*NR\_slot\_length* when all active serving cells and SCells being activated or released have configured SSB bursts in the same slot for intra-band scenario. In case of inter-band SCell activation, TFirstSSB\_MAX is the time to the end of the first complete configured SSB burst of the SCell being activated. In FR2-2, the occasion when all active serving cells and SCells being activated or released are transmitting SSB bursts in the same slot.

L1 (L1 ≤ L1,max) is the number of configured SMTC occasions not available at the UE. L1,max = 2 if Trs ≤ 40 ms; otherwise L1,max = 1.

L2,1 (L2,1 ≤ L2,1,max) and L3,1 (L3,1 ≤ L3,1,max) are the numbers of configured SMTC occasions not available at the UE, for a known and unknown SCell activation respectively,

in the SCell being activated, for inter-band scenario, or

in any of the SCells already activated or being activated provided their cell specific reference signals are configured in the same slot, for intra-band scenario

and L2,1,max = 2 if TSMTC\_MAX ≤ 40 ms; otherwise L2,1,max = 1. L3,1,max = 2 if TSMTC\_MAX ≤ 40 ms; otherwise L3,1,max = 1.

L2,2 (L2,2 ≤ L2,2,max) and L3,2 (L3,2 ≤ L3,2,max)are the number of configured SMTC occasions not available at the UE in the SCell being activated. L2,2,max = 2 if Trs ≤ 40 ms; otherwise L2,2,max = 1. L3,2,max = 2 if Trs ≤ 40 ms; otherwise L3,2,max = 1.

N = TBD for an FR2-2 unknown SCell activation.

L4,1 (L4,1 ≤ L4,1,max) and L5,1 (L5,1 ≤ L5,1,max) are the numbers of SMTC occasions groups not available at the UE, for an FR2-2 unknown SCell activation,

in the SCell being activated, for inter-band scenario, or

in any of the SCells already activated or being activated provided their cell specific reference signals are configured in the same slot, for intra-band scenario

and L4,1,max = 2 if TSMTC\_MAX ≤ 40 ms; otherwise L4,1,max = 1. L5,1,max = 2 if TSMTC\_MAX ≤ 40 ms; otherwise L5,1,max = 1.

L4,2 (L4,2 ≤ L4,2,max) and L5,2 (L5,2 ≤ L5,2,max)are the number of SMTC occasions groups not available at the UE in the FR2-2 unknown SCell being activated. L4,2,max = 2 if Trs ≤ 40 ms; otherwise L4,2,max = 1. L5,2,max = 2 if Trs ≤ 40 ms; otherwise L5,2,max = 1.

TFineTiming is the time period between UE finish processing the last activation command for PDCCH TCI, PDSCH TCI (when applicable) and the timing of first complete available SSB corresponding to the TCI state.

TL1-RSRP, measure is L1-RSRP measurement delay TL1-RSRP\_Measurement\_Period\_SSB\_CCA msas defined in clause 9.5A.4.1 with the assumption of M=1.

TL1-RSRP, report is delay of acquiring CSI reporting resources.

Tuncertainty\_MAC is the time period between reception of the last activation command for PDCCH TCI, PDSCH TCI (when applicable) relative to

- SCell activation command for known case;

- First valid L1-RSRP reporting for unknown case.

Tuncertainty\_RRC is the time period between reception of the RRC configuration message for TCI of periodic CSI-RS for CQI reporting (when applicable) relative to

- SCell activation command for known case;

- First valid L1-RSRP reporting for unknown case.

Tuncertainty\_SP is the time period between reception of the activation command for semi-persistent CSI-RS resource set for CQI reporting relative to

- SCell activation command for known case;

- First valid L1-RSRP reporting for unknown case.

TRRC\_delay is the RRC procedure delay as specified in TS38.331 [2].

Longer delays for RRM measurement requirements, and in case of FR2-2 also SSB based RLM/BFD/CBD/L1-RSRP measurement requirements, can be expected during the cell detection time for unknown SCell activation.

When *absoluteFrequencySSB* is not configured in *DownlinkConfigCommon* for target SCell but SMTC for target SCell is configured, no requirement would be applied.

TCSI\_reporting\_withCCA = TCSI\_reporting + TCSI\_ReportingDelay , where

TCSI\_reporting is the delay (in ms) including uncertainty in acquiring the first available downlink CSI reference resource, UE processing time for CSI reporting and uncertainty in acquiring the first available CSI reporting resources as specified in TS 38.331 [2].

TCSI\_ReportingDelay is the additional delay in transmission of CSI reporting due to UL CCA failures at the UE. If there are no uplink resources for reporting the valid CSI, then the UE shall use the next available opportunities for reporting the corresponding valid CSI as specified in TS 38.213 [3].

Upon exceeding any of the maximum numbers L1,max, L2,1,max, L2,2,max, L3,1,max, and L3,2,max of SMTC occasions or CSI-RS occasions, respectively, not available at the UE, the UE shall abandon the SCell activation procedure.

SCell operating with CCA in FR1 is known if it has been meeting the following conditions:

- During the period equal to max(5 measCycleSCell,  5 DRX cycles) before the reception of the SCell activation command:

- the UE has sent a valid measurement report for the SCell being activated and

- the SSB measured remains detectable in the SMTC occasions available at the UE, according to the cell identification conditions specified in clause 9.2A and 9.3A.

- the SSB measured during the period equal to max(5 measCycleSCell, 5 DRX cycles) also remains detectable - the SSB measured during the period equal to max(5 measCycleSCell, 5 DRX cycles) also remains detectable in the SMTC occasions available at the UE during the SCell activation delay according to the cell identification conditions specified in clause 9.2A and 9.3A.

Otherwise SCell operating with CCA in FR1 is unknown.

For the first SCell activation with CCA in FR2-2 bands, the SCell is known if it has been meeting the following conditions:

- During the period equal to 4s for UE supporting power class 1/5 and 3s for UE supporting power class 2/3/4 before UE receives the last activation command for PDCCH TCI, PDSCH TCI (when applicable) and semi-persistent CSI-RS for CQI reporting (when applicable):

- the UE has sent a valid L3-RSRP measurement report with SSB index

- SCell activation command is received after L3-RSRP reporting and no later than the time when UE receives MAC-CE command for TCI activation

- During the period from L3-RSRP reporting to the valid CQI reporting, the reported SSBs with indexes remain detectable according to the cell identification conditions specified in clauses 9.2 and 9.3, and the TCI state is selected based on one of the latest reported SSB indexes.

Otherwise, the first SCell with CCA in FR2-2 band is unknown. The requirement for unknown SCell applies provided that the activation commands for PDCCH TCI, PDSCH TCI (when applicable), semi-persistent CSI-RS for CQI reporting (when applicable), and configuration message for TCI of periodic CSI-RS for CQI reporting (when applicable) are based on the latest valid L1-RSRP reporting.

If the UE has been provided with higher layer in TS 38.331 [2] signaling of *smtc2*prior to the activation command, TSMTC\_Scell follows *smtc1* or *smtc2* according to the physical cell ID of the target cell being activated. TSMTC\_MAX follows *smtc1* or *smtc2* according to the physical cell IDs of the target cells being activated and the active serving cells.

In addition to CSI reporting defined above, UE shall also apply other actions related to the activation command specified in TS 38.331 [2] for a SCell at the first opportunities for the corresponding actions once the SCell is activated.

For intra-band CA, the starting point of an interruption window on SpCell or any activated SCell as specified in clause 8.2, shall not occur before slot n+1+ and not occur after slot n+1+ , where TX is:

- TFirstSSB, for known SCell activation when SCell measurement cycle is equal to or smaller than 160ms;

- TFirstSSB\_MAX + L2,1\* TSMTC\_MAX for known SCell activation when SCell measurement cycle is greater than 160ms;

- TFirstSSB\_MAX + L3,1\* TSMTC\_MAX for unknown SCell activation

For inter-band CA, the starting point of an interruption window on SpCell or any activated SCell as specified in clause 8.2, shall not occur before slot n+1+ and not occur after slot n+1+ , where TX is:

- TFirstSSB, for known SCell activation when SCell measurement cycle is equal to, or smaller than, 160ms.

For intra-band CA,

- While the SCell being activated is known with measurement cycle equal to or smaller than 160ms, no more than one interruption is allowed during SCell activation.

- While the SCell being activated is known with measurement cycle greater than 160ms, up to 1+L2,1 interruptions are allowed during SCell activation,

- While the SCell being activated is unknown, up to 1+L3,1 interruptions are allowed during SCell activation. When L3,1>0, performance degradation may be expected on any activated intra-band victim cells during the SCell activation

- For a single interruption (L=0), interruption window length at SCell activation does not depend on DL CCA failures.

For inter-band CA,

- For any active cell in the same band with the SCell being activated, the interruption requirements (i.e. number of interruptions and starting point of an interruption) for intra-band CA apply.

- For any active cell outside the band with the SCell being activated, a single interruption applies

The number of interruptions and length of each interruption window may be different for different victim cells and depends on the applicable scenario and on the frequency band relation between the aggressor cell and the victim cell. For a single interruption (L=0), the interruption window length at SCell activation does not depend on DL CCA failures.

Starting from slot *n* + THARQ + 3 ms where slot *n* is the slot where SCell activation command is received (as specified in clause 4.3 of TS 38.213 [3]) and until the SCell activation completion at UE, after at least one CSI-RS transmission occasion for the channel measurement and reporting (specified in clause 5.2.2.5 of TS 38.214 [26]), the UE shall report out of range if the UE has available uplink resources to report CQI for the SCell.

Starting from the slot specified in clause 4.3 of TS 38.213 [3] (timing for secondary Cell activation/deactivation) and until the UE has completed a first L1-RSRP measurement, the UE shall report lowest valid L1 SS-RSRP range if the UE has available uplink resources to report L1-RSRP for the SCell.

The requirements in this section do not apply when *sCellDeactivationTimer* [2] is not configured and when Tactivation\_time\_withCCA exceeds 1280 ms.

### 8.3A.3 SCell Deactivation Delay Requirement for Activated SCell

The requirements in this clause shall apply for the UE configured with one downlink SCell operating with CCA in EN-DC or in standalone NR carrier aggregation.

Upon receiving SCell deactivation command in slot *n*, the UE shall accomplish the deactivation actions for the SCell being deactivated no later than in slot *n+*(THARQ +3ms)/*NR\_slot\_length*. The starting point of an interruption window on spCell or any activated SCell, as specified in clause 8.2, shall not occur before slot n+1+ and not occur after slot n+1+, where NR slot length is with respect to the numerology used in the SCell being deactivated.

Upon expiry of the *sCellDeactivationTimer* in slot *n*, the UE shall accomplish the deactivation actions for the SCell being deactivated no later than in slot *n +*. The starting point of an interruption window on spCell or any activated SCell, as specified in clause 8.2, shall not occur before slot n+1 and not occur after slot n+1+, where NR slot length is with respect to the numerology used in the SCell being deactivated.The length of the interruption window may be different for different victim cells, and depends on the applicable scenario and on the frequency band relation between the aggressor cell and the victim cell.

The requirements in this section do not apply when *sCellDeactivationTimer* [2] is not configured and when SCell deactivation delay exceeds 1280 ms.

## 8.4 UE UL carrier RRC reconfiguration delay

### 8.4.1 Introduction

The requirements in this clause apply for a UE being configured or deconfigured with a supplementary UL carrier or NR UL carrier.

### 8.4.2 UE UL carrier configuration delay requirement

When the UE receives a RRC message implying NR UL or supplementary UL carrier configuration, the UE shall be ready to start transmission on the newly configured carrier within TUL\_carrier\_config from the end of slot n.

Where

- Slot n is the last slot overlapping with the PDSCH containing the RRC command.

- TUL\_carrier\_config equals the maximum RRC procedure delay defined in clause 11.2 in TS 36.331 [16] if the corresponding RRC message is embedded in E-UTRA RRC message, otherwise it equals the maximum RRC procedure delay defined in clause 12 in TS 38.331 [2].

### 8.4.3 UE UL carrier deconfiguration delay requirement

When the UE receives a RRC message implying NR UL or supplementary UL carrier deconfiguration RRC signalling, the UE shall stop UL signalling on the deconfigured UL carrier within TUL\_carrier\_deconfig from the end of slot n.

Where

- Slot n is the last slot overlapping with the PDSCH containing the RRC command.

- TUL\_carrier\_deconfig equals the maximum RRC procedure delay defined in clause 11.2 in TS 36.331 [16] if the corresponding RRC message is embedded in E-UTRA RRC message, otherwise it equals the maximum RRC procedure delay defined in clause 12 in TS 38.331 [2].

## 8.5 Link Recovery Procedures

### 8.5.1 Introduction

The UE shall assess the downlink radio link quality of a serving cell based on the reference signal in the set  as specified in TS 38.213 [3] in order to detect beam failure on:

- PCell in SA, NR-DC, or NE-DC operation mode,

- PSCell in NR-DC and EN-DC operation mode,

- SCell in SA, NR-DC, NE-DC or EN-DC operation mode,

- Deactivated PSCell in NR-DC and EN-DC operation mode

The RS resource configurations in the set  on PCell, PSCell or deactivated PSCell (if configured with *bfd-and-RLM* with value *true*) can be periodic CSI-RS resources and/or SSBs. RS resource configuration in the set  on SCell shall be periodic CSI-RS. UE is not required to perform beam failure detection outside the active DL BWP. UE is not required to meet the requirements in clause 8.5.2 and 8.5.3 if UE does not have set . UE is not required to perform beam failure detection on a deactivated SCell, and also not required to perform beam failure detection on resources which is implicitly configured for a deactivated SCell. When more than 2 periodic CSI-RS resources on a CC are configured in the set  for current SCell or implicitly configured in the set  for other SCell, it is up to UE implementation to select two of CSI-RS resources in active BWP in current CC to perform beam failure detection. UE is not required to perform beam failure detection on a SCell on which  is not configured.

On each RS resource configuration in the set , the UE shall estimate the radio link quality and compare it to the threshold Qout\_LR for the purpose of accessing downlink radio link quality of the serving cell beams.

When a CORESET that the UE uses for monitoring PDCCH includes two TCI states and the UE is provided *sfnSchemePdcch* set to 'sfnSchemeA' or 'sfnSchemeB', the UE shall estimate a single downlink radio link quality to derive a single SNR and compare it to the single thresholds Qout\_LR for the purpose of accessing downlink radio link quality of the serving cell beams. How to compute the single SNR based on two active TCI states is up to UE implementation.

The threshold Qout\_LR is defined as the level at which the downlink radio level link of a given resource configuration on set  cannot be reliably received and shall correspond to the BLERout = 10% block error rate of a hypothetical PDCCH transmission. For SSB based beam failure detection, Qout\_LR\_SSB is derived based on the hypothetical PDCCH transmission parameters listed in Table 8.5.2.1-1. For CSI-RS based beam failure detection, Qout\_LR\_CSI-RS is derived based on the hypothetical PDCCH transmission parameters listed in Table 8.5.3.1-1.

Upon request the UE shall deliver configuration indexes from the set as specified in TS 38.213 [3] , to higher layers, and the corresponding L1-RSRP measurement provided that the measured L1-RSRP is equal to or better than the threshold Qin\_LR, which is indicated by higher layer parameter *rsrp-ThresholdSSB*. The UE applies the Qin\_LR threshold to the L1-RSRP measurement obtained from an SSB. The UE applies the Qin\_LR threshold to the L1-RSRP measurement obtained for a CSI-RS resource after scaling a respective CSI-RS reception power with a value provided by higher layer parameter *powerControlOffsetSS*. The RS resource configurations in the set  can be periodic CSI-RS resources or SSBs or both SSB and CSI-RS resources. UE is not required to perform candidate beam detection outside the active DL BWP. UE is not required to perform candidate beam detection on a SCell on which  is not configured.

For a deactivated SCG, the UE may be provided via an RRC reconfiguration message with *tci-info* for PDCCH/PDSCH reception at the transition from deactivated SCG to activated SCG while the SCG is deactivated. After the reception of the RRC reconfiguration message the UE shall perform the BFD on the PSCellof the deactivated SCG using the TCI states accroding to *tci-info* specified in clause 6.3.2 in TS38.331[2]*.*

#### 8.5.1.1 Introduction of Requirement on Link Recovery Procedures for UE configured with relaxed measurement criteria

For the UE supports *bfd-Relaxation-r17* and configured with dedicated signaling *goodServingCellEvaluationBFD*, which is always configured to the UE when the network enables BFD relaxation for the UE as specified in TS 38.331[2], the relaxed requirements defined in clause 8.5.2.4 for SSB based beam failure detection and the relaxed requirements defined in clause 8.5.3.4 for CSI-RS based beam failure detection are allowed to apply to the relaxed BFD measurements on the serving cell after fulfilling the following conditions:

- for the serving cells in intra-band carrier aggregation configured with SSB-based or CSI-RS based RLM on SpCell together with CSI-RS based BFD on SCell, when

- the good serving cell quality criterion defined in clause 5.7.13.2 of TS 38.331 [2] is fulfilled for the serving cell based on the measurements that are configured for SSB-based or CSI-RS based RLM on SpCell together with CSI-RS based BFD on Scell in the intra-band carrier aggregation if the *lowMobilityEvaluationConnected* is not configured, or

- the UE is also configured with *lowMobilityEvaluationConnected* and both low mobility criterion defined in clause 5.7.13.1 of TS 38.331 [2] is fulfilled for a period of TSearchDeltaP-Connected and good serving cell quality criterion defined in clause 5.7.13.2 of TS 38.331 [2] is fulfilled for the serving cell based on the measurements that are configured for SSB-based or CSI-RS based RLM on SpCell together with CSI-RS based BFD on Scell in the intra-band carrier aggregation.

- for other serving cells, when

- the good serving cell quality criterion defined in clause 5.7.13.2 of TS 38.331 [2] is fulfilled for the serving cell configured with BFD-RS if the *lowMobilityEvaluationConnected* is not configured, or

- the UE is also configured with *lowMobilityEvaluationConnected*, and both low mobility criterion defined in clause 5.7.13.1 of TS 38.331 [2] is fulfilled for a period of TSearchDeltaP-Connected and good serving cell quality criterion defined in clause 5.7.13.2 of TS 38.331 [2] is fulfilled for the serving cell configured with BFD-RS.

otherwise, UE shall apply the requirements defined in clause 8.5.2.2 for SSB based beam failure detection and the requirements defined in clause 8.5.3.2 for CSI-RS based beam failure detection. Note that when multiple resources are configured on a serving cell for RLM or BFD evaluation, the good serving cell quality critierion is considered as fulfilled for the serving cell when any resource configured for the cell fulfills the good serving defined in clause 5.7.13.2 of TS 38.331 [2].

The scenario and RS resource configurations in the set  defined in section 8.5.1 apply for this section.

The UE is no longer allowed to relax BFD measurements and apply the relaxed link recovery procedures provided that at least one of the following conditions is met:

- The timer *beamFailureDetectionTimer* is running.

- No DRX is used or DRX cycle is longer than 80ms

### 8.5.2 Requirements for SSB based beam failure detection

#### 8.5.2.1 Introduction

The requirements in this clause apply for each SSB resource in the set  configured for a serving cell, provided that the SSB configured for beam failure detection is actually transmitted within the UE active DL BWP during the entire evaluation period specified in clause 8.5.2.2. The requirements in this clause could not be applicable if UE is required to perform beam failure detection on more than 1 serving cell per band.

Table 8.5.2.1-1: PDCCH transmission parameters for beam failure instance

|  |  |
| --- | --- |
| Attribute | Value for BLER |
| DCI format | 1-0 |
| Number of control OFDM symbols | 2 |
| Aggregation level (CCE) | 8 |
| Ratio of hypothetical PDCCH RE energy to average SSS RE energy | 0dB |
| Ratio of hypothetical PDCCH DMRS energy to average SSS RE energy | 0dB |
| Bandwidth (PRBs) | 24 |
| Sub-carrier spacing (kHz) | Same as the SCS of RMSI CORESET |
| DMRS precoder granularity | REG bundle size |
| REG bundle size | 6 |
| CP length | Normal |
| Mapping from REG to CCE | Distributed |

#### 8.5.2.2 Minimum requirement

UE shall be able to evaluate whether the downlink radio link quality on the configured SSB resource in set  estimated over the last TEvaluate\_BFD\_SSB ms period becomes worse than the threshold Qout\_LR\_SSB within TEvaluate\_BFD\_SSB ms period.

The value of TEvaluate\_BFD\_SSB is defined in Table 8.5.2.2-1 or Table 8.5.2.2-4 (deactivated PSCell) for FR1.

The value of TEvaluate\_BFD\_SSB is defined in Table 8.5.2.2-2 or Table 8.5.2.2-5 (deactivated PSCell) for FR2 with scaling factor N=8 for FR2-1 and N=12 for FR2-2, for FR2 power classes other than power class 6 or for FR2 class 6 when *highSpeedMeasFlagFR2-r17* is not configured.

The value of TEvaluate\_BFD\_SSB is defined in Table 8.5.2.2-3 for FR2 power class 6 UE configured with *highSpeedMeasFlagFR2-r17*.

When concurrent gaps are configured,

- P value for a BFD-RS resource to be measured is defined as

- Ntotal / Noutside\_MG in FR1

- Psharing factor \* Ntotal / Noutside\_MG in FR2 with Navailable = 0

- Ntotal / Navailable in FR2 with Navailable > 0

- For a window W of duration max(TL1, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE measurement gaps and per-FR measurement gaps within the same FR as serving cell, and starting at the beginning of any BFD-RS resource occasion:

- Ntotal is the total number of BFD-RS resource occasions within the window, including those overlapped with measurement gap occasions or SMTC occasions within the window, and

- Noutside\_MG is the number of BFD-RS resource occasions that are not overlapped with any measurement gap occasion within the window W

- Navailable is the number of BFD-RS resource occasions that are not overlapped with any measurement gap occasion nor any SMTC occasion within the window W

- TL1 is periodicity of the target BFD-RS.

Otherwise, for a UE not supporting *concurrentMeasGap-r17* or when concurrent gaps are not configured,

For FR1,

- , when in the monitored cell there are GAPs configured for intra-frequency, inter-frequency or inter-RAT measurements, which are overlapping with some but not all occasions of the SSB.

- P=1 when in the monitored cell there are no GAPs overlapping with any occasion of the SSB.

For FR2

- , when BFD-RS resource is not overlapped with GAPs and the BFD-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod).

- P = Psharing factor, when the BFD-RS resource is not overlapped with GAP and the BFD-RS resource is fully overlapped with SMTC period (TSSB = TSMTCperiod).

- , when the BFD-RS resource is partially overlapped with GAP and the BFD-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with GAP and

- TSMTCperiod ≠ xRP or

- TSMTCperiod = xRP and TSSB < 0.5\*TSMTCperiod

- , when the BFD-RS resource is partially overlapped with GAP and the BFD-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with GAP and TSMTCperiod = xRP and TSSB = 0.5\*TSMTCperiod

- , when the BFD-RS resource is partially overlapped with GAP (TSSB <xRP) and the BFD-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is partially or fully overlapped with GAP.

- , when the BFD-RS resource is partially overlapped with GAP and the BFD-RS resource is fully overlapped with SMTC occasion (TSSB = TSMTCperiod) and SMTC occasion is partially overlapped with GAP (TSMTCperiod < xRP)

where,

- Psharing factor = 1, if the BFD-RS resource outside gap is

- not overlapped with the SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol before each consecutive SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol after each consecutive SSB symbols indicated by *SSB-ToMeasure*, given that *SSB-ToMeasure* is configured, where the *SSB-ToMeasure* is the union set of *SSB-ToMeasure* from all the configured measurement objects merged on the same serving carrier, and,

- not overlapped by the RSSI symbols indicated by *ss-RSSI-Measurement* and 1 data symbol before each RSSI symbol indicated by *ss-RSSI-Measurement* and 1 data symbol after each RSSI symbol indicated by *ss-RSSI-Measurement*, given that *ss-RSSI-Measurement* is configured.

- Psharing factor = 3, otherwise.

- If the high layer in TS 38.331 [2] signaling of *smtc2* is configured, TSMTCperiod corresponds to the value of higher layer parameter *smtc2*; Otherwise TSMTCperiod corresponds to the value of higher layer parameter *smtc1*. TSMTCperiod is the shortest SMTC period among all CCs in the same FR2 band, given the SMTC offset of all CCs in FR2 provided the same offset.

- When a measurement gap is configured and the measurement gap is not NCSG,

- a BFD-RS resource or an SMTC occasion is considered to be overlapped with the GAP if it overlaps a measurement gap occasion, and

- xRP = MGRP

- Otherwise, when NCSG measurement gap is configured,

- a BFD-RS resource or an SMTC occasion is considered to be overlapped with the GAP if

- it overlaps the VIL1 or VIL2 of NCSG, or

it overlaps the ML of NCSG in FR2, and there exists a target carrier to be measured within NCSG that is intra-frequency carrier or inter-frequency carrier in the same band as the serving cell, or inter-frequency carrier in different band as the serving cell and UE does not support IBM between the target carrier and the serving cell,

- and

- xRP = VIRP

- If the UE is configured with Pre-MG, a BFD-RS resource or an SMTC occasion is only considered to be overlapped by the Pre-MG if the Pre-MG is activated.

- When concurrent gaps are configured, a BFD-RS or an SMTC occasion is not considered to be overlapped by a gap occasion if the gap occasion is dropped according to 9.1.8.

Longer evaluation period would be expected if the combination of BFD-RS resource, SMTC occasion and GAP configurations does not meet pervious conditionsFor either an FR1 or FR2 serving cell, longer evaluation period would be expected during the period Tidentify\_CGI when the UE is requested to decode an NR CGI.

For either an FR1 or FR2 serving cell, longer BFD evaluation period would be expected during the period Tidentify\_CGI,E-UTRAN when the UE is requested to decode an LTE CGI.

Table 8.5.2.2-1: Evaluation period TEvaluate\_BFD\_SSB for FR1

|  |  |
| --- | --- |
| Configuration | TEvaluate\_BFD\_SSB (ms) |
| no DRX | Max(50, Ceil(5 × P) × TSSB) |
| DRX cycle ≤ 320ms | Max(50, Ceil(7.5 × P) × Max(TDRX,TSSB)) |
| DRX cycle > 320ms | Ceil(5 × P) × TDRX |
| Note: TSSB is the periodicity of SSB in the set . TDRX is the DRX cycle length. | |

Table 8.5.2.2-2: Evaluation period TEvaluate\_BFD\_SSB for FR2

|  |  |
| --- | --- |
| Configuration | TEvaluate\_BFD\_SSB (ms) |
| no DRX | Max(50, Ceil(5 × P × N) × TSSB) |
| DRX cycle ≤ 320ms | Max(50, Ceil(7.5 × P × N) × Max(TDRX,TSSB)) |
| DRX cycle > 320ms | Ceil(5 × P × N) × TDRX |
| Note: TSSB is the periodicity of SSB in the set . TDRX is the DRX cycle length. | |

Table 8.5.2.2-3: Evaluation period TEvaluate\_BFD\_SSB for FR2 power class 6 UE configured with *highSpeedMeasFlagFR2-r17*

|  |  |
| --- | --- |
| Configuration | TEvaluate\_BFD\_SSB (ms) |
| no DRX | Max(50, Ceil(5 × P × N Note2) × TSSB) |
| DRX cycle ≤ 80ms | Max(50, Ceil(7.5 × P × N Note2) × Max(TDRX,TSSB)) |
| Note 1: TSSB is the periodicity of SSB in the set . TDRX is the DRX cycle length.  Note 2: scaling factor N=2 when *highSpeedMeasFlagFR2-r17* is configured to set1 or scaling factor N=6 when *highSpeedMeasFlagFR2-r17* is configured to set2. | |

Table 8.5.2.2-4: Evaluation period TEvaluate\_BFD\_SSB for deactivated PSCell in FR1

|  |  |
| --- | --- |
| Configuration | TEvaluate\_BFD\_SSB (ms) |
| no DRX | Ceil(5 × P) × measCyclePscell |
| DRX cycle ≤ 320ms | Ceil(7.5 × P) × Max(measCyclePscell, TDRX) |
| DRX cycle > 320ms | Ceil(5 × P) × Max(measCyclePscell, TDRX) |
| Note: DRX cycle is the configured DRX cycle of the PSCell. measCyclePSCell is the measurement cycle length of the deactivated PSCell. | |

Table 8.5.2.2-5: Evaluation period TEvaluate\_BFD\_SSB for deactivated PSCell in FR2

|  |  |
| --- | --- |
| Configuration | TEvaluate\_BFD\_SSB (ms) |
| no DRX | Ceil(5 × P × N) × measCyclePscell |
| DRX cycle ≤ 320ms | Ceil(7.5 × P × N) × Max(measCyclePscell, TDRX) |
| DRX cycle > 320ms | Ceil(5 × P × N) × Max(measCyclePscell, TDRX) |
| Note: DRX cycle is the configured DRX cycle of the PSCell. measCyclePSCell is the measurement cycle length of the deactivated PSCell. | |

#### 8.5.2.3 Measurement restriction for SSB based beam failure detection

The UE is required to be capable of measuring SSB for BFD without measurement gaps. The UE is required to perform the SSB measurements with measurement restrictions as described in the following scenarios.

For FR1, when the SSB for BFD measurement is in the same OFDM symbol as CSI-RS for RLM, BFD, CBD or L1-RSRP measurement,

- If SSB and CSI-RS have same SCS, UE shall be able to measure the SSB for BFD measurement without any restriction;

- If SSB and CSI-RS have different SCS,

- If UE supports *simultaneousRxDataSSB-DiffNumerology*, UE shall be able to measure the SSB for BFD measurement without any restriction;

- If UE does not support *simultaneousRxDataSSB-DiffNumerology*, UE is required to measure one of but not both SSB for BFD measurement and CSI-RS. Longer measurement period for SSB based BFD measurement is expected, and no requirements are defined.

For FR2, when the SSB for BFD measurement on one CC is in the same OFDM symbol as CSI-RS for RLM, BFD, CBD or L1-RSRP measurement on the same CC or different CCs in the same band, UE is required to measure one of but not both SSB for BFD measurement and CSI-RS. Longer measurement period for SSB based BFD measurement is expected, and no requirements are defined.

For FR2, if the network configures same or mixed numerology between SSB for BFD measurement on one FR2 band and CSI-RS for RLM, BFD, CBD, L1-RSRP or L1-SINR measurement on the other FR2 band, UE shall be able to perform the related SSB based measurements in one band without any measurement restrictions on the other band, provided that UE is capable of independent beam management on this FR2 band pair.

#### 8.5.2.4 Minimum requirement of SSB based beam failure detection for UE fulfilling relaxed measurement criteria

This clause contains minimum requirements for SSB based relaxed beam failure detection.

UE shall be able to evaluate whether the downlink radio link quality on the configured SSB resource in set  estimated over the last TEvaluate\_BFD\_SSB\_Relax ms period becomes worse than the threshold Qout\_LR\_SSB within TEvaluate\_BFD\_SSB\_Relax ms period.

The value of TEvaluate\_BFD\_SSB\_Relax is defined in Table 8.5.2.4-1 for FR1.

The value of TEvaluate\_BFD\_SSB\_Relax is defined in Table 8.5.2.4-2 for FR2 with scaling factor N=8

The value of P is defined in clause 8.5.2.2.

Longer evaluation period would be expected if the combination of BFD-RS resource, SMTC occasion and measurement gap configurations does not meet pervious conditions.

For either an FR1 or FR2 serving cell, longer evaluation period would be expected during the period Tidentify\_CGI when the UE is requested to decode an NR CGI.

For either an FR1 or FR2 serving cell, longer BFD evaluation period would be expected during the period Tidentify\_CGI,E-UTRAN when the UE is requested to decode an LTE CGI.

Table 8.5.2.4-1: Evaluation period TEvaluate\_BFD\_SSB\_Relax for FR1

|  |  |
| --- | --- |
| **Configuration** | **TEvaluate\_BFD\_SSB\_Relax (ms)** |
| Max(TDRX, TSSB) ≤ 80 ms | Max(50 × K3, Ceil(7.5 × K1 × P) × Max(TDRX,TSSB)) |
| 80ms＜Max(TDRX, TSSB) ≤ 160 ms | Max(50, Ceil(7.5 × P) × Max(TDRX,TSSB)) |
| Note 1: TSSB is the periodicity of SSB in the set . TDRX is the DRX cycle length and no longer than 80ms.  Note 2: K1 is the relaxation factor. K1 = 2 for 40ms＜Max(TDRX, TSSB) ≤ 80 ms, K1 = 4 for Max(TDRX, TSSB) ≤ 40 ms  Note 3: K3 is the relaxation factor for the lower bound. K3 = K1, if 1 < K1 ≤ 2; K3 = 1 otherwise. | |

Table 8.5.2.4-2: Evaluation period TEvaluate\_BFD\_SSB\_Relax for FR2

|  |  |
| --- | --- |
| **Configuration** | **TEvaluate\_BFD\_SSB\_Relax (ms)** |
| Mas(TDRX, TSSB) ≤ 80 ms | Max(50 × K4, Ceil(7.5 × K2 × P × N) × Max(TDRX,TSSB)) |
| 80ms＜Max(TDRX, TSSB) ≤ 160 ms | Max(50, Ceil(7.5 × P× N) × Max(TDRX,TSSB)) |
| Note 1: TSSB is the periodicity of SSB in the set . TDRX is the DRX cycle length and no longer than 80ms.  Note 2: K2 is the relaxation factor. K2 = 2.  Note 3: K4 is the relaxation factor for the lower bound. K4 = K2, if 1 < K2 ≤ 2; K4 = 1 otherwise. | |

### 8.5.3 Requirements for CSI-RS based beam failure detection

#### 8.5.3.1 Introduction

The requirements in this clause apply for each CSI-RS resource in the set  of resource configurations for a serving cell, provided that the CSI-RS resource(s) in set for beam failure detection are actually transmitted within the UE active DL BWP during the entire evaluation period specified in clause 8.5.3.2. UE is not expected to perform beam failure detection measurements on the CSI-RS configured for BFD if the CSI-RS is not QCL-ed, with QCL-TypeD when applicable, with the RS in the active TCI state of any CORESET configured in the UE active BWP. The requirements in this clause apply when UE is required to perform beam failure detection on no more than 1 serving cell per band.

Table 8.5.3.1-1: PDCCH transmission parameters for beam failure instance

|  |  |
| --- | --- |
| Attribute | Value for BLER |
| DCI format | 1-0 |
| Number of control OFDM symbols | 2 |
| Aggregation level (CCE) | 8 |
| Ratio of hypothetical PDCCH RE energy to average CSI-RS RE energy | 0dB |
| Ratio of hypothetical PDCCH DMRS energy to average CSI-RS RE energy | 0dB |
| Bandwidth (PRBs) | 48 |
| Sub-carrier spacing (kHz) | SCS of the active DL BWP |
| DMRS precoder granularity | REG bundle size |
| REG bundle size | 6 |
| CP length | Normal |
| Mapping from REG to CCE | Distributed |

#### 8.5.3.2 Minimum requirement

UE shall be able to evaluate whether the downlink radio link quality on the CSI-RS resource in set  estimated over the last TEvaluate\_BFD\_CSI-RS ms period becomes worse than the threshold Qout\_LR\_CSI-RS within TEvaluate\_BFD\_CSI-RS ms period.

The value of TEvaluate\_BFD\_CSI-RS is defined in Table 8.5.3.2-1 or Table 8.5.3.2-3 (deactivated PSCell) for FR1.

The value of TEvaluate\_BFD\_CSI-RS is defined in Table 8.5.3.2-2 or Table 8.5.3.2-4 (deactivated PSCell) for FR2 with N=1. The requirements of TEvaluate\_BFD\_CSI-RS apply provided that the CSI-RS for BFD is not in a resource set configured with repetition ON. The requirements shall not apply when the CSI-RS resource in the active TCI state of CORESET is the same CSI-RS resource for BFD and the TCI state information of the CSI-RS resource is not given, wherein the TCI state information means QCL Type-D to SSB for L1-RSRP or CSI-RS with repetition ON.

When concurrent gaps are configured,

- P value for a BFD-RS resource to be measured is defined as

- Ntotal / Noutside\_MG in FR1

- Psharing factor \* Ntotal / Noutside\_MG in FR2 with Navailable = 0

- Ntotal / Navailable in FR2 with Navailable > 0

- For a window W of duration max(TL1, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE measurement gaps and per-FR measurement gaps within the same FR as serving cell, and starting at the beginning of any BFD-RS resource occasion:

- Ntotal is the total number of BFD-RS resource occasions within the window, including those overlapped with measurement gap occasions or SMTC occasions within the window, and

- Noutside\_MG is the number of BFD-RS resource occasions that are not overlapped with any measurement gap occasion within the window W

- Navailable is the number of BFD-RS resource occasions that are not overlapped with any measurement gap occasion nor any SMTC occasion within the window W

TL1 is periodicity of the target BFD-RS.

Otherwise, for a UE not supporting *concurrentMeasGap-r17* or when concurrent gaps are not configured,

For FR1,

- , when in the monitored cell there are GAPs configured for intra-frequency, inter-frequency or inter-RAT measurements, which are overlapping with some but not all occasions of the CSI-RS.

- P = 1 when in the monitored cell there are no GAPs overlapping with any occasion of the CSI-RS.

For FR2,

- P = 1, when the BFD-RS resource is not overlapped with GAP and also not overlapped with SMTC occasion.

- , when the BFD-RS resource is partially overlapped with GAP and the BFD-RS resource is not overlapped with SMTC occasion (TCSI-RS < xRP)

- , when the BFD-RS resource is not overlapped with GAP and the BFD-RS resource is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod).

- P = Psharing factor, when the BFD-RS resource is not overlapped with GAP and the BFD-RS resource is fully overlapped with SMTC occasion (TCSI-RS = TSMTCperiod).

- , when the BFD-RS resource is partially overlapped with GAP and the BFD-RS resource is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is not overlapped with GAP and

- TSMTCperiod ≠ xRP or

- TSMTCperiod = xGRP and TCSI-RS < 0.5 × TSMTCperiod

- , when the BFD-RS resource is partially overlapped with GAP and the BFD-RS resource is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is not overlapped with GAP and TSMTCperiod = xRP and TCSI-RS = 0.5 × TSMTCperiod

- , when the BFD-RS resource is partially overlapped with GAP (TCSI-RS < xRP) and the BFD-RS resource is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is partially or fully overlapped with GAP.

- , when the BFD-RS resource is partially overlapped with [measurement gap] and the BFD-RS resource is fully overlapped with SMTC occasion (TCSI-RS = TSMTCperiod) and SMTC occasion is partially overlapped with GAP (TSMTCperiod < xRP)

where,

- Psharing factor = 1, if the BFD-RS resource outside gap is

- not overlapped with the SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol before each consecutive SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol after each consecutive SSB symbols indicated by *SSB-ToMeasure*, given that *SSB-ToMeasure* is configured, where the *SSB-ToMeasure* is the union set of *SSB-ToMeasure* from all the configured measurement objects merged on the same serving carrier, and,

- not overlapped by the RSSI symbols indicated by *ss-RSSI-Measurement* and 1 data symbol before each RSSI symbol indicated by *ss-RSSI-Measurement* and 1 data symbol after each RSSI symbol indicated by *ss-RSSI-Measurement*, given that *ss-RSSI-Measurement* is configured.

- Psharing factor = 3, otherwise.

- If the high layer in TS 38.331 [2] signaling of *smtc2* is configured, TSMTCperiod corresponds to the value of higher layer parameter *smtc2*; Otherwise TSMTCperiod corresponds to the value of higher layer parameter *smtc1*. TSMTCperiod is the shortest SMTC period among all CCs in the same FR2 band, provided the SMTC offset of all CCs in FR2 have the same offset.

- When a measurement gap is configured and the measurement gap is not NCSG,

- a BFD-RS resource or an SMTC occasion is considered to be overlapped with the GAP if it overlaps a measurement gap occasion, and

- xRP = MGRP

- Otherwise, when NCSG measurement gap is configured,

- a BFD-RS resource or an SMTC occasion is considered to be overlapped with the GAP if

- it overlaps the VIL1 or VIL2 of NCSG, or

- it overlaps the ML of NCSG in FR2, and there exists a target carrier to be measured within NCSG that is intra-frequency carrier or inter-frequency carrier in the same band as the serving cell, or inter-frequency carrier in different band as the serving cell and UE does not support IBM between the target carrier and the serving cell,

- and

- xRP = VIRP

- If the UE is configured with Pre-MG, a BFD-RS resource or an SMTC occasion is only considered to be overlapped by the Pre-MG if the Pre-MG is activated.

- When concurrent gaps are configured, a BFD-RS or an SMTC occasion is not considered to be overlapped by a gap occasion if the gap occasion is dropped according to 9.1.8.

Note: The overlap between CSI-RS for BFD and SMTC means that CSI-RS for BFD is within the SMTC window duration.

Longer evaluation period would be expected if the combination of the BFD-RS resource, SMTC occasion and GAP configurations does not meet pervious conditions.

For either an FR1 or FR2 serving cell, longer evaluation period would be expected during the period Tidentify\_CGI when the UE is requested to decode an NR CGI.

For either an FR1 or FR2 serving cell, longer BFD evaluation period would be expected during the period Tidentify\_CGI,E-UTRAN when the UE is requested to decode an LTE CGI.

The values of MBFD used in Table 8.5.3.2-1 and Table 8.5.3.2-2 are defined as

- MBFD = 10, if the CSI-RS resource(s) in set  used for BFD is transmitted with Density = 3 and over the bandwidth ≥ 24 PRBs.

The values of PBFD used in Table 8.5.3.2-1 and Table 8.5.3.2-2 are defined as

For each CSI-RS resource in the set  configured for PCell or PSCell in EN-DC or NE-DC or SA; or PCell in NR-DC

- PBFD = 1.

For each CSI-RS resource in the set  configured for PSCell in NR-DC

- PBFD = 2 if UE is configured for beam failure detection on SCell, 1 otherwise.

For each CSI-RS resource in the set  configured for a SCell

- PBFD = Z in EN-DC or NE-DC or SA.

- PBFD = 2\* Z in NR-DC.

- Where Z is the number of band(s) on which UE is performing beam failure detection only for SCell.

Table 8.5.3.2-1: Evaluation period TEvaluate\_BFD\_CSI-RS for FR1

|  |  |
| --- | --- |
| Configuration | TEvaluate\_BFD\_CSI-RS (ms) |
| no DRX | Max(50, Ceil(MBFD × P × PBFD) × TCSI-RS) |
| DRX cycle ≤ 320ms | Max(50, Ceil(1.5 × MBFD × P × PBFD) × Max(TDRX, TCSI-RS)) |
| DRX cycle > 320ms | Ceil(MBFD × P × PBFD) × TDRX |
| Note: TCSI-RS is the periodicity of CSI-RS resource in the set . TDRX is the DRX cycle length. | |

Table 8.5.3.2-2: Evaluation period TEvaluate\_BFD\_CSI-RS for FR2

|  |  |
| --- | --- |
| Configuration | TEvaluate\_BFD\_CSI-RS (ms) |
| no DRX | Max(50, Ceil(MBFD × P × N × PBFD) × TCSI-RS) |
| DRX cycle ≤ 320ms | Max(50, Ceil(1.5 × MBFD × P × N × PBFD) × Max(TDRX, TCSI-RS)) |
| DRX cycle > 320ms | Ceil(MBFD × P × N × PBFD) × TDRX |
| Note: TCSI-RS is the periodicity of CSI-RS resource in the set . TDRX is the DRX cycle length. | |

Table 8.5.3.2-3: Evaluation period TEvaluate\_BFD\_CSI-RS for deactivated PSCell in FR1

|  |  |
| --- | --- |
| **Configuration** | **TEvaluate\_BFD\_CSI-RS (ms)** |
| no DRX | Ceil(MBFD × P × PBFD) × measCyclePscell |
| DRX cycle ≤ 320ms | Ceil(1.5 × MBFD × P × PBFD) × Max(TDRX, measCyclePscell) |
| DRX cycle > 320ms | Ceil(MBFD × P × PBFD) × Max(TDRX, measCyclePscell) |
| Note: DRX cycle is the configured DRX cycle of the PSCell. measCyclePSCell is the measurement cycle length of the deactivated PSCell. | |

Table 8.5.3.2-4: Evaluation period TEvaluate\_BFD\_CSI-RS for deactivated PSCell in FR2

|  |  |
| --- | --- |
| **Configuration** | **TEvaluate\_BFD\_CSI-RS (ms)** |
| no DRX | Ceil(MBFD × P × N × PBFD) × measCyclePscell |
| DRX cycle ≤ 320ms | Ceil(1.5 × MBFD × P × N × PBFD) × Max(TDRX, measCyclePscell) |
| DRX cycle > 320ms | Ceil(MBFD × P × N × PBFD) × Max(TDRX, measCyclePscell) |
| Note: DRX cycle is the configured DRX cycle of the PSCell. measCyclePSCell is the measurement cycle length of the deactivated PSCell. | |

#### 8.5.3.3 Measurement restrictions for CSI-RS beam failure detection

The UE is required to be capable of measuring CSI-RS for BFD without measurement gaps. The UE is required to perform the CSI-RS measurements with measurement restrictions as described in the following scenarios.

For both FR1 and FR2, when the CSI-RS for BFD measurement is in the same OFDM symbol as SSB for RLM, BFD, CBD or L1-RSRP measurement, UE is not required to receive CSI-RS for BFD measurement in the PRBs that overlap with an SSB.

For FR1, when the SSB for RLM, BFD, CBD or L1-RSRP measurement is within the active BWP and has same SCS than CSI-RS for BFD measurement, the UE shall be able to perform CSI-RS measurement without restrictions.

For FR1, when the SSB for RLM, BFD, CBD or L1-RSRP measurement is within the active BWP and has different SCS than CSI-RS for BFD measurement, the UE shall be able to perform CSI-RS measurement with restrictions according to its capabilities:

- If the UE supports *simultaneousRxDataSSB-DiffNumerology* the UE shall be able to perform CSI-RS measurement without restrictions.

- If the UE does not support *simultaneousRxDataSSB-DiffNumerology*, UE is required to measure one of but not both CSI-RS for BFD measurement and SSB. Longer measurement period for CSI-RS based BFD measurement is expected, and no requirements are defined.

For FR1, when the CSI-RS for BFD measurement is in the same OFDM symbol as another CSI-RS for RLM, BFD, CBD or L1-RSRP measurement, UE shall be able to measure the CSI-RS for BFD measurement without any restriction.

For FR2, when the CSI-RS for BFD measurement on one CC is in the same OFDM symbol as SSB for RLM, BFD or L1-RSRP measurement on the same CC or different CCs in the same band, or in the same symbol as SSB for CBD measurement on the same CC or different CCs in the same band when beam failure is detected, UE is required to measure one of but not both CSI-RS for BFD measurement and SSB. Longer measurement period for CSI-RS based BFD measurement is expected, and no requirements are defined.

For FR2, when the CSI-RS for BFD measurement on one CC is in the same OFDM symbol as another CSI-RS for RLM, BFD, CBD or L1-RSRP measurement on the same CC or different CCs in the same band,

- In the following cases, UE is required to measure one of but not both CSI-RS for BFD measurement and the other CSI-RS. Longer measurement period for CSI-RS based BFD measurement is expected, and no requirements are defined.

- The CSI-RS for BFD measurement or the other CSI-RS in a resource set configured with repetition ON, or

- The other CSI-RS is configured in set  and beam failure is detected, or

- The two CSI-RS-es are not QCL-ed w.r.t. QCL-TypeD, or the QCL information is not known to UE,

- Otherwise, UE shall be able to measure the CSI-RS for BFD measurement without any restriction.

#### 8.5.3.4 Minimum requirement of CSI-RS based beam failure detection for UE fulfilling relaxed measurement criteria

This clause contains the minimum requirements for CSI-RS based relaxed beam failure detection.

UE shall be able to evaluate whether the downlink radio link quality on the CSI-RS resource in set  estimated over the last TEvaluate\_BFD\_CSI-RS\_Relax ms period becomes worse than the threshold Qout\_LR\_CSI-RS within TEvaluate\_BFD\_CSI-RS\_Relax ms period.

The value of TEvaluate\_BFD\_CSI-RS\_Relax is defined in Table 8.5.3.4-1 for FR1.

The value of TEvaluate\_BFD\_CSI-RS\_Relax is defined in Table 8.5.3.4-2 for FR2 with N=1.

The values of P, MBFD and PBFD is defined in clause 8.5.3.2.

Longer evaluation period would be expected if the combination of RLM-RS resource, SMTC occasion and measurement gap configurations does not meet previous conditions.

For either an FR1 or FR2 serving cell, longer evaluation period would be expected during the period Tidentify\_CGI when the UE is requested to decode an NR CGI.

For either an FR1 or FR2 serving cell, longer evaluation period would be expected during the period Tidentify\_CGI,E-UTRAN when the UE is requested to decode an LTE CGI.

Table 8.5.3.4-1: Evaluation period TEvaluate\_BFD\_CSI-RS\_Relax for FR1

|  |  |
| --- | --- |
| **Configuration** | **TEvaluate\_BFD\_CSI-RS Relax (ms)** |
| Max(TDRX, TCSI-RS) ≤ 80 ms | Max(50 × K3, Ceil(K1 × 1.5 × MBFD × P × PBFD) × Max(TDRX, TCSI-RS)) |
| Note 1: TCSI-RS is the periodicity of CSI-RS resource in the set . TDRX is the DRX cycle length and no longer than 80ms.  Note 2: K1 is the relaxation factor. K1 = 2 for 40 ms < MAX(TDRX, TCSI-RS) ≤ 80 ms, K1 = 4 for MAX(TDRX, TCSI-RS) ≤ 40 ms  Note 3: K3 is the relaxation factor for the lower bound. K3 = K1, if 1 < K1 ≤ 2; K3 = 1 otherwise. | |

Table 8.5.3.4-2: Evaluation period TEvaluate\_BFD\_CSI-RS\_Relax for FR2

|  |  |
| --- | --- |
| **Configuration** | **TEvaluate\_BFD\_CSI-RS Relax (ms)** |
| Max(TDRX, TCSI-RS) ≤ 80ms | Max(50 × K4, Ceil(K2 × 1.5 × MBFD × P× N × PBFD) × Max(TDRX, TCSI-RS)) |
| Note 1: TCSI-RS is the periodicity of CSI-RS resource in the set . TDRX is the DRX cycle length and no longer than 80ms.  Note 2: K2 is the relaxation factor. K2 = 2  Note 3: K4 is the relaxation factor for the lower bound. K4 = K2, if 1 < K2 ≤ 2; K4 = 1 otherwise. | |

### 8.5.4 Minimum requirement for L1 indication

When the radio link quality on all the RS resources in set  is worse than Qout\_LR, layer 1 of the UE shall send a beam failure instance indication to the higher layers

The beam failure instance evaluation for the RS resources in set  shall be performed as specified in clause 6 in TS 38.213 [3]. Two successive indications from layer 1 shall be separated by at least TIndication\_interval\_BFD.

When DRX is not used, TIndication\_interval\_BFD is max(2ms, TSSB-RS,M) ) or max(2ms, TCSI-RS,M), where TSSB-RS,M and TCSI-RS,M is the shortest periodicity of all RS resources in set  for the accessed cell, corresponding to either the shortest periodicity of the SSB in the set  or CSI-RS resource in the set .

When DRX is used, for SSB based link quality measurement,

- TIndication\_interval\_BFD = Max(1.5 × DRX\_cycle\_length, 1.5 × TSSB-RS,M), if DRX\_cycle\_length ≤ 320ms,

- TIndication\_interval\_BFD = DRX\_cycle\_length, if DRX\_cycle\_length > 320ms.

When DRX is used, for CSI-RS based link quality measurement,

- TIndication\_interval\_BFD = Max(1.5 × DRX\_cycle\_length, 1.5 × TCSI-RS,M), if DRX\_cycle\_length ≤ 320ms,

- TIndication\_interval\_BFD = DRX\_cycle\_length, if DRX\_cycle\_length > 320ms.

For deactivated PSCell,

when DRX is not used, TIndication\_interval\_BFD is Max (2ms, *measCyclePSCell*).

when DRX is used, for SSB based link quality measurement,

- TIndication\_interval\_BFD = Max (1.5 × DRX\_cycle\_length, 1.5 × *measCyclePSCell*), if DRX\_cycle\_length ≤ 320ms,

- TIndication\_interval\_BFD = Max (DRX\_cycle\_length, *measCyclePSCell*), if DRX\_cycle\_length > 320ms.

When DRX is used, for CSI-RS based link quality measurement,

- TIndication\_interval\_BFD = Max (1.5 × DRX\_cycle\_length, 1.5 × *measCyclePSCell*), if DRX\_cycle\_length ≤ 320ms,

- TIndication\_interval\_BFD = Max (DRX\_cycle\_length, *measCyclePSCell*), if DRX\_cycle\_length > 320ms.

### 8.5.5 Requirements for SSB based candidate beam detection

#### 8.5.5.1 Introduction

The requirements in this clause apply for each SSB resource in the set  configured for a serving cell, provided that the SSBs configured for candidate beam detection are actually transmitted within UE active DL BWP during the entire evaluation period specified in clause 8.5.5.2. The requirements in this clause apply when UE is required to perform beam failure detection on no more than 1 serving cell per band.

#### 8.5.5.2 Minimum requirement

Upon request the UE shall be able to evaluate whether the L1-RSRP measured on the configured SSB resource in set  estimated over the last TEvaluate\_CBD\_SSB ms period becomes better than the threshold Qin\_LR provided SSB\_RP and SSB Ês/Iot are according to Annex Table B.2.4.1 for a corresponding band.

The UE shall monitor the configured SSB resources using the evaluation period in table 8.5.5.2-1 and 8.5.5.2-2 corresponding to the non-DRX mode, if the configured DRX cycle ≤ 320ms.

The value of TEvaluate\_CBD\_SSB is defined in Table 8.5.5.2-1 for FR1.

The value of TEvaluate\_CBD\_SSB is defined in Table 8.5.5.2-2 for FR2 with scaling factor N=8 for FR2-1 and N=12 for FR2-2.

When concurrent gaps are configured,

- P value for a CBD-RS resource to be measured is defined as

- Ntotal / Noutside\_MG in FR1

- Psharing factor \* Ntotal / Noutside\_MG in FR2 with Navailable = 0

- Ntotal / Navailable in FR2 with Navailable > 0

- For a window W of duration max(TL1, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE measurement gaps and per-FR measurement gaps within the same FR as serving cell, and starting at the beginning of any CBD-RS resource occasion:

- Ntotal is the total number of CBD-RS resource occasions within the window, including those overlapped with measurement gap occasions or SMTC occasions within the window, and

- Noutside\_MG is the number of CBD-RS resource occasions that are not overlapped with any measurement gap occasion within the window W

- Navailable is the number of CBD-RS resource occasions that are not overlapped with any measurement gap occasion nor any SMTC occasion within the window W

- TL1 is periodicity of the target CBD-RS.

Otherwise, for a UE not supporting *concurrentMeasGap-r17* or when concurrent gaps are not configured,

For FR1,

- , when in the monitored cell there are GAPs configured for intra-frequency, inter-frequency or inter-RAT measurements, which are overlapping with some but not all occasions of the SSB,

- P = 1 when in the monitored cell there are no GAPs overlapping with any occasion of the SSB.

For FR2,

- , when candidate beam detection RS is not overlapped with GAP and candidate beam detection RS is partially overlapped with SMTC occasion (TSSB < TSMTCperiod).

- P is Psharing factor, when candidate beam detection RS is not overlapped with GAP and candidate beam detection RS is fully overlapped with SMTC period (TSSB = TSMTCperiod).

- , when candidate beam detection RS is partially overlapped with GAP and candidate beam detection RS is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with GAP and

- TSMTCperiod ≠ xRP or

- TSMTCperiod = xRP and TSSB < 0.5 × TSMTCperiod

- , when candidate beam detection RS is partially overlapped with GAP and candidate beam detection RS is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with GAP and TSMTCperiod = xRP and TSSB = 0.5 × TSMTCperiod

- , when candidate beam detection RS is partially overlapped with GAP and candidate beam detection RS is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is partially or fully overlapped with GAP

- , when candidate beam detection RS is partially overlapped with [measurement gap] and candidate beam detection RS is fully overlapped with SMTC occasion (TSSB = TSMTCperiod) and SMTC occasion is partially overlapped with GAP (TSMTCperiod < xRP)

where,

- Psharing factor = 1, if the CBD-RS resource outside gap is

- not overlapped with the SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol before each consecutive SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol after each consecutive SSB symbols indicated by *SSB-ToMeasure*, given that *SSB-ToMeasure* is configured, where the *SSB-ToMeasure* is the union set of *SSB-ToMeasure* from all the configured measurement objects merged on the same serving carrier, and,

- not overlapped by the RSSI symbols indicated by *ss-RSSI-Measurement* and 1 data symbol before each RSSI symbol indicated by *ss-RSSI-Measurement* and 1 data symbol after each RSSI symbol indicated by *ss-RSSI-Measurement*, given that *ss-RSSI-Measurement* is configured.

- Psharing factor = 3, otherwise.

- If the high layer in TS 38.331 [2] signaling of *smtc2*is present, TSMTCperiod follows *smtc2*; Otherwise TSMTCperiod follows *smtc1.* TSMTCperiod is the shortest SMTC period among all CCs in the same FR2 band, provided the SMTC offset of all CCs in FR2 have the same offset.

- If the UE is configured with Pre-MG, a CBD-RS resource or an SMTC occasion is only considered to be overlapped by the Pre-MG if the Pre-MG is activated.

- When a measurement gap is configured and the measurement gap is not NCSG,

- a CBD-RS resource or an SMTC occasion is considered to be overlapped with the GAP if it overlaps a measurement gap occasion, and

- xRP = MGRP

- Otherwise, when NCSG is measurement gap configured,

- a CBD-RS resource or an SMTC occasion is considered to be overlapped with the GAP if

- it overlaps the VIL1 or VIL2 of NCSG, or

- it overlaps the ML of NCSG in FR2, and there exists a target carrier to be measured within NCSG that is intra-frequency carrier or inter-frequency carrier in the same band as the serving cell, or inter-frequency carrier in different band as the serving cell and UE does not support IBM between the target carrier and the serving cell,

- and

- xRP = VIRP

- When concurrent gaps are configured, a CBD-RS or an SMTC occasion is not considered to be overlapped by a gap occasion if the gap occasion is dropped according to 9.1.8.

Longer evaluation period would be expected if the combination of the CBD-RS resource, SMTC occasion and GAP configurations does not meet pervious conditions.

For either an FR1 or FR2 serving cell, longer evaluation period would be expected during the period Tidentify\_CGI when the UE is requested to decode an NR CGI.

For either an FR1 or FR2 serving cell, longer CBD evaluation period would be expected during the period Tidentify\_CGI,E-UTRAN when the UE is requested to decode an LTE CGI.

The values of PCBD used in Table 8.5.5.2-1 and Table 8.5.5.2-2 are defined as

For each SSB resource in the set  configured for PCell or PSCell in EN-DC or NE-DC or SA; or PCell in NR-DC

- PCBD = 1.

For each SSB resource in the set  configured for PSCell in NR-DC

- PCBD = 2 if UE is configured for candidate beam detection on SCell, 1 otherwise.

For each SSB resource in the set  configured for a SCell

- PCBD = Z in EN-DC or NE-DC or SA.

- PCBD = 2\* Z in NR-DC.

- Where Z is the number of band(s) on which UE is performing beam failure detection only for SCell

- PCBD is the number of band(s) on which UE is performing candidate beam detection only for SCell.

Table 8.5.5.2-1: Evaluation period TEvaluate\_CBD\_SSB for FR1

|  |  |
| --- | --- |
| **Configuration** | **TEvaluate\_CBD\_SSB (ms)** |
| non-DRX, DRX cycle ≤ 320ms | Max(25, Ceil(3 × P × PCBD) × TSSB) |
| DRX cycle > 320ms | Ceil(3 × P × PCBD) × TDRX |
| Note: TSSB is the periodicity of SSB in the set . TDRX is the DRX cycle length. | |

Table 8.5.5.2-2: Evaluation period TEvaluate\_CBD\_SSB for FR2

|  |  |
| --- | --- |
| **Configuration** | **TEvaluate\_CBD\_SSB (ms)** |
| non-DRX, DRX cycle ≤ 320ms | Max(25, Ceil(3 × P × N × PCBD) × TSSB) |
| DRX cycle > 320ms | Ceil(3 × P × N × PCBD) × TDRX |
| Note: TSSB is the periodicity of SSB in the set . TDRX is the DRX cycle length. | |

#### 8.5.5.3 Measurement restriction for SSB based candidate beam detection

For FR1, when the SSB for CBD measurement is in the same OFDM symbol as CSI-RS for RLM, BFD, CBD or L1-RSRP measurement,

- If SSB and CSI-RS have same SCS, UE shall be able to measure the SSB for CBD measurement without any restrictions;

- If SSB and CSI-RS have different SCS-es,

- If UE supports *simultaneousRxDataSSB-DiffNumerology*, UE shall be able to measure the SSB for CBD measurement without any restriction;

- If UE does not support *simultaneousRxDataSSB-DiffNumerology*, UE is required to measure one of but not both SSB for CBD measurement and CSI-RS. Longer measurement period for SSB based CBD measurement is expected, and no requirements are defined.

For FR2, when the SSB for CBD measurement on one CC is in the same OFDM symbol as CSI-RS for RLM, BFD, CBD or L1-RSRP measurement on the same CC or different CCs in the same band, UE is required to measure one of but not both SSB for CBD measurement and CSI-RS. Longer measurement period for SSB based CBD measurement is expected, and no requirements are defined.

For FR2, if network configures same or mixed numerology between SSB for CBD measurement on one FR2 band and CSI-RS for RLM, BFD, CBD, L1-RSRP or L1-SINR measurement on the other FR2 band, UE shall be able to perform the related SSB based measurements in one band without any measurement restrictions in the other band, provided that UE is capable of independent beam management on this FR2 band pair.

### 8.5.6 Requirements for CSI-RS based candidate beam detection

#### 8.5.6.1 Introduction

The requirements in this clause apply for each CSI-RS resource in the set  configured for a serving cell, provided that the CSI-RS resources configured for candidate beam detection are actually transmitted within UE active DL BWP during the entire evaluation period specified in clause 8.5.6.2. The requirements in this clause apply when UE is required to perform beam failure detection on no more than 1 serving cell per band.

#### 8.5.6.2 Minimum requirement

Upon request the UE shall be able to evaluate whether the L1-RSRP measured on the configured CSI-RS resource in set  estimated over the last TEvaluate\_CBD\_CSI-RS [ms] period becomes better than the threshold Qin\_LR within TEvaluate\_CBD\_CSI-RS [ms] period provided CSI-RS Ês/Iot is according to Annex Table B.2.4.2 for a corresponding band.

The UE shall monitor the configured CSI-RS resources using the evaluation period in table 8.5.6.2-1 and 8.5.6.2-2 corresponding to the non-DRX mode, if the configured DRX cycle ≤ 320ms.

The value of TEvaluate\_CBD\_CSI-RS is defined in Table 8.5.6.2-1 for FR1.

The value of TEvaluate\_CBD\_CSI-RS is defined in Table 8.5.6.2-2 for FR2 with scaling factor N=8 for FR2-1 and N=12 for FR2-2.

When concurrent gaps are configured,

- P value for a CBD-RS resource to be measured is defined as

- Ntotal / Noutside\_MG in FR1

- Psharing factor \* Ntotal / Noutside\_MG in FR2 with Navailable = 0

- Ntotal / Navailable in FR2 with Navailable > 0

- For a window W of duration max(TL1, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE measurement gaps and per-FR measurement gaps within the same FR as serving cell, and starting at the beginning of any CBD-RS resource occasion:

- Ntotal is the total number of CBD-RS resource occasions within the window, including those overlapped with measurement gap occasions or SMTC occasions within the window, and

- Noutside\_MG is the number of CBD-RS resource occasions that are not overlapped with any measurement gap occasion within the window W

- Navailable is the number of CBD-RS resource occasions that are not overlapped with any measurement gap occasion nor any SMTC occasion within the window W

- TL1 is periodicity of the target CBD-RS.

Otherwise, for a UE not supporting *concurrentMeasGap-r17* or when concurrent gaps are not configured,

For FR1,

- , when in the monitored cell there are GAPs configured for intra-frequency, inter-frequency or inter-RAT measurements, which are overlapping with some but not all occasions of the CSI-RS; and

- P = 1 when in the monitored cell there are no GAPs overlapping with any occasion of the CSI-RS.

For FR2,

- P = 1, when candidate beam detection RS is not overlapped with GAP and also not overlapped with SMTC occasion.

- when candidate beam detection RS is partially overlapped with GAP and candidate beam detection RS is not overlapped with SMTC occasion (TCSI-RS < xRP)

- , when candidate beam detection RS is not overlapped with GAP and candidate beam detection RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod).

- P =Psharing factor, when candidate beam detection RS is not overlapped with GAP and candidate beam detection RS is fully overlapped with SMTC occasion (TCSI-RS = TSMTCperiod).

- ,, when candidate beam detection RS is partially overlapped with GAP and candidate beam detection RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is not overlapped with GAP and

- TSMTCperiod ≠ xRP or

- TSMTCperiod = xRP and TCSI-RS < 0.5 × TSMTCperiod

- , when candidate beam detection RS is partially overlapped with GAP and candidate beam detection RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is not overlapped with GAP and TSMTCperiod = xRP and TCSI-RS = 0.5 × TSMTCperiod

- , when candidate beam detection RS is partially overlapped with GAP and candidate beam detection RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is partially or fully overlapped with GAP

- ,, when candidate beam detection RS is partially overlapped with GAP and candidate beam detection RS is fully overlapped with SMTC occasion (TCSI-RS = TSMTCperiod) and SMTC occasion is partially overlapped with GAP (TSMTCperiod < xRP)

where,

- Psharing factor = 1, if the CBD-RS resource outside gap is

- not overlapped with the SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol before each consecutive SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol after each consecutive SSB symbols indicated by *SSB-ToMeasure*, given that *SSB-ToMeasure* is configured, where the *SSB-ToMeasure* is the union set of *SSB-ToMeasure* from all the configured measurement objects merged on the same serving carrier, and,

- not overlapped by the RSSI symbols indicated by *ss-RSSI-Measurement* and 1 data symbol before each RSSI symbol indicated by *ss-RSSI-Measurement* and 1 data symbol after each RSSI symbol indicated by *ss-RSSI-Measurement*, given that *ss-RSSI-Measurement* is configured.

- Psharing factor = 3, otherwise.

- If the high layer in TS 38.331 [2] signaling of *smtc2* is present, TSMTCperiod follows *smtc2*; Otherwise TSMTCperiod follows *smtc1*. TSMTCperiod is the shortest SMTC period among all CCs in the same FR2 band, provided the SMTC offset of all CCs in FR2 have the same offset.

- If the UE is configured with Pre-MG, a CBD-RS resource or an SMTC occasion is only considered to be overlapped by the Pre-MG if the Pre-MG is activated.

- When a measurement gap is configured and the measurement gap is not NCSG,

- a CBD-RS resource or an SMTC occasion is considered to be overlapped with the GAP if it overlaps the measurement gap occasion, and

- xRP = MGRP

- Otherwise, when NCSG measurement gap is configured,

- a CBD-RS resource or an SMTC occasion is considered to be overlapped with the GAP if

- it overlaps the VIL1 or VIL2 of NCSG, or

- it overlaps the ML of NCSG in FR2, and there exists a target carrier to be measured within NCSG that is intra-frequency carrier or inter-frequency carrier in the same band as the serving cell, or inter-frequency carrier in different band as the serving cell and UE does not support IBM between the target carrier and the serving cell,

- and

- xRP = VIRP

- When concurrent gaps are configured, a CBD-RS or an SMTC occasion is not considered to be overlapped by a gap occasion if the gap occasion is dropped according to 9.1.8.

Note: The overlap between CSI-RS for CBD and SMTC means that CSI-RS for CBD is within the SMTC window duration.

Longer evaluation period would be expected if the combination of the CBD-RS resource, SMTC occasion and [measurement gap] configurations does not meet pervious conditions.

Longer evaluation period would be expected if the CSI-RS is on the same OFDM symbols with RLM, BFD, BM-RS, or other CBD-RS, according to the measurement restrictions defined in clause 8.5.6.3.

For either an FR1 or FR2 serving cell, longer evaluation period would be expected during the period Tidentify\_CGI when the UE is requested to decode an NR CGI.

For either an FR1 or FR2 serving cell, longer CBD evaluation period would be expected during the period Tidentify\_CGI,E-UTRAN when the UE is requested to decode an LTE CGI.

The values of MCBD used in Table 8.5.6.2-1 and Table 8.5.6.2-2 are defined as

- MCBD = 3, if the CSI-RS resource configured in the set  is transmitted with Density = 3 and over the bandwidth ≥ 24 PRBs.

The values of PCBD used in Table 8.5.6.2-1 and Table 8.5.6.2-2 are defined as

- For each CSI-RS resource in the set  configured for PCell or PSCell in EN-DC or NE-DC or SA; or PCell in NR-DC

- PCBD = 1.

- For each CSI-RS resource in the set  configured for PSCell in NR-DC

- PCBD = 2 if UE configured for candidate beam detection on SCell, 1 otherwise.

- For each CSI-RS resource in the set  configured for a SCell

- PCBD = Z in EN-DC or NE-DC or SA.

- PCBD = 2\* Z in NR-DC.

- Where Z is the number of band(s) on which UE is performing beam failure detection only for SCell

- PCBD is the number of band(s) on which UE is performing candidate beam detection only for SCell.

Table 8.5.6.2-1: Evaluation period TEvaluate\_CBD\_CSI-RS for FR1

|  |  |
| --- | --- |
| **Configuration** | **TEvaluateC\_CBD\_CSI-RS (ms)** |
| non-DRX, DRX cycle ≤ 320ms | Max(25, Ceil(MCBD × P × PCBD) × TCSI-RS) |
| DRX cycle > 320ms | Ceil(MCBD × P × PCBD) × TDRX |
| Note: TCSI-RS is the periodicity of CSI-RS resource in the set . TDRX is the DRX cycle length. | |

Table 8.5.6.2-2: Evaluation period TEvaluate\_CBD\_CSI-RS for FR2

|  |  |
| --- | --- |
| **Configuration** | **TEvaluate\_CBD\_CSI-RS (ms)** |
| non-DRX, DRX cycle ≤ 320ms | Max(25, Ceil(MCBD × P × N × PCBD) × TCSI-RS) |
| DRX cycle > 320ms | Ceil(MCBD × P × N × PCBD) × TDRX |
| Note: TCSI-RS is the periodicity of CSI-RS resource in the set . TDRX is the DRX cycle length. | |

#### 8.5.6.3 Measurement restriction for CSI-RS based candidate beam detection

For both FR1 and FR2, when the CSI-RS for CBD measurement is in the same OFDM symbol as SSB for RLM, BFD, CBD or L1-RSRP measurement, UE is not required to receive CSI-RS for CBD measurement in the PRBs that overlap with an SSB.

For FR1, when the SSB for RLM, BFD, CBD or L1-RSRP measurement is within the active BWP and has same SCS than CSI-RS for CBD measurement, the UE shall be able to perform CSI-RS based CBD measurement without restrictions.

For FR1, when the SSB for RLM, BFD, CBD or L1-RSRP measurement is within the active BWP and has different SCS than CSI-RS for CBD measurement, the UE shall be able to perform CSI-RS based CBD measurement with restrictions according to its capabilities:

- If the UE supports *simultaneousRxDataSSB-DiffNumerology* the UE shall be able to perform CSI-RS based CBD measurement for without restrictions.

- If the UE does not support *simultaneousRxDataSSB-DiffNumerology*, UE is required to measure one of but not both CSI-RS for CBD measurement and SSB. Longer measurement period for CSI-RS based CBD measurement is expected, and no requirements are defined.

For FR1, when the CSI-RS for CBD measurement is in the same OFDM symbol as another CSI-RS for RLM, BFD, CBD or L1-RSRP measurement, UE shall be able to measure the CSI-RS for CBD measurement without any restriction.

For FR2, when the CSI-RS for CBD measurement on one CC is in the same OFDM symbol as SSB for RLM, BFD, CBD or L1-RSRP measurement on the same CC or different CCs in the same band, UE is required to measure one of but not both CSI-RS for CBD measurement and SSB. Longer evaluation period for CSI-RS based CBD measurement is expected, and no requirements are defined.

For FR2, when the CSI-RS for CBD measurement on one CC is in the same OFDM symbol as another CSI-RS for RLM, BFD, CBD or L1-RSRP measurement on the same CC or different CCs in the same band, UE is required to measure one of but not both CSI-RS for CBD measurement and the other CSI-RS. Longer evaluation period for CSI-RS based CBD measurement is expected, and no requirements are defined.

### 8.5.7 Scheduling availability of UE during beam failure detection

Scheduling availability restrictions when the UE is performing beam failure detection are described in the following clauses.

#### 8.5.7.1 Scheduling availability of UE performing beam failure detection with a same subcarrier spacing as PDSCH/PDCCH on FR1

There are no scheduling restrictions due to beam failure detection performed on SSB and CSI-RS configured for BFD with the same SCS as PDSCH or PDCCH in FR1.

#### 8.5.7.2 Scheduling availability of UE performing beam failure detection with a different subcarrier spacing than PDSCH/PDCCH on FR1

For UEs which support *simultaneousRxDataSSB-DiffNumerology* [14] there are no restrictions on scheduling availability due to beam failure detection when SSB is configured as BFD. For UEs which do not support *simultaneousRxDataSSB-DiffNumerology* [14] the following restrictions apply due to beam failure detection when SSB is configured as BFD.

- The UE is not expected to transmit PUCCH, PUSCH or SRS or receive PDCCH, PDSCH or CSI-RS for tracking or CSI-RS for CQI on SSB symbols to be measured for beam failure detection.

When intra-band carrier aggregation in FR1 is configured, the scheduling restrictions on FR1 serving PCell or PSCell apply to all serving cells in the same band on the symbols that fully or partially overlap with restricted symbols. When inter-band carrier aggregation within FR1 is configured, there are no scheduling restrictions on FR1 serving cell(s) configured in other bands than the bands in which PCell or PSCell is configured.

#### 8.5.7.3 Scheduling availability of UE performing beam failure detection on FR2

The following scheduling restriction applies due to beam failure detection.

- For the case where no RSs are provided for BFD, or when CSI-RS is configured for BFD is explicitly configured and is type-D QCLed with active TCI state for PDCCH or PDSCH, and the CSI-RS is not in a CSI-RS resource set with repetition ON

- There are no scheduling restrictions due to beam failure detection performed based on the CSI-RS.

- Otherwise

- For FR2-1 or the BFD-RS is not using 480 kHz SCS or 960 kHz SCS on FR2-2, the UE is not expected to transmit PUCCH, PUSCH or SRS or receive PDCCH, PDSCH or CSI-RS for tracking or CSI-RS for CQI on BFD-RS resource symbols to be measured for beam failure detection.

- For FR2-2 and the BFD-RS is using 480 kHz SCS or 960 kHz SCS, the UE is not expected to transmit PUCCH, PUSCH or SRS or receive PDCCH, PDSCH or CSI-RS for tracking or CSI-RS for CQI on BFD-RS resource symbols to be measured for beam failure detection, and on one data symbol before each BFD-RS symbol to be measured and one data symbol after each BFD-RS symbol to be measured.

When intra-band carrier aggregation in FR2 is performed, the scheduling restrictions on FR2 serving PCell or PSCell apply to all serving cells in the same band on the symbols that fully or partially overlap with restricted symbols.

When inter-band carrier aggregation in FR2 is performed, there are no scheduling restrictions on FR2 serving cells in the bands due to beam failure detection performed on FR2 serving cell(s) in different band(s), provided that UE is capable of independent beam management on this FR2 band pair. Additionally, there is no scheduling restriction if the UE is configured with different numerology between SSB on one FR2 band and data on the other FR2 band provided the UE is configured for IBM operation for the band pair.

For FR2, if following conditions are met,

- UE has been notified about system information update through paging,

- The gap between UE’s reception of PDCCH that UE monitors in the Type2-PDCCH CSS set and that notifies system information update, and the PDCCH that UE monitors in the Type0-PDCCH CSS set, is greater than 2 slots,

For the SSB and CORESET for RMSI scheduling multiplexing patterns 3, UE is expected to receive the PDCCH that UE monitors in the Type0-PDCCH CSS set, and the corresponding PDSCH, on SSB symbols to be measured for BFD mesurement; and

For the SSB and CORESET for RMSI scheduling multiplexing patterns 2, UE is expected to receive PDSCH that corresponds to the PDCCH that UE monitors in the Type0-PDCCH CSS set, on SSB symbols to be measured for BFD mesurement.

#### 8.5.7.4 Scheduling availability of UE performing beam failure detection on FR1 or FR2 in case of FR1-FR2 inter-band CA and NR DC

There are no scheduling restrictions on FR1 serving cell(s) due to beam failure detection performed on FR2 serving PCell and/or PSCell.

There are no scheduling restrictions on FR2 serving cell(s) due to beam failure detection performed on FR1 serving PCell and/or PSCell.

### 8.5.8 Scheduling availability of UE during candidate beam detection

Scheduling availability restrictions when the UE is performing L1-RSRP measurement for candidate beam detection are described in the following clauses.

#### 8.5.8.1 Scheduling availability of UE performing L1-RSRP measurement with a same subcarrier spacing as PDSCH/PDCCH on FR1

There are no scheduling restrictions due to L1-RSRP measurement performed on SSB and CSI-RS configured as link recovery detection resource with the same SCS as PDSCH or PDCCH in FR1.

#### 8.5.8.2 Scheduling availability of UE performing L1-RSRP measurement with a different subcarrier spacing than PDSCH/PDCCH on FR1

For UEs which support *simultaneousRxDataSSB-DiffNumerology* [14] there are no restrictions on scheduling availability due to L1-RSRP measurement based on SSB as link recovery detection resource. For UEs which do not support *simultaneousRxDataSSB-DiffNumerology* [14] the following restrictions apply due to L1-RSRP measurement based on SSB configured as link recovery detection resource.

- The UE is not expected to transmit PUCCH, PUSCH or SRS or receive PDCCH, PDSCH, TRS, CSI-RS for tracking or CSI-RS for CQI on SSB symbols to be measured for L1-RSRP.

When intra-band carrier aggregation in FR1 is configured, the scheduling restrictions on one serving cell apply to all other serving cells in the same band on the symbols that fully or partially overlap with the restricted symbols. When inter-band carrier aggregation within FR1 is configured, there are no scheduling restrictions on FR1 serving cell(s) configured in other bands.

#### 8.5.8.3 Scheduling availability of UE performing L1-RSRP measurement on FR2

The following scheduling restriction applies due to candidate beam detection

- For FR2-1 or the reference symbols to be measured for candidate beam detection is not using 480 kHz SCS or 960 kHz SCS on FR2-2, the UE is not expected to transmit PUCCH, PUSCH or SRS or receive PDCCH, PDSCH, CSI-RS for tracking or CSI-RS for CQI on reference symbols to be measured for candidate beam detection.

- For FR2-2 and the reference symbols to be measured for candidate beam detection is using 480 kHz SCS or 960 kHz SCS, the UE is not expected to transmit PUCCH, PUSCH or SRS or receive PDCCH, PDSCH, CSI-RS for tracking or CSI-RS for CQI on reference symbols to be measured for candidate beam detection, and on one data symbol before each reference symbol to be measured for candidate beam detection and one data symbol after each reference symbol to be measured for candidate beam detection.

When intra-band carrier aggregation in FR2 is configured, the scheduling restrictions on to one serving cell apply to all serving cells in the same band on the symbols that fully or partially overlap with restricted symbols.

When inter-band carrier aggregation in FR2 is performed, there are no scheduling restrictions on FR2 serving cells in the bands due to candidate beam detection performed on FR2 serving cell(s) in different band(s), provided that the FR2 serving cell(s) and the FR2 serving cell(s) for candidate beam detection are in a FR2 band pair and UE is capable of independent beam management on this FR2 band pair. Additionally, there is no scheduling restriction if the UE is configured with different numerology between SSB on one FR2 band and data on the other FR2 band provided the UE is configured for IBM operation for the band pair.

For FR2, if following conditions are met,

- UE has been notified about system information update through paging,

- The gap between UE’s reception of PDCCH that UE monitors in the Type2-PDCCH CSS set and that notifies system information update, and the PDCCH that UE monitors in the Type0-PDCCH CSS set, is greater than 2 slots,

For the SSB and CORESET for RMSI scheduling multiplexing patterns 3, UE is expected to receive the PDCCH that UE monitors in the Type0-PDCCH CSS set, and the corresponding PDSCH, on SSB symbols to be measured for CBD mesurement; and

For the SSB and CORESET for RMSI scheduling multiplexing patterns 2, UE is expected to receive PDSCH that corresponds to the PDCCH that UE monitors in the Type0-PDCCH CSS set, on SSB symbols to be measured for CBD mesurement.

#### 8.5.8.4 Scheduling availability of UE performing L1-RSRP measurement on FR1 or FR2 in case of FR1-FR2 inter-band CA and NR-DC

There are no scheduling restrictions on FR1 serving cell(s) due to L1-RSRP measurement performed on FR2 serving cell(s).

There are no scheduling restrictions on FR2 serving cell(s) due to L1-RSRP measurement performed on FR1 serving cell(s).

### 8.5.9 Requirements for Beam Failure Recovery in SCell

#### 8.5.9.1 Introduction

For the UE provided with a configuration of PUCCH transmission with a link recovery request (LRR) as described in clause 9.2.4 in TS 38.213 [3], if beam recovery procedure is triggered for any of SCells, the UE shall transmit SR for UL resouce, followed by MAC CE providing one index for at least one corresponding SCell with radio link quality is worse than Qout,LR, and the index for a periodic CSI-RS configuration or for a SSB provided by higher layer, as described in clause 5.17 of TS38.321 [7], if any, for a corresponding SCell.

For the UE not provided with a configuration of PUCCH transmission with a link recovery request (LRR) as described in clause 9.2.4 in TS 38.213 [3], if beam recovery procedure is triggered for any of SCells, the UE shall transmit preamble for UL-SCH resource application, followed by MAC CE providing one index for at least one corresponding SCell with radio link quality is worse than Qout,LR, and the index for a periodic CSI-RS configuration or for a SSB provided by higher layer, as described in clause 5.17 of TS38.321 [7], if any, for a corresponding SCell.

#### 8.5.9.2 Requirement

Provided that UE is configured by *schedulingRequestIDForBFR* a configuration for LRR in a PUCCH transmission, after BFR is triggered on any of SCells as described in clause 5.17 of TS38.321 [7], UE shall be capable of transmit PUCCH with a LRR within a period of T, where

- T = T1 x Ceil((T2+D) /T1) in which T1, T2 and D are defined as

- T1 is equal to the periodicity of PUCCH configured with *schedulingRequestIDForBFR*.

- T2 = TEvaluate\_CBD is the evaluation period specified in clause 8.5.5 or 8.5.6 for SSB or CSI-RS based candidate beam detection, that is TEvaluate\_CBD\_SSB or TEvaluate\_CBD\_CSI-RS, depending on the applicable reference signal configured for candidate beam detection.

- D = 2ms is the UE Processing time.

### 8.5.10 Minimum requirement at transitions for beam failure detection

When the UE transitions between DRX and no DRX or when DRX cycle periodicity changes, for each BFD-RS resource, for a duration of time equal to the evaluation period corresponding to the second mode after the transition occurs, the UE shall use an evaluation period that is no less than the minimum of evaluation period corresponding to the first mode and the second mode. Subsequent to this duration, the UE shall use an evaluation period corresponding to the second mode for each BFD-RS resource.

When the UE transitions from a first configuration of BFD resources to a second configuration of BFD resources that is different from the first configuration, for each BFD resource present in the second configuration, for a duration of time equal to the evaluation period corresponding to the second configuration after the transition occurs, the UE shall use an evaluation period that is no less than the minimum of evaluation periods corresponding to the first configuration and the second configuration. Subsequent to this duration, the UE shall use an evaluation period corresponding to the second configuration for each BFD resource present in the second configuration.

When the UE transitions from a first configuration of active TCI state of the CORESET to a second configuration of active TCI state of the CORESET, for each CSI-RS for BFD present in the second configuration, the UE shall use an evaluation period corresponding to the second configuration from the time of transition.

## 8.5A Link Recovery Procedures when CCA is used on target frequency

### 8.5A.1 Introduction

The requirements for link recovery procedure in the clause apply when CCA is used on a serving frequency on the downlink.

The UE shall assess the downlink radio link quality of a serving cell based on the reference signal in the set as specified in TS 38.213 [3] in order to detect beam failure on:

- PCell in SA operation mode,

- PSCell in EN-DC operation mode.

- PSCell in NR-DC operation mode.

The RS resource configurations in the set can be periodic SSBs. UE is not required to perform beam failure detection outside the active DL BWP. UE is not required to meet the requirements in clause 8.5A.2 and 8.5A.3 if UE does not have set .

On each RS resource configuration in the set , the UE shall estimate the radio link quality and compare it to the threshold Qout\_LR,CCA for the purpose of accessing downlink radio link quality of the serving cell beams.

The threshold Qout\_LR,CCA is defined as the level at which the downlink radio level link of a given resource configuration on set cannot be reliably received and shall correspond to the BLERout,CCA = 10% block error rate of a hypothetical PDCCH transmission. For SSB based beam failure detection, Qout\_LR\_SSB,CCA is derived based on the hypothetical PDCCH transmission parameters listed in Table 8.5A.2.1-1.

Upon request the UE shall deliver configuration indexes from the set as specified in TS 38.213 [3] , to higher layers, and the corresponding L1-RSRP measurement provided that the measured L1-RSRP is equal to or better than the threshold Qin\_LR,CCA, which is indicated by higher layer parameter *rsrp-ThresholdSSB*. The UE applies the Qin\_LR,CCA threshold to the L1-RSRP measurement obtained from an SSB. The RS resource configurations in the set can be periodic SSBs. UE is not required to perform candidate beam detection outside the active DL BWP.

In the requirements of clause 8.5A, the term CBD-RS SSB occasions not available at the UE refers to when the CBD-RS SSB is configured by gNB in a cell on a carrier frequency subject to CCA, but the first two successive candidate SSB positions for the same SSB index within the set of configured CBD-RS resources are not available at the UE due to DL CCA failures at gNB during the corresponding evaluation period; otherwise the CBD-RS SSB is considered as available at the UE.

The requirements in clause 8.5A apply for any *channelAccessMode* configuration [TS 38.331, 2].

### 8.5A.2 Requirements for SSB based beam failure detection

#### 8.5A.2.1 Introduction

The requirements in this clause apply for each SSB resource in the set configured for a serving cell, provided that the SSB configured for beam failure detection is actually transmitted within the UE active DL BWP during the entire evaluation period specified in clause 8.5A.2.2, but occasionally may not be transmitted due to CCA operation.

Table 8.5A.2.1-1: PDCCH transmission parameters for beam failure instance

|  |  |
| --- | --- |
| Attribute | Value for BLER |
| DCI format | 1-0 |
| Number of control OFDM symbols | 2 |
| Aggregation level (CCE) | 8 |
| Ratio of hypothetical PDCCH RE energy to average SSS RE energy | 0dB |
| Ratio of hypothetical PDCCH DMRS energy to average SSS RE energy | 0dB |
| Bandwidth (PRBs) | 24 |
| Sub-carrier spacing (kHz) | Same as the SCS of RMSI CORESET |
| DMRS precoder granularity | REG bundle size |
| REG bundle size | 6 |
| CP length | Normal |
| Mapping from REG to CCE | Distributed |

#### 8.5A.2.2 Minimum requirement

UE shall be able to evaluate whether the downlink radio link quality on the configured BFD-RS SSB resource in set estimated over the last TEvaluate\_BFD\_SSB\_CCA ms period becomes worse than the threshold Qout\_LR\_SSB,CCA within TEvaluate\_BFD\_SSB\_CCA ms period.

The value of TEvaluate\_BFD\_SSB\_CCA is defined in Table 8.5A.2.2-1 for FR1.

The value of TEvaluate\_BFD\_SSB\_CCA is defined in Table 8.5A.2.2-2 for FR2-2 with scaling factor N=12.

When concurrent gaps are configured,

- P value for a BFD-RS resource to be measured is defined as Ntotal / Noutside\_MG

- For a window W of duration max(TL1, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE measurement gap and per-FR measurement gap within the same FR as serving cell, and starting at the beginning of any BFD-RS resource occasion:

- Ntotal is the total number of BFD-RS resource occasions within the window, including those overlapped with measurement gap occasions within the window, and

- Noutside\_MG is the number of BFD-RS resource occasions that are not overlapped with any measurement gap occasion within the window W

- Otherwise, for a UE not supporting *concurrentMeasGap-r17* or when concurrent gaps are not configured,

- , when in the monitored cell there are GAPs configured for intra-frequency, inter-frequency or inter-RAT measurements, which are overlapping with some but not all occasions of the BFD-RS SSB.

- P=1 when in the monitored cell there are no GAPs overlapping with any occasion of the BFD-RS SSB.

- When a measurement gap is configured and the measurement gap is not NCSG,

- a BFD-RS resource is considered to be overlapped with the GAP if it overlaps a measurement gap occasion, and

- xRP = MGRP

- Otherwise, when NCSG measurement gap is configured,

- a BFD-RS resource is considered to be overlapped with the GAP if it overlaps the VIL1 or VIL2 of NCSG, and

- xRP = VIRP

- When concurrent gaps are configured, a BFD-RS is not considered to be overlapped by a gap occasion if the gap occasion is dropped according to 9.1.8.

For FR2-2,

- , when BFD-RS resource is not overlapped with measurement gap and the BFD-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod).

- P = Psharing factor, when the BFD-RS resource is not overlapped with measurement gap and the BFD-RS resource is fully overlapped with SMTC period (TSSB = TSMTCperiod).

- , when the BFD-RS resource is partially overlapped with measurement gap and the BFD-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and

- TSMTCperiod ≠ MGRP or

- TSMTCperiod = MGRP and TSSB < 0.5\*TSMTCperiod

- , when the BFD-RS resource is partially overlapped with measurement gap and the BFD-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and TSMTCperiod = MGRP and TSSB = 0.5\*TSMTCperiod

- , when the BFD-RS resource is partially overlapped with measurement gap (TSSB <MGRP) and the BFD-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is partially or fully overlapped with measurement gap.

- , when the BFD-RS resource is partially overlapped with measurement gap and the BFD-RS resource is fully overlapped with SMTC occasion (TSSB = TSMTCperiod) and SMTC occasion is partially overlapped with measurement gap (TSMTCperiod < MGRP)

- Psharing factor = 1, if the BFD-RS resource outside measurement gap is

- not overlapped with the SSB symbols indicated by SSB-ToMeasure and K data symbol before each consecutive SSB symbols indicated by SSB-ToMeasure and K data symbol after each consecutive SSB symbols indicated by SSB-ToMeasure, given that SSB-ToMeasure is configured, where the *SSB-ToMeasure* is the union set of *SSB-ToMeasure* from all the configured measurement objects merged on the same serving carrier, and K is defined in clause 9.2.5.3.3, and;

- not overlapped with the RSSI symbols indicated by ss-RSSI-Measurement and K data symbol before each RSSI symbol indicated by ss-RSSI-Measurement and K data symbol after each RSSI symbol indicated by ss-RSSI-Measurement, given that ss-RSSI-Measurement is configured, and K is defined in clause 9.2.5.3.3.

- Psharing factor = 3, otherwise.

where,

If the high layer in TS 38.331 [2] signaling of *smtc2* is configured, TSMTCperiod corresponds to the value of higher layer parameter *smtc2*; Otherwise TSMTCperiod corresponds to the value of higher layer parameter *smtc1*. TSMTCperiod is the shortest SMTC period among all CCs in the same FR2-2 band, given the SMTC offset of all CCs in FR2-2 provided the same offset.

If the high layer in TS 38.331 [2] signaling of *smtc2* is configured, TSMTCperiod corresponds to the value of higher layer parameter *smtc2*; Otherwise TSMTCperiod corresponds to the value of higher layer parameter *smtc1*.

If the UE is configured with Pre-MG, a BFD-RS resource is only considered to be overlapped by the Pre-MG if the Pre-MG is activated.

Longer evaluation period would be expected if the combination of BFD-RS SSB resource, SMTC occasion and GAP configurations does not meet pervious conditions.

Table 8.5A.2.2-1: Evaluation period TEvaluate\_BFD\_SSB\_CCA for FR1

|  |  |  |
| --- | --- | --- |
| Configuration | TEvaluate\_BFD\_SSB\_CCA (ms) | |
|  | BFD-RS SSB Es/Iot Note2 ≥ -7 dB | BFD-RS SSB Es/Iot Note2 < -7 dB |
| no DRX | Max(50, Ceil((10 × P) × TSSB)) | Max(50, Ceil((12 × P) × TSSB)) |
| DRX cycle ≤ 320ms | Max(50, Ceil(1.5 × 8 × P) × Max(TDRX,TSSB)) | Max(50, Ceil(1.5 × 10 × P) × Max(TDRX,TSSB)) |
| DRX cycle > 320ms | Ceil(7 × P) × TDRX | Ceil(8 × P) × TDRX |
| Note 1: TSSB is the periodicity of SSB in the set . TDRX is the DRX cycle length.  Note 2: BFD-RS SSB Es/Iot is the averaged BFD-RS SSB Es/Iot over the most recent previous evaluation period. | | |

Table 8.5A.2.2-2: Evaluation period TEvaluate\_BFD\_SSB\_CCA for FR2-2

|  |  |
| --- | --- |
| Configuration | TEvaluate\_BFD\_SSB\_CCA (ms) |
|  |
| no DRX | Max(200, Ceil([12]\*P\* N)\*TSSB) |
| DRX cycle ≤ 320ms | Max(200, Ceil(1.5\*[10]\*P\* N)\*Max(TDRX,TSSB)) |
| DRX cycle > 320ms | Ceil([10]\*P\* N)\*TDRX |
| Note 1: TSSB is the periodicity of SSB in the set . TDRX is the DRX cycle length. | |

#### 8.5A.2.3 Measurement restriction for SSB based beam failure detection

The UE is required to be capable of measuring SSB for BFD without measurement gaps. The UE is required to perform the SSB measurements with measurement restrictions as described in the following clauses.

For FR1, when the SSB for BFD measurement is in the same OFDM symbol as CSI-RS for BFD, CBD or L1-RSRP measurement,

- If SSB and CSI-RS have same SCS, UE shall be able to measure the SSB for BFD measurement without any restriction;

- If SSB and CSI-RS have different SCS,

- If UE supports *simultaneousRxDataSSB-DiffNumerology*, UE shall be able to measure the SSB for BFD measurement without any restriction;

- If UE does not support *simultaneousRxDataSSB-DiffNumerology*, UE is required to measure SSB for BFD measurement.

For FR2-2, when the SSB for BFD measurement on one CC is in the same OFDM symbol as CSI-RS for RLM, BFD, CBD or L1-RSRP measurement on the same CC or different CCs in the same band, UE is required to measure one of but not both SSB for BFD measurement and CSI-RS. Longer measurement period for SSB based BFD measurement is expected, and no requirements are defined.

### 8.5A.3 Void

### 8.5A.4 Minimum requirement for L1 indication

When the radio link quality on all the RS resources in set is worse than Qout\_LR,CCA, layer 1 of the UE shall send a beam failure instance indication to the higher layers.

The beam failure instance evaluation for the RS resources in set shall be performed as specified in clause 6 in TS 38.213 [3]. Two successive indications from layer 1 shall be separated by at least TIndication\_interval\_BFD\_CCA.

When DRX is not used, TIndication\_interval\_BFD\_CCA is max(2ms, TSSB-RS,M) ), where TSSB-RS,M is the shortest periodicity of all RS resources in set for the accessed cell, corresponding to either the shortest periodicity of the SSB in the set .

When DRX is used, for SSB based link quality measurement,

- TIndication\_interval\_BFD\_CCA = Max(1.5 × DRX\_cycle\_length, 1.5 × TSSB-RS,M), if DRX\_cycle\_length ≤ 320ms,

- TIndication\_interval\_BFD\_CCA = DRX\_cycle\_length, if DRX\_cycle\_length > 320ms.

### 8.5A.5 Requirements for SSB based candidate beam detection

#### 8.5A.5.1 Introduction

The requirements in this clause apply for each CBD-RS SSB resource in the set configured for a serving cell, provided that the SSBs configured for candidate beam detection are actually transmitted within UE active DL BWP during the entire evaluation period specified in clause 8.5A.5.2, but occasionally may not be transmitted due to CCA operation.

#### 8.5A.5.2 Minimum requirement

Upon request the UE shall be able to evaluate whether the L1-RSRP measured on the configured CBD-RS SSB resource in set  estimated over the last TEvaluate\_CBD\_SSB\_CCA ms period becomes better than the threshold Qin\_LR,CCA provided SSB\_RP and SSB Ês/Iot are according to Annex Table B.2.4.1 for a corresponding band.

The UE shall monitor the configured SSB resources using the evaluation period in table 8.5A.5.2-1 corresponding to the non-DRX mode, if the configured DRX cycle ≤ 320ms.

The value of TEvaluate\_CBD\_SSB\_CCA is defined in Table 8.5A.5.2-1 for FR1.

The value of TEvaluate\_CBD\_SSB\_CCA is defined in Table 8.5A.5.2-2 for FR2-2 with scaling factor N=TBD.

For FR1,

- For a UE supporting *concurrentMeasGap-r17* and when concurrent gaps are configured,

- P value for a CBD-RS resource to be measured is defined as Ntotal / Noutside\_MG

- For a window W of duration max(TL1, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE measurement gaps and per-FR measurement gaps within the same FR as serving cell, and starting at the beginning of any CBD-RS resource occasion:

- Ntotal is the total number of CBD-RS resource occasions within the window, including those overlapped with measurement gap occasions within the window, and

- Noutside\_MG is the number of CBD-RS resource occasions that are not overlapped with any measurement gap occasion within the window W

- Otherwise, for a UE not supporting *concurrentMeasGap-r17* or when concurrent gaps are not configured,

- , when in the monitored cell there are GAPs configured for intra-frequency, inter-frequency or inter-RAT measurements, which are overlapping with some but not all occasions of the CBD-RS SSB,

- P = 1 when in the monitored cell there are no GAPs overlapping with any occasion of the CBD-RS SSB.

For FR2-2,

- , when candidate beam detection RS is not overlapped with measurement gap and candidate beam detection RS is partially overlapped with SMTC occasion (TSSB < TSMTCperiod).

- P is Psharing factor, when candidate beam detection RS is not overlapped with measurement gap and candidate beam detection RS is fully overlapped with SMTC period (TSSB = TSMTCperiod).

- , when candidate beam detection RS is partially overlapped with measurement gap and candidate beam detection RS is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and

- TSMTCperiod ≠ MGRP or

- TSMTCperiod = MGRP and TSSB < 0.5 × TSMTCperiod

- , when candidate beam detection RS is partially overlapped with measurement gap and candidate beam detection RS is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and TSMTCperiod = MGRP and TSSB = 0.5 × TSMTCperiod

- , when candidate beam detection RS is partially overlapped with measurement gap and candidate beam detection RS is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is partially or fully overlapped with measurement gap

- , when candidate beam detection RS is partially overlapped with measurement gap and candidate beam detection RS is fully overlapped with SMTC occasion (TSSB = TSMTCperiod) and SMTC occasion is partially overlapped with measurement gap (TSMTCperiod < MGRP)

- Psharing factor = 1, if the candidate beam detection RS outside measurement gap is

- not overlapped with the SSB symbols indicated by *SSB-ToMeasure* and TBD data symbol before each consecutive SSB symbols indicated by *SSB-ToMeasure* and TBD data symbol after each consecutive SSB symbols indicated by *SSB-ToMeasure*, given that *SSB-ToMeasure* is configured, where the *SSB-ToMeasure* is the union set of *SSB-ToMeasure* from all the configured measurement objects merged on the same serving carrier, and;

- not overlapped with the RSSI symbols indicated by *ss-RSSI-Measurement* and TBD data symbol before each RSSI symbol indicated by *ss-RSSI-Measurement* and TBD data symbol after each RSSI symbol indicated by *ss-RSSI-Measurement*, given that *ss-RSSI-Measurement* is configured

- Psharing factor = 3, otherwise.

where,

- If the high layer in TS 38.331 [2] signaling of *smtc2*is present, TSMTCperiod follows *smtc2*; Otherwise TSMTCperiod follows *smtc1.* TSMTCperiod is the shortest SMTC period among all CCs in the same FR2-2 band, provided the SMTC offset of all CCs in FR2-2 have the same offset.

- If the UE is configured with Pre-MG, a CBD-RS resource is only considered to be overlapped by the Pre-MG if the Pre-MG is activated.

- When a measurement gap is configured and the measurement gap is not NCSG,

- a CBD-RS resource is considered to be overlapped with the GAP if it overlaps a measurement gap occasion, and

- xRP = MGRP

- Otherwise, when NCSG measurement gap is configured,

- a CBD-RS resource is considered to be overlapped with the GAP if it overlaps the VIL1 or VIL2 of NCSG, and

- xRP = VIRP

* When concurrent gaps are configured, a CBD-RS is not considered to be overlapped by a gap occasion if the gap occasion is dropped according to9.1.8.

**Table 8.5A.5.2-1: Evaluation period TEvaluate\_CBD\_SSB\_CCA for FR1**

|  |  |
| --- | --- |
| Configuration | TEvaluate\_CBD\_SSB\_CCA (ms) |
| non-DRX, DRX cycle ≤ 320ms | Max(25, Ceil((3 + LCBD) × P) × TSSB) |
| DRX cycle > 320ms | Ceil((3 + LCBD) × P) × TDRX |
| Note 1: TSSB is the periodicity of SSB in the set . TDRX is the DRX cycle length.  Note 2: When DRX is not configured, LCBD is the number of CBD-RS SSB occasions not available at the UE during TEvaluate\_CBD\_SSB\_CCA where LCBD ≤ LCBD,max. When DRX is configured, LCBD is the number of DRX cycles in which at least one of the CBD-RS SSB occasions not available at the UE during TEvaluate\_CBD\_SSB\_CCA where LCBD ≤ LCBD,max. The UE, which is configured with DRX, is not required to determine the availability of SSB occasions more frequent than  Once per Max(25ms, P \* TSSB) if DRX cycle ≤ 320ms,  Once per P \* TDRX if DRX cycle > 320ms.  Note 3: LCBD,max=7 for Max(TDRX, TSSB) ≤ 40 assuming TDRX=0 for non-DRX,  LCBD,max=5 for 40 < Max(TDRX, TSSB) ≤ 320,  LCBD,max=3 for TDRX > 320.  Note 4 If LCBD>LCBD,max, the UE shall assume no new candidate beams are found for this evaluation period. | |

Table 8.5A.5.2-2: Evaluation period TEvaluate\_CBD\_SSB\_CCA for FR2-2

|  |  |
| --- | --- |
| **Configuration** | **TEvaluate\_CBD\_SSB\_CCA (ms)** |
| non-DRX, DRX cycle ≤ 320ms | Max(25, Ceil((3 + LCBD) × P× N) × TSSB) |
| DRX cycle > 320ms | Ceil((3 + LCBD) × P × N) × TDRX |
| Note 1: TSSB is the periodicity of SSB in the set . TDRX is the DRX cycle length.  Note 2: When DRX is not configured, Lin is the number of CBD-RS SSB occasions group which are not available at the UE during TEvaluate\_CBD\_SSB,CCA, where LCBD ≤ LCBD,max. A CBD-RS SSB occasions group consists of N consecutive CBD-RS SSB occasions, and the CBD-RS SSB occasions group is not available at the UE when at least one CBD-SSB occasion in the group is not transmitted by the gNB. When DRX is configured, Lin is the number of DRX cycles groups which are not available at the UE during TEvaluate\_CBD\_SSB,CCA, where Lin ≤ LCBD,max. A DRX group consists of N DRX cycles, and the DRX group is not available when there is at least one DRX in which at least one CBD-RS SSB occasion is not available. The UE is not required to determine the availability of SSB occasions more frequent than once per DRX cycle length, when configured with DRX.  Note 3: LCBD,max=7 for Max(TDRX, TSSB) ≤ 40 assuming TDRX=0 for non-DRX,  LCBD,max=5 for 40 < Max(TDRX, TSSB) ≤ 320,  LCBD,max=3 for TDRX > 320.  Note 4: If LCBD>LCBD,max, the UE shall assume no new candidate beams are found for this evaluation period. | |

#### 8.5A.5.3 Measurement restriction for SSB based candidate beam detection

For FR1, when the SSB for CBD measurement is in the same OFDM symbol as CSI-RS for BFD, CBD or L1-RSRP measurement,

- If SSB and CSI-RS have same SCS, UE shall be able to measure the SSB for CBD measurement without any restrictions;

- If SSB and CSI-RS have different SCS-es,

- If UE supports *simultaneousRxDataSSB-DiffNumerology*, UE shall be able to measure the SSB for CBD measurement without any restriction;

- If UE does not support *simultaneousRxDataSSB-DiffNumerology*, UE is required to measure SSB for CBD measurement.

For FR2-2, when the SSB for CBD measurement on one CC is in the same OFDM symbol as CSI-RS for RLM, BFD, CBD or L1-RSRP measurement on the same CC or different CCs in the same band, UE is required to measure one of but not both SSB for CBD measurement and CSI-RS. Longer measurement period for SSB based CBD measurement is expected, and no requirements are defined.

### 8.5A.6 Void

### 8.5A.7 Scheduling availability of UE during beam failure detection

Scheduling availability restrictions when the UE is performing beam failure detection are described in the following clauses.

#### 8.5A.7.1 Scheduling availability of UE performing beam failure detection with a same subcarrier spacing as PDSCH/PDCCH

In this clause, the same requirements apply as in Clause 8.5.7.1.

#### 8.5A.7.2 Scheduling availability of UE performing beam failure detection with a different subcarrier spacing than PDSCH/PDCCH

In this clause, the same requirements apply as in Clause 8.5.7.2.

#### 8.5A.7.3 Scheduling availability of UE performing beam failure detection on FR2-2

In this clause, the same requirements apply as in Clause 8.5.7.3.

#### 8.5A.7.4 Scheduling availability of UE performing beam failure detection on FR1 or FR2-2 in case of FR1-FR2-2 inter-band CA and NR DC

In this clause, the same requirements apply as in Clause 8.5.7.4.

### 8.5A.8 Scheduling availability of UE during candidate beam detection

Scheduling availability restrictions when the UE is performing L1-RSRP measurement for candidate beam detection are described in the following clauses.

8.5A.8.1 Scheduling availability of UE performing L1-RSRP measurement with a same subcarrier spacing as PDSCH/PDCCH on FR1

In this clause, the same requirements apply as in Clause 8.5.8.1.

8.5A.8.2 Scheduling availability of UE performing L1-RSRP measurement with a different subcarrier spacing than PDSCH/PDCCH on FR1

In this clause, the same requirements apply as in Clause 8.5.8.2.

#### 8.5A.8.3 Scheduling availability of UE performing L1-RSRP measurement on FR2-2

In this clause, the same requirements apply as in Clause 8.5.8.3.

#### 8.5.8.4 Scheduling availability of UE performing L1-RSRP measurement on FR1 or FR2-2 in case of FR1-FR2-2 inter-band CA and NR-DC

In this clause, the same requirements apply as in Clause 8.5.8.4.

## 8.5B Link Recovery Procedures for Redcap

### 8.5B.1 Introduction

The Redcap UE shall assess the downlink radio link quality of a serving cell based on the reference signal in the set  as specified in TS 38.213 [3] in order to detect beam failure on PCell in SA. The SSB and SMTC in this section applies for both CD-SSB and NCD-SSB if it is not additional specified.

The RS resource configurations in the set  on PCell can be periodic CSI-RS resources and/or SSBs. UE is not required to perform beam failure detection outside the active DL BWP. UE is not required to meet the requirements in clause 8.5B.2 and 8.5B.3 if UE does not have set .

On each RS resource configuration in the set , the UE shall estimate the radio link quality and compare it to the threshold Qout\_LR\_Redcap for the purpose of accessing downlink radio link quality of the serving cell beams.

The threshold Qout\_LR\_Redcap is defined as the level at which the downlink radio level link of a given resource configuration on set  cannot be reliably received and shall correspond to the BLERout = 10% block error rate of a hypothetical PDCCH transmission. For SSB based beam failure detection, Qout\_LR\_SSB is derived based on the hypothetical PDCCH transmission parameters listed in Table 8.5B.2.1-1. For CSI-RS based beam failure detection, Qout\_LR\_CSI-RS is derived based on the hypothetical PDCCH transmission parameters listed in Table 8.5B.3.1-1.

Upon request the UE shall deliver configuration indexes from the set as specified in TS 38.213 [3] , to higher layers, and the corresponding L1-RSRP measurement provided that the measured L1-RSRP is equal to or better than the threshold Qin\_LR\_RedCap , which is indicated by higher layer parameter *rsrp-ThresholdSSB*. The UE applies the Qin\_LR\_RedCap  threshold to the L1-RSRP measurement obtained from an SSB. The UE applies the Qin\_LR\_RedCap threshold to the L1-RSRP measurement obtained for a CSI-RS resource after scaling a respective CSI-RS reception power with a value provided by higher layer parameter *powerControlOffsetSS*. The RS resource configurations in the set  can be periodic CSI-RS resources or SSBs or both SSB and CSI-RS resources. UE is not required to perform candidate beam detection outside the active DL BWP.

### 8.5B.2 Requirements for SSB based beam failure detection for Redcap

#### 8.5B.2.1 Introduction

The requirements in this clause apply for each SSB resource in the set  configured for a serving cell, provided that the SSB configured for beam failure detection is actually transmitted within the UE active DL BWP during the entire evaluation period specified in clause 8.5B.2.2.

Table 8.5B.2.1-1: PDCCH transmission parameters for beam failure instance

|  |  |
| --- | --- |
| Attribute | Value for BLER |
| DCI format | 1-0 |
| Number of control OFDM symbols | 2 |
| Aggregation level (CCE) | 16 for 1 Rx UE; 8 for 2 Rx UE |
| Ratio of hypothetical PDCCH RE energy to average SSS RE energy | 0dB |
| Ratio of hypothetical PDCCH DMRS energy to average SSS RE energy | 0dB |
| Bandwidth (PRBs) | 48 for 1 Rx UE; 24 for 2 Rx UE |
| Sub-carrier spacing (kHz) | Same as the SCS of RMSI CORESET |
| DMRS precoder granularity | REG bundle size |
| REG bundle size | 6 |
| CP length | Normal |
| Mapping from REG to CCE | Distributed |
| Note 1： Note: SCS=60kHz is not applicable for FR1 | |

#### 8.5B.2.2 Minimum requirement

UE shall be able to evaluate whether the downlink radio link quality on the configured SSB resource in set  estimated over the last TEvaluate\_BFD\_SSB\_Redcap ms period becomes worse than the threshold Qout\_LR\_SSB within TEvaluate\_BFD\_SSB\_Redcap ms period.

The value of TEvaluate\_BFD\_SSB\_Redcap is defined in Table 8.5B.2.2-1 for FR1.

The value of TEvaluate\_BFD\_SSB\_Redcap is defined in Table 8.5B.2.2-2 for FR2 with scaling factor N=8

For FR1,

- , when in the monitored cell there are measurement gaps configured for intra-frequency, inter-frequency or inter-RAT measurements, which are overlapping with some but not all occasions of the SSB.

- P=1 when in the monitored cell there are no measurement gaps overlapping with any occasion of the SSB.

For FR2,

- , when BFD-RS resource is not overlapped with measurement gap and the BFD-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod).

- P = Psharing factor, when the BFD-RS resource is not overlapped with measurement gap and the BFD-RS resource is fully overlapped with SMTC period (TSSB = TSMTCperiod).

- , when the BFD-RS resource is partially overlapped with measurement gap and the BFD-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and

- TSMTCperiod ≠ MGRP or

- TSMTCperiod = MGRP and TSSB < 0.5\*TSMTCperiod

- , when the BFD-RS resource is partially overlapped with measurement gap and the BFD-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and TSMTCperiod = MGRP and TSSB = 0.5\*TSMTCperiod

- , when the BFD-RS resource is partially overlapped with measurement gap (TSSB <MGRP) and the BFD-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is partially or fully overlapped with measurement gap.

- , when the BFD-RS resource is partially overlapped with measurement gap and the BFD-RS resource is fully overlapped with SMTC occasion (TSSB = TSMTCperiod) and SMTC occasion is partially overlapped with measurement gap (TSMTCperiod < MGRP)

- Psharing factor = 1, if the BFD-RS resource outside measurement gap is

- not overlapped with the SSB symbols indicated by SSB-ToMeasure and 1 data symbol before each consecutive SSB symbols indicated by SSB-ToMeasure and 1 data symbol after each consecutive SSB symbols indicated by SSB-ToMeasure, given that SSB-ToMeasure is configured, where the *SSB-ToMeasure* is the union set of *SSB-ToMeasure* from all the configured measurement objects merged on the same serving carrier, and;

- not overlapped with the RSSI symbols indicated by ss-RSSI-Measurement and 1 data symbol before each RSSI symbol indicated by ss-RSSI-Measurement and 1 data symbol after each RSSI symbol indicated by ss-RSSI-Measurement, given that ss-RSSI-Measurement is configured.- Psharing factor = 3, otherwise.

where,

If the high layer in TS 38.331 [2] signaling of *smtc2* is configured, TSMTCperiod corresponds to the value of higher layer parameter *smtc2*; Otherwise TSMTCperiod corresponds to the value of higher layer parameter *smtc1*.

Longer evaluation period would be expected if the combination of BFD-RS resource, SMTC occasion and measurement gap configurations does not meet pervious conditions.

For either an FR1 or FR2 serving cell, longer evaluation period would be expected during the period Tidentify\_CGI when the UE is requested to decode an NR CGI.

For either an FR1 or FR2 serving cell, longer BFD evaluation period would be expected during the period Tidentify\_CGI,E-UTRAN when the UE is requested to decode an LTE CGI.

Table 8.5B.2.2-1: Evaluation period TEvaluate\_BFD\_SSB\_Redcap for FR1

|  |  |  |
| --- | --- | --- |
| Configuration | TEvaluate\_BFD\_SSB\_Redcap (ms) for Redcap UE with 2 Rx | TEvaluate\_BFD\_SSB\_Redcap (ms) for 1 Rx Redcap |
| no DRX | Max(50, Ceil(5 × P) × TSSB) | [ Max(50, Ceil(10 × P) × TSSB)] |
| DRX cycle ≤ 320ms | Max(50, Ceil(7.5 × P) × Max(TDRX,TSSB)) | [ Max(50, Ceil(15 × P) × Max(TDRX,TSSB)) ] |
| DRX cycle > 320ms | Ceil(5 × P) × TDRX | [ Ceil(10 × P) × TDRX] |
| Note: TSSB is the periodicity of SSB in the set . TDRX is the DRX cycle length. | | |

Table 8.5B.2.2-2: Evaluation period TEvaluate\_BFD\_SSB\_Redcap for FR2

|  |  |
| --- | --- |
| Configuration | TEvaluate\_BFD\_SSB\_Redcap (ms) |
| no DRX | Max(50, Ceil(5 × P × N) × TSSB) |
| DRX cycle ≤ 320ms | Max(50, Ceil(7.5 × P × N) × Max(TDRX,TSSB)) |
| DRX cycle > 320ms | Ceil(5 × P × N) × TDRX |
| Note: TSSB is the periodicity of SSB in the set . TDRX is the DRX cycle length. | |

#### 8.5B.2.3 Measurement restriction for SSB based beam failure detection

The UE is required to be capable of measuring SSB for BFD without measurement gaps. The UE is required to perform the SSB measurements with measurement restrictions as described in the following scenarios.

For FR1, when the SSB for BFD measurement is in the same OFDM symbol as CSI-RS for RLM, BFD, CBD or L1-RSRP measurement,

- If SSB and CSI-RS have same SCS, UE shall be able to measure the SSB for BFD measurement without any restriction;

- If SSB and CSI-RS have different SCS,

- If UE supports *simultaneousRxDataSSB-DiffNumerology*, UE shall be able to measure the SSB for BFD measurement without any restriction;

- If UE does not support *simultaneousRxDataSSB-DiffNumerology*, UE is required to measure one of but not both SSB for BFD measurement and CSI-RS. Longer measurement period for SSB based BFD measurement is expected, and no requirements are defined.

For FR2, when the SSB for BFD measurement on one CC is in the same OFDM symbol as CSI-RS for RLM, BFD, CBD or L1-RSRP measurement on the same CC, UE is required to measure one of but not both SSB for BFD measurement and CSI-RS. Longer measurement period for SSB based BFD measurement is expected, and no requirements are defined.

### 8.5B.3 Requirements for CSI-RS based beam failure detection for Redcap

#### 8.5B.3.1 Introduction

The requirements in this clause apply for each CSI-RS resource in the set  of resource configurations for a serving cell, provided that the CSI-RS resource(s) in set for beam failure detection are actually transmitted within the UE active DL BWP during the entire evaluation period specified in clause 8.5B.3.2. UE is not expected to perform beam failure detection measurements on the CSI-RS configured for BFD if the CSI-RS is not QCL-ed, with QCL-TypeD when applicable, with the RS in the active TCI state of any CORESET configured in the UE active BWP.

Table 8.5B.3.1-1: PDCCH transmission parameters for beam failure instance

|  |  |
| --- | --- |
| Attribute | Value for BLER |
| DCI format | 1-0 |
| Number of control OFDM symbols | 2 |
| Aggregation level (CCE) | 16 for 1 Rx UE; 8 for 2 Rx UE |
| Ratio of hypothetical PDCCH RE energy to average CSI-RS RE energy | 0dB |
| Ratio of hypothetical PDCCH DMRS energy to average CSI-RS RE energy | 0dB |
| Bandwidth (PRBs) | 48 for 1 Rx UE; 24 for 2 Rx UE |
| Sub-carrier spacing (kHz) | SCS of the active DL BWP |
| DMRS precoder granularity | REG bundle size |
| REG bundle size | 6 |
| CP length | Normal |
| Mapping from REG to CCE | Distributed |
| Note 1： Note: SCS=60kHz is not applicable for FR1 | |

#### 8.5B.3.2 Minimum requirement

UE shall be able to evaluate whether the downlink radio link quality on the CSI-RS resource in set  estimated over the last TEvaluate\_BFD\_CSI-RS\_Redcap ms period becomes worse than the threshold Qout\_LR\_CSI-RS within TEvaluate\_BFD\_CSI-RS\_Redcap ms period.

The value of TEvaluate\_BFD\_CSI-RS\_Redcap is defined in Table 8.5B.3.2-1 for FR1.

The value of TEvaluate\_BFD\_CSI-RS\_Redcap is defined in Table 8.5B.3.2-2 for FR2 with N=1. The requirements of TEvaluate\_BFD\_CSI-RS\_Redcap apply provided that the CSI-RS for BFD is not in a resource set configured with repetition ON. The requirements shall not apply when the CSI-RS resource in the active TCI state of CORESET is the same CSI-RS resource for BFD and the TCI state information of the CSI-RS resource is not given, wherein the TCI state information means QCL Type-D to SSB for L1-RSRP or CSI-RS with repetition ON.

For FR1,

- , when in the monitored cell there are measurement gaps configured for intra-frequency, inter-frequency or inter-RAT measurements, which are overlapping with some but not all occasions of the CSI-RS.

- P = 1 when in the monitored cell there are no measurement gaps overlapping with any occasion of the CSI-RS.

For FR2,

- P = 1, when the BFD-RS resource is not overlapped with measurement gap and also not overlapped with SMTC occasion.

- , when the BFD-RS resource is partially overlapped with measurement gap and the BFD-RS resource is not overlapped with SMTC occasion (TCSI-RS < MGRP)

- , when the BFD-RS resource is not overlapped with measurement gap and the BFD-RS resource is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod).

- P = Psharing factor, when the BFD-RS resource is not overlapped with measurement gap and the BFD-RS resource is fully overlapped with SMTC occasion (TCSI-RS = TSMTCperiod).

- , when the BFD-RS resource is partially overlapped with measurement gap and the BFD-RS resource is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and

- TSMTCperiod ≠ MGRP or

- TSMTCperiod = MGRP and TCSI-RS < 0.5 × TSMTCperiod

- , when the BFD-RS resource is partially overlapped with measurement gap and the BFD-RS resource is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and TSMTCperiod = MGRP and TCSI-RS = 0.5 × TSMTCperiod

- , when the BFD-RS resource is partially overlapped with measurement gap (TCSI-RS < MGRP) and the BFD-RS resource is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is partially or fully overlapped with measurement gap.

- , when the BFD-RS resource is partially overlapped with measurement gap and the BFD-RS resource is fully overlapped with SMTC occasion (TCSI-RS = TSMTCperiod) and SMTC occasion is partially overlapped with measurement gap (TSMTCperiod < MGRP)

- Psharing factor = 1, if the BFD-RS resource outside measurement gap is

- not overlapped with the SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol before each consecutive SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol after each consecutive SSB symbols indicated by *SSB-ToMeasure*, given that *SSB-ToMeasure* is configured, where the *SSB-ToMeasure* is the union set of *SSB-ToMeasure* from all the configured measurement objects merged on the same serving carrier, and;

- not overlapped with the RSSI symbols indicated by *ss-RSSI-Measurement* and 1 data symbol before each RSSI symbol indicated by *ss-RSSI-Measurement* and 1 data symbol after each RSSI symbol indicated by *ss-RSSI-Measurement*, given that *ss-RSSI-Measurement* is configured,

- Psharing factor = 3, otherwise.

where,

If the high layer in TS 38.331 [2] signaling of *smtc2* is configured, TSMTCperiod corresponds to the value of higher layer parameter *smtc2*; Otherwise TSMTCperiod corresponds to the value of higher layer parameter *smtc1*.

Note: The overlap between CSI-RS for BFD and SMTC means that CSI-RS for BFD is within the SMTC window duration.

Longer evaluation period would be expected if the combination of the BFD-RS resource, SMTC occasion and measurement gap configurations does not meet pervious conditions.

For either an FR1 or FR2 serving cell, longer evaluation period would be expected during the period Tidentify\_CGI when the UE is requested to decode an NR CGI.

For either an FR1 or FR2 serving cell, longer BFD evaluation period would be expected during the period Tidentify\_CGI,E-UTRAN when the UE is requested to decode an LTE CGI.

The values of MBFD used in Table 8.5B.3.2-1 and Table 8.5B.3.2-2 are defined as

- MBFD = 10, if the CSI-RS resource(s) in set  used for BFD is transmitted with Density = 3 and over the bandwidth ≥ 24 PRBs.

The values of PBFD used in Table 8.5B.3.2-1 and Table 8.5B.3.2-2 are defined as

For each CSI-RS resource in the set  configured for PCell

- PBFD = 1.

Table 8.5B.3.2-1: Evaluation period TEvaluate\_BFD\_CSI-RS\_Redcap for FR1

|  |  |  |
| --- | --- | --- |
| Configuration | TEvaluate\_BFD\_CSI-RS\_Redcap (ms) for Redcap UE with 2 Rx | TEvaluate\_BFD\_CSI-RS\_Redcap (ms) for 1 Rx Redcap |
| no DRX | Max(50, Ceil(MBFD × P × PBFD) × TCSI-RS) | Max(50, Ceil(2×MBFD × P × PBFD) × TCSI-RS) |
| DRX cycle ≤ 320ms | Max(50, Ceil(1.5 × MBFD × P × PBFD) × Max(TDRX, TCSI-RS)) | Max(50, Ceil(2×1.5 × MBFD × P × PBFD) × Max(TDRX, TCSI-RS)) |
| DRX cycle > 320ms | Ceil(MBFD × P × PBFD) × TDRX | Ceil(2×MBFD × P × PBFD) × TDRX |
| Note: TCSI-RS is the periodicity of CSI-RS resource in the set . TDRX is the DRX cycle length. | | |

Table 8.5B.3.2-2: Evaluation period TEvaluate\_BFD\_CSI-RS\_Redcap for FR2

|  |  |
| --- | --- |
| Configuration | TEvaluate\_BFD\_CSI-RS\_Redcap (ms) |
| no DRX | Max(50, Ceil(MBFD × P × N × PBFD) × TCSI-RS) |
| DRX cycle ≤ 320ms | Max(50, Ceil(1.5 × MBFD × P × N × PBFD) × Max(TDRX, TCSI-RS)) |
| DRX cycle > 320ms | Ceil(MBFD × P × N × PBFD) × TDRX |
| Note: TCSI-RS is the periodicity of CSI-RS resource in the set . TDRX is the DRX cycle length. | |

#### 8.5B.3.3 Measurement restrictions for CSI-RS beam failure detection

The UE is required to be capable of measuring CSI-RS for BFD without measurement gaps. The UE is required to perform the CSI-RS measurements with measurement restrictions as described in the following scenarios.

For both FR1 and FR2, when the CSI-RS for BFD measurement is in the same OFDM symbol as SSB for RLM, BFD, CBD or L1-RSRP measurement, UE is not required to receive CSI-RS for BFD measurement in the PRBs that overlap with an SSB.

For FR1, when the SSB for RLM, BFD, CBD or L1-RSRP measurement is within the active BWP and has same SCS than CSI-RS for BFD measurement, the UE shall be able to perform CSI-RS measurement without restrictions.

For FR1, when the SSB for RLM, BFD, CBD or L1-RSRP measurement is within the active BWP and has different SCS than CSI-RS for BFD measurement, the UE shall be able to perform CSI-RS measurement with restrictions according to its capabilities:

- If the UE supports *simultaneousRxDataSSB-DiffNumerology* the UE shall be able to perform CSI-RS measurement without restrictions.

- If the UE does not support *simultaneousRxDataSSB-DiffNumerology*, UE is required to measure one of but not both CSI-RS for BFD measurement and SSB. Longer measurement period for CSI-RS based BFD measurement is expected, and no requirements are defined.

For FR1, when the CSI-RS for BFD measurement is in the same OFDM symbol as another CSI-RS for RLM, BFD, CBD or L1-RSRP measurement, UE shall be able to measure the CSI-RS for BFD measurement without any restriction.

For FR2, when the CSI-RS for BFD measurement on one CC is in the same OFDM symbol as SSB for RLM, BFD or L1-RSRP measurement on the same CC or different CCs in the same band, or in the same symbol as SSB for CBD measurement on the same CC or different CCs in the same band when beam failure is detected, UE is required to measure one of but not both CSI-RS for BFD measurement and SSB. Longer measurement period for CSI-RS based BFD measurement is expected, and no requirements are defined.

For FR2, when the CSI-RS for BFD measurement on one CC is in the same OFDM symbol as another CSI-RS for RLM, BFD, CBD or L1-RSRP measurement on the same CC or different CCs in the same band,

- In the following cases, UE is required to measure one of but not both CSI-RS for BFD measurement and the other CSI-RS. Longer measurement period for CSI-RS based BFD measurement is expected, and no requirements are defined.

- The CSI-RS for BFD measurement or the other CSI-RS in a resource set configured with repetition ON, or

- The other CSI-RS is configured in set  and beam failure is detected, or

- The two CSI-RS-es are not QCL-ed w.r.t. QCL-TypeD, or the QCL information is not known to UE,

- Otherwise, UE shall be able to measure the CSI-RS for BFD measurement without any restriction.

### 8.5B.4 Minimum requirement for L1 indication for Redcap

When the radio link quality on all the RS resources in set  is worse than Qout\_LR\_Redcap, layer 1 of the UE shall send a beam failure instance indication to the higher layers

The beam failure instance evaluation for the RS resources in set  shall be performed as specified in clause 6 in TS 38.213 [3]. Two successive indications from layer 1 shall be separated by at least TIndication\_interval\_BFD\_Redcap.

When DRX is not used, TIndication\_interval\_BFD\_Redcap is max(2ms, TSSB-RS,M) ) or max(2ms, TCSI-RS,M), where TSSB-RS,M and TCSI-RS,M is the shortest periodicity of all RS resources in set  for the accessed cell, corresponding to either the shortest periodicity of the SSB in the set  or CSI-RS resource in the set .

When DRX is used, for SSB based link quality measurement,

- TIndication\_interval\_BFD\_Redcap = Max(1.5 × DRX\_cycle\_length, 1.5 × TSSB-RS,M), if DRX\_cycle\_length ≤ 320ms,

- TIndication\_interval\_BFD\_Redcap = DRX\_cycle\_length, if DRX\_cycle\_length > 320ms.

When DRX is used, for CSI-RS based link quality measurement,

- TIndication\_interval\_BFD\_Redcap = Max(1.5 × DRX\_cycle\_length, 1.5 × TCSI-RS,M), if DRX\_cycle\_length ≤ 320ms,

- TIndication\_interval\_BFD\_Redcap = DRX\_cycle\_length, if DRX\_cycle\_length > 320ms.

For HD-FDD UE, the above conditions and requirements TIndication\_interval\_BFD\_Redcap apply given that for each BFD-RS configuration, at least one BFD-RS sample must fall with DL occasion within an indication perio

### 8.5B.5 Requirements for SSB based candidate beam detection for Redcap

#### 8.5B.5.1 Introduction

The requirements in this clause apply for each SSB resource in the set  configured for a serving cell, provided that the SSBs configured for candidate beam detection are actually transmitted within UE active DL BWP during the entire evaluation period specified in clause 8.5.5.2.

#### 8.5B.5.2 Minimum requirement

Upon request the UE shall be able to evaluate whether the L1-RSRP measured on the configured SSB resource in set  estimated over the last TEvaluate\_CBD\_SSB ms period becomes better than the threshold Qin\_LR\_RedCap provided SSB\_RP and SSB Ês/Iot are according to Annex Table B.2.4.1 for a corresponding band.

The UE shall monitor the configured SSB resources using the evaluation period in table 8.5B.5.2-1 and 8.5B.5.2-2 corresponding to the non-DRX mode, if the configured DRX cycle ≤ 320ms.

The value of TEvaluate\_CBD\_SSB\_Redcap is defined in Table 8.5B.5.2-1 for FR1.

The value of TEvaluate\_CBD\_SSB\_Redcap is defined in Table 8.5B.5.2-2 for FR2 with scaling factor N=8.

where,

For FR1,

- , when in the monitored cell there are measurement gaps configured for intra-frequency, inter-frequency or inter-RAT measurements, which are overlapping with some but not all occasions of the SSB,

- P = 1 when in the monitored cell there are no measurement gaps overlapping with any occasion of the SSB.

For FR2,

- , when candidate beam detection RS is not overlapped with measurement gap and candidate beam detection RS is partially overlapped with SMTC occasion (TSSB < TSMTCperiod).

- P is Psharing factor, when candidate beam detection RS is not overlapped with measurement gap and candidate beam detection RS is fully overlapped with SMTC period (TSSB = TSMTCperiod).

- , when candidate beam detection RS is partially overlapped with measurement gap and candidate beam detection RS is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and

- TSMTCperiod ≠ MGRP or

- TSMTCperiod = MGRP and TSSB < 0.5 × TSMTCperiod

- , when candidate beam detection RS is partially overlapped with measurement gap and candidate beam detection RS is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and TSMTCperiod = MGRP and TSSB = 0.5 × TSMTCperiod

- , when candidate beam detection RS is partially overlapped with measurement gap and candidate beam detection RS is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is partially or fully overlapped with measurement gap

- , when candidate beam detection RS is partially overlapped with measurement gap and candidate beam detection RS is fully overlapped with SMTC occasion (TSSB = TSMTCperiod) and SMTC occasion is partially overlapped with measurement gap (TSMTCperiod < MGRP)

- Psharing factor = 1, if the candidate beam detection RS outside measurement gap is

- not overlapped with the SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol before each consecutive SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol after each consecutive SSB symbols indicated by *SSB-ToMeasure*, given that *SSB-ToMeasure* is configured, where the *SSB-ToMeasure* is the union set of *SSB-ToMeasure* from all the configured measurement objects merged on the same serving carrier, and;

- not overlapped with the RSSI symbols indicated by *ss-RSSI-Measurement* and 1 data symbol before each RSSI symbol indicated by *ss-RSSI-Measurement* and 1 data symbol after each RSSI symbol indicated by *ss-RSSI-Measurement*, given that *ss-RSSI-Measurement* is configured

- Psharing factor = 3, otherwise.

where,

If the high layer in TS 38.331 [2] signaling of *smtc2*is present, TSMTCperiod follows *smtc2*; Otherwise TSMTCperiod follows *smtc1.*

Longer evaluation period would be expected if the combination of the CBD-RS resource, SMTC occasion and measurement gap configurations does not meet pervious conditions.

For either an FR1 or FR2 serving cell, longer evaluation period would be expected during the period Tidentify\_CGI when the UE is requested to decode an NR CGI.

For either an FR1 or FR2 serving cell, longer CBD evaluation period would be expected during the period Tidentify\_CGI,E-UTRAN when the UE is requested to decode an LTE CGI.

The values of PCBD used in Table 8.5.5.2-1 and Table 8.5.5.2-2 are defined as

For each SSB resource in the set  configured for PCell

- PCBD = 1.

Table 8.5B.5.2-1: Evaluation period TEvaluate\_CBD\_SSB\_Redcap for FR1

|  |  |
| --- | --- |
| **Configuration** | **TEvaluate\_CBD\_SSB**\_Redcap **(ms)** |
| non-DRX, DRX cycle ≤ 320ms | Max(25, Ceil(3 × P × PCBD) × TSSB) |
| DRX cycle > 320ms | Ceil(3 × P × PCBD) × TDRX |
| Note: TSSB is the periodicity of SSB in the set . TDRX is the DRX cycle length. | |

Table 8.5B.5.2-2: Evaluation period TEvaluate\_CBD\_SSB\_Redcap for FR2

|  |  |
| --- | --- |
| **Configuration** | **TEvaluate\_CBD\_SSB**\_Redcap **(ms)** |
| non-DRX, DRX cycle ≤ 320ms | Max(25, Ceil(3 × P × N × PCBD) × TSSB) |
| DRX cycle > 320ms | Ceil(3 × P × N × PCBD) × TDRX |
| Note: TSSB is the periodicity of SSB in the set . TDRX is the DRX cycle length. | |

#### 8.5B.5.3 Measurement restriction for SSB based candidate beam detection

For FR1, when the SSB for CBD measurement is in the same OFDM symbol as CSI-RS for RLM, BFD, CBD or L1-RSRP measurement,

- If SSB and CSI-RS have same SCS, UE shall be able to measure the SSB for CBD measurement without any restrictions;

- If SSB and CSI-RS have different SCS-es,

- If UE supports *simultaneousRxDataSSB-DiffNumerology*, UE shall be able to measure the SSB for CBD measurement without any restriction;

- If UE does not support *simultaneousRxDataSSB-DiffNumerology*, UE is required to measure one of but not both SSB for CBD measurement and CSI-RS. Longer measurement period for SSB based CBD measurement is expected, and no requirements are defined.

For FR2, when the SSB for CBD measurement on one CC is in the same OFDM symbol as CSI-RS for RLM, BFD, CBD or L1-RSRP measurement on the same CC, UE is required to measure one of but not both SSB for CBD measurement and CSI-RS. Longer measurement period for SSB based CBD measurement is expected, and no requirements are defined.

### 8.5B.6 Requirements for CSI-RS based candidate beam detection for Redcap

#### 8.5B.6.1 Introduction

The requirements in this clause apply for each CSI-RS resource in the set  configured for a serving cell, provided that the CSI-RS resources configured for candidate beam detection are actually transmitted within UE active DL BWP during the entire evaluation period specified in clause 8.5B.6.2.

#### 8.5B.6.2 Minimum requirement

Upon request the UE shall be able to evaluate whether the L1-RSRP measured on the configured CSI-RS resource in set  estimated over the last TEvaluate\_CBD\_CSI-RS\_Redcap [ms] period becomes better than the threshold Qin\_LR\_RedCap within TEvaluate\_CBD\_CSI-RS\_Redcap [ms] period provided CSI-RS Ês/Iot is according to Annex Table B.2.4.2 for a corresponding band.

The UE shall monitor the configured CSI-RS resources using the evaluation period in table 8.5B.6.2-1 and 8.5B.6.2-2 corresponding to the non-DRX mode, if the configured DRX cycle ≤ 320ms.

The value of TEvaluate\_CBD\_CSI-RS\_Redcap is defined in Table 8.5B.6.2-1 for FR1.

The value of TEvaluate\_CBD\_CSI-RS\_Redcap is defined in Table 8.5B.6.2-2 for FR2 with scaling factor N=8.

For FR1,

- , when in the monitored cell there are measurement gaps configured for intra-frequency, inter-frequency or inter-RAT measurements, which are overlapping with some but not all occasions of the CSI-RS; and

- P = 1 when in the monitored cell there are no measurement gaps overlapping with any occasion of the CSI-RS.

For FR2,

- P = 1, when candidate beam detection RS is not overlapped with measurement gap and also not overlapped with SMTC occasion.

- when candidate beam detection RS is partially overlapped with measurement gap and candidate beam detection RS is not overlapped with SMTC occasion (TCSI-RS < MGRP)

- , when candidate beam detection RS is not overlapped with measurement gap and candidate beam detection RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod).

- P =Psharing factor, when candidate beam detection RS is not overlapped with measurement gap and candidate beam detection RS is fully overlapped with SMTC occasion (TCSI-RS = TSMTCperiod).

- ,, when candidate beam detection RS is partially overlapped with measurement gap and candidate beam detection RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and

- TSMTCperiod ≠ MGRP or

- TSMTCperiod = MGRP and TCSI-RS < 0.5 × TSMTCperiod

- , when candidate beam detection RS is partially overlapped with measurement gap and candidate beam detection RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and TSMTCperiod = MGRP and TCSI-RS = 0.5 × TSMTCperiod

- , when candidate beam detection RS is partially overlapped with measurement gap and candidate beam detection RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is partially or fully overlapped with measurement gap

- ,, when candidate beam detection RS is partially overlapped with measurement gap and candidate beam detection RS is fully overlapped with SMTC occasion (TCSI-RS = TSMTCperiod) and SMTC occasion is partially overlapped with measurement gap (TSMTCperiod < MGRP)

- Psharing factor = 1, if the candidate beam detection RS outside measurement gap is

- not overlapped with the SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol before each consecutive SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol after each consecutive SSB symbols indicated by *SSB-ToMeasure*, given that *SSB-ToMeasure* is configured, where the *SSB-ToMeasure* is the union set of *SSB-ToMeasure* from all the configured measurement objects merged on the same serving carrier, and;

- not overlapped with the RSSI symbols indicated by *ss-RSSI-Measurement* and 1 data symbol before each RSSI symbol indicated by *ss-RSSI-Measurement* and 1 data symbol after each RSSI symbol indicated by *ss-RSSI-Measurement*, given that *ss-RSSI-Measurement* is configured.

- Psharing factor = 3, otherwise.

where,

If the high layer in TS 38.331 [2] signaling of *smtc2* is present, TSMTCperiod follows *smtc2*; Otherwise TSMTCperiod follows *smtc1*.

Note: The overlap between CSI-RS for CBD and SMTC means that CSI-RS for CBD is within the SMTC window duration.

Longer evaluation period would be expected if the combination of the CBD-RS resource, SMTC occasion and measurement gap configurations does not meet pervious conditions.

Longer evaluation period would be expected if the CSI-RS is on the same OFDM symbols with RLM, BFD, BM-RS, or other CBD-RS, according to the measurement restrictions defined in clause 8.5.6.3.

For either an FR1 or FR2 serving cell, longer evaluation period would be expected during the period Tidentify\_CGI when the UE is requested to decode an NR CGI.

For either an FR1 or FR2 serving cell, longer CBD evaluation period would be expected during the period Tidentify\_CGI,E-UTRAN when the UE is requested to decode an LTE CGI.

The values of MCBD used in Table 8.5B.6.2-1 and Table 8.5B.6.2-2 are defined as

- MCBD = 3, if the CSI-RS resource configured in the set  is transmitted with Density = 3 and over the bandwidth ≥ 24 PRBs.

The values of PCBD used in Table 8.5B.6.2-1 and Table 8.5B.6.2-2 are defined as

For each CSI-RS resource in the set  configured for PCell

- PCBD = 1.

Table 8.5B.6.2-1: Evaluation period TEvaluate\_CBD\_CSI-RS\_Redcap for FR1

|  |  |
| --- | --- |
| **Configuration** | **TEvaluateC\_CBD\_CSI-RS**\_Redcap **(ms)** |
| non-DRX, DRX cycle ≤ 320ms | Max(25, Ceil(MCBD × P × PCBD) × TCSI-RS) |
| DRX cycle > 320ms | Ceil(MCBD × P × PCBD) × TDRX |
| Note: TCSI-RS is the periodicity of CSI-RS resource in the set . TDRX is the DRX cycle length. | |

Table 8.5B.6.2-2: Evaluation period TEvaluate\_CBD\_CSI-RS\_Redcap for FR2

|  |  |
| --- | --- |
| **Configuration** | **TEvaluate\_CBD\_CSI-RS**\_Redcap **(ms)** |
| non-DRX, DRX cycle ≤ 320ms | Max(25, Ceil(MCBD × P × N × PCBD) × TCSI-RS) |
| DRX cycle > 320ms | Ceil(MCBD × P × N × PCBD) × TDRX |
| Note: TCSI-RS is the periodicity of CSI-RS resource in the set . TDRX is the DRX cycle length. | |

#### 8.5B.6.3 Measurement restriction for CSI-RS based candidate beam detection

For both FR1 and FR2, when the CSI-RS for CBD measurement is in the same OFDM symbol as SSB for RLM, BFD, CBD or L1-RSRP measurement, UE is not required to receive CSI-RS for CBD measurement in the PRBs that overlap with an SSB.

For FR1, when the SSB for RLM, BFD, CBD or L1-RSRP measurement is within the active BWP and has same SCS than CSI-RS for CBD measurement, the UE shall be able to perform CSI-RS based CBD measurement without restrictions.

For FR1, when the SSB for RLM, BFD, CBD or L1-RSRP measurement is within the active BWP and has different SCS than CSI-RS for CBD measurement, the UE shall be able to perform CSI-RS based CBD measurement with restrictions according to its capabilities:

- If the UE supports *simultaneousRxDataSSB-DiffNumerology* the UE shall be able to perform CSI-RS based CBD measurement for without restrictions.

- If the UE does not support *simultaneousRxDataSSB-DiffNumerology*, UE is required to measure one of but not both CSI-RS for CBD measurement and SSB. Longer measurement period for CSI-RS based CBD measurement is expected, and no requirements are defined.

For FR1, when the CSI-RS for CBD measurement is in the same OFDM symbol as another CSI-RS for RLM, BFD, CBD or L1-RSRP measurement, UE shall be able to measure the CSI-RS for CBD measurement without any restriction.

For FR2, when the CSI-RS for CBD measurement on one CC is in the same OFDM symbol as SSB for RLM, BFD, CBD or L1-RSRP measurement on the same CC or different CCs in the same band, UE is required to measure one of but not both CSI-RS for CBD measurement and SSB. Longer evaluation period for CSI-RS based CBD measurement is expected, and no requirements are defined.

For FR2, when the CSI-RS for CBD measurement on one CC is in the same OFDM symbol as another CSI-RS for RLM, BFD, CBD or L1-RSRP measurement on the same CC or different CCs in the same band, UE is required to measure one of but not both CSI-RS for CBD measurement and the other CSI-RS. Longer evaluation period for CSI-RS based CBD measurement is expected, and no requirements are defined.

### 8.5B.7 Scheduling availability of UE during beam failure detection for Redcap

Scheduling availability restrictions when the UE is performing beam failure detection are described in the following clauses.

#### 8.5B.7.1 Scheduling availability of UE performing beam failure detection with a same subcarrier spacing as PDSCH/PDCCH on FR1

There are no scheduling restrictions due to beam failure detection performed on SSB and CSI-RS configured for BFD with the same SCS as PDSCH or PDCCH in FR1.

#### 8.5B.7.2 Scheduling availability of UE performing beam failure detection with a different subcarrier spacing than PDSCH/PDCCH on FR1

For UEs which support *simultaneousRxDataSSB-DiffNumerology* [14] there are no restrictions on scheduling availability due to beam failure detection when SSB is configured as BFD. For UEs which do not support *simultaneousRxDataSSB-DiffNumerology* [14] the following restrictions apply due to beam failure detection when SSB is configured as BFD.

- The UE is not expected to transmit PUCCH, PUSCH or SRS or receive PDCCH, PDSCH or CSI-RS for tracking or CSI-RS for CQI on SSB symbols to be measured for beam failure detection.

#### 8.5B.7.3 Scheduling availability of UE performing beam failure detection on FR2

The following scheduling restriction applies due to beam failure detection.

- For the case where no RSs are provided for BFD, or when CSI-RS is configured for BFD is explicitly configured and is type-D QCLed with active TCI state for PDCCH or PDSCH, and the CSI-RS is not in a CSI-RS resource set with repetition ON

- There are no scheduling restrictions due to beam failure detection performed based on the CSI-RS.

- Otherwise

- The UE is not expected to transmit PUCCH, PUSCH or SRS or receive PDCCH, PDSCH or CSI-RS for tracking or CSI-RS for CQI on BFD-RS resource symbols to be measured for beam failure detection.

For FR2, if following conditions are met,

- UE has been notified about system information update through paging,

- The gap between UE’s reception of PDCCH that UE monitors in the Type2-PDCCH CSS set and that notifies system information update, and the PDCCH that UE monitors in the Type0-PDCCH CSS set, is greater than 2 slots,

For the SSB and CORESET for RMSI scheduling multiplexing patterns 3, UE is expected to receive the PDCCH that UE monitors in the Type0-PDCCH CSS set, and the corresponding PDSCH, on SSB symbols to be measured for BFD mesurement; and

For the SSB and CORESET for RMSI scheduling multiplexing patterns 2, UE is expected to receive PDSCH that corresponds to the PDCCH that UE monitors in the Type0-PDCCH CSS set, on SSB symbols to be measured for BFD mesurement.

### 8.5B.8 Scheduling availability of UE during candidate beam detection for Redcap

Scheduling availability restrictions when the UE is performing L1-RSRP measurement for candidate beam detection are described in the following clauses.

#### 8.5B.8.1 Scheduling availability of UE performing L1-RSRP measurement with a same subcarrier spacing as PDSCH/PDCCH on FR1

There are no scheduling restrictions due to L1-RSRP measurement performed on SSB and CSI-RS configured as link recovery detection resource with the same SCS as PDSCH or PDCCH in FR1.

#### 8.5B.8.2 Scheduling availability of UE performing L1-RSRP measurement with a different subcarrier spacing than PDSCH/PDCCH on FR1

For UEs which support *simultaneousRxDataSSB-DiffNumerology* [14] there are no restrictions on scheduling availability due to L1-RSRP measurement based on SSB as link recovery detection resource. For UEs which do not support *simultaneousRxDataSSB-DiffNumerology* [14] the following restrictions apply due to L1-RSRP measurement based on SSB configured as link recovery detection resource.

- The UE is not expected to transmit PUCCH, PUSCH or SRS or receive PDCCH, PDSCH, TRS, CSI-RS for tracking or CSI-RS for CQI on SSB symbols to be measured for L1-RSRP.

#### 8.5B.8.3 Scheduling availability of UE performing L1-RSRP measurement on FR2

The following scheduling restriction applies due to candidate beam detection

- The UE is not expected to transmit PUCCH, PUSCH or SRS or receive PDCCH, PDSCH, CSI-RS for tracking or CSI-RS for CQI on reference symbols to be measured for candidate beam detection.

For FR2, if following conditions are met,

- UE has been notified about system information update through paging,

- The gap between UE’s reception of PDCCH that UE monitors in the Type2-PDCCH CSS set and that notifies system information update, and the PDCCH that UE monitors in the Type0-PDCCH CSS set, is greater than 2 slots,

For the SSB and CORESET for RMSI scheduling multiplexing patterns 3, UE is expected to receive the PDCCH that UE monitors in the Type0-PDCCH CSS set, and the corresponding PDSCH, on SSB symbols to be measured for CBD mesurement; and

For the SSB and CORESET for RMSI scheduling multiplexing patterns 2, UE is expected to receive PDSCH that corresponds to the PDCCH that UE monitors in the Type0-PDCCH CSS set, on SSB symbols to be measured for CBD mesurement.

### 8.5B.9 Minimum requirement at transitions for beam failure detection for Redcap

When the UE transitions between BFD CD-SSB resource and BFD NCD-SSB resource during one evaluation period, the UE is allowed to restart the ongoing evaluation using the second SSB type after BWP switching. Subsequent to this duration, the UE shall use an evaluation period corresponding to the second SSB type for each BFD-RS resource.

The requirements in clause 8.5.10 shall also apply except the scenarios described above.

## 8.5C Link Recovery Procedures for Satellite Access

### 8.5C.1 Introduction

The UE shall assess the downlink radio link quality of a serving cell based on the reference signal in the set  as specified in TS 38.213 [3] in order to detect beam failure on PCell and the UE is configured with only PCell, which is served by satellite access node (SAN).

The RS resource configurations in the set  on PCell can be periodic CSI-RS resources and/or SSBs.

On each RS resource configuration in the set , the UE shall estimate the radio link quality and compare it to the threshold Qout\_LR for the purpose of accessing downlink radio link quality of the serving cell beams.

The threshold Qout\_LR is defined as the level at which the downlink radio level link of a given resource configuration on set e cannot be reliably received and shall correspond to the BLERout = 10% block error rate of a hypothetical PDCCH transmission. For SSB based beam failure detection, Qout\_LR\_SSB is derived based on the hypothetical PDCCH transmission parameters listed in Table 8.5.2.1C-1. For CSI-RS based beam failure detection, Qout\_LR\_CSI-RS is derived based on the hypothetical PDCCH transmission parameters listed in Table 8.5C.3.1-1.

Upon request the UE shall deliver configuration indexes from the set as specified in TS 38.213 [3] , to higher layers, and the corresponding L1-RSRP measurement provided that the measured L1-RSRP is equal to or better than the threshold Qin\_LR, which is indicated by higher layer parameter *rsrp-ThresholdSSB*. The UE applies the Qin\_LR threshold to the L1-RSRP measurement obtained from an SSB. The UE applies the Qin\_LR threshold to the L1-RSRP measurement obtained for a CSI-RS resource after scaling a respective CSI-RS reception power with a value provided by higher layer parameter *powerControlOffsetSS*. The RS resource configurations in the set  can be periodic CSI-RS resources or SSBs or both SSB and CSI-RS resources.

### 8.5C.2 Requirements for SSB based beam failure detection

#### 8.5C.2.1 Introduction

The requirements in this clause apply for each SSB resource in the set e configured for a serving cell, provided that the SSB configured for beam failure detection is actually transmitted within the UE active DL BWP during the entire evaluation period specified in clause 8.5C.2.2.

Table 8.5.2.1C-1: PDCCH transmission parameters for beam failure instance

|  |  |
| --- | --- |
| Attribute | Value for BLER |
| DCI format | 1-0 |
| Number of control OFDM symbols | 2 |
| Aggregation level (CCE) | 8 |
| Ratio of hypothetical PDCCH RE energy to average SSS RE energy | 0dB |
| Ratio of hypothetical PDCCH DMRS energy to average SSS RE energy | 0dB |
| Bandwidth (PRBs) | 24 |
| Sub-carrier spacing (kHz) | Same as the SCS of RMSI CORESET |
| DMRS precoder granularity | REG bundle size |
| REG bundle size | 6 |
| CP length | Normal |
| Mapping from REG to CCE | Distributed |

#### 8.5C.2.2 Minimum requirement

UE shall be able to evaluate whether the downlink radio link quality on the configured SSB resource in set  estimated over the last TEvaluate\_BFD\_SSB ms period becomes worse than the threshold Qout\_LR\_SSB within TEvaluate\_BFD\_SSB ms period.

The value of TEvaluate\_BFD\_SSB is defined in Table 8.5C.2.2-1 for FR1.

P value for an RLM-RS resource to be measured is defined as

- Psharing factor \* Ntotal / Noutside\_MG with Navailable = 0

- Ntotal / Navailable with Navailable > 0

For a window W of duration max(TL1, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE measurement gaps, and starting at the beginning of any RLM-RS resource occasion:

- Ntotal is the total number of RLM-RS resource occasions within the window, including those overlapped with measurement gap occasions or SMTC occasions within the window W, and

- Noutside\_MG is the number of RLM-RS resource occasions that are not overlapped with any measurement gap occasion within the window W

- Navailable is

- the number of RLM-RS resource occasions that are not overlapped with any measurement gap occasion nor any SMTC occasion within the window W, if UE does not support *parallelMeasurementWithoutRestriction* and LEO satellites are measured for intra-frequency measurement, and

- same as Noutside\_MG, otherwise

- TL1 is periodicity of the target RLM-RS

- Psharing factor = 3.

Longer evaluation period would be expected if the combination of BFD-RS resource, SMTC occasion and measurement gap configurations does not meet pervious conditions.

For an FR1serving cell, longer evaluation period would be expected during the period Tidentify\_CGI when the UE is requested to decode an NR CGI.

Table 8.5C.2.2-1: Evaluation period TEvaluate\_BFD\_SSB for FR1

|  |  |
| --- | --- |
| Configuration | TEvaluate\_BFD\_SSB (ms) |
| no DRX | Max(50, Ceil(5 ´ P) ´ TSSB) |
| DRX cycle ≤ 320ms | Max(50, Ceil(7.5 ´ P) ´ Max(TDRX,TSSB)) |
| DRX cycle > 320ms | Ceil(5 ´ P) ´ TDRX |
| Note: TSSB is the periodicity of SSB in the set . TDRX is the DRX cycle length. | |

#### 8.5C.2.3 Measurement restriction for SSB based beam failure detection

The UE is required to be capable of measuring SSB for BFD without measurement gaps. The UE is required to perform the SSB measurements with measurement restrictions as described in the following scenarios.

For FR1, when the SSB for BFD measurement is in the same OFDM symbol as CSI-RS for RLM, BFD, CBD or L1-RSRP measurement,

- If SSB and CSI-RS have same SCS, UE shall be able to measure the SSB for BFD measurement without any restriction;

- If SSB and CSI-RS have different SCS,

- If UE supports *simultaneousRxDataSSB-DiffNumerology*, UE shall be able to measure the SSB for BFD measurement without any restriction;

- If UE does not support *simultaneousRxDataSSB-DiffNumerology*, UE is required to measure one of but not both SSB for BFD measurement and CSI-RS. Longer measurement period for SSB based BFD measurement is expected, and no requirements are defined.

### 8.5C.3 Requirements for CSI-RS based beam failure detection

#### 8.5C.3.1 Introduction

The requirements in this clause apply for each CSI-RS resource in the set  of resource configurations for a serving cell, provided that the CSI-RS resource(s) in set for beam failure detection are actually transmitted within the UE active DL BWP during the entire evaluation period specified in clause 8.5C.3.2. UE is not expected to perform beam failure detection measurements on the CSI-RS configured for BFD if the CSI-RS is not QCL-ed, with QCL-TypeD when applicable, with the RS in the active TCI state of any CORESET configured in the UE active BWP.

Table 8.5C.3.1-1: PDCCH transmission parameters for beam failure instance

|  |  |
| --- | --- |
| Attribute | Value for BLER |
| DCI format | 1-0 |
| Number of control OFDM symbols | 2 |
| Aggregation level (CCE) | 8 |
| Ratio of hypothetical PDCCH RE energy to average CSI-RS RE energy | 0dB |
| Ratio of hypothetical PDCCH DMRS energy to average CSI-RS RE energy | 0dB |
| Bandwidth (PRBs) | 48 |
| Sub-carrier spacing (kHz) | SCS of the active DL BWP |
| DMRS precoder granularity | REG bundle size |
| REG bundle size | 6 |
| CP length | Normal |
| Mapping from REG to CCE | Distributed |

#### 8.5C.3.2 Minimum requirement

UE shall be able to evaluate whether the downlink radio link quality on the CSI-RS resource in set  estimated over the last TEvaluate\_BFD\_CSI-RS ms period becomes worse than the threshold Qout\_LR\_CSI-RS within TEvaluate\_BFD\_CSI-RS ms period.

The value of TEvaluate\_BFD\_CSI-RS is defined in Table 8.5C.3.2-1 for FR1.

The requirements of TEvaluate\_BFD\_CSI-RS apply provided that the CSI-RS for BFD is not in a resource set configured with repetition ON. The requirements shall not apply when the CSI-RS resource in the active TCI state of CORESET is the same CSI-RS resource for BFD and the TCI state information of the CSI-RS resource is not given, wherein the TCI state information means QCL Type-D to SSB for L1-RSRP or CSI-RS with repetition ON.

P value for an RLM-RS resource to be measured is defined as

- Psharing factor \* Ntotal / Noutside\_MG with Navailable = 0

- Ntotal / Navailable with Navailable > 0

For a window W of duration max(TL1, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE measurement gaps, and starting at the beginning of any RLM-RS resource occasion:

- Ntotal is the total number of RLM-RS resource occasions within the window, including those overlapped with measurement gap occasions or SMTC occasions within the window W, and

- Noutside\_MG is the number of RLM-RS resource occasions that are not overlapped with any measurement gap occasion within the window W

- Navailable is

- the number of RLM-RS resource occasions that are not overlapped with any measurement gap occasion nor any SMTC occasion within the window W, if UE does not support *parallelMeasurementWithoutRestriction* and LEO satellites are measured for intra-frequency measurement, and

- same as Noutside\_MG, otherwise

- TL1 is periodicity of the target RLM-RS

- Psharing factor = 3.

Note: The overlap between CSI-RS for BFD and SMTC means that CSI-RS for BFD is within the SMTC window duration.

Longer evaluation period would be expected if the combination of the BFD-RS resource, SMTC occasion and measurement gap configurations does not meet pervious conditions.

For an FR1 serving cell, longer evaluation period would be expected during the period Tidentify\_CGI when the UE is requested to decode an NR CGI.

The values of MBFD used in Table 8.5C.3.2-1 and Table 8.5C.3.2-2 are defined as

- MBFD = 10, if the CSI-RS resource(s) in set  used for BFD is transmitted with Density = 3 and over the bandwidth ≥ 24 PRBs.

The values of PBFD used in Table 8.5C.3.2-1 and Table 8.5C.3.2-2 are defined as

For each CSI-RS resource in the set  configured for PCell SA

- PBFD = 1.

Table 8.5C.3.2-1: Evaluation period TEvaluate\_BFD\_CSI-RS for FR1

|  |  |
| --- | --- |
| Configuration | TEvaluate\_BFD\_CSI-RS (ms) |
| no DRX | Max(50, Ceil(MBFD ´ P ´ PBFD) ´ TCSI-RS) |
| DRX cycle ≤ 320ms | Max(50, Ceil(1.5 × MBFD ´ P ´ PBFD) ´ Max(TDRX, TCSI-RS)) |
| DRX cycle > 320ms | Ceil(MBFD ´ P ´ PBFD) ´ TDRX |
| Note: TCSI-RS is the periodicity of CSI-RS resource in the set . TDRX is the DRX cycle length. | |

#### 8.5C.3.3 Measurement restrictions for CSI-RS beam failure detection

The UE is required to be capable of measuring CSI-RS for BFD without measurement gaps. The UE is required to perform the CSI-RS measurements with measurement restrictions as described in the following scenarios.

For FR1, when the CSI-RS for BFD measurement is in the same OFDM symbol as SSB for RLM, BFD, CBD or L1-RSRP measurement, UE is not required to receive CSI-RS for BFD measurement in the PRBs that overlap with an SSB.

For FR1, when the SSB for RLM, BFD, CBD or L1-RSRP measurement is within the active BWP and has same SCS than CSI-RS for BFD measurement, the UE shall be able to perform CSI-RS measurement without restrictions.

For FR1, when the SSB for RLM, BFD, CBD or L1-RSRP measurement is within the active BWP and has different SCS than CSI-RS for BFD measurement, the UE shall be able to perform CSI-RS measurement with restrictions according to its capabilities:

- If the UE supports *simultaneousRxDataSSB-DiffNumerology* the UE shall be able to perform CSI-RS measurement without restrictions.

- If the UE does not support *simultaneousRxDataSSB-DiffNumerology*, UE is required to measure one of but not both CSI-RS for BFD measurement and SSB. Longer measurement period for CSI-RS based BFD measurement is expected, and no requirements are defined.

For FR1, when the CSI-RS for BFD measurement is in the same OFDM symbol as another CSI-RS for RLM, BFD, CBD or L1-RSRP measurement, UE shall be able to measure the CSI-RS for BFD measurement without any restriction.

### 8.5C.4 Minimum requirement for L1 indication

When the radio link quality on all the RS resources in set  is worse than Qout\_LR, layer 1 of the UE shall send a beam failure instance indication to the higher layers

The beam failure instance evaluation for the RS resources in set  shall be performed as specified in clause 6 in TS 38.213 [3]. Two successive indications from layer 1 shall be separated by at least TIndication\_interval\_BFD.

When DRX is not used, TIndication\_interval\_BFD is max(2ms, TSSB-RS,M) ) or max(2ms, TCSI-RS,M), where TSSB-RS,M and TCSI-RS,M is the shortest periodicity of all RS resources in set  for the accessed cell, corresponding to either the shortest periodicity of the SSB in the set  or CSI-RS resource in the set .

When DRX is used, for SSB based link quality measurement,

- TIndication\_interval\_BFD = Max(1.5 × DRX\_cycle\_length, 1.5 × TSSB-RS,M), if DRX\_cycle\_length ≤ 320ms,

- TIndication\_interval\_BFD = DRX\_cycle\_length, if DRX\_cycle\_length > 320ms.

When DRX is used, for CSI-RS based link quality measurement,

- TIndication\_interval\_BFD = Max(1.5 × DRX\_cycle\_length, 1.5 × TCSI-RS,M), if DRX\_cycle\_length ≤ 320ms,

- TIndication\_interval\_BFD = DRX\_cycle\_length, if DRX\_cycle\_length > 320ms.

### 8.5C.5 Requirements for SSB based candidate beam detection

#### 8.5C.5.1 Introduction

The requirements in this clause apply for each SSB resource in the set  configured for a serving cell, provided that the SSBs configured for candidate beam detection are actually transmitted within UE active DL BWP during the entire evaluation period specified in clause 8.5C.5.2.

#### 8.5C.5.2 Minimum requirement

Upon request the UE shall be able to evaluate whether the L1-RSRP measured on the configured SSB resource in set  estimated over the last TEvaluate\_CBD\_SSB ms period becomes better than the threshold Qin\_LR provided SSB\_RP and SSB Ês/Iot are according to Annex Table B. 2.x.y for a corresponding band.

The UE shall monitor the configured SSB resources using the evaluation period in table 8.5C.5.2-1 and 8.5C.5.2-2 corresponding to the non-DRX mode, if the configured DRX cycle ≤ 320ms.

The value of TEvaluate\_CBD\_SSB is defined in Table 8.5C.5.2-1 for FR1.

where,

P value for an RLM-RS resource to be measured is defined as

- Psharing factor \* Ntotal / Noutside\_MG with Navailable = 0

- Ntotal / Navailable with Navailable > 0

For a window W of duration max(TL1, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE measurement gaps, and starting at the beginning of any RLM-RS resource occasion:

- Ntotal is the total number of RLM-RS resource occasions within the window, including those overlapped with measurement gap occasions or SMTC occasions within the window W, and

- Noutside\_MG is the number of RLM-RS resource occasions that are not overlapped with any measurement gap occasion within the window W

- Navailable is

- the number of RLM-RS resource occasions that are not overlapped with any measurement gap occasion nor any SMTC occasion within the window W, if UE does not support *parallelMeasurementWithoutRestriction* and LEO satellites are measured for intra-frequency measurement, and

- same as Noutside\_MG, otherwise

- TL1 is periodicity of the target RLM-RS

- Psharing factor = 3.

Longer evaluation period would be expected if the combination of the CBD-RS resource, SMTC occasion and measurement gap configurations does not meet pervious conditions.

For an FR1 serving cell, longer evaluation period would be expected during the period Tidentify\_CGI when the UE is requested to decode an NR CGI.

The values of PCBD used in Table 8.5C.5.2-1 and Table 8.5C.5.2-2 are defined as

For each SSB resource in the set  configured for PCell.

- PCBD = 1.

Table 8.5C.5.2-1: Evaluation period TEvaluate\_CBD\_SSB for FR1

|  |  |
| --- | --- |
| **Configuration** | **TEvaluate\_CBD\_SSB (ms)** |
| non-DRX, DRX cycle ≤ 320ms | Max(25, Ceil(3 ´ P ´ PCBD) ´ TSSB) |
| DRX cycle > 320ms | Ceil(3 ´ P ´ PCBD) ´ TDRX |
| Note: TSSB is the periodicity of SSB in the set . TDRX is the DRX cycle length. | |

#### 8.5C.5.3 Measurement restriction for SSB based candidate beam detection

For FR1, when the SSB for CBD measurement is in the same OFDM symbol as CSI-RS for RLM, BFD, CBD or L1-RSRP measurement,

- If SSB and CSI-RS have same SCS, UE shall be able to measure the SSB for CBD measurement without any restrictions;

- If SSB and CSI-RS have different SCS-es,

- If UE supports *simultaneousRxDataSSB-DiffNumerology*, UE shall be able to measure the SSB for CBD measurement without any restriction;

- If UE does not support *simultaneousRxDataSSB-DiffNumerology*, UE is required to measure one of but not both SSB for CBD measurement and CSI-RS. Longer measurement period for SSB based CBD measurement is expected, and no requirements are defined.

### 8.5C.6 Requirements for CSI-RS based candidate beam detection

#### 8.5C.6.1 Introduction

The requirements in this clause apply for each CSI-RS resource in the set  configured for a serving cell, provided that the CSI-RS resources configured for candidate beam detection are actually transmitted within UE active DL BWP during the entire evaluation period specified in clause 8.5C.6.2.

#### 8.5C.6.2 Minimum requirement

Upon request the UE shall be able to evaluate whether the L1-RSRP measured on the configured CSI-RS resource in set  estimated over the last TEvaluate\_CBD\_CSI-RS [ms] period becomes better than the threshold Qin\_LR within TEvaluate\_CBD\_CSI-RS [ms] period provided CSI-RS Ês/Iot is according to Annex Table B.2. x.y for a corresponding band.

The UE shall monitor the configured CSI-RS resources using the evaluation period in table 8.5C.6.2-1 and 8.5C.6.2-2 corresponding to the non-DRX mode, if the configured DRX cycle ≤ 320ms.

The value of TEvaluate\_CBD\_CSI-RS is defined in Table 8.5C.6.2-1 for FR1.

P value for an RLM-RS resource to be measured is defined as

- Psharing factor \* Ntotal / Noutside\_MG with Navailable = 0

- Ntotal / Navailable with Navailable > 0

For a window W of duration max(TL1, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE measurement gaps, and starting at the beginning of any RLM-RS resource occasion:

- Ntotal is the total number of RLM-RS resource occasions within the window, including those overlapped with measurement gap occasions or SMTC occasions within the window W, and

- Noutside\_MG is the number of RLM-RS resource occasions that are not overlapped with any measurement gap occasion within the window W

- Navailable is

- the number of RLM-RS resource occasions that are not overlapped with any measurement gap occasion nor any SMTC occasion within the window W, if UE does not support *parallelMeasurementWithoutRestriction* and LEO satellites are measured for intra-frequency measurement, and

- same as Noutside\_MG, otherwise

- TL1 is periodicity of the target RLM-RS

- Psharing factor = 3.

Note: The overlap between CSI-RS for CBD and SMTC means that CSI-RS for CBD is within the SMTC window duration.

Longer evaluation period would be expected if the combination of the CBD-RS resource, SMTC occasion and measurement gap configurations does not meet pervious conditions.

For an FR1 serving cell, longer evaluation period would be expected during the period Tidentify\_CGI when the UE is requested to decode an NR CGI.

The values of MCBD used in Table 8.5C.6.2-1 and Table 8.5C.6.2-2 are defined as

- MCBD = 3, if the CSI-RS resource configured in the set  is transmitted with Density = 3 and over the bandwidth ≥ 24 PRBs.

The values of PCBD used in Table 8.5C.6.2-1 are defined as

For each CSI-RS resource in the set  configured for SA

- PCBD = 1.

Table 8.5C.6.2-1: Evaluation period TEvaluate\_CBD\_CSI-RS for FR1

|  |  |
| --- | --- |
| **Configuration** | **TEvaluateC\_CBD\_CSI-RS (ms)** |
| non-DRX, DRX cycle ≤ 320ms | Max(25, Ceil(MCBD ´ P ´ PCBD) ´ TCSI-RS) |
| DRX cycle > 320ms | Ceil(MCBD ´ P ´ PCBD) ´ TDRX |
| Note: TCSI-RS is the periodicity of CSI-RS resource in the set . TDRX is the DRX cycle length. | |

#### 8.5C.6.3 Measurement restriction for CSI-RS based candidate beam detection

For both FR1, when the CSI-RS for CBD measurement is in the same OFDM symbol as SSB for RLM, BFD, CBD or L1-RSRP measurement, UE is not required to receive CSI-RS for CBD measurement in the PRBs that overlap with an SSB.

For FR1, when the SSB for RLM, BFD, CBD or L1-RSRP measurement is within the active BWP and has same SCS than CSI-RS for CBD measurement, the UE shall be able to perform CSI-RS based CBD measurement without restrictions.

For FR1, when the SSB for RLM, BFD, CBD or L1-RSRP measurement is within the active BWP and has different SCS than CSI-RS for CBD measurement, the UE shall be able to perform CSI-RS based CBD measurement with restrictions according to its capabilities:

- If the UE supports *simultaneousRxDataSSB-DiffNumerology* the UE shall be able to perform CSI-RS based CBD measurement for without restrictions.

- If the UE does not support *simultaneousRxDataSSB-DiffNumerology*, UE is required to measure one of but not both CSI-RS for CBD measurement and SSB. Longer measurement period for CSI-RS based CBD measurement is expected, and no requirements are defined.

For FR1, when the CSI-RS for CBD measurement is in the same OFDM symbol as another CSI-RS for RLM, BFD, CBD or L1-RSRP measurement, UE shall be able to measure the CSI-RS for CBD measurement without any restriction.

### 8.5C.7 Scheduling availability of UE during beam failure detection

Scheduling availability restrictions when the UE is performing beam failure detection are described in the following clauses.

#### 8.5C.7.1 Scheduling availability of UE performing beam failure detection with a same subcarrier spacing as PDSCH/PDCCH on FR1

There are no scheduling restrictions due to beam failure detection performed on SSB and CSI-RS configured for BFD with the same SCS as PDSCH or PDCCH in FR1.

#### 8.5C.7.2 Scheduling availability of UE performing beam failure detection with a different subcarrier spacing than PDSCH/PDCCH on FR1

For UEs which support *simultaneousRxDataSSB-DiffNumerology* [14] there are no restrictions on scheduling availability due to beam failure detection when SSB is configured as BFD. For UEs which do not support *simultaneousRxDataSSB-DiffNumerology* [14] the following restrictions apply due to beam failure detection when SSB is configured as BFD.

- The UE is not expected to transmit PUCCH, PUSCH or SRS or receive PDCCH, PDSCH or CSI-RS for tracking or CSI-RS for CQI on SSB symbols to be measured for beam failure detection.

### 8.5C.8 Scheduling availability of UE during candidate beam detection

Scheduling availability restrictions when the UE is performing L1-RSRP measurement for candidate beam detection are described in the following clauses.

#### 8.5C.8.1 Scheduling availability of UE performing L1-RSRP measurement with a same subcarrier spacing as PDSCH/PDCCH on FR1

There are no scheduling restrictions due to L1-RSRP measurement performed on SSB and CSI-RS configured as link recovery detection resource with the same SCS as PDSCH or PDCCH in FR1.

#### 8.5C.8.2 Scheduling availability of UE performing L1-RSRP measurement with a different subcarrier spacing than PDSCH/PDCCH on FR1

For UEs which support *simultaneousRxDataSSB-DiffNumerology* [14] there are no restrictions on scheduling availability due to L1-RSRP measurement based on SSB as link recovery detection resource. For UEs which do not support *simultaneousRxDataSSB-DiffNumerology* [14] the following restrictions apply due to L1-RSRP measurement based on SSB configured as link recovery detection resource.

- The UE is not expected to transmit PUCCH, PUSCH or SRS or receive PDCCH, PDSCH, TRS, CSI-RS for tracking or CSI-RS for CQI on SSB symbols to be measured for L1-RSRP.

### 8.5C.9 Minimum requirement at transitions for beam failure detection

When the UE transitions between DRX and no DRX or when DRX cycle periodicity changes, for each BFD-RS resource, for a duration of time equal to the evaluation period corresponding to the second mode after the transition occurs, the UE shall use an evaluation period that is no less than the minimum of evaluation period corresponding to the first mode and the second mode. Subsequent to this duration, the UE shall use an evaluation period corresponding to the second mode for each BFD-RS resource.

When the UE transitions from a first configuration of BFD resources to a second configuration of BFD resources that is different from the first configuration, for each BFD resource present in the second configuration, for a duration of time equal to the evaluation period corresponding to the second configuration after the transition occurs, the UE shall use an evaluation period that is no less than the minimum of evaluation periods corresponding to the first configuration and the second configuration. Subsequent to this duration, the UE shall use an evaluation period corresponding to the second configuration for each BFD resource present in the second configuration.

When the UE transitions from a first configuration of active TCI state of the CORESET to a second configuration of active TCI state of the CORESET, for each CSI-RS for BFD present in the second configuration, the UE shall use an evaluation period corresponding to the second configuration from the time of transition.

## 8.6 Active BWP switch delay

### 8.6.1 Introduction

The requirements in this clause apply for a UE configured PCell or any activated SCell in standalone NR or NE-DC, PCell, PSCell or any activated SCell in MCG or SCG in NR-DC, or PSCell or any activated SCell in SCG in EN-DC. The requirements in this clause also apply for a UE configured with more than one BWP on PCell or any activated SCell with CCA in standalone NR, or PSCell or any activated SCell with CCA in SCG in EN-DC. The requirements in 8.6.4 apply for a UE which is capable of *ul-LBT-FailureDetectionRecovery-r16* configured with more than one UL BWP on PCell with CCA in standalone NR or PSCell with CCA in EN-DC.

UE shall complete the switch of active DL and/or UL BWP within the delay defined in this clause.

### 8.6.2 DCI and timer based BWP switch delay on a single CC

The requirements in this clause only apply to the case that the BWP switch is performed on a single CC with more than one BWP configurations configured.

For DCI-based BWP switch, after the UE receives BWP switching request at DL slot n on a serving cell, UE shall be able to receive PDSCH (for DL active BWP switch) or transmit PUSCH (for UL active BWP switch) on the new BWP on the serving cell on which BWP switch on the first DL or UL slot occurs right after a time duration of TBWPswitchDelay + Y which starts from the beginning of DL slot n. Where,

- Y=0, if the serving cell where UE receives DCI for BWP switch request is same as the serving cell on which BWP switch occurs.

- Y equals to the length of 1 slot, if the serving cell where UE receives DCI for BWP switch is different from the serving cell on which BWP switch occurs for any involved serving cell. In this scenario, TBWPswitchDelay + Y shall follow the smaller SCS of scheduling cell, scheduled cells before and scheduled cells after active BWP change.If both scheduling cell and scheduled cell are in FR2-2, Y shall follow the SCS of 120 KHz.

The UE is not required to transmit UL signals or receive DL signals until the first DL or UL slot occurs right after a time duration of TBWPswitchDelay which starts from the beginning of DL slot n except DCI triggering BWP switch on the cell where DCI-based BWP switch occurs. The UE is not required to follow the requirements defined in this clause when performing a DCI-based BWP switch between the BWPs in disjoint channel bandwidths or in partially overlapping channel bandwidths.

For timer-based BWP switch, the UE shall start BWP switch at DL slot n, where slot n is the first slot of a DL subframe (FR1) or DL half-subframe (FR2) immediately after a BWP-inactivity timer *bwp-InactivityTimer* [2] expires on a serving cell, and the UE shall be able to receive PDSCH (for DL active BWP switch) or transmit PUSCH (for UL active BWP switch) on the new BWP on the serving cell on which BWP switch on the first DL or UL slot occurs right after a time duration of TBWPswitchDelay which starts from the beginning of DL slot n.

The UE is not required to transmit UL signals or receive DL signals during time duration TBWPswitchDelay after *bwp-InactivityTimer* [2] expires on the cell where timer-based BWP switch occurs.

Depending on UE capability *bwp-SwitchingDelay* [2], UE shall finish BWP switch within the time duration TBWPswitchDelay defined in Table 8.6.2-1.

Table 8.6.2-1: BWP switch delay

|  |  |  |  |
| --- | --- | --- | --- |
|  | NR Slot length | BWP switch delay TBWPswitchDelay (slots) | |
|  | (ms) | Type 1Note 1 | Type 2Note 1 |
| 0 | 1 | 1 | 3 |
| 1 | 0.5 | 2 | 5 |
| 2 | 0.25 | 3 | 9 |
| 3 | 0.125 | 6 | 18 |
| 5 | 0.03125 | 20 | 65 |
| 6 | 0.015625 | 39 | 129 |
| Note 1: Depends on UE capability.  Note 2: If the BWP switch involves changing of SCS, the BWP switch delay is determined by the smaller SCS between the SCS before BWP switch and the SCS after BWP switch. | | | |

Provided the UE does not have the required TCI-state information to receive PDCCH and PDSCH in the new BWP, the UE shall use old TCI-states before the BWP switch until a new MAC CE updating the required TCI-state information for PDCCH and PDSCH is received after the BWP switch.

If UE has the information on the required TCI-state information to receive PDCCH and PDSCH in the new BWP,

- UE shall be able to receive PDCCH and PDSCH with old TCI-states before the delay as specified in Clause 8.10 in the new BWP.

- UE shall be able to receive PDCCH and PDSCH with new TCI-states after the delay as specified in Clause 8.10 in the new BWP.

Provided the UE does not have the required activated TCI-state(s) information to receive PDCCH/ PDSCH and to transmit PUSCH/PUCCH/SRS in the new BWP, the UE shall use old TCI-state(s) before the BWP switch until a new MAC CE updating the required activated TCI-state(s) information is received after the BWP switch.

If the BWP switch is triggered within or outside DRX active time, and one of the two BWPs in a BWP switching is a dormant BWP [TS 38.321, 7], UE shall be able to complete active BWP switching within the time duration of

- TdormantBWPswitchDelay =TBWPswitchDelay+ X, provided that the dormancy indication is received in any of the first 3 OFDM symbols of a slot in the serving cell where DCI for dormancy indication is receiveds, or

- TdormantBWPswitchDelay =TBWPswitchDelay + X + Z, provided that the dormancy indication is received after the first 3 OFDM symbols of a slot in the serving cell where DCI for dormancy indication is received, where

- TBWPswitchDelay is defined in Table 8.6.2-1 corresponding to the smallest value among the SCS of the serving cell where UE receives dormancy indication and the SCSs of the dormant BWP and the active BWP immediately before or after switching the BWP of the serving cell where BWP switching occurs;

- X equals to the length of 1 slot corresponding to the smallest value among the SCS of the serving cell where UE receives dormancy indication and the SCSs of the dormant BWP and the active BWP immediately before or after switching the BWP of the serving cell where BWP switching occurs. If both scheduling cell and scheduled cell are in FR2-2, X shall follow the SCS of 120 KHz.

- Z equals to the length of 1 slot corresponding to the SCS of the serving cell where UE receives dormancy indication.

For DCI-based BWP switch, if the new BWP is a dormant BWP, after the UE receives BWP switching request at DL slot n on a serving cell, UE shall be able to receive CSI-RS (for DL active BWP switch) on the new BWP on the serving cell on which BWP switch on the first DL slot occurs right after a time duration of TdormantBWPswitchDelay which starts from the beginning of DL slot n.

### 8.6.2A DCI based BWP switch delay on multiple CCs

The requirements in this clause only apply to the case when the same type of BWP switch (DCI based BWP switch) is performed on multiple CCs simultaneously or over partially overlapping time period.

#### 8.6.2A.1 Simultaneous DCI based BWP switch delay on multiple CCs

The delay requirements for simultaneous DCI based BWP switch on multiple CCs in this clause apply only if the timing difference among the first symbol of slot carrying DCI for all CCs is received within the MRTD for inter-band CA as defined in clause 7.6.4.

For DCI-based BWP switch on multiple CCs, after the UE receives BWP switching request, UE shall be able to receive PDSCH (for DL active BWP switch) or transmit PUSCH (for UL active BWP switch) on the new BWPs on the serving cells on which BWP switch on the first DL or UL slot occurs right after a time duration of TMultipleBWPswitchDelay which starts from the beginning of DL slot n, where slot n is slot which UE receives the earliest BWP switching request among CCs on which UE is performing simultaneous DCI-based BWP switching.

The UE is not required to transmit UL signals or receive DL signals until the first DL or UL slot occurs right after a time duration of TMultipleBWPswitchDelay which starts from the beginning of DL slot n except DCI triggering BWP switch on the cell where DCI-based BWP switch occurs. The UE is not required to follow the requirements defined in this clause when performing a DCI-based BWP switch between the BWPs in disjoint channel bandwidths or in partially overlapping channel bandwidths on any serving cell.

UE shall finish BWP switch within the time duration TMultipleBWPswitchDelay + Y, which is defined as:

TMultipleBWPswitchDelay = TBWPswitchDelay + D\*(N-1)

Where:

- TBWPswitchDelay is the BWP switching delay on single CC defined in Table 8.6.2-1 depending on UE capability *bwp-SwitchingDelay* [2]. TBWPswitchDelay shall be based on the smallest SCS among SCS of all involved CCs before and after BWP switch. If the BWP switch on multiple CCs results in the change of the SCS on any CC among involved CCs, TBWPswitchDelay should be based on the smallest SCS among all SCS values of all involved CCs.

- D is the incremental delay for each additional CC involved in simultaneous BWP switch and depends on UE capability *bwp-SwitchingMultiCCs-r16* [TS 38.306, 14] for switching between non-dormant BWPs, and *bwp-SwitchingMultiDormancyCCs-r16* for switching between non-dormant and dormant BWPs.

- For UE which is capable of per-FR gap, and no BWP switch involves SCS change, N is the number of CCs in same FR; For UE which is not capable of per-FR gap, or the BWP switches on any CC involves SCS changing, N is the number of CCs undergoing simultaneous BWP switch.

* Y=0, ­if the serving cell where UE receives DCI for BWP switch is same as the serving cell on which BWP switch occurs for each involved serving cell.

Y equals to the length of one slot at smaller SCS of scheduling cell, scheduled cells before and scheduled cells after active BWP change,

- ­if the serving cell where UE receives DCI for BWP switch is different from the serving cell on which BWP switch occurs for any involved serving cell. If both scheduling cell and scheduled cell are in FR2-2, Y shall follow the SCS of 120 KHz. .

Provided the UE does not have the required TCI-state information to receive PDCCH and PDSCH in the new BWP, the UE shall use old TCI-states before the BWP switch until a new MAC CE updating the required TCI-state information for PDCCH and PDSCH is received after the BWP switch.

If UE has the information on the required TCI-state information to receive PDCCH and PDSCH in the new BWP,

- UE shall be able to receive PDCCH and PDSCH with old TCI-states before the delay as specified in Clause 8.10 in the new BWP.

- UE shall be able to receive PDCCH and PDSCH with new TCI-states after the delay as specified in Clause 8.10 in the new BWP.

Provided the UE does not have the required activated TCI-state(s) information to receive PDCCH/ PDSCH and to transmit PUSCH/PUCCH/SRS in the new BWP, the UE shall use old TCI-state(s) before the BWP switch until a new MAC CE updating the required activated TCI-state(s) information is received after the BWP switch.

If the BWP switch is triggered on multiple CCs simultaneously within or outside DRX active time, and one of the two BWPs on each CC in a BWP switching is a dormant BWP [TS 38.321, 7], UE shall be able to complete active BWP switching within the time duration of

- TDormantMultipleBWPswitchDelay = TMultipleBWPswitchDelay+X, provided that the dormancy indication is received in any of the first 3 OFDM symbols of a slot in the serving cell where DCI for dormancy indication is received, or

- TDormantMultipleBWPswitchDelay = TMultipleBWPswitchDelay +X+Z, provided that the dormancy indication is received after the first 3 OFDM symbols of a slot in the serving cell where DCI for dormancy indication is received, where

- TMultipleBWPswitchDelay is defined above corresponding to the smallest value among the SCS of the serving cell where UE receives dormancy indication and the SCSs of the dormant BWP and the active BWP immediately before or after switching the BWP of the serving cell where BWP switching occurs;

- X equals to the length of 1 slot corresponding to the smallest value among the SCS of the serving cell where UE receives dormancy indication and the SCSs of the dormant BWP and the active BWP immediately before or after switching the BWP of the serving cell where BWP switching occurs. If both scheduling cell and scheduled cell are in FR2-2, X shall follow the SCS of 120 KHz.

- Z equals to the length of 1 slot corresponding to the SCS of the serving cell where DCI for dormancy indication is received.

The number of CCs, N, on which the UE can simultaneously switch BWPs while still meeting the requirements, if any, related to allocations on downlink, uplink, or transmission of HARQ-ACK, depends on the UE reported capabilities related to BWP switching, the network configuration and the BWP switch method.

#### 8.6.2A.2 Non-simultaneous DCI based BWP switch delay on multiple CCs

In non-simultaneous case, the DCI-based BWP switch on multiple CCs is triggered over partially overlapping time period between CCs or multiple CCs in different Cell groups. The delay requirements for non-simultaneous DCI based BWP switch on multiple CCs in this clause apply only if:

- the timing difference among the first symbol of slot carrying DCI for all CCs involved in non-simultaneous BWP switch is received exceeds the MRTD for inter-band CA as defined in clause 7.6.4, and

- UE is operating in NR-DC (FR1+FR2), and

- UE is capable of per-FR gap, and

- BWP switch does not involve SCS change

For non-simultaneous DCI based BWP switch on multiple CCs, BWP switching delay requirements defined in clause 8.6.2 apply when BWP switching occurs on single CC in the cell group. BWP switching delay requirements defined in clause 8.6.2A.1 apply when simultaneous BWP switching occurs on multiple CCs in the cell group.

### 8.6.2B Timer based BWP switch delay on multiple CCs

The requirements in this clause only apply to the case when the same type of BWP switch (timer based BWP switch) is performed on multiple CCs simultaneously or over partially overlapping time period.

#### 8.6.2B.1 Simultaneous timer based BWP switch delay on multiple CCs

The delay requirements for simultaneous timer based BWP switch on multiple CCs in this clause apply only if the timing difference among the beginning of the slot where timer based BWP switching starts for all CCs is within the MRTD for inter-band CA as defined in clause 7.6.4.

For timer-based BWP switch on multiple CCs, UE shall start BWP switch at DL slot n, where slot n is the first slot of a DL subframe (in FR1) or DL half-subframe ((in FR2) immediately after the earliest BWP-inactivity timer *bwp-InactivityTimer* [2] expiration occurs on multiple serving cells, and the UE shall be able to receive PDSCH (for DL active BWP switch) or transmit PUSCH (for UL active BWP switch) on the new BWPs on the serving cells on which BWP switch on the first DL or UL slot occurs right after a time duration of TMultipleBWPswitchDelay which starts from the beginning of DL slot n, where TMultipleBWPswitchDelay is defined in 8.6.2A.1.

The UE is not required to transmit UL signals or receive DL signals during time duration TMultipleBWPswitchDelay after *bwp-InactivityTimer* [2] expires on the cell where timer-based BWP switch occurs.

Provided the UE does not have the required TCI-state information to receive PDCCH and PDSCH in the new BWP, the UE shall use old TCI-states before the BWP switch until a new MAC CE updating the required TCI-state information for PDCCH and PDSCH is received after the BWP switch.

If UE has the information on the required TCI-state information to receive PDCCH and PDSCH in the new BWP,

- UE shall be able to receive PDCCH and PDSCH with old TCI-states before the delay as specified in Clause 8.10 in the new BWP.

- UE shall be able to receive PDCCH and PDSCH with new TCI-states after the delay as specified in Clause 8.10 in the new BWP.

Provided the UE does not have the required activated TCI-state(s) information to receive PDCCH/ PDSCH and to transmit PUSCH/PUCCH/SRS in the new BWP, the UE shall use old TCI-state(s) before the BWP switch until a new MAC CE updating the required activated TCI-state(s) information is received after the BWP switch.

#### 8.6.2B.2 Non-simultaneous timer based BWP switch delay on multiple CCs

In non-simultaneous case, the timer-based BWP switch on multiple CCs is triggered over partially overlapping time period.

The delay requirements for non-simultaneous timer based BWP switch on multiple CCs in this clause apply if the timing difference among the beginning of the slot where timer based BWP switching starts for all CCs is exceeds the MRTD for inter-band CA as defined in clause 7.6.4, and the BWP switch does not involve SCS change. The UE performs the non-simultaneous timer-based BWP switch on the CCs sequentially.

For non-simultaneous timer-based BWP switch, the UE shall be able to receive PDSCH (for DL active BWP switch) or transmit PUSCH (for UL active BWP switch) on the new BWP on the serving cell on which BWP switch on the first DL or UL slot occurs right after a time duration of TMultipleBWPswitchDelayTotal which starts from the beginning of DL slot n, where slot n is the first slot of a DL subframe (in FR1) or DL half-subframe (in FR2) immediately after the earliest BWP-inactivity timer *bwp-InactivityTimer* [2] expires.

TMultipleBWPswitchDelayTotal = TDelay + TMultipleBWPswitchDelay

Where:

TDelay is the time required to complete the ongoing timer-based BWP switching on other CCs.

TMultipleBWPswitchDelay is the timer-based BWP switch delay on current single CC defined in clause 8.6.2 or simultaneously triggered on multiple CCs defined in clause 8.6.2B.1.

The UE is not required to transmit UL signals or receive DL signals during time duration TMultipleBWPswitchDelayTotal after *bwp-InactivityTimer* [2] expires on the cell where timer-based BWP switch occurs.

Provided the UE does not have the required TCI-state information to receive PDCCH and PDSCH in the new BWP, the UE shall use old TCI-states before the BWP switch until a new MAC CE updating the required TCI-state information for PDCCH and PDSCH is received after the BWP switch.

If UE has the information on the required TCI-state information to receive PDCCH and PDSCH in the new BWP,

- UE shall be able to receive PDCCH and PDSCH with old TCI-states before the delay as specified in Clause 8.10 in the new BWP.

- UE shall be able to receive PDCCH and PDSCH with new TCI-states after the delay as specified in Clause 8.10 in the new BWP.

Provided the UE does not have the required activated TCI-state(s) information to receive PDCCH/ PDSCH and to transmit PUSCH/PUCCH/SRS in the new BWP, the UE shall use old TCI-state(s) before the BWP switch until a new MAC CE updating the required activated TCI-state(s) information is received after the BWP switch.

### 8.6.3 RRC based BWP switch delay on a single CC

The requirements in this clause only apply to the case that the BWP switch is performed on a single CC with one or more than one BWP configuration(s) configured, with

* Active BWP switch or parameter change of its active BWPs for SpCell
* Parameter change of its active BWPs except parameter *firstActiveDownlinkBWP-Id* and *firstActiveUplinkBWP-Id* for SCell

For RRC-based BWP switch, after the UE receives RRC reconfiguration involving active BWP switching or parameter change of its active BWP, UE shall be able to receive PDSCH/PDCCH (for DL active BWP switch) or transmit PUSCH (for UL active BWP switch) on the new BWP on the serving cell on which BWP switch occurs on the first DL or UL slot right after a time duration of slots which begins from the beginning of DL slot n, where

DL slot n is the last slot overlapping with the PDSCH containing the RRC command, and

is determined by the smaller SCS between the SCS before BWP switch and the SCS after BWP switch if the BWP switch involves changing of SCS.

is the length of the RRC procedure delay in ms as defined in clause 11.2 in TS 36.331 [16] if the corresponding RRC message is embedded in E-UTRA RRC message, otherwise it is the length of the RRC procedure delay in ms as defined in clause 12 in TS 38.331 [2], and

is the time used by the UE to perform BWP switch.

The UE is not required to transmit UL signals or receive DL signals during the time defined by on the cell where RRC-based BWP switch occurs. When a longer switching delay is allowed. Where is the time between DL data transmission and acknowledgement as specified in TS 38.213 [3].

### 8.6.3A RRC based BWP switch delay on multiple CCs

The requirements in this clause only apply to the case when the same type of BWP switch (RRC based BWP switch) is performed on multiple CCs simultaneously or over partially overlapping time period.

The requirements in this clause shall apply:

* Active BWP switching or parameter change of its active BWPs for SpCell
* Parameter change of its active BWPs except parameter *firstActiveDownlinkBWP-Id* and *firstActiveUplinkBWP-Id* for SCells

#### 8.6.3A.1 Simultaneous RRC based BWP switch delay on multiple CCs

Requirements in this clause apply only if RRC based BWP switching on multiple CCs for NR-CA is triggered by a single RRC command.

For RRC-based BWP switch, after the UE receives RRC reconfiguration involving active BWP switching or parameter change of its active BWPs, UE shall be able to receive PDSCH/PDCCH (for DL active BWP switch) or transmit PUSCH (for UL active BWP switch) on the new BWPs on the serving cells on which BWP switch occurs on the first DL or UL slot right after a time duration of slots which begins from the beginning of DL slot n, where

DL slot n is the last slot overlapping with the PDSCH containing the RRC command, and

are defined in clause 8.6.3, and

for UE which is capable of type 1 BWP switching delay depending on UE capability *bwp-SwitchingDelay* [2]. for UE which is capable of type 2 BWP switching delay depending on UE capability *bwp-SwitchingDelay* [2], where D is the incremental delay for each additional CC involved in simultaneous BWP switch and depends on UE capability [TS 38.306, 14].

N is the number of CCs within the NR-CA configured for performing simultaneous BWP switch.

The UE is not required to transmit UL signals or receive DL signals during the time defined by on the cells where RRC-based BWP switch occurs.

#### 8.6.3A.2 Non-simultaneous RRC based BWP switch delay on multiple CCs

In non-simultaneous case, the RRC-based BWP switch on multiple CCs is triggered over partially overlapping time period in different Cell groups. The delay requirements in this clause apply only if:

BWP switching on multiple CCs in different cell groups are triggered by separate RRC commands, and

UE is operating in NR-DC (FR1+FR2), and

UE is capable of per-FR gap, and

BWP switch does not involve SCS change.

For non-simultaneous RRC-based BWP switch, after the UE receives RRC reconfiguration involving active BWP switching or parameter change of its active BWPs, UE shall be able to receive PDSCH/PDCCH (for DL active BWP switch) or transmit PUSCH (for UL active BWP switch) on the new BWPs on the serving cells on which BWP switch occurs on the first DL or UL slot right after a time duration of slots which begins from the beginning of DL slot n, where

DL slot n is the last slot containing the RRC command,

is the waiting time for RRC based BWP switch which is upper bounded by the ongoing BWP switch time in the first CG defined in clause 8.6.3A.1,

*M* is the number of CCs within the NR-CA configured for performing simultaneous BWP switch in the second CG; M=1 if the BWP switch is performed on single CC,

and are defined in clause 8.6.3, and

is defined in clause 8.6.3A.1.

The UE is not required to transmit UL signals or receive DL signals during the time defined by on the cells in the second CG where RRC-based BWP switch occurs.

### 8.6.4 BWP switch delay on Consistent UL CCA recovery

Upon detection of consistent UL CCA failure is slot#n in SpCell when UE detects *lbt-FailureInstanceMaxCount* number ofCCA failure within *lbt-FailureDetectionTimer*, the UE shall switch the active UL BWP to an UL BWP configured with PRACH occasion and for which consistent CCA failure has not been triggered as defined in TS 38.321 clause 5.21 [7]. The UE shall be ready to transmit PRACH on the new UL BWP of the SpCell on the first UL slot occurs right after slot n+TBWPswitchDelay +1, where TBWPswitchDelay is defined in Table 8.6.2-1. The UE shall finish the UL BWP switch within the time duration TBWPswitchDelay depending on UE capability *bwp-SwitchingDelay* [2].

Note: Additional delay in acquiring the first available RACH occasion will be derived in a way similar to that in handover in clause 6.1B.1.

The UE is not required to transmit UL signals or receive DL signals during time duration TBWPswitchDelay on the SpCell in the UL BWP switch. The UE is not required to follow the requirements defined in this clause when performing a UL BWP switch between the UL BWPs in disjoint channel bandwidths or in partially overlapping channel bandwidths.

## 8.6A Active BWP switch delay for RedCap

### 8.6A.1 Introduction

The requirements in this clause apply for RedCap UE. UE shall complete the switch of active DL and/or UL BWP within the delay defined in this clause.

### 8.6A.2 DCI and timer based BWP switch delay on a single CC

The requirements in this clause only apply to the case that the BWP switch is performed on a single CC with more than one BWP configurations configured.

For DCI-based BWP switch, after the UE receives BWP switching request at DL slot n on a serving cell, UE shall be able to receive PDSCH (for DL active BWP switch) or transmit PUSCH (for UL active BWP switch) on the new BWP on the serving cell on which BWP switch on the first DL or UL slot occurs right after a time duration of TBWPswitchDelay + Y which starts from the beginning of DL slot n. Where,

- Y=0, if the serving cell where UE receives DCI for BWP switch request is same as the serving cell on which BWP switch occurs.

- Y equals to the length of 1 slot, if the serving cell where UE receives DCI for BWP switch is different from the serving cell on which BWP switch occurs for any involved serving cell. In this scenario, TBWPswitchDelay + Y shall follow the smaller SCS of scheduling cell, scheduled cells before and scheduled cells after active BWP change.

The UE is not required to transmit UL signals or receive DL signals until the first DL or UL slot occurs right after a time duration of TBWPswitchDelay which starts from the beginning of DL slot n except DCI triggering BWP switch on the cell where DCI-based BWP switch occurs. The UE is not required to follow the requirements defined in this clause when performing a DCI-based BWP switch between the BWPs in disjoint channel bandwidths or in partially overlapping channel bandwidths.

For timer-based BWP switch, the UE shall start BWP switch at DL slot n, where slot n is the first slot of a DL subframe (FR1) or DL half-subframe (FR2) immediately after a BWP-inactivity timer *bwp-InactivityTimer* [2] expires on a serving cell, and the UE shall be able to receive PDSCH (for DL active BWP switch) or transmit PUSCH (for UL active BWP switch) on the new BWP on the serving cell on which BWP switch on the first DL or UL slot occurs right after a time duration of TBWPswitchDelay which starts from the beginning of DL slot n.

The UE is not required to transmit UL signals or receive DL signals during time duration TBWPswitchDelay after *bwp-InactivityTimer* [2] expires on the cell where timer-based BWP switch occurs.

Depending on UE capability *bwp-SwitchingDelay* [2], UE shall finish BWP switch within the time duration TBWPswitchDelay defined in Table 8.6.2-1.

Table 8.6A.2-1: BWP switch delay

|  |  |  |  |
| --- | --- | --- | --- |
|  | NR Slot length | BWP switch delay TBWPswitchDelay (slots) | |
|  | (ms) | Type 1Note 1 | Type 2Note 1 |
| 0 | 1 | 1 | 3 |
| 1 | 0.5 | 2 | 5 |
| 2 | 0.25 | 3 | 9 |
| 3 | 0.125 | 6 | 18 |
| Note 1: Depends on UE capability.  Note 2: If the BWP switch involves changing of SCS, the BWP switch delay is determined by the smaller SCS between the SCS before BWP switch and the SCS after BWP switch. | | | |

Provided the UE does not have the required TCI-state information to receive PDCCH and PDSCH in the new BWP, the UE shall use old TCI-states before the BWP switch until a new MAC CE updating the required TCI-state information for PDCCH and PDSCH is received after the BWP switch.

If UE has the information on the required TCI-state information to receive PDCCH and PDSCH in the new BWP,

- UE shall be able to receive PDCCH and PDSCH with old TCI-states before the delay as specified in Clause 8.10 in the new BWP.

- UE shall be able to receive PDCCH and PDSCH with new TCI-states after the delay as specified in Clause 8.10 in the new BWP.

If the BWP switch is triggered within or outside DRX active time, and one of the two BWPs in a BWP switching is a dormant BWP [TS 38.321, 7], UE shall be able to complete active BWP switching within the time duration of

- TdormantBWPswitchDelay =TBWPswitchDelay+ X, provided that the dormancy indication is received in any of the first 3 OFDM symbols of a slot in the serving cell where DCI for dormancy indication is receiveds, or

- TdormantBWPswitchDelay =TBWPswitchDelay + X + Z, provided that the dormancy indication is received after the first 3 OFDM symbols of a slot in the serving cell where DCI for dormancy indication is received, where

- TBWPswitchDelay is defined in Table 8.6.2-1 corresponding to the smallest value among the SCS of the serving cell where UE receives dormancy indication and the SCSs of the dormant BWP and the active BWP immediately before or after switching the BWP of the serving cell where BWP switching occurs;

- X equals to the length of 1 slot corresponding to the smallest value among the SCS of the serving cell where UE receives dormancy indication and the SCSs of the dormant BWP and the active BWP immediately before or after switching the BWP of the serving cell where BWP switching occurs.

- Z equals to the length of 1 slot corresponding to the SCS of the serving cell where UE receives dormancy indication.

For DCI-based BWP switch, if the new BWP is a dormant BWP, after the UE receives BWP switching request at DL slot n on a serving cell, UE shall be able to receive CSI-RS (for DL active BWP switch) on the new BWP on the serving cell on which BWP switch on the first DL slot occurs right after a time duration of TdormantBWPswitchDelay which starts from the beginning of DL slot n.

### 8.6A.3 RRC based BWP switch delay on a single CC

The requirements in this clause only apply to the case that the BWP switch is performed on a single CC with one or more than one BWP configuration(s) configured, with

Active BWP switch or parameter change of its active BWPs for PCell

Parameter change of its active BWPs except parameter *firstActiveDownlinkBWP-Id* and *firstActiveUplinkBWP-Id* for SCell

For RRC-based BWP switch, after the UE receives RRC reconfiguration involving active BWP switching or parameter change of its active BWP, UE shall be able to receive PDSCH/PDCCH (for DL active BWP switch) or transmit PUSCH (for UL active BWP switch) on the new BWP on the serving cell on which BWP switch occurs on the first DL or UL slot right after a time duration of slots which begins from the beginning of DL slot n, where

DL slot n is the last slot overlapping with the PDSCH containing the RRC command, and

is determined by the smaller SCS between the SCS before BWP switch and the SCS after BWP switch if the BWP switch involves changing of SCS.

is the length of the RRC procedure delay in ms as defined in clause 11.2 in TS 36.331 [16] if the corresponding RRC message is embedded in E-UTRA RRC message, otherwise it is the length of the RRC procedure delay in ms as defined in clause 12 in TS 38.331 [2], and

is the time used by the UE to perform BWP switch.

The UE is not required to transmit UL signals or receive DL signals during the time defined by on the cell where RRC-based BWP switch occurs. When a longer switching delay is allowed. Where is the time between DL data transmission and acknowledgement as specified in TS 38.213 [3].

## 8.6C Active BWP switch delay for satellite access

*Editor’s note: Applicability of frequency range, CA, DA, duplex mode, inter-RAT measurement, etc is subject to updates/changes based on the scope of the corresponding WID.*

*Editor’s note: Terminology will be further clarified and selected between, e.g. NTN and satellite access, based on further agreements.*

### 8.6C.1 Introduction

The requirements in this clause apply for a UE configured with only PCell, which is served by satellite access node (SAN). The requirements in this clause also apply for a UE configured with more than one BWP on PCell.

UE shall complete the switch of active DL and/or UL BWP within the delay defined in this clause.

### 8.6C.2 DCI and timer based BWP switch delay on a single CC

The requirements in this clause only apply to the case that the BWP switch is performed on a single CC with more than one BWP configurations configured.

For DCI-based BWP switch, after the UE receives BWP switching request at DL slot n on a serving cell, UE shall be able to receive PDSCH (for DL active BWP switch) or transmit PUSCH (for UL active BWP switch) on the new BWP on the serving cell on which BWP switch on the first DL or UL slot occurs right after a time duration of TBWPswitchDelay + Y which starts from the beginning of DL slot n. Where,

- Y=0, if the serving cell where UE receives DCI for BWP switch request is same as the serving cell on which BWP switch occurs.

- Y equals to the length of 1 slot, if the serving cell where UE receives DCI for BWP switch is different from the serving cell on which BWP switch occurs for any involved serving cell. In this scenario, TBWPswitchDelay + Y shall follow the smaller SCS of scheduling cell, scheduled cells before and scheduled cells after active BWP change.

The UE is not required to transmit UL signals or receive DL signals until the first DL or UL slot occurs right after a time duration of TBWPswitchDelay which starts from the beginning of DL slot n except DCI triggering BWP switch on the cell where DCI-based BWP switch occurs. The UE is not required to follow the requirements defined in this clause when performing a DCI-based BWP switch between the BWPs in disjoint channel bandwidths or in partially overlapping channel bandwidths.

For timer-based BWP switch, the UE shall start BWP switch at DL slot n, where slot n is the first slot of a DL subframe (FR1) immediately after a BWP-inactivity timer *bwp-InactivityTimer* [2] expires on a serving cell, and the UE shall be able to receive PDSCH (for DL active BWP switch) or transmit PUSCH (for UL active BWP switch) on the new BWP on the serving cell on which BWP switch on the first DL or UL slot occurs right after a time duration of TBWPswitchDelay which starts from the beginning of DL slot n.

The UE is not required to transmit UL signals or receive DL signals during time duration TBWPswitchDelay after *bwp-InactivityTimer* [2] expires on the cell where timer-based BWP switch occurs.

Depending on UE capability *bwp-SwitchingDelay* [2], UE shall finish BWP switch within the time duration TBWPswitchDelay defined in Table 8.6C.2-1.

Table 8.6C.2-1: BWP switch delay

|  |  |  |  |
| --- | --- | --- | --- |
|  | NR Slot length | BWP switch delay TBWPswitchDelay (slots) | |
|  | (ms) | Type 1Note 1 | Type 2Note 1 |
| 0 | 1 | 1 | 3 |
| 1 | 0.5 | 2 | 5 |
| 2 | 0.25 | 3 | 9 |
| Note 1: Depends on UE capability.  Note 2: If the BWP switch involves changing of SCS, the BWP switch delay is determined by the smaller SCS between the SCS before BWP switch and the SCS after BWP switch. | | | |

Provided the UE does not have the required TCI-state information to receive PDCCH and PDSCH in the new BWP, the UE shall use old TCI-states before the BWP switch until a new MAC CE updating the required TCI-state information for PDCCH and PDSCH is received after the BWP switch.

If UE has the information on the required TCI-state information to receive PDCCH and PDSCH in the new BWP,

- UE shall be able to receive PDCCH and PDSCH with old TCI-states before the delay as specified in Clause 8.10 in the new BWP.

- UE shall be able to receive PDCCH and PDSCH with new TCI-states after the delay as specified in Clause 8.10 in the new BWP.

If the BWP switch is triggered within or outside DRX active time, and one of the two BWPs in a BWP switching is a dormant BWP [TS 38.321, 7], UE shall be able to complete active BWP switching within the time duration of

- TdormantBWPswitchDelay =TBWPswitchDelay+ X, provided that the dormancy indication is received in any of the first 3 OFDM symbols of a slot in the serving cell where DCI for dormancy indication is receiveds, or

- TdormantBWPswitchDelay =TBWPswitchDelay + X + Z, provided that the dormancy indication is received after the first 3 OFDM symbols of a slot in the serving cell where DCI for dormancy indication is received, where

- TBWPswitchDelay is defined in Table 8.6C.2-1 corresponding to the smallest value among the SCS of the serving cell where UE receives dormancy indication and the SCSs of the dormant BWP and the active BWP immediately before or after switching the BWP of the serving cell where BWP switching occurs.

- X equals to the length of 1 slot corresponding to the smallest value among the SCS of the serving cell where UE receives dormancy indication and the SCSs of the dormant BWP and the active BWP immediately before or after switching the BWP of the serving cell where BWP switching occurs.

- Z equals to the length of 1 slot corresponding to the SCS of the serving cell where UE receives dormancy indication.

For DCI-based BWP switch, if the new BWP is a dormant BWP, after the UE receives BWP switching request at DL slot n on a serving cell, UE shall be able to receive CSI-RS (for DL active BWP switch) on the new BWP on the serving cell on which BWP switch on the first DL slot occurs right after a time duration of TdormantBWPswitchDelay which starts from the beginning of DL slot n.

### 8.6C.3 RRC based BWP switch delay on a single CC

The requirements in this clause only apply to the case that the BWP switch is performed on a single CC with one or more than one BWP configuration(s) configured, with

* Active BWP switch or parameter change of its active BWPs for PCell

For RRC-based BWP switch, after the UE receives RRC reconfiguration involving active BWP switching or parameter change of its active BWP, UE shall be able to receive PDSCH/PDCCH (for DL active BWP switch) or transmit PUSCH (for UL active BWP switch) on the new BWP on the serving cell on which BWP switch occurs on the first DL or UL slot right after a time duration of slots which begins from the beginning of DL slot n, where

DL slot n is the last slot containing the RRC command, and

is determined by the smaller SCS between the SCS before BWP switch and the SCS after BWP switch if the BWP switch involves changing of SCS.

is the length of the RRC procedure delay in ms as defined in clause 12 in TS 38.331 [2], and

is the time used by the UE to perform BWP switch.

The UE is not required to transmit UL signals or receive DL signals during the time defined by on the cell where RRC-based BWP switch occurs. When a longer switching delay is allowed. Where is the time between DL data transmission and acknowledgement as specified in TS 38.213 [3].

## 8.7 Void

## 8.8 NE-DC: E-UTRAN PSCell Addition and Release Delay

### 8.8.1 Introduction

This clause defines requirements for the delay within which the UE shall be able to configure an E-UTRAN PSCell in NR - E-UTRA dual connectivity. The requirements are applicable to an NR - E-UTRA dual connectivity capable UE.

### 8.8.2 E-UTRAN PSCell Addition Delay Requirement

The requirements in this clause shall apply for the UE, which is configured with PCell, and may also be configured with one or more SCells.

Upon receiving E-UTRAN PSCell addition in subframe *n*, the UE shall be capable to transmit PRACH preamble towards E-UTRAN PSCell no later than in subframe *n* + Tconfig\_EUTRAN-PSCell:

Where:

Tconfig\_EUTRAN-PSCell = TRRC\_delay + Tactivation\_time + 50ms + TE-UTRAN-PSCell\_ DU

TRRC\_delay is the RRC procedure delay as specified in TS 38.331 [2].

Tactivation\_time is the E-UTRAN PSCell activation delay. If the E-UTRAN PSCell is known, then Tactivation\_time is 20ms. If the E-UTRAN PSCell is unknown, then Tactivation\_time is 30ms provided the E-UTRAN PSCell can be successfully detected on the first attempt.

TE-UTRAN-PSCell\_DU is the delay uncertainty in acquiring the first available PRACH occasion in the E-UTRAN PSCell. TE-UTRAN-PSCell\_DU is up to 30ms.

E-UTRAN PSCell is known if it has been meeting the following conditions:

- During the last 5 seconds before the reception of the E-UTRAN PSCell configuration command:

- the UE has sent a valid measurement report for the E-UTRAN PSCell being configured and

- the E-UTRAN PSCell being configured remains detectable according to the cell identification conditions specified in clause 8.8 of TS 36.133 [15],

- E-UTRAN PSCell being configured also remains detectable during the E-UTRAN PSCell configuration delay Tconfig\_EUTRAN-PSCell according to the cell identification conditions specified in clause 8.8 of TS 36.133 [15].

otherwise it is unknown.

The PCell interruption specified in clause 8.2 is allowed only during the RRC reconfiguration procedure [2].

### 8.8.3 E-UTRAN PSCell Release Delay Requirement

also be configured with one or more SCells and/or E-UTRAN SCells.

Upon receiving E-UTRAN PSCell release in subframe *n*, the UE shall accomplish the release actions specified in TS 38.331 [2] no later than in subframe *n+* TRRC\_delay:

Where

TRRC\_delay is the RRC procedure delay as specified in TS 38.331 [2].

The PCell interruption specified in clause 8.2 is allowed only during the RRC reconfiguration procedure [2].

## 8.9 NR-DC: PSCell Addition and Release Delay

### 8.9.1 Introduction

This clause defines requirements for the delay within which the UE shall be able to configure an PSCell in NR dual connectivity. The requirements are applicable to an NR dual connectivity capable UE.

### 8.9.2 PSCell Addition Delay Requirement

The requirements in this clause shall apply for the UE configured with only PCell in FR1.

Upon receiving PSCell addition in subframe *n*, the UE shall be capable to transmit PRACH preamble towards PSCell in FR2 no later than in subframe *n* + Tconfig\_PSCell Upon receiving PSCell addition in subframe *n*, the UE shall be capable to transmit PRACH preamble towards PSCell in FR2 no later than in slot :

where:

Tconfig\_PSCell = TRRC\_delay + Tprocessing + Tsearch + T∆ + TPSCell\_ DU + 2 ms

TRRC\_delay is the RRC procedure delay as specified in TS 38.331 [2].

Tprocessing is the SW processing time needed by UE, including RF warm up period. Tprocessing = 40 ms.

Tsearch is the time for AGC settling and PSS/SSS detection. If the target cell is known, Tsearch = 0 ms. If the target cell is unknown and the target cell Ês/Iot ≥ -2dB, Tsearch = 3\*N\* Trs ms. N = 8 when the target cell is in FR2-1, and N = 12 when the target cell is in FR2-2

T∆ is time for fine time tracking and acquiring full timing information of the target cell. T∆ = 1\*Trs ms for a known or unknown PSCell.

TPSCell\_ DU is the delay uncertainty in acquiring the first available PRACH occasion in the PSCell. TPSCell\_ DU is up to the summation of SSB to PRACH occasion association period and 10 ms. SSB to PRACH occasion associated period is defined in Table 8.1-1 of TS 38.213 [3].

Trs is the SMTC periodicity of the target cell if the UE has been provided with an SMTC configuration for the target cell in PSCell addition message, otherwise Trs is the SMTC configured in the measObjectNR having the same SSB frequency and subcarrier spacing. If the UE is not provided SMTC configuration or measurement object on this frequency, the requirement in this clause is applied with Trs = 5 ms assuming the SSB transmission periodicity is 5 ms. There is no requirement if the SSB transmission periodicity is not 5 ms.

In FR1 and FR2, the PSCell is known if it has been meeting the following conditions:

- During the last 5 seconds before the reception of the PSCell configuration command:

- the UE has sent a valid measurement report for the PSCell being configured and

- One of the SSBs measured from the PSCell being configured remains detectable according to the cell identification conditions specified in clause 9.3.

- One of the SSBs measured from PSCell being configured also remains detectable during the PSCell configuration delay Tconfig\_PSCell according to the cell identification conditions specified in clause 9.3.

otherwise it is unknown.

The PCell interruption specified in clause 8.2 is allowed only during the RRC reconfiguration procedure [2].

### 8.9.3 PSCell Release Delay Requirement

The requirements in this clause shall apply for a UE which is configured with PCell and one PSCell.

Upon receiving PSCell release in subframe *n*, the UE shall accomplish the release actions specified in TS 38.331 [2] no later than in slot :

where

TRRC\_delay is the RRC procedure delay as specified in TS 38.331 [2].

The PCell interruption specified in clause 8.2 is allowed only during the RRC reconfiguration procedure [2].

## 8.9A Conditional PSCell Addition Delay

### 8.9A.1 Introduction

This clause defines requirements for the delay within which the UE shall be able to perform conditional PSCell addition in EN-DC or NR-DC. The requirements in this clause are applicable to EN-DC and NR-DC.

### 8.9A.2 Conditional PSCell Addition Delay Requirement

The requirements in this clause shall apply for the UE configured with only PCell in FR1.

Upon receiving conditional PSCell addition in subframe *n*, the UE shall be capable to transmit PRACH preamble towards PSCell no later than in subframe *n* + Tconfig\_PSCell\_Addition\_Conditional:

Where:

Tconfig\_PSCell\_Addition\_Conditional = TRRC\_delay + TEvent\_DU + Tmeasure + TUE\_preparation + Tprocessing + T∆ + TPSCell\_ DU + 2 ms

TRRC\_delay is the RRC processing delay defined in Clause 11.2 in 36.331 [16] which is the corresponding RRC message embedded in E-UTRA RRC message, otherwise it is the RRC procedure delay defined in clause 12 in TS 38.331 [2] for processing the conditional PSCell addition command.

TEvent\_DU is the delay uncertainty which is the time from when the UE successfully decodes a conditional PSCell addition command until a condition exists at the measurement reference point which will trigger the conditional PSCell addition.

Tmeasure is the measurements time stated in clause 8.9A.2.1.

TUE\_preparation is the UE preparation time for conditional PSCell addition, and starts after UE realizes the condition of PSCell addition is met and identity of the PSCell is determined. TUE\_preparation is up to 10 ms.

Tprocessing is the SW processing time needed by UE, including RF warm up period. Tprocessing = 20 ms when PSCell is in FR1, and Tprocessing = 40 ms when PSCell is in FR2.

T∆ is time for fine time tracking and acquiring full timing information of the target cell. T∆ = 1\*Trs ms.

TPSCell\_ DU is the delay uncertainty in acquiring the first available PRACH occasion in the PSCell. TPSCell\_ DU is up to the summation of SSB to PRACH occasion association period and 10 ms. SSB to PRACH occasion associated period is defined in Table 8.1-1 of TS 38.213 [3].

Trs is the SMTC periodicity of the target cell if the UE has been provided with an SMTC configuration for the target cell in PSCell addition message, otherwise Trs is the SMTC configured in the measObjectNR having the same SSB frequency and subcarrier spacing. If the UE is not provided SMTC configuration or measurement object on this frequency, the requirement in this clause is applied with Trs = 5 ms assuming the SSB transmission periodicity is 5 ms. There is no requirement if the SSB transmission periodicity is not 5 ms.

The PCell interruption specified in clause 8.2 is allowed only after the UE starts to execute a conditional PSCell addition.

#### 8.9A.2.1 Measurement time

The measurement time delay is defined from the end of TEvent\_DU until UE executes a PSCell addition and interruption time starts.

The measurement time delay measured without Time To Trigger (TTT) and L3 filtering shall be less than Tidentify\_inter\_with\_index defined in clause 9.3.4. When TTT or L3 filtering is used an additional delay can be expected.

A cell is detectable only if at least one SSB measured from the cell being configured remains detectable during the time period Tidentify\_inter\_with\_index for PSCell addition. If a cell, which has been detectable at least for the time period Tidentify\_inter\_with\_index for PSCell addition, becomes undetectable for a period and then the cell becomes detectable again and triggers a PSCell addition, the measurement time delay shall be less than TSSB\_measurement\_period\_inter provided the timing to that cell has not changed more than ± 3200/ Tc while the measurement gap has not been available and the L3 filter has not been used, where *µ* is the SCS configuration as defined in clause 4.2 of TS 38.211 [3]. When L3 filtering is used, an additional delay can be expected.

## 8.9B NR-DC: PSCell Addition and Release Delay in Carriers with CCA

### 8.9B.1 Introduction

This clause defines requirements for the delay within which the UE shall be able to configure an PSCell in FR2-2 with CCA in NR dual connectivity. The requirements are applicable to an NR dual connectivity capable UE.

### 8.9B.2 PSCell Addition Delay Requirement

The requirements in this clause shall apply for the UE configured with only PCell in FR1.

Upon receiving PSCell addition in subframe *n*, the UE shall be capable to transmit PRACH preamble towards PSCell in FR2-2 no later than in slot :

where:

Tconfig\_PSCell\_CCA = TRRC\_delay + Tprocessing + Tsearch\_CCA + T∆\_CCA + TPSCell\_ DU + 2 ms

TRRC\_delay is the RRC procedure delay as specified in TS 38.331 [2].

Tprocessing is the SW processing time needed by UE, including RF warm up period. Tprocessing = 40 ms.

Tsearch\_CCA is the time for AGC settling and PSS/SSS detection. If the target cell is known, Tsearch = 0 ms. If the target cell is unknown and the target cell Ês/Iot ≥ -2dB, Tsearch = (3\*N+L1\*N) \* Trs ms, where L1 is the number of SMTC occasions groups with at least one SSB/SMTC occasion in the group is not transmitted by the gNB during the AGC settling and PSS/SSS detection. L1, max=TBD, N is the Rx beam sweeping factor for FR2-2.

T∆\_CCA is time for fine time tracking and acquiring full timing information of the target cell. T∆ = (1+L2) \*Trs ms for a known or unknown PSCell, where L2 is the number of SMTC occasions not avaible at the UE during the time tracking period. L2, max =TBD.

TPSCell\_ DU is the interruption uncertainty due to the random access procedure when sending PRACH to the new cell. TPSCell\_ DU can be up to: (1+ L3) \* TSSB,RO + 10 ms where TSSB,RO is the SSB to PRACH occasion association period as defined in Table 8.1-1 of TS 38.213 [3] and L3 is the number of consecutive SSB to PRACH occasion association periods during which no PRACH occasion is available for PRACH transmission due to UL CCA failure. L3 = 0 for Type 3 UL channel access procedure as defined in TS 37.213 [33].

Trs is the SMTC periodicity of the target cell if the UE has been provided with an SMTC configuration for the target cell in PSCell addition message, otherwise Trs is the SMTC configured in the measObjectNR having the same SSB frequency and subcarrier spacing. If the UE is not provided SMTC configuration or measurement object on this frequency, the requirement in this clause is applied with Trs = 5 ms assuming the SSB transmission periodicity is 5 ms. There is no requirement if the SSB transmission periodicity is not 5 ms.

NOTE 1: The interruption time considering the potential extensions caused by L1,L2, L3 and by the UL CCA failure detection/recovery mechanism is limited by the T304 timer. The UE behaviour at the T304 timer expiry is detailed in TS 38.331 [2].

In FR2-2, the PSCell is known if it has been meeting the following conditions:

- During the last 5 seconds before the reception of the PSCell configuration command:

- the UE has sent a valid measurement report for the PSCell being configured and

- One of the SSBs measured from the PSCell being configured remains detectable according to the cell identification conditions specified in clause 9.3A.

- One of the SSBs measured from PSCell being configured also remains detectable during the PSCell configuration delay Tconfig\_PSCell\_CCA according to the cell identification conditions specified in clause 9.3A.

otherwise it is unknown.

The PCell interruption specified in clause 8.2 is allowed only during the RRC reconfiguration procedure [2].

### 8.9B.3 PSCell Release Delay Requirement

The requirements in this clause shall apply for a UE which is configured with PCell in FR1 and one PSCell in FR2-2.

Upon receiving PSCell release in subframe *n*, the UE shall accomplish the release actions specified in TS 38.331 [2] no later than in slot :

where

- TRRC\_delay is the RRC procedure delay as specified in TS 38.331 [2].

The PCell interruption specified in clause 8.2 is allowed only during the RRC reconfiguration procedure [2].

## 8.10 Active TCI state switching delay

8.10.1 Introduction

The requirements in this clause apply for a UE configured with one or more TCI state configurations on serving cell in MR-DC or standalone NR. UE shall complete the switch of active TCI state within the delay defined in this clause.

8.10.2 Known conditions for TCI state

The TCI state is known if the following conditions are met:

- During the period from the last transmission of the RS resource used for the L1-RSRP measurement reporting for the target TCI state to the completion of active TCI state switch, where the RS resource for L1-RSRP measurement is the RS in target TCI state or QCLed to the target TCI state

- TCI state switch command is received within 1280 ms upon the last transmission of the RS resource for beam reporting or measurement

- The UE has sent at least 1 L1-RSRP report for the target TCI state before the TCI state switch command

- The TCI state remains detectable during the TCI state switching period

- The SSB associated with the TCI state remain detectable during the TCI switching period

- SNR of the TCI state ≥ -3dB

Otherwise, the TCI state is unknown.

8.10.3 MAC-CE based TCI state switch delay

If the target TCI state is known, upon receiving PDSCH carrying MAC-CE activation command in slot n, UE shall be able to receive PDCCH with target TCI state of the serving cell on which TCI state switch occurs at the first slot that is after slot n+ THARQ + + TOk\*(Tfirst-SSB + TSSB-proc) / *NR slot length*. The UE shall be able to receive PDCCH with the old TCI state until slot n+ THARQ + .Where THARQ is the timing between DL data transmission and acknowledgement as specified in TS 38.213 [3];

- Tfirst-SSB is time to first SSB transmission after MAC CE command is decoded by the UE; The SSB shall be the QCL-TypeA or QCL-TypeC to target TCI state

- TSSB-proc = 2 ms;

- TOk = 1 if target TCI state is not in the active TCI state list for PDSCH, 0 otherwise.

If the target TCI state is unknown, upon receiving PDSCH carrying MAC-CE activation command in slot n, UE shall be able to receive PDCCH with target TCI state of the serving cell on which TCI state switch occurs at the first slot that is after slot n+ THARQ + + TL1-RSRP +TOuk\*(Tfirst-SSB+ TSSB-proc) / *NR slot length*. The UE shall be able to receive PDCCH with the old TCI state until slot n+ THARQ + .

Where

- T L1-RSRP = 0 in FR1 or when the TCI state switching not involving QCL-TypeD in FR2. Otherwise,

- T L1-RSRP is the time for Rx beam refinement in FR2, defined as

- TL1-RSPR\_Measurement\_Period\_SSB for SSB as specified in clause 9.5.4.1,

- with the assumption of M=1

- with TReport = 0

- TL1-RSRP\_Measurement\_Period\_CSI-RS for CSI-RS as specified in clause 9.5.4.2

- configured with higher layer parameter *repetition* set to ON

- with the assumption of M=1 for periodic CSI-RS

- for aperiodic CSI-RS if number of resources in resource set at least equal to *MaxNumberRxBeam*

- with TReport = 0

- TOuk = 1 for CSI-RS based L1-RSRP measurement, and 0 for SSB based L1-RSRP measurement when TCI state switching involves QCL-TypeD

- TOuk = 1 when TCI state switching involves other QCL types only

- Tfirst-SSB is time to first SSB transmission after L1-RSRP measurement when TCI state switching involves QCL-TypeD;

- Tfirst-SSB is time to first SSB transmission after MAC CE command is decoded by the UE for other QCL types;

- The SSB shall be the QCL-TypeA or QCL-TypeC to target TCI state

### 8.10.3A MAC-CE based TCI state switch delay in HST FR2 scenarios

For FR2 power class 6 UE*,* if the target TCI state is known, upon receiving PDSCH carrying MAC-CE activation command in slot n, UE shall be able to receive PDCCH with target TCI state of the serving cell on which TCI state switch occurs at the symbol m of the first slot that is after slot n+ THARQ + + TOk\*(Tfirst-SSB + TSSB-proc + Trs + Trs-proc) / *NR slot length*. The UE shall be able to receive PDCCH with the old TCI state until slot n+ THARQ + .Where THARQ is the timing between DL data transmission and acknowledgement as specified in TS 38.213 [3];

- Tfirst-SSB is time to first SSB transmission after MAC CE command is decoded by the UE;

- TSSB-proc = 2 ms;

- Trs is time to the first TRS or SSB transmission after the SSB transmission in the definition of Tfirst-SSB is processed by the UE;

- Trs-proc = 2 ms;

- TOk = 1, m = 0 if target TCI state is not in the active TCI state list for PDSCH; otherwise TOk = 0, m = 1.

For FR2 power class 6 UE, if the target TCI state is unknown, the same requirement for unknown target TCI state case specified in clause 8.10.3 applies.

### 8.10.4 DCI based TCI state switch delay

If the target TCI state is known, when a UE is configured with the higher layer parameter *tci-PresentInDCI* which is set as 'enabled'for the CORESET scheduling PDSCH at slot n, UE shall be able to receive PDSCH with target TCI state of the serving cell on which TCI state switch occurs at the first slot that is after slot n+*timeDurationForQCL*, where, *timeDurationForQCL* is the time required by the UE to perform PDCCH reception and applying spatial QCL information received in DCI for PDSCH processing as described in TS 38.214 [26], the value of *timeDurationForQCL* is defined in TS 38.331 [2].

The known condition for TCI state defined in clause 8.10.2 is applied.

### 8.10.5 RRC based TCI state switch delay

If the target TCI state is known, UE shall be able to receive PDCCH with target TCI state of the serving cell on which TCI state switch occurs at the first slot that is after slot n+ (TRRC\_processing +TOk\*(Tfirst-SSB + TSSB-proc)) / *NR slot length*, The UE is not required to receive PDCCH/PDSCH/CSI-RS or transmit PUCCH/PUSCH until the end of switching period.

Where

- Slot n is the last slot overlapping with the PDSCH carrying RRC activation command.

- TRRC\_processing is the RRC processing delay defined in Clause 11.2 of TS 36.331 [16] if the corresponding RRC message is embedded in E-UTRA RRC message, otherwise it is the RRC processing delay defined in Clause 12 of TS 38.331 [2].

- Tfirst-SSB is time to first SSB transmission after RRC processing by the UE; The SSB shall be the QCL-TypeA or QCL-TypeC to target TCI state.

- TSSB-proc and TOk are defined in clause 8.10.3.

If the target TCI state is unknown, UE shall be able to receive PDCCH with target TCI state of the serving cell on which TCI state switch occurs at the first slot that is after slot n+ (TRRC\_processing  +TL1-RSRP +TOuk\*(Tfirst-SSB + TSSB-proc)) / *NR slot length*, The UE is not required to receive PDCCH/PDSCH/CSI-RS or transmit PUCCH/PUSCH until the end of switching period.

Where

- Slot n is the last slot overlapping with the PDSCH carrying RRC activation command.

- TRRC\_processing is the RRC processing delay defined in Clause 11.2 of TS 36.331 [16] if the corresponding RRC message is embedded in E-UTRA RRC message, otherwise it is the RRC processing delay defined in Clause 12 of TS 38.331 [2].

- Tfirst-SSB is time to first SSB transmission after L1-RSRP measurement when TCI state switching involves QCL-TypeD;

- Tfirst-SSB is time to first SSB transmission after RRC processing time at the UE for other QCL types;

- The SSB shall be the QCL-TypeA or QCL-TypeC to target TCI state

- TL1-RSRP, TOuk and TSSB-proc are defined in clause 8.10.3.

The requirements for RRC based TCI state switch delay apply when only 1 TCI state is configured in RRC TCI state list. When a longer switching delay is allowed. Where is the time between DL data transmission and acknowledgement as specified in TS 38.213 [3].

### 8.10.6 Active TCI state list update delay

If the target TCI state is known, upon receiving PDSCH carrying MAC-CE active TCI state list update at slot n, UE shall be able to receive PDCCH to schedule PDSCH with the new target TCI state at the first slot that is after n+ THARQ + +TOk\*(Tfirst-SSB + TSSB-proc) / *NR slot length*. Where THARQ, Tfirst-SSB, TSSB-proc and TOk are defined in clause 8.10.3.

## 8.10A Active TCI state switching delay with CCA

### 8.10A.1 Introduction

The requirements in this clause apply for a UE configured with one or more TCI state configurations on serving cell in EN-DC with PSCell on a carrier frequency with CCA or SA NR with PCell on a carrier frequency with CCA. UE shall complete the switch of active TCI state within the delay defined in this clause.

In the requirements of clause 8.10A, the term SSB occasion not available at the UE refers to when the SSB is configured by gNB in a cell on a carrier frequency subject to CCA, but the first two successive candidate SSB positions for the same SSB index within the discovery burst transmission window are not available at the UE due to DL CCA failures at gNB during the corresponding period; otherwise the SSB occasion is considered as available at the UE.

### 8.10A.2 Known conditions for TCI state

The TCI state is known if the following conditions are met:

- During the period from the last transmission of the RS resource used for the L1-RSRP measurement reporting for the target TCI state to the completion of active TCI state switch, where the RS resource for L1-RSRP measurement is the RS in target TCI state or QCLed to the target TCI state

- TCI state switch command is received within 1280 ms of the last transmission of the RS resource for beam reporting or measurement

- The UE has sent at least 1 L1-RSRP report for the target TCI state before the TCI state switch command

- The TCI state remain detectable during the TCI state switching period in the SSB occasions available at the UE

- The SSB associated with the TCI state remain detectable during the TCI switching period in the SSB occasions available at the UE

- SNR of the TCI state is ≥ -3dB

Otherwise, the TCI state is unknown.

### 8.10A.3 MAC-CE based TCI state switch delay

If the target TCI state is known, upon receiving PDSCH carrying MAC-CE activation command at slot n, UE shall be able to receive PDCCH with target TCI state of the serving cell on which TCI state switch occurs at the first slot that is after slot n+ +(THARQ +TOk\*(Tfirst-SSB + TSSB-proc+TSSB\*LMAC,known)) */NR slot length*. The UE shall be able to receive on the old TCI state until slot n + + (THARQ +TOk\*(Tfirst-SSB+ TSSB\*LMAC,known)) / *NR slot length*, where

THARQ (in ms) is the timing between DL data transmission and acknowledgement as specified in TS 38.213 [3]. In the event of UE not being able to transmit the acknowledgment due to UL CCA failures: THARQ is extended to also include the time to all next HARQ feedback transmissions and retransmission opportunities, until the time of its successful transmission, as specified in TS 38.213 [3]; no extension of THARQ due to UL CCA failures is allowed for Type 2C UL channel access in TS 37.213;

Tfirst-SSB is time to first SSB transmission occasion after MAC CE command is decoded by the UE, during which some SSB occasions may not be available at the UE due to DL CCA failures;

The SSB shall be the QCL-TypeA or QCL-TypeC to target TCI state;

TSSB-proc = 2 ms;

TOk = 1 if target TCI state is not in the active TCI state list for PDSCH, 0 otherwise;

TSSB = ssb-periodicityServingCell;

LMAC,known≤ LMAC,known,max is the corresponding number of SSB occasions not available at the UE;

LMAC,known,max =2 for TSSB≤40 ms, LMAC,known,max =1 for TSSB>40 ms.

If the target TCI state is unknown, upon receiving PDSCH carrying MAC-CE activation command at slot n, UE shall be able to receive PDCCH with target TCI state of the serving cell on which TCI state switch occurs at the first slot that is after slot n+ + (THARQ+ TL1-RSRP +TOuk\*(Tfirst-SSB+ TSSB-proc+TSSB\*LMAC,unknown)) / *NR slot length*. The UE shall be able to receive on the old TCI state until slot n+ + (THARQ+TOuk\*(Tfirst-SSB+ TSSB\*LMAC,unknown)) / *NR slot length*,

Where:

- LMAC,unknown≤LMAC,unknown,max is the corresponding number of SSB occasions groups not available at the UE;

- LMAC,unknown,max = 2 for TSSB≤40 ms, LMAC,unknown,max = 1 for TSSB>40 ms;

- TOuk = 1.

- T L1-RSRP = 0 in FR1 or when the TCI state switching not involving QCL-TypeD in FR2-2. Otherwise,

- T L1-RSRP is the time for Rx beam refinement in FR2-2, defined as

- TL1-RSPR\_Measurement\_Period\_SSB\_CCA for SSB as specified in clause 9.5A.4.1,

- with the assumption of M=1

- with TReport = 0

- TOuk = 0 for SSB based L1-RSRP measurement when TCI state switching involves QCL-TypeD

- TOuk = 1 when TCI state switching involves other QCL types only

- Tfirst-SSB is time to first SSB transmission after L1-RSRP measurement when TCI state switching involves QCL-TypeD;

- Tfirst-SSB is time to first SSB transmission after MAC CE command is decoded by the UE for other QCL types;

- The SSB shall be the QCL-TypeA or QCL-TypeC to target TCI state

### 8.10A.4 DCI based TCI state switch delay

If the target TCI state is known, when a UE is configured with the higher layer parameter *tci-PresentInDCI* which is set as 'enabled'for the CORESET scheduling the PDSCH at slot n, UE shall be able to receive PDSCH with target TCI state of the serving cell on which TCI state switch occurs at the first slot that is after slot n+*timeDurationForQCL*, where, *timeDurationForQCL* is the time required by the UE to perform PDCCH reception and applying spatial QCL information received in DCI for PDSCH processing as described in TS 38.214 [26], the value of *timeDurationForQCL* is defined in TS 38.306 [14].

The known condition for TCI state defined in clause 8.10A.2 is applied.

### 8.10A.5 RRC based TCI state switch delay

If the target TCI state is known, UE shall be able to receive PDCCH with target TCI state of the serving cell on which TCI state switch occurs at the first slot that is after slot n+ (TRRC\_processing  +TOk\*(Tfirst-SSB + TSSB-proc+ TSSB\*LRRC,known)) / *NR slot length*. The UE is not required to receive PDCCH/PDSCH/CSI-RS or transmit PUCCH/PUSCH until the end of switching period.

Where

- Slot n is last slot overlapping with the PDSCH carrying RRC activation command.

- TRRC\_processing is the RRC processing delay defined in Clause 11.2 of 36.331 [16] is the corresponding RRC message is embedded in E-UTRA RRC message, otherwise it is the RRC processing delay defined in Clause 12 of TS38.331 [2]

- Tfirst-SSB is time to first SSB transmission occasion after RRC processing by the UE, during which some of the SSB occasions may not be availabledue to DL CCA failures;

- The SSB shall be the QCL-TypeA or QCL-TypeC to target TCI state;

- LRRC,known≤ LRRC,known,max is the corresponding number of SSB occasions not available at the UE;

- LRRC,known,max =2 for TSSB ≤ 40 ms, LRRC,known,max =1 for TSSB>40 ms.

- TSSB-proc, TOk, and TSSB are as defined in clause 8.10A.3.

If the target TCI state is unknown, UE shall be able to receive PDCCH with target TCI state of the serving cell on which TCI state switch occurs at the first slot that is after slot n+ (TRRC\_processing  +TL1-RSRP +TOuk\*(Tfirst-SSB+ TSSB-proc+TSSB\*LRRC,unknown) ) / *NR slot length*. The UE is not required to receive PDCCH/PDSCH/CSI-RS or transmit PUCCH/PUSCH until the end of switching period.

Where,

- Slot n is the last slot overlapping with the PDSCH carrying RRC activation command.

- TRRC\_processing is the RRC processing delay defined in Clause 11.2 of 36.331 [16] is the corresponding RRC message is embedded in E-UTRA RRC message, otherwise it is the RRC processing delay defined in Clause 12 of TS38.331 [2].

- Tfirst-SSB is time to first SSB transmission after L1-RSRP measurement when TCI state switching involves QCL-TypeD;

- Tfirst-SSB is time to first SSB transmission occasion after RRC processing time at the UE for other QCL types, during which some SSB occasions may not be available at the UE due to DL CCA failures;

- The SSB shall be the QCL-TypeA or QCL-TypeC to target TCI state;

- LRRC,unknown≤LRRC,unknown,max is the corresponding number of SSB occasions not available at the UE;

- LRRC,unknown,max = 2 for TSSB ≤40 ms, LRRC,unknown,max = 1 for TSSB>40 ms.

- TL1-RSRP, TOuk, TSSB-proc, and TSSB are as defined in clause 8.10A.3

The requirements for RRC based TCI state switch delay apply when only 1 TCI state is configured in RRC TCI state list. When a longer switching delay is allowed. Where is the time between DL data transmission and acknowledgement as specified in TS 38.213 [3].

### 8.10A.6 Active TCI state list update delay

If the target TCI state is known, upon receiving PDSCH carrying MAC-CE active TCI state list update at slot n, UE shall be able to receive PDCCH to schedule PDSCH with the new target TCI state at the first slot that is after n+ + (THARQ +TOk\*(Tfirst-SSB + TSSB-proc+TSSB\*LMAC,known)) / *NR slot length*. Where THARQ, Tfirst-SSB, TSSB-proc , TSSB, LMAC,known and TOk are as defined in clause 8.10A.3.

## 8.10B Active TCI state switching delay for RedCap

### 8.10B.1 Introduction

The requirements in this clause apply for a RedCap UE configured with one or more TCI state configurations on serving cell in standalone NR. UE shall complete the switch of active TCI state within the delay defined in this clause.

### 8.10B.2 Known conditions for TCI state

The TCI state is known if the following conditions are met:

- During the period from the last transmission of the RS resource used for the L1-RSRP measurement reporting for the target TCI state to the completion of active TCI state switch, where the RS resource for L1-RSRP measurement is the RS in target TCI state or QCLed to the target TCI state

- TCI state switch command is received within 1280 ms upon the last transmission of the RS resource for beam reporting or measurement

- The UE has sent at least 1 L1-RSRP report for the target TCI state before the TCI state switch command

- The TCI state remains detectable during the TCI state switching period

- The SSB associated with the TCI state remain detectable during the TCI switching period

- SNR of the TCI state ≥ -3dB

Otherwise, the TCI state is unknown.

### 8.10B.3 MAC-CE based TCI state switch delay

If the target TCI state is known, upon receiving PDSCH carrying MAC-CE activation command in slot n, UE shall be able to receive PDCCH with target TCI state of the serving cell on which TCI state switch occurs at the first slot that is after slot n+ THARQ + + TOk\*(Tfirst-SSB + TSSB-proc) / *NR slot length*. The UE shall be able to receive PDCCH with the old TCI state until slot n+ THARQ + .Where THARQ is the timing between DL data transmission and acknowledgement as specified in TS 38.213 [3];

- Tfirst-SSB is time to first SSB transmission after MAC CE command is decoded by the UE; The SSB shall be the QCL-TypeA or QCL-TypeC to target TCI state

- TSSB-proc = 2 ms;

- TOk = 1 if target TCI state is not in the active TCI state list for PDSCH, 0 otherwise.

If the target TCI state is unknown, upon receiving PDSCH carrying MAC-CE activation command in slot n, UE shall be able to receive PDCCH with target TCI state of the serving cell on which TCI state switch occurs at the first slot that is after slot n+ THARQ + + TL1-RSRP +TOuk\*(Tfirst-SSB+ TSSB-proc) / *NR slot length*. The UE shall be able to receive PDCCH with the old TCI state until slot n+ THARQ + .

Where

- T L1-RSRP = 0 in FR1 or when the TCI state switching not involving QCL-TypeD in FR2. Otherwise,

- T L1-RSRP is the time for Rx beam refinement in FR2, defined as

- TL1-RSPR\_Measurement\_Period\_SSB\_RedCap for SSB as specified in clause 9.5B.4.1,

- with the assumption of M=1

- with TReport = 0

- TL1-RSRP\_Measurement\_Period\_CSI-RS\_RedCap for CSI-RS as specified in clause 9.5B.4.2

- configured with higher layer parameter *repetition* set to ON

- with the assumption of M=1 for periodic CSI-RS

- for aperiodic CSI-RS if number of resources in resource set at least equal to *MaxNumberRxBeam*

- with TReport = 0

- TOuk = 1 for CSI-RS based L1-RSRP measurement, and 0 for SSB based L1-RSRP measurement when TCI state switching involves QCL-TypeD

- TOuk = 1 when TCI state switching involves other QCL types only

- Tfirst-SSB is time to first SSB transmission after L1-RSRP measurement when TCI state switching involves QCL-TypeD;

- Tfirst-SSB is time to first SSB transmission after MAC CE command is decoded by the UE for other QCL types;

- The SSB shall be the QCL-TypeA or QCL-TypeC to target TCI state

### 8.10B.4 DCI based TCI state switch delay

If the target TCI state is known, when a UE is configured with the higher layer parameter *tci-PresentInDCI* which is set as 'enabled'for the CORESET scheduling PDSCH at slot n, UE shall be able to receive PDSCH with target TCI state of the serving cell on which TCI state switch occurs at the first slot that is after slot n+*timeDurationForQCL*, where, *timeDurationForQCL* is the time required by the UE to perform PDCCH reception and applying spatial QCL information received in DCI for PDSCH processing as described in TS 38.214 [26], the value of *timeDurationForQCL* is defined in TS 38.331 [2].

The known condition for TCI state defined in clause 8.10.2 is applied.

### 8.10B.5 RRC based TCI state switch delay

If the target TCI state is known, UE shall be able to receive PDCCH with target TCI state of the serving cell on which TCI state switch occurs at the first slot that is after slot n+ (TRRC\_processing +TOk\*(Tfirst-SSB + TSSB-proc)) / *NR slot length*, The UE is not required to receive PDCCH/PDSCH/CSI-RS or transmit PUCCH/PUSCH until the end of switching period.

Where

- Slot n is the last slot overlapping with the PDSCH carrying RRC activation command.

- TRRC\_processing is the RRC processing delay defined in Clause 11.2 of TS 36.331 [16] if the corresponding RRC message is embedded in E-UTRA RRC message, otherwise it is the RRC processing delay defined in Clause 12 of TS 38.331 [2].

- Tfirst-SSB is time to first SSB transmission after RRC processing by the UE; The SSB shall be the QCL-TypeA or QCL-TypeC to target TCI state.

- TSSB-proc and TOk are defined in clause 8.10.3.

If the target TCI state is unknown, UE shall be able to receive PDCCH with target TCI state of the serving cell on which TCI state switch occurs at the first slot that is after slot n+ (TRRC\_processing  +TL1-RSRP +TOuk\*(Tfirst-SSB + TSSB-proc)) / *NR slot length*, The UE is not required to receive PDCCH/PDSCH/CSI-RS or transmit PUCCH/PUSCH until the end of switching period.

Where

- Slot n is the last slot overlapping with the PDSCH carrying RRC activation command.

- TRRC\_processing is the RRC processing delay defined in Clause 11.2 of TS 36.331 [16] if the corresponding RRC message is embedded in E-UTRA RRC message, otherwise it is the RRC processing delay defined in Clause 12 of TS 38.331 [2].

- Tfirst-SSB is time to first SSB transmission after L1-RSRP measurement when TCI state switching involves QCL-TypeD;

- Tfirst-SSB is time to first SSB transmission after RRC processing time at the UE for other QCL types;

- The SSB shall be the QCL-TypeA or QCL-TypeC to target TCI state

- TL1-RSRP, TOuk and TSSB-proc are defined in clause 8.10.3.

The requirements for RRC based TCI state switch delay apply when only 1 TCI state is configured in RRC TCI state list. When a longer switching delay is allowed. Where is the time between DL data transmission and acknowledgement as specified in TS 38.213 [3].

### 8.10B.6 Active TCI state list update delay

If the target TCI state is known, upon receiving PDSCH carrying MAC-CE active TCI state list update at slot n, UE shall be able to receive PDCCH to schedule PDSCH with the new target TCI state at the first slot that is after n+ THARQ + +TOk\*(Tfirst-SSB + TSSB-proc) / *NR slot length*. Where THARQ, Tfirst-SSB, TSSB-proc and TOk are defined in clause 8.10.3.

## 8.10C Active TCI state switching delay for satellite access

### 8.10C.1 Introduction

The requirements in this clause apply for a UE configured with one or more TCI state configurations on Pcell in satellite access. UE shall complete the switch of active TCI state within the delay defined in this clause.

### 8.10C.2 MAC-CE based TCI state switch delay

Upon receiving PDSCH carrying MAC-CE activation command in slot n, UE shall be able to receive PDCCH with target TCI state of the serving cell on which TCI state switch occurs at the first slot that is after slot n+ THARQ + + TOk\*(Tfirst-SSB + TSSB-proc) / *NR slot length*. The UE shall be able to receive PDCCH with the old TCI state until slot n+ THARQ + .Where THARQ is the timing between DL data transmission and acknowledgement as specified in TS 38.213 [3];

- Tfirst-SSB is time to first SSB transmission after MAC CE command is decoded by the UE; The SSB shall be the QCL-TypeA or QCL-TypeC to target TCI state

- TSSB-proc = 2 ms;

- TOk = 1 if target TCI state is not in the active TCI state list for PDSCH, 0 otherwise.

### 8.10C.4 DCI based TCI state switch delay

When a UE is configured with the higher layer parameter *tci-PresentInDCI* which is set as 'enabled'for the CORESET scheduling PDSCH at slot n, UE shall be able to receive PDSCH with target TCI state of the serving cell on which TCI state switch occurs at the first slot that is after slot n+*timeDurationForQCL*, where, *timeDurationForQCL* is the time required by the UE to perform PDCCH reception and applying spatial QCL information received in DCI for PDSCH processing as described in TS 38.214 [26], the value of *timeDurationForQCL* is defined in TS 38.331 [2].

### 8.10C.5 RRC based TCI state switch delay

UE shall be able to receive PDCCH with target TCI state of the serving cell on which TCI state switch occurs at the first slot that is after slot n+ (TRRC\_processing +TOk\*(Tfirst-SSB + TSSB-proc)) / *NR slot length*, The UE is not required to receive PDCCH/PDSCH/CSI-RS or transmit PUCCH/PUSCH until the end of switching period.

Where

- Slot n is the last slot overlapping with the PDSCH carrying RRC activation command.

- TRRC\_processing is the RRC processing delay defined in Clause 12 of TS 38.331 [2].

- Tfirst-SSB is time to first SSB transmission after RRC processing by the UE; The SSB shall be the QCL-TypeA or QCL-TypeC to target TCI state.

- TSSB-proc and TOk are defined in clause 8.10C.2.

The requirements for RRC based TCI state switch delay apply when only 1 TCI state is configured in RRC TCI state list. When a longer switching delay is allowed. Where is the time between DL data transmission and acknowledgement as specified in TS 38.213 [3].

### 8.10C.6 Active TCI state list update delay

Upon receiving PDSCH carrying MAC-CE active TCI state list update at slot n, UE shall be able to receive PDCCH to schedule PDSCH with the new target TCI state at the first slot that is after n+ THARQ + +TOk\*(Tfirst-SSB + TSSB-proc) / *NR slot length*. Where THARQ, Tfirst-SSB, TSSB-proc and TOk are defined in clause 8.10C.2.

## 8.11 PSCell Change

This clause defines requirements for the delay within which the UE shall be able to change PSCell to other cell in EN-DC or NR-DC. The requirements in this clause are applicable to EN-DC and NR-DC.

The UE shall be capable of transmitting PRACH preamble towards the target PSCell no later than specified in clause 8.9.2 for the case of NR-DC and in TS 36.133 clause 7.31.2 for the case of EN-DC,, where the following values for slot n, Tprocessing  and TRRC\_delay shall override the existing ones:

- Slot n is the last slot overlapping with the PDSCH containing PSCell change,

- Tprocessing = 20 ms when source and target cells are in the same FR,

- Tprocessing = 40 ms when source and target cells are in different FRs.

- TRRC\_delay is the RRC procedure delay as specified in TS 36.331 [16] if the corresponding RRC message is embedded in E-UTRA RRC message, otherwise it is the RRC procedure delay as specified in TS 38.331 [2].

If the SMTC periodicity of the target cell is not provided within the PSCell change message, and measObjectNRs having the same SSB frequency and subcarrier spacing configured by MN and SN have different SMTC, Trs is the periodicity of one of the SMTC which is up to UE implementation.

The target PSCell is known if it has been meeting the conditions in clause 8.9.2 for the case of NR-DC and in TS36.133 clause 7.31.2 for the case of EN-DC.

The interruption on PCell and other serving cells specified in TS36.133 clause 7.32.2.1 for EN-DC and in TS38.133 clause 8.2.4.2.1 for NR-DC is allowed only during the RRC reconfiguration procedure [2].

## 8.11A PSCell Change in Carriers with CCA

This clause defines requirements for the delay within which the UE shall be able to change PSCell in FR2-2 with CCA to other cell in NR-DC. The requirements in this clause are applicable to NR-DC.

The UE shall be capable of transmitting PRACH preamble towards the target PSCell no later than specified in clause 8.9A.2 for the case of NR-DC, where the following values for slot n, Tprocessing and TRRC\_delay shall override the existing ones:

- Slot n is the last slot overlapping with the PDSCH containing PSCell change,

- Tprocessing = 20 ms when source and target cells are in the same FR,

- Tprocessing = 40 ms when source and target cells are in different FRs.

- TRRC\_delay is the RRC procedure delay as specified in TS 38.331 [2].

If the SMTC periodicity of the target cell is not provided within the PSCell change message, and measObjectNRs having the same SSB frequency and subcarrier spacing configured by MN and SN have different SMTC, Trs is the periodicity of one of the SMTC which is up to UE implementation.

The target PSCell is known if it has been meeting the conditions in clause 8.9A.2 for the case of NR-DC.

The interruption on PCell and other serving cells specified in TS38.133 clause 8.2.4.2.1 for NR-DC is allowed only during the RRC reconfiguration procedure [2].

## 8.11B Conditional PSCell Change

### 8.11B.1 Introduction

This clause defines requirements for the delay within which the UE shall be able to perform conditional PSCell change in EN-DC or NR-DC. The requirements in this clause are applicable to EN-DC and NR-DC.

### 8.11B.2 Conditoinal PSCell Change delay

The requirements in this clause shall apply for the UE configured with only PCell in FR1.

The UE shall be capable to transmit PRACH preamble towards the new target PSCell no later than in slot *n* + Tconfig\_PSCell\_Conditional:

Where:

- Slot n is the last slot overlapping with the PDSCH containing conditional PSCell change.

- Tconfig\_PSCell\_Conditional = TRRC\_delay + TEvent\_DU + Tmeasure + TUE\_preparation + Tprocessing + T∆ + TPSCell\_ DU + 2 ms

- TRRC\_delay is the RRC processing delay defined in Clause 11.2 in 36.331 [16] is the corresponding RRC message is embedded in E-UTRA RRC message, otherwise it is the RRC procedure delay defined in clause 12 in TS 38.331 [2] for processing the conditional PSCell change command.

- TEvent\_DU is the delay uncertainty which is the time from when the UE successfully decodes a conditional PSCell change command until a condition exists at the measurement reference point which will trigger the conditional PSCell change.

- Tmeasure is the measurements time stated in clause 8.11B.2.1.

- TUE\_preparation is the UE preparation time for conditional PSCell change, and starts after UE realizes the condition of PSCell change is met and identity of new PSCell is determined. TUE\_preparation is up to 10ms.

- Tprocessing is the SW processing time needed by UE, including RF warm up period. Tprocessing = 20 ms when source and target cells are in the same FR, and Tprocessing = 40 ms when source and target cells are in different FRs.

- T∆ is time for fine time tracking and acquiring full timing information of the target cell. T∆ = 1\*Trs ms.

- Trs is the SMTC periodicity of the target cell if the UE has been provided with an SMTC configuration for the target cell in PSCell addition message, otherwise Trs is the SMTC configured in the measObjectNR having the same SSB frequency and subcarrier spacing. If the UE is not provided SMTC configuration or measurement object on this frequency, the requirement in this clause is applied with Trs = 5 ms assuming the SSB transmission periodicity is 5 ms. There is no requirement if the SSB transmission periodicity is not 5 ms.

- TPSCell\_ DU is the delay uncertainty in acquiring the first available PRACH occasion in the PSCell. TPSCell\_ DU is up to the summation of SSB to PRACH occasion association period and 10 ms. SSB to PRACH occasion associated period is defined in Table 8.1-1 of TS 38.213 [3].

The PCell interruption specified in clause 8.2 is allowed only after the UE starts to execute a conditional PSCell change.

#### 8.11B.2.1 Measurement time

The measurement time delay is defined from the end of TEvent\_DU until UE executes a PSCell change to a target cell and interruption time starts.

For intra-frequency PSCell change, the measurement time delay measured without Time To Trigger (TTT) and L3 filtering shall be less than Tidentify intra with index or Tidentify\_intra\_without\_index defined in clause 9.2.5.1 or clause 9.2.6.2.

For inter-frequency PSCell change, the measurement time delay measured without Time To Trigger (TTT) and L3 filtering shall be less than Tidentify\_inter\_without\_index or Tidentify\_inter\_with\_index defined in clause 9.3.4. When TTT or L3 filtering is used an additional delay can be expected.

A cell is detectable only if at least one SSB measured from the cell being configured remains detectable during the time period Tidentify\_intra\_without\_index or Tidentify\_intra\_with\_index for intra-frequency PSCell change or the time period Tidentify\_inter\_without\_index or Tidentify\_inter\_with\_index for inter-frequency PSCell change. If a cell, which has been detectable at least for the time period Tidentify\_intra\_without\_index or Tidentify\_intra\_with\_index for intra-frequency PSCell change or the time period Tidentify\_inter\_without\_index or Tidentify\_inter\_with\_index for inter-frequency PSCell change, becomes undetectable for a period and then the cell becomes detectable again and triggers a PSCell change, the measurement time delay shall be less than TSSB\_measurement\_period\_intra or TSSB\_measurement\_period\_inter provided the timing to that cell has not changed more than ± 3200/ Tc while the measurement gap has not been available and the L3 filter has not been used, where *µ* is the SCS configuration as defined in clause 4.2 of TS 38.211 [3]. When L3 filtering is used, an additional delay can be expected.

## 8.11D Conditional PSCell Change in Carriers with CCA

### 8.11D.1 Introduction

This clause defines requirements for the delay within which the UE shall be able to perform conditional PSCell in FR2-2 with CCA change in NR-DC. The requirements in this clause are applicable to NR-DC.

### 8.11D.2 Conditional PSCell Change delay

The requirements in this clause shall apply for the UE configured with only PCell in FR1.

The UE shall be capable to transmit PRACH preamble towards the new target PSCell no later than in slot :

Where:

- Slot n is the last slot overlapping with the PDSCH containing conditional PSCell change.

- Tconfig\_PSCell\_Conditional = TRRC\_delay + TEvent\_DU + Tmeasure\_CCA + TUE\_preparation + Tprocessing + T∆\_CCA + TPSCell\_ DU + 2 ms

- TRRC\_delay is the RRC procedure delay defined in clause 12 in TS 38.331 [2] for processing the conditional PSCell change command.

- TEvent\_DU is the delay uncertainty which is the time from when the UE successfully decodes a conditional PSCell change command until a condition exists at the measurement reference point which will trigger the conditional PSCell change.

- Tmeasure\_CCA is the measurements time stated in clause 8.11D.2.1.

- TUE\_preparation is the UE preparation time for conditional PSCell change, and starts after UE realizes the condition of PSCell change is met and identity of new PSCell is determined. TUE\_preparation is up to 10ms.

- Tprocessing is the SW processing time needed by UE, including RF warm up period. Tprocessing = 20 ms when source and target cells are in the same FR, and Tprocessing = 40 ms when source and target cells are in different FRs.

- T∆\_CCA is time for fine time tracking and acquiring full timing information of the target cell. T∆ = (1+L2) \*Trs ms, where L2 is the number of SMTC occasions not avaible at the UE during the time tracking period. L2, max =TBD.

- Trs is the SMTC periodicity of the target cell if the UE has been provided with an SMTC configuration for the target cell in PSCell addition message, otherwise Trs is the SMTC configured in the measObjectNR having the same SSB frequency and subcarrier spacing. If the UE is not provided SMTC configuration or measurement object on this frequency, the requirement in this clause is applied with Trs = 5 ms assuming the SSB transmission periodicity is 5 ms. There is no requirement if the SSB transmission periodicity is not 5 ms.

- TPSCell\_ DU is the interruption uncertainty due to the random access procedure when sending PRACH to the new cell. TPSCell\_ DU can be up to: (1+ L3) \* TSSB,RO + 10 ms where TSSB,RO is the SSB to PRACH occasion association period as defined in Table 8.1-1 of TS 38.213 [3] and L3 is the number of consecutive SSB to PRACH occasion association periods during which no PRACH occasion is available for PRACH transmission due to UL CCA failure. L3 = 0 for Type 3 UL channel access procedure as defined in TS 37.213 [33].

NOTE 1: The interruption time considering the potential extensions caused by L2, L3 and by the UL CCA failure detection/recovery mechanism is limited by the T304 timer. The UE behaviour at the T304 timer expiry is detailed in TS 38.331 [2].

The PCell interruption specified in clause 8.2 is allowed only after the UE starts to execute a conditional PSCell change.

#### 8.11D.2.1 Measurement time

The measurement time delay is defined from the end of TEvent\_DU until UE executes a PSCell change to a target cell and interruption time starts.

For intra-frequency PSCell change, the measurement time delay measured without Time To Trigger (TTT) and L3 filtering shall be less than Tidentify intra\_cca with index or Tidentify\_intra\_cca\_without\_index defined in clause 9.2A.5.1 or clause 9.2A.6.2.

For inter-frequency PSCell change, the measurement time delay measured without Time To Trigger (TTT) and L3 filtering shall be less than Tidentify\_inter\_cca\_without\_index or Tidentify\_inter\_cca\_with\_index defined in clause 9.3A.4. When TTT or L3 filtering is used an additional delay can be expected.

A cell is detectable only if at least one SSB measured from the cell being configured remains detectable during the time period Tidentify\_intra\_cca\_without\_index or Tidentify\_intra\_cca\_with\_index for intra-frequency PSCell change or the time period Tidentify\_inter\_cca\_without\_index or Tidentify\_inter\_cca\_with\_index for inter-frequency PSCell change. If a cell, which has been detectable at least for the time period Tidentify\_intra\_cca\_without\_index or Tidentify\_intra\_cca\_with\_index for intra-frequency PSCell change or the time period Tidentify\_inter\_cca\_without\_index or Tidentify\_inter\_cca\_with\_index for inter-frequency PSCell change, becomes undetectable for a period and then the cell becomes detectable again and triggers a PSCell change, the measurement time delay shall be less than TSSB\_measurement\_period\_intra\_cca or TSSB\_measurement\_period\_inter\_cca provided the timing to that cell has not changed more than ± 3200 Tc while the measurement gap has not been available and the L3 filter has not been used. When L3 filtering is used, an additional delay can be expected.

## 8.12 Uplink spatial relation switch delay

### 8.12.1 Introduction

The requirements in this clause apply for a UE configured with one or more spatial relation configurations on serving cell in MR-DC or standalone NR. There is no requirement when the UE is requested to switch to a spatial relation with the higher layer parameter *spatialRelationInfo* associated to SRS. UE shall complete the switch of active spatial relation within the delay defined in this clause when the UE is requested to switch to a spatial relation with the higher layer parameter *spatialRelationInfo* associated to a DL RS.

### 8.12.2 Known conditions for spatial relation when associated with DL-RS

The spatial relation associated to DL RS is known if the following conditions are met:

- During the period from the last transmission of the DL RS resource used for the L1-RSRP measurement reporting for the target spatial relation to the completion of active spatial relation switch, where the DL RS resource for L1-RSRP measurement is the DL RS in target spatial relation or QCLed to the target spatial relation with QCL type-D.

- Spatial relation switch command is received within 1280 ms upon the last transmission of the DL RS resource for beam reporting or measurement

- The UE has sent at least 1 L1-RSRP report for the target spatial relation before the spatial relation switch command

- The DL RS configured in spatial relation remains detectable during the spatial relation switching period

- SNR of the DL RS configured in spatial relation ≥ -3dB

- The SSB associated with the spatial relation remain detectable during the spatial relation switching period

- SNR of the SSB associated with the spatial relation ≥ -3dB

Otherwise, the spatial relation is unknown.

### 8.12.3 MAC-CE based spatial relation switch delay

If the target spatial relation associated to DL RS is known, upon receiving PDSCH carrying MAC-CE activation command in slot n, for UL spatial relation switch for PUCCH or semi-persistent SRS transmission of serving cell with a target UL spatial relation, the UE shall be able to transmit PUCCH or semi-persistent SRS with the target UL spatial relation in the slot n+ THARQ + + 1 when *beamCorrespondenceWithoutUL-BeamSweeping* is set to 1 where THARQ is the timing between DL data transmission and acknowledgement as specified in TS 38.213 [3].

If the target spatial relation associated to DL RS is unknown, upon receiving PDSCH carrying MAC-CE activation command in slot n, for UL spatial relation switch for PUCCH or semi-persistent SRS transmission of serving cell with a target UL spatial relation, the UE shall be able to transmit PUCCH or semi-persistent SRS with the target UL spatial relation in the slot n+ THARQ + + TL1-RSRP+1 when *beamCorrespondenceWithoutUL-BeamSweeping* is set to 1.

Where

- THARQ is the timing between DL data transmission and acknowledgement as specified in TS 38.213 [3],

- T L1-RSRP is the time for Rx beam refinement in FR2, defined as

- TL1-RSPR\_Measurement\_Period\_SSB for SSB as specified in clause 9.5.4.1,

- with the assumption of M=1

- with TReport = 0

- TL1-RSRP\_Measurement\_Period\_CSI-RS for CSI-RS as specified in clause 9.5.4.2

- configured with higher layer parameter *repetition* set to ON

- with the assumption of M=1 for periodic CSI-RS

- for aperiodic CSI-RS if number of resources in resource set at least equal to *MaxNumberRxBeam*

- with TReport = 0

The UE shall be able to transmit with the old UL spatial relation until slot n+ THARQ + .

When the UL spatial relation info switch for PUCCH changes both the associated DL RS and *pucch-PathlossReferenceRS* with the same MAC-CE activation, and if both the DL RS and *pucch-PathlossReferenceRS* are known as specified in clause 8.12.2 and 8.14.2 respectively, the UE shall be able to transmit PUCCH with the target UL spatial relation after the delay specified in clause 8.14.3. If either the associated DL RS or *pucch-PathlossReferenceRS* are unknown, a longer switching delay is allowed. The UE is not required to transmit PUCCH with the target UL spatial relation until the DL RS and pathloss reference RS switch are completed.

### 8.12.4 DCI based spatial relation switch delay

If the target spatial relation associated to DL RS is known, when a UE receives the DCI triggering aperiodic SRS at slot n with the higher layer parameter *spatialRelationInfo*, UE shall be able to transmit aperiodic SRS with target spatial relation of the serving cell on which spatial relation switch occurs in the slot+1, where, *k* is configured via higher layer parameter *slotOffset*[2]for each triggered SRS resources set and is based on the subcarrier spacing of the triggered SRS transmission, *µSRS* and *µPDCCH* are the subcarrier spacing configurations for triggered SRS and PDCCH carrying the triggering command respectively in TS 38.214 [26].

The known condition for spatial relation associated to DL RS defined in clause 8.12.2 is applied.

### 8.12.5 RRC based spatial relation switch delay

If the target spatial relation associated to DL RS is known, UE shall be able to transmit target periodic SRS with spatial relation of the serving cell on which periodic SRS with spatial relation reconfigured in the slot n+ TRRC\_processing /*NR slot length* +1 when *beamCorrespondenceWithoutUL-BeamSweeping* is set to 1.

Where

- Slot n is the last slot overlapping with the PDSCH carrying RRC activation command,

- TRRC\_processing is the RRC processing delay defined in 36.331 [16] is the corresponding RRC message is embedded in E-UTRA RRC message, otherwise it is the RRC processing delay defined in TS38.331 [2].

If the target spatial relation associated to DL RS is unknown, UE shall be able to transmit target periodic SRS with spatial relation of the serving cell on which periodic SRS with spatial relation reconfigured in the slot n+ TRRC\_processing /*NR slot length* + TL1-RSRP +1 when *beamCorrespondenceWithoutUL-BeamSweeping* is set to 1.

Where

- Slot n is the last slot overlapping with the PDSCH carrying RRC activation command,

- TRRC\_processing is the RRC processing delay defined in 36.331 [16] is the corresponding RRC message is embedded in E-UTRA RRC message, otherwise it is the RRC processing delay defined in TS38.331 [2].

- TL1-RSRP is defined in clause 8.12.3

## 8.12A Uplink spatial relation switch delay for RedCap

### 8.12A.1 Introduction

The requirements in this clause apply for a RedCap UE configured with one or more spatial relation configurations on serving cell in standalone NR. There is no requirement when the UE is requested to switch to a spatial relation with the higher layer parameter *spatialRelationInfo* associated to SRS. UE shall complete the switch of active spatial relation within the delay defined in this clause when the UE is requested to switch to a spatial relation with the higher layer parameter *spatialRelationInfo* associated to a DL RS.

### 8.12A.2 Known conditions for spatial relation when associated with DL-RS

The spatial relation associated to DL RS is known if the following conditions are met:

- During the period from the last transmission of the DL RS resource used for the L1-RSRP measurement reporting for the target spatial relation to the completion of active spatial relation, where the DL RS resource for L1-RSRP measurement is the DL RS in target spatial relation or QCLed to the target spatial relation with QCL type-D.

- Spatial relation switch command is received within 1280 ms upon the last transmission of the DL RS resource for beam reporting or measurement

- The UE has sent at least 1 L1-RSRP report for the target spatial relation before the spatial relation switch command

- The DL RS configured in spatial relation remains detectable during the spatial relation switching period

- SNR of the DL RS configured in spatial relation ≥ -3dB

- The SSB associated with the spatial relation remain detectable during the spatial relation switching period

- SNR of the SSB associated with the spatial relation ≥ -3dB

Otherwise, the spatial relation is unknown.

### 8.12A.3 MAC-CE based spatial relation switch delay

If the target spatial relation associated to DL RS is known and UE is configured with uplink resources for transmission on target spatial relation, upon receiving PDSCH carrying MAC-CE activation command in slot n, for UL spatial relation switch for PUCCH or semi-persistent SRS transmission of serving cell with a target UL spatial relation, the UE shall be able to transmit PUCCH or semi-persistent SRS with the target UL spatial relation no later than slot n+ THARQ + + 1 when *beamCorrespondenceWithoutUL-BeamSweeping* is set to 1 where THARQ is the timing between DL data transmission and acknowledgement as specified in TS 38.213 [3].

If the target spatial relation associated to DL RS is unknown and UE is configured with uplink resources for transmission on target spatial relation, upon receiving PDSCH carrying MAC-CE activation command in slot n, for UL spatial relation switch for PUCCH or semi-persistent SRS transmission of serving cell with a target UL spatial relation, the UE shall be able to transmit PUCCH or semi-persistent SRS with the target UL spatial relation no later than slot n+ THARQ + + TL1-RSRP+1 when *beamCorrespondenceWithoutUL-BeamSweeping* is set to 1.

Where

- THARQ is the timing between DL data transmission and acknowledgement as specified in TS 38.213 [3],

- T L1-RSRP is the time for Rx beam refinement in FR2, defined as

- TL1-RSRP\_Measurement\_Period\_SSB\_RedCap for SSB as specified in clause 9.5B,

- with the assumption of M=1

- with TReport = 0

- TL1-RSRP\_Measurement\_Period\_CSI-RS\_RedCap for CSI-RS as specified in clause 9.5.4.2

- configured with higher layer parameter *repetition* set to ON

- with the assumption of M=1 for periodic CSI-RS

- for aperiodic CSI-RS if number of resources in resource set at least equal to *MaxNumberRxBeam*

- with TReport = 0

The UE shall be able to transmit with the old UL spatial relation until slot n+ THARQ + .

For RedCap UE in HD-FDD mode, if a downlink reception overlaps with PUCCH or semi-persistent SRS transmission of the serving cell with the target UL spatial relation then the UE is allowed to postpone the uplink transmission.

When the UL spatial relation info switch for PUCCH changes both the associated DL RS and *pucch-PathlossReferenceRS* with the same MAC-CE activation, and if both the DL RS and *pucch-PathlossReferenceRS* are known as specified in clause 8.12A.2 and 8.14.2 respectively, the UE shall be able to transmit PUCCH with the target UL spatial relation after the delay specified in clause 8.14.3. If either the associated DL RS or *pucch-PathlossReferenceRS* are unknown, a longer switching delay is allowed. The UE is not required to transmit PUCCH with the target UL spatial relation until the DL RS and pathloss reference RS switch are completed.

### 8.12A.4 DCI based spatial relation switch delay

If the target spatial relation associated to DL RS is known and UE is configured with uplink resources for transmission on target spatial relation, when a UE receives the DCI triggering aperiodic SRS at slot n with the higher layer parameter *spatialRelationInfo*, UE shall be able to transmit aperiodic SRS with target spatial relation of the serving cell on which spatial relation switch occurs no later than slot+1, where, *k* is configured via higher layer parameter *slotOffset*[2]for each triggered SRS resources set and is based on the subcarrier spacing of the triggered SRS transmission, *µSRS* and *µPDCCH* are the subcarrier spacing configurations for triggered SRS and PDCCH carrying the triggering command respectively in TS 38.214 [26].

For RedCap UE in HD-FDD mode, if a downlink reception overlaps with aperiodic SRS with target spatial relation of the serving cell then the UE is allowed to postpone the uplink transmission.

The known condition for spatial relation associated to DL RS defined in clause 8.12A.2 is applied.

### 8.12A.5 RRC based spatial relation switch delay

If the target spatial relation associated to DL RS is known and UE is configured with uplink resources for transmission on target spatial relation, UE shall be able to transmit target periodic SRS with spatial relation of the serving cell on which periodic SRS with spatial relation reconfigured no later than slot n+ TRRC\_processing /*NR slot length* +1 when *beamCorrespondenceWithoutUL-BeamSweeping* is set to 1.

Where

- Slot n is the last slot overlapping with the PDSCH carrying RRC activation command,

- TRRC\_processing is the RRC processing delay defined in 36.331 [16] is the corresponding RRC message is embedded in E-UTRA RRC message, otherwise it is the RRC processing delay defined in TS38.331 [2].

If the target spatial relation associated to DL RS is unknown and UE is configured with uplink resources for transmission on target spatial relation, UE shall be able to transmit target periodic SRS with spatial relation of the serving cell on which periodic SRS with spatial relation reconfigured no later than slot n+ TRRC\_processing /*NR slot length* + TL1-RSRP +1 when *beamCorrespondenceWithoutUL-BeamSweeping* is set to 1.

Where

- Slot n is the last slot overlapping with the PDSCH carrying RRC activation command,

- TRRC\_processing is the RRC processing delay defined in 36.331 [16] is the corresponding RRC message is embedded in E-UTRA RRC message, otherwise it is the RRC processing delay defined in TS38.331 [2].

- TL1-RSRP is defined in clause 8.12A.3

For RedCap UE in HD-FDD mode, if a downlink reception overlaps with target periodic SRS with spatial relation of the serving cell with periodic SRS with spatial relation reconfigured then the UE is allowed to postpone the uplink transmission.

## 8.12C Uplink spatial relation switch delay for satellite access

UL Spatial relation switch delay requirements do not apply for satellite access in FR1.

### 8.12C.1 Void

### 8.12C.2 Void

### 8.12C.3 Void

### 8.12C.4 Void

### 8.12C.5 Void

## 8.13 UE-specific CBW change

### 8.13.1 Introduction

The requirements in this clause apply for a UE receives reconfiguration of *offsetToCarrier* or *carrierBandwidth* to change channel bandwidth.

### 8.13.2 UE-specific CBW change delay

After the UE receives RRC reconfiguration involving *offsetToCarrier* or *carrierBandwidth* change on the old CBW, UE shall be able to receive PDSCH/PDCCH on the DL BWP with BWP ID firstActiveDownlinkBWP-Id or transmit PUSCH on the UL BWP with BWP ID firstActiveUplinkBWP-Id of the new CBW right after a time duration of slots which begins from the beginning of DL slot n, where

DL slot n is the last slot overlapping with the PDSCH containing the RRC command, and

is the length of the RRC procedure delay in millisecond as defined in clause 11.2 in TS 36.331 [6] is the corresponding RRC message is embedded in E-UTRA RRC message, otherwise it is the length of the RRC procedure delay in millisecond as defined in clause 12 in TS 38.331 [2], and

is the time used by the UE to perform CBW change.

The UE is not required to transmit UL signals or receive DL signals during the above defined time duration on the cell where UE-specific CBW change occurs. When a longer switching delay is allowed. Where is the time between DL data transmission and acknowledgement as specified in TS 38.213 [3].

## 8.13A UE-specific CBW change for RedCap

### 8.13A.1 Introduction

The requirements in this clause apply for a RedCap UE receives reconfiguration of *offsetToCarrier* or *carrierBandwidth* to change channel bandwidth.

### 8.13A.2 UE-specific CBW change delay

After the UE receives RRC reconfiguration involving *offsetToCarrier* or *carrierBandwidth* change on the old CBW, UE shall be able to receive PDSCH/PDCCH on an active DL BWP or transmit PUSCH on an active UL BWP of the new CBW right after a time duration of slots which begins from the beginning of DL slot n, where

DL slot n is the last slot overlapping with the PDSCH containing the RRC command, and

is the length of the RRC procedure delay in millisecond as defined in clause 11.2 in TS 36.331 [6] is the corresponding RRC message is embedded in E-UTRA RRC message, otherwise it is the length of the RRC procedure delay in millisecond as defined in clause 12 in TS 38.331 [2], and

is the time used by the UE to perform CBW change.

The UE is not required to transmit UL signals or receive DL signals during the above defined time duration on the cell where UE-specific CBW change occurs. When a longer switching delay is allowed. Where is the time between DL data transmission and acknowledgement as specified in TS 38.213 [3].

## 8.13C UE-specific CBW change for satellite access

*Editor’s note: Applicability of frequency range, CA, DA, duplex mode, inter-RAT measurement, etc is subject to updates/changes based on the scope of the corresponding WID.*

*Editor’s note: Terminology will be further clarified and selected between, e.g. NTN and satellite access, based on further agreements.*

### 8.13C.1 Introduction

The requirements in this clause apply for a UE receives reconfiguration of *offsetToCarrier* or *carrierBandwidth* to change channel bandwidth.

### 8.13C.2 UE-specific CBW change delay

After the UE receives RRC reconfiguration involving *offsetToCarrier* or *carrierBandwidth* change on the old CBW, UE shall be able to receive PDSCH/PDCCH on an active DL BWP or transmit PUSCH on an active UL BWP of the new CBW right after a time duration of slots which begins from the beginning of DL slot n, where

DL slot n is the last slot containing the RRC command, and

is the length of the RRC procedure delay in millisecond as defined in clause 12 in TS 38.331 [2], and

is the time used by the UE to perform CBW change.

The UE is not required to transmit UL signals or receive DL signals during the above defined time duration on the cell where UE-specific CBW change occurs. When a longer switching delay is allowed. Where is the time between DL data transmission and acknowledgement as specified in TS 38.213 [3].

## 8.14 Pathloss reference signal switching delay

### 8.14.1 Introduction

The requirements in this clause apply for pathloss reference signal activated or updated on serving cell in MR-DC or standalone NR in clause 7.1.1 in TS 38.213 [3].

UE shall complete the switch of pathloss reference signal within the delay defined in this clause.

### 8.14.2 Known conditions for pathloss reference signal

The pathloss reference signal is known if the following conditions are met during the period between the last transmission of the RS resource used for L1-RSRP measurement reporting and the completion of pathloss reference signal switch, where the RS resource is the target pathloss reference signal or QCLed (with Type D) to the target pathloss reference signal.

- Pathloss reference signal switch command is received within 1280 ms upon the last transmission of the RS resource for beam reporting or measurement

- The UE has sent at least 1 L1-RSRP report for the target pathloss reference signal before the pathloss reference signal switch command

- The target pathloss reference signal remains detectable during the pathloss reference signal switching period

- SNR of the target pathloss reference signal≥-3dB

- The associated SSBs with the target pathloss reference signal remain detectable during the pathloss reference signal switching period

- SNR of the associated SSB ≥-3dB

Otherwise, the pathloss reference signal is unknown.

### 8.14.3 MAC-CE based pathloss reference signal switch delay

The requirements in this clause apply for a UE to update a pathloss reference signal by MAC-CE for PUCCH, PUSCH, semi-persistent SRS and aperiodic SRS.

If the target pathloss reference signal is known, upon receiving PDSCH carrying MAC-CE activation in slot n, UE shall be able to apply the target pathloss reference signal of the serving cell on which pathloss reference signal switch occurs no later than the slot *n* + + . The UE shall be able to apply old pathloss reference signals until the slot n + + . Where

- is the timing between pathloss reference MAC-CE activation command and acknowledgement as specified in TS 38.321 [7].

- NM= 1, if the target PL-RS is not maintained by the UE, 0 otherwise.

- is the periodicity of the target pathloss reference signal which would be SSB or NZP CSI-RS.

Note: longer application time is expected if measurement sample is not available due to measurement gap, DRX or other UE activities.

Note: longer application time is expected if the pathloss reference signal is unknown.

## 8.14C Pathloss reference signal switching delay for satellite access

*Editor’s note: Applicability of frequency range, CA, DA, duplex mode, inter-RAT measurement, etc is subject to updates/changes based on the scope of the corresponding WID.*

*Editor’s note: Terminology will be further clarified and selected between, e.g. NTN and satellite access, based on further agreements.*

### 8.14C.1 Introduction

The requirements in this clause apply for pathloss reference signal activated or updated on PCell in clause 7.1.1 in TS 38.213 [3] and the UE is configured with only PCell, which is served by satellite access node (SAN).

UE shall complete the switch of pathloss reference signal within the delay defined in this clause.

### 8.14C.2 Known conditions for pathloss reference signal

The pathloss reference signal is known if the following conditions are met during the period between the last transmission of the RS resource used for L1-RSRP measurement reporting and the completion of pathloss reference signal switch, where the RS resource is the target pathloss reference signal or QCLed (with Type D) to the target pathloss reference signal.

- Pathloss reference signal switch command is received within 1280 ms upon the last transmission of the RS resource for beam reporting or measurement

- The UE has sent at least 1 L1-RSRP report for the target pathloss reference signal before the pathloss reference signal switch command

- The target pathloss reference signal remains detectable during the pathloss reference signal switching period

- SNR of the target pathloss reference signal≥-3dB

- The associated SSBs with the target pathloss reference signal remain detectable during the pathloss reference signal switching period

- SNR of the associated SSB ≥-3dB

Otherwise, the pathloss reference signal is unknown.

### 8.14C.3 MAC-CE based pathloss reference signal switch delay

The requirements in this clause apply for a UE to update a pathloss reference signal by MAC-CE for PUCCH, PUSCH, semi-persistent SRS and aperiodic SRS.

If the target pathloss reference signal is known, upon receiving PDSCH carrying MAC-CE activation in slot n, UE shall be able to apply the target pathloss reference signal of the serving cell on which pathloss reference signal switch occurs no later than the slot *n* + + . The UE shall be able to apply old pathloss reference signals until the slot n + + . Where

- is the timing between pathloss reference MAC-CE activation command and acknowledgement as specified in TS 38.321 [7].

- NM= 1, if the target PL-RS is not maintained by the UE, 0 otherwise.

- is the periodicity of the target pathloss reference signal which would be SSB or NZP CSI-RS.

Note: longer application time is expected if measurement sample is not available due to measurement gap, DRX or other UE activities.

Note: longer application time is expected if the pathloss reference signal is unknown.

## 8.15 Active downlink TCI state switching delay for unified TCI

### 8.15.1 Introduction

The requirements in this clause apply for a UE configured with *DLorJoint-TCIState* configurations for DL channels on a serving cell.Further the requirements also apply for all the list of serving cells in *simultaneousU-TCI-UpdateList1, simultaneousU-TCI-UpdateList2, simultaneousU-TCI-UpdateList3, simultaneousU-TCI-UpdateList4* in MR-DC or standalone NR. UE shall complete the switch of active downlink TCI state within the delay defined in this clause.

When the target DL TCI state refers to an additional PCI different from the serving cell PCI in which this DL TCI-State is configured, the requirements in this clause are applicable provided that following conditions are met:

- Active BWP of the serving cell and a cell with the additional PCI are the same

- Center frequency, SCS and SFN offset of a cell with the additional PCI are as the same as serving cell - The cell with the additional PCI is known to the UE.

A cell with the additional PCI is known if the following conditions are met:

- During the last 5s before L1-RSRP measurement is configured, the UE has sent a valid L3 measurement report for the cell with the additional PCI

- Timing offset between serving cell and the cell with the additional PCI is within CP of the corresponding SCS

Otherwise, the cell with the additional PCI is unknown.

8.15.2 Known conditions for downlink TCI state

The downlink TCI state is known if the following conditions are met:

- During the period from the last transmission of the RS resource used for the L1-RSRP measurement reporting for the target downlink TCI state to the completion of active downlink TCI state switch, where the RS resource for L1-RSRP measurement is the RS in target downlink TCI state or QCLed to the target downlink TCI state

- Downlink TCI state switch command is received within 1280 ms upon the last transmission of the RS resource for beam reporting or measurement

- The UE has sent at least 1 L1-RSRP report for the target downlink TCI state before the downlink TCI state switch command

- The target downlink TCI state remains detectable during the downlink TCI state switching period

- The SSB associated with the downlink TCI state remain detectable during the downlink TCI switching period

- SNR of the downlink TCI state ≥ -3dB

- The SSB can be associated with either the serving cell PCI or a PCI different from serving cell PCI.

Otherwise, the downlink TCI state is unknown.

8.15.3 MAC-CE based downlink TCI state switch delay

The requirements in this clause shall apply for DL TCI state switch using separate DL TCI state or joint TCI state of unified TCI state switch framework.

In case that source RS in DL TCI state or joint TCI state is associated with a PCI different from that of the serving cell, the requirements in this clause shall apply if the cell with different PCI satisfies the known cell condition defined in 8.15.1. If the known cell condition is not met, longer delay may be expected.

In case of joint TCI state switch, if the target PL-RS is not maintained, UE is not expected to receive on DL based on the target TCI state before UE completes the DL and UL TCI state switch.

If the target TCI state is known, upon receiving PDSCH carrying MAC-CE activation command in slot n, UE shall be able to receive UE-dedicated PDCCH/PDSCH with target TCI state of the serving cell on which TCI state switch occurs at the first slot that is after slot n+ THARQ + + TOk\*(Tfirst-SSB + TSSB-proc) / *NR slot length*. The UE shall be able to receive UE-dedicated PDCCH/PDSCH with the old TCI state until slot n+ THARQ + where THARQ (in slot) is the timing between DL data transmission and acknowledgement as specified in TS 38.213 [3];

- Tfirst-SSB is time to first SSB transmission after MAC CE command is decoded by the UE; The SSB shall be the QCL-TypeA or QCL-TypeC to target TCI state

- TSSB-proc = 2 ms;

- TOk = 1 if target TCI state is not in the active TCI state list for PDSCH/PDCCH, 0 otherwise.

If the target TCI state is unknown, upon receiving PDSCH carrying MAC-CE activation command in slot n, UE shall be able to receive UE-dedicated PDCCH/PDSCH with target TCI state of the serving cell on which TCI state switch occurs at the first slot that is after slot n+ THARQ + + (TL1-RSRP +TOuk\*(Tfirst-SSB+ TSSB-proc)) / *NR slot length*. The UE shall be able to receive UE-dedicated PDCCH/PDSCH with the old TCI state until slot n+ THARQ + .

Where

- T L1-RSRP = 0 in FR1 or when the TCI state switching not involving QCL-TypeD in FR2. Otherwise,

- T L1-RSRP is the time for Rx beam refinement in FR2, defined as

- TL1-RSPR\_Measurement\_Period\_SSB for SSB as specified in clause 9.5.4.1,

- with the assumption of M=1

- with TReport = 0

- TL1-RSRP\_Measurement\_Period\_CSI-RS for CSI-RS as specified in clause 9.5.4.2

- CSI-RS based L1-RSRP measurement only apply for TCI state switch when source RS is associated with serving cell

- configured with higher layer parameter *repetition* set to ON

- with the assumption of M=1 for periodic CSI-RS

- for aperiodic CSI-RS if number of resources in resource set at least equal to *MaxNumberRxBeam*

- with TReport = 0

- TOuk = 1 for CSI-RS based L1-RSRP measurement, and 0 for SSB based L1-RSRP measurement when TCI state switching involves QCL-TypeD

- TOuk = 1 when TCI state switching involves other QCL types only

- Tfirst-SSB is time to first SSB transmission after L1-RSRP measurement when TCI state switching involves QCL-TypeD;

- Tfirst-SSB is time to first SSB transmission after MAC CE command is decoded by the UE for other QCL types;

- The SSB shall be the QCL-TypeA or QCL-TypeC to target TCI state

### 8.15.4 DCI based downlink TCI state switch delay

When a UE is configured with the higher layer parameter with *DLorJointTCIState* or *UL-TCIState,* activated with TCI states for downlink transmission by MAC CE indication of more than one codepoints, and receives DCI format 1\_1/1\_2 with or without DL assignment providing indicated TCI-State or TCI state pair in the active TCI list for a CC or all CCs with a common indicated TCI-State in the same CC list configured by *simultaneousU-TCI-UpdateList1, simultaneousU-TCI-UpdateList2, simultaneousU-TCI-UpdateList3, simultaneousU-TCI-UpdateList4*., the UE transmits a PUCCH with HARQ-ACK information corresponding to the DCI carrying the TCI-State indication.

If the target TCI state is known, the downlink TCI switching to the indicated DL TCI state or joint TCI state in the DCI format shall be completed starting from the first slot that is at least *BeamAppTime-r17* symbols after the last symbol of the PUCCH carrying HARQ-ACK in response to the DCI triggering TCI state activation. The first slot and the *BeamAppTime-r17* symbols are both determined on the carrier with the smallest SCS among the carrier(s) applying the beam indication. The value of *BeamAppTime-r17* is defined in TS 38.331 [2]. The known condition for TCI state defined in clause 8.15.2 is applied.

### 8.15.5 Active Downlink TCI state list update delay

The requirements specified in this clause are applicable if

- higher layer configuration ‘*unifiedTCI-StateType-r17*’ is set to ‘*separate*’, and a MAC CE activates more than one target separate TCIs, and at least one DL TCI is included, or

- higher layer configuration ‘*unifiedTCI-StateType-r17*’ is set to ‘*joint*’, and a MAC CE activates more than one target joint TCI.

If all the target TCI states in the active TCI state list are known, upon receiving PDSCH carrying MAC-CE active TCI state list update at slot n, UE shall be able to receive PDCCH or PDSCH with the new target TCI states at the first slot that is after

n + THARQ + + TOk\*(Tfirst-SSB\_List + TSSB-proc) / *NR slot length*.

If a subset of the target TCI states in the active TCI state list are unknown, upon receiving PDSCH carrying MAC-CE active TCI state list update at slot n, UE shall be able to receive UE-dedicated PDCCH or PDSCH with the new target TCI states at the first slot that is after

n+ THARQ + + (TL1-RSRP\_list +TOuk\*(Tfirst-SSB\_List+ TSSB-proc)) / *NR slot length*.

If all target TCI states in the active TCI state list are unknown, the requirements specified in this clause are not applicable.

Where

- TL1-RSRP\_List = is the longest L1 measurement time (TL1-RSRP) of the source RS among the unknown target TCI states , where TL1-RSRP is specified in clause 8.15.3

- If the number of cells associated with the target TCI states in the active TCI list is 2, and time to first SSBs associated to the TCIs are overlapped in FR2,

- Tfirst-SSB\_List = Tfirst-SSB\_SC + min(TSSB\_SC ,TSSB\_CDP).

- If the number of cells associated with the target TCI states in the active TCI list is 2, and time to first SSBs associated to the TCIs are not overlapped in FR1 or FR2,

- Tfirst-SSB\_List = max(Tfirst-SSB\_SC , Tfirst-SSB\_CDP)

*-* Otherwise,

- Tfirst-SSB\_List = Tfirst-SSB\_SC.

- TSSB\_SC is the SSB periodicity of serving cell.

- TSSB\_CDP is the SSB periodicity of cell with different PCI from serving cell.

- Tfirst-SSB\_SC is the Tfirst-SSB from serving cell

- Tfirst-SSB\_CDP is the Tfirst-SSB from cell with different PCI from serving cell.

- THARQ, Tfirst-SSB, TSSB-proc , TOk, TOuk are defined in clause 8.15.3. TSSB is the SSB periodicity.

When UE receives PDSCH carrying MAC-CE for active TCI state list update, and

- higher layer configuration ‘*unifiedTCI-StateType-r17*’ is set to ‘*joint*’, or

- higher layer configuration ‘*unifiedTCI-StateType-r17*’ is set to ‘*separate*’, while the target TCI list comprises at least one DL TCIs and at least one UL TCIs,

UE is not expected to receive on DL before UE completes the DL and UL TCI state list update.

## 8.16 Active uplink TCI state switching delay for unified TCI

### 8.16.1 Introduction

The requirements in this clause apply for a UE configured with *DLorJoint-TCIState* (if unifiedTCI-StateType is indicated as *Joint*) or *UL-TCIState* configurations for UL channels/signals on a serving cell. Further the requirements also apply for all the list of serving cells in *simultaneousU-TCI-UpdateList1, simultaneousU-TCI-UpdateList2, simultaneousU-TCI-UpdateList3, simultaneousU-TCI-UpdateList4* in MR-DC or standalone NR. There is no requirement when the UE is requested to switch to a TCI state with the higher layer parameter *UL-TCIState* associated to SRS. UE shall complete the switch of active uplink TCI state within the delay defined in this clause when the UE is requested to switch to a TCI state with the higher layer parameter *DLorJointTCIState* or *UL-TCIState* associated to a DL RS.

PL-RS may be associated with or included in UL TCI state or joint TCI state. The requirements in this clause shall apply if the following conditions are met:

- PL-RS is identical to source RS in UL TCI state or joint TCI state

- PL-RS and source RS in UL TCI state or joint TCI state are QCL-Type D

When the target UL TCI state refers to an additional PCI different from serving cell PCI in which this UL TCI state is configured, the requirements in this clause are applicable provided that the following conditions are met:

- Active BWP of the serving cell and a cell with the additional PCI are the same

-Center frequency, SCS and SFN offset of a cell with the additional PCI are as the same as serving cell

- The cell with the additional PCI is known to the UE.

A cell with the additional PCI is known if the following conditions are met:

- During the last 5s before L1-RSRP measurement is configured, the UE has sent a valid L3 measurement report for the cell with the additional PCI

- Timing offset between serving cell and the cell with the additional PCI is within CP of the corresponding SCS

- The SSB from the cell with the additional PCI remains detectable according to the cell identification requirements specified in clause 9.2

Otherwise, the cell with the additional PCI is unknown.

8.16.2 Known conditions for uplink TCI state

The uplink TCI state is known if the following conditions are met:

- During the period from the last transmission of the RS resource used for the L1-RSRP measurement reporting for the target uplink TCI state to the completion of active uplink TCI state switch, where the RS resource for L1-RSRP measurement is the RS in target uplink TCI state or QCLed to the target uplink TCI state

- Uplink TCI state switch command is received within 1280 ms upon the last transmission of the RS resource for beam reporting or measurement

- The UE has sent at least 1 L1-RSRP report for the target uplink TCI state before the uplink TCI state switch command

- The RS configured in target uplink TCI state remains detectable during the uplink TCI state switching period

- SNR of the RS configured in target uplink TCI state ≥ -3dB

- The target uplink TCI state remains detectable during the uplink TCI state switching period

- The SSB associated with the uplink TCI state remain detectable during the uplink TCI switching period

- SNR of the uplink TCI state ≥ -3dB

- The SSB can be associated with either the serving cell PCI or a PCI different from serving cell PCI.

Otherwise, the uplink TCI state is unknown.

8.16.3 MAC-CE based uplink TCI state switch delay

The requirements in this clause shall apply for UL TCI state switch using separate UL TCI state or joint TCI state of unified TCI state switch framework.

In case that source RS in UL TCI state or joint TCI state is associated with a PCI different from that of the serving cell, the requirements in this clause shall apply if the cell with different PCI satisfies the known cell condition defined in 8.16.1. If the known cell condition is not met, longer delay may be expected.

In case of joint TCI state switch, UE is not expected to transmit on UL before UE completes the DL and UL TCI state switch.

For separate UL TCI state switch or joint TCI state switch for PUCCH or PUSCH, or semi-persistent/aperiodic/periodic SRS, when *beamCorrespondenceWithoutUL-BeamSweeping* is set to 1, upon receiving PDSCH carrying MAC-CE activation command in slot n on serving cell,

- The UE shall be able to transmit uplink signal with the target TCI state in the slot n+THARQ + + NM*\** (Tfirst\_target-PL-RS + 4\*Ttarget\_PL-RS + 2ms) / *NR slot length*.

- If target TCI state is unknown,

- The UE shall be able to transmit uplink signal with the target TCI state in the slot n+THARQ + *+* (TL1-RSRP+ Tfirst\_target-PL-RS + 4\*Ttarget\_PL-RS + 2ms) / *NR slot length*. with the target TCI state in the slot n+THARQ + 3ms *+* TL1-RSRP+ Tfirst\_target-PL-RS + 4\*Ttarget\_PL-RS + 2ms.

Where,

- THARQ (in slot) is the timing between DL data transmission and acknowledgement as specified in TS 38.213 [3].

- NM = 1, if the target PL-RS is not maintained by the UE, 0 otherwise.

[- PL-RS is maintained provided:

- the target PL-RS is associated with or included in the UL or joint TCI states in the active TCI list for PUSCH/PUCCH/SRS transmissions

- There are no more than 4 different RS configured as PL-RS per serving cell among all active UL (or joint) TCI states for PUSCH/PUCCH/SRS transmissions

- Conditions for known path loss reference signal in section 8.14.2 are fulfilled.Note: The requirements specified in this clause are not applicable if more than 4 different RSs are configured as PL-RS per serving cell among all active UL (or joint) TCI states.]

- Tfirst\_target-PL-RS is time to first pathloss RS transmission after L1-RSRP measurement when target TCI state is unknown.

- Tfirst\_target-PL-RS is time to first pathloss RS transmission after MAC CE command is decoded by the UE for known TCI State.

- Ttarget\_PL-RS is the periodicity of the target pathloss reference signal which would be SSB or NZP CSI-RS when PL-RS is associated with serving cell

- Ttarget\_PL-RS is the periodicity of the target pathloss reference signal which would be SSB when PL-RS is associated with PCI different from serving cell

- T L1-RSRP is the time for Rx beam refinement in FR2, defined as

- TL1-RSPR\_Measurement\_Period\_SSB for SSB as specified in clause 9.5.4.1,

- with the assumption of M=1

- with TReport = 0

- TL1-RSRP\_Measurement\_Period\_CSI-RS for CSI-RS as specified in clause 9.5.4.2

- CSI-RS based L1-RSRP measurement only apply for TCI state switch when source RS is associated with serving cell

- configured with higher layer parameter *repetition* set to ON

- with the assumption of M=1 for periodic CSI-RS

- for aperiodic CSI-RS if number of resources in resource set at least equal to *MaxNumberRxBeam*

- with TReport = 0

Editor note: when PL-RS is SSB in FR2, the delay requirement is FFS.

### 8.16.4 DCI based uplink TCI state switch delay

When a UE is configured with the higher layer parameter with *DLorJointTCIState* or *UL-TCIState,* activated with TCI states for uplink transmission by MAC CE indication of more than one codepoints, and receives DCI format 1\_1/1\_2 with or without DL assignment providing indicated TCI-State or TCI state pair in the active TCI list for a CC or all CCs with a common indicated TCI-State in the same CC list configured by *simultaneousU-TCI-UpdateList1, simultaneousU-TCI-UpdateList2, simultaneousU-TCI-UpdateList3, simultaneousU-TCI-UpdateList4*, the UE transmits a PUCCH with HARQ-ACK information corresponding to the DCI carrying the TCI-State indication.

The requirements in this clause are applicable only if the DCI format indicating UL TCI state or joint TCI state switch is received by UE when

- target TCI state is known, and

- target TCI state is in active TCI state list, and

- target PL-RS is maintained as defined in clause 8.16.3

If the target TCI state is known, the uplink TCI switching to the indicated UL TCI state or joint TCI state in the DCI format shall be completed starting from the first slot that is at least *BeamAppTime-r17* symbols after the last symbol of the PUCCH carrying HARQ-ACK in response to the DCI triggering TCI state activation. The first slot and the *BeamAppTime-\_r17* symbols are both determined on the carrier with the smallest SCS among the carrier(s) applying the beam indication. The value of *BeamAppTime\_r17* is defined in TS 38.331 [2]. The known condition for TCI state defined in clause 8.16.2 is applied.

If a PL-RS is associated with or included in UL TCI state or joint TCI state, the UL TCI switching and PL-RS switching shall be completed at the same time.

### 8.16.5 Active Uplink TCI state list update delay

The requirements specified in this clause are applicable if

- higher layer configuration ‘*unifiedTCI-StateType-r17*’ is set to ‘*separate*’, and a MAC CE activates more than one target separate TCIs, and at least one UL TCI is included, or

- higher layer configuration ‘*unifiedTCI-StateType-r17*’ is set to ‘*joint*’, and a MAC CE activates more than one target joint TCI.

If all the target TCI states in the active TCI state list are known, upon receiving PDSCH carrying MAC-CE active TCI state list update at slot n, UE shall be able to transmit PUCCH, PUSCH or SRS with the new target TCI states at the first slot that is after

n + THARQ + + NM \* (Tfirst\_target-PL-RS\_List + 4 \* Ttarget\_PL-RS\_List + 2ms) / *NR slot length*,

If a subset of target TCI states in the active TCI state list are unknown, upon receiving PDSCH carrying MAC-CE active TCI state list update at slot n, UE shall be able to transmit PUCCH, PUSCH or SRS with the new target TCI states at the first slot that is after

n+THARQ + *+* (TL1-RSRP\_List+ Tfirst\_target-PL-RS\_List + 4\*Ttarget\_PL-RS\_List + 2ms) / *NR slot length*

If all target TCI states in the active TCI state list are unknown, the requirements specified in this clause are not applicable.

Where

- If all TCIs are known,

- if the target PL-RS associated with or included in any UL TCI is not maintained, NM = 1; Where maintained PL-RS is defined in clause 8.16.3

- if a subset of target TCI states in the active TCI state list are unknown,

- TL1-RSRP\_List = is the longest L1 measurement time (TL1-RSRP) of the source RS among the unknown target TCI states , where TL1-RSRP is specified in clause 8.16.3

- if the number of cells associated with the target TCI states in the active TCI list is 2, and time to first PL-RS associated to the TCIs are overlapped in FR2,

- Tfirst\_target-PL-RS\_List = Tfirst\_target-PL-RS\_SC + min(Ttarget-PL-RS\_SC , Ttarget-PL-RS\_CDP) ;

- Ttarget-PL-RS\_List = 2 \* Ttarget-PL-RS\_SC, if Ttarget-PL-RS\_SC = Ttarget-PL-RS\_CDP

- Ttarget-PL-RS\_List = max(Ttarget-PL-RS\_SC , Ttarget-PL-RS\_CDP), if Ttarget-PL-RS\_SC ≠ Ttarget-PL-RS\_CDP

- if the number of cells associated with the target TCI states in the active TCI list is 2, and time to first PL-RS associated to the TCIs are not overlapped in FR2,

- Tfirst\_target-PL-RS\_List = max (Tfirst\_target-PL-RS\_SC, Tfirst\_target-PL-RS\_SC);

- Ttarget-PL-RS\_List = max(Ttarget-PL-RS\_SC , Ttarget-PL-RS\_CDP)

- Otherwise,

- Tfirst\_target-PL-RS\_List = Tfirst\_target-PL-RS\_SC

- Ttarget-PL-RS\_List = Ttarget-PL-RS\_SC.

- Tfirst\_target-PL-RS\_SC is Tfirst\_target-PL-RS for serving cell

- Tfirst\_target-PL-RS\_CDP is Tfirst\_target-PL-RS for cell with different PCI from serving cell

- Ttarget-PL-RS\_SC is Ttarget-PL-RS for serving cell

- Ttarget-PL-RS\_CDP is Ttarget-PL-RS for cell with different PCI from serving cell- THARQ, Tfirst\_target-PL-RS, Ttarget-PL-RS are defined in clause 8.16.3.

Note: The requirements specified in this clause do not apply if more than 4 different RSs are configured as PL-RS per serving cell among all active UL (or joint) TCI states.

When UE receives PDSCH carrying MAC-CE for active TCI state list update, and

- higher layer configuration ‘*unifiedTCI-StateType-r17*’ is set to ‘*joint*’, or

- higher layer configuration ‘*unifiedTCI-StateType-r17*’ is set to ‘*separate*’, while the target TCI list comprises at least one DL TCIs and at least one UL TCIs,

UE is not expected to transmit on UL before UE completes the DL and UL TCI list update.

[For active UL or joint TCI state, it is FFS if a UE is expected to track timing or frequency derived from DL-RS associated with a source RS in UL TCI state or joint TCI that is not in DL TCI state list.]

## 8.17 SCG Activation and Deactivation Delay

### 8.17.1 Introduction

This clause defines requirements for the delay within which the UE shall be able to activate one SCG and deactivate on SCG.

The requirements shall apply for NR-DC with an NR PCell, PSCell or SCell.

### 8.17.2 SCG Activation Delay Requirement

The requirements in this clause shall apply for the UE configured with one deactivated SCG in NR-DC and when PScell in one SCG is being activated.

The delay within which the UE shall be able to activate the deactivated SCG depends upon the specified conditions.

Upon receiving SCG activation command in slot *n*, the UE shall be capable to transmit PRACH preamble or PUCCH or PUSCH towards PSCell no later than in slot ,

where:

Tactivation\_time = TRRC\_delay + Tprocessing + Tsearch + T∆ + TIU + 2 ms

TRRC\_delay is the RRC procedure delay as specified in TS 38.331 [2].

Tprocessing is the SW processing time needed by UE, including RF warm up period. When PSCell is activated from deactivated state, if any PSCell parameter is modified, Tprocessing = 20ms. Otherwise, Tprocessing = 5 ms. Tsearch is the time for AGC settling and PSS/SSS detection.

Tsearch is the time for AGC settling and PSS/SSS detection.

For RACH based PSCell activation, if the target cell is a known NR FR2 PSCell, Tsearch = 0 ms. If the target cell is an unknown FR2 PSCell and Es/Iot ≥ -2 dB, then Tsearch = 24\* Trs ms.

For RACH-less based PSCell activation, if RLM and BFD are configured and TCI state is known, Tsearch = 0 ms if the target cell is a known FR2 PScell. There are no requirements if PSCell is unknown.

T∆ is time for fine time tracking and acquiring full timing information of the target PSCell. T∆ = 1\*Trs ms.

TIU: When RACH based PSCell activation is configured, it is the delay uncertainty in acquiring the first available PRACH occasion in the PSCell. TIU is up to the summation of SSB to PRACH occasion association period and 10 ms. SSB to PRACH occasion associated period is defined in Table 8.1-1 of TS 38.213 [3].

When RACH-less based PSCell activation is configured, it is the uncertainty in acquiring the first PUSCH transmission occasion [or SR on PUCCH].

Trs is the SMTC periodicity of the PSCell if the UE has been provided with an SMTC configuration for the target cell in SCG activation command, otherwise Trs is the SMTC configured in the measObjectNR having the same SSB frequency and subcarrier spacing. If the UE is not provided SMTC configuration or measurement object on this frequency, the requirement in this clause is applied with Trs = 5 ms assuming the SSB transmission periodicity is 5 ms. There is no requirement if the SSB transmission periodicity is not 5.

In FR2, the PSCell is known if it has been meeting the following conditions:

- During the last 5 seconds before the reception of the SCG activation command:

- the UE has sent a valid measurement report for the PSCell being activated and

- One of the SSBs measured from the PSCell being activated remains detectable according to the cell identification conditions specified in clause 9.3.

- One of the SSBs measured from PSCell being activated also remains detectable during the PSCell activation delay Tactivation\_time according to the cell identification conditions specified in clause 9.3.

otherwise it is unknown.

If the UE is configured to perform BFD while the SCG is deactivated

- The TCI state is known if the following conditions are met:

- During the period from the PSCell deactivation to the completion of PSCell activation, while PSCell was deactivated,

- UE has not detected beam failure

- Otherwise, the TCI state is unknown.

The PCell interruption specified in clause 8.2 is allowed only during the RRC reconfiguration procedure [2].

### 8.17.3 SCG Deactivation Delay Requirement

The requirements in this clause shall apply for a UE which is configured with at least PCell and PScell.

Upon receiving RRC-based SCG deactivation command in subframe *n*, the UE shall accomplish the deactivationactions specified in TS 38.331 [2] no later than in slot :

where

TRRC\_delay is the RRC procedure delay as specified in TS 38.331 [2].

The PCell interruption specified in clause 8.2 is allowed only during the RRC reconfiguration procedure [2].

## 8.18 TRP specific Link Recovery Procedures

### 8.18.1 Introduction

The UE shall assess the downlink radio link quality of a serving cell based on the reference signal provided in the two sets and as specified in TS 38.213 [3] in order to detect beam failure on:

- PCell in SA, NR-DC, or NE-DC operation mode,

- PSCell in NR-DC and EN-DC operation mode,

- SCell in SA, NR-DC, NE-DC or EN-DC operation mode.

The RS resource configurations in the two sets and on PCell or PSCell can be periodic CSI-RS resources and/or SSBs. RS resource configuration in the two sets and on SCell shall be periodic CSI-RS. UE is not required to perform beam failure detection outside the active DL BWP. UE is not required to meet the requirements in clause 8.18.2 and 8.18.3 if UE does not have configured sets and . UE is not required to perform beam failure detection on a deactivated SCell, and also not required to perform beam failure detection on resources which is implicitly configured for a deactivated SCell. UE is not required to perform beam failure detection on a SCell on which and is not configured.

If *additionalPCIList* is configured for the serving cell, the SSBs in sets and can be associated to the same additional PCI other than serving cell PCI.

On each RS resource configuration in the two sets and , the UE shall estimate the radio link quality and compare it to the threshold Qout\_LR for the purpose of accessing downlink radio link quality of the serving cell.

The threshold Qout\_LR is defined as the level at which the downlink radio level link of a given resource configuration on two sets and cannot be reliably received and shall correspond to the BLERout = 10% block error rate of a hypothetical PDCCH transmission. For SSB based beam failure detection, Qout\_LR\_SSB is derived based on the hypothetical PDCCH transmission parameters listed in Table 8.518.2.1-1. For CSI-RS based beam failure detection, Qout\_LR\_CSI-RS is derived based on the hypothetical PDCCH transmission parameters listed in Table 8.181.3.1-1.

Upon request the UE shall deliver configuration indexes from the two sets and as specified in TS 38.213 [3] , to higher layers, and the corresponding L1-RSRP measurement provided that the measured L1-RSRP is equal to or better than the threshold Qin\_LR, which is indicated by higher layer parameter *rsrp-ThresholdSSB*. The UE applies the Qin\_LR threshold to the L1-RSRP measurement obtained from an SSB. The UE applies the Qin\_LR threshold to the L1-RSRP measurement obtained for a CSI-RS resource after scaling a respective CSI-RS reception power with a value provided by higher layer parameter *powerControlOffsetSS*. The RS resource configurations in the two sets and can be periodic CSI-RS resources or SSBs or both SSB and CSI-RS resources. UE is not required to perform candidate beam detection outside the active DL BWP. UE is not required to perform candidate beam detection on a SCell on which and is not configured.

### 8.18.2 Requirements for TRP specific SSB based beam failure detection

#### 8.18.2.1 Introduction

The requirements in this clause apply for each SSB resource in the set two sets and configured for a serving cell, provided that the SSB configured for beam failure detection is actually transmitted within the UE active DL BWP during the entire evaluation period specified in clause 8.18.2.2. The SSB(s) in set can be associated with an additionalPCI other than serving cell PCI.

Table 8.18.2.1-1: PDCCH transmission parameters for beam failure instance

|  |  |
| --- | --- |
| Attribute | Value for BLER |
| DCI format | 1-0 |
| Number of control OFDM symbols | 2 |
| Aggregation level (CCE) | 8 |
| Ratio of hypothetical PDCCH RE energy to average SSS RE energy | 0dB |
| Ratio of hypothetical PDCCH DMRS energy to average SSS RE energy | 0dB |
| Bandwidth (PRBs) | 24 |
| Sub-carrier spacing (kHz) | Same as the SCS of RMSI CORESET |
| DMRS precoder granularity | REG bundle size |
| REG bundle size | 6 |
| CP length | Normal |
| Mapping from REG to CCE | Distributed |

#### 8.18.2.2 Minimum requirement

UE shall be able to evaluate whether the downlink radio link quality on the configured SSB resource in two sets and estimated over the last TEvaluate\_BFD\_SSB ms period becomes worse than the threshold Qout\_LR\_SSB within TEvaluate\_BFD\_SSB ms period.

The value of TEvaluate\_BFD\_SSB is defined in Table 8.18.2.2-1 for FR1.

The value of TEvaluate\_BFD\_SSB is defined in Table 8.18.2.2-2 for FR2 with scaling factor N=8

For FR1,

- , when in the monitored cell there are measurement gaps configured for intra-frequency, inter-frequency or inter-RAT measurements, which are overlapping with some but not all occasions of the SSB.

- P=1 when in the monitored cell there are no measurement gaps overlapping with any occasion of the SSB.

For FR2,

- , when BFD-RS resource is not overlapped with measurement gap and the BFD-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod).

- P = Psharing factor, when the BFD-RS resource is not overlapped with measurement gap and the BFD-RS resource is fully overlapped with SMTC period (TSSB = TSMTCperiod).

- , when the BFD-RS resource is partially overlapped with measurement gap and the BFD-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and

- TSMTCperiod ≠ MGRP or

- TSMTCperiod = MGRP and TSSB < 0.5\*TSMTCperiod

- , when the BFD-RS resource is partially overlapped with measurement gap and the BFD-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and TSMTCperiod = MGRP and TSSB = 0.5\*TSMTCperiod

- , when the BFD-RS resource is partially overlapped with measurement gap (TSSB <MGRP) and the BFD-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is partially or fully overlapped with measurement gap.

- , when the BFD-RS resource is partially overlapped with measurement gap and the BFD-RS resource is fully overlapped with SMTC occasion (TSSB = TSMTCperiod) and SMTC occasion is partially overlapped with measurement gap (TSMTCperiod < MGRP)

- Psharing factor = 1, if the BFD-RS resource outside measurement gap is

- not overlapped with the SSB symbols indicated by SSB-ToMeasure and 1 data symbol before each consecutive SSB symbols indicated by SSB-ToMeasure and 1 data symbol after each consecutive SSB symbols indicated by SSB-ToMeasure, given that SSB-ToMeasure is configured, where the *SSB-ToMeasure* is the union set of *SSB-ToMeasure* from all the configured measurement objects merged on the same serving carrier, and;

- not overlapped with the RSSI symbols indicated by ss-RSSI-Measurement and 1 data symbol before each RSSI symbol indicated by ss-RSSI-Measurement and 1 data symbol after each RSSI symbol indicated by ss-RSSI-Measurement, given that ss-RSSI-Measurement is configured.

- Psharing factor = 3, otherwise.

where,

If the high layer in TS 38.331 [2] signaling of *smtc2* is configured, TSMTCperiod corresponds to the value of higher layer parameter *smtc2*; Otherwise TSMTCperiod corresponds to the value of higher layer parameter *smtc1*. TSMTCperiod is the shortest SMTC period among all CCs in the same FR2 band, given the SMTC offset of all CCs in FR2 provided the same offset.

Longer evaluation period would be expected if the combination of BFD-RS resource, SMTC occasion and measurement gap configurations does not meet pervious conditions.

For either an FR1 or FR2 serving cell, longer BFD evaluation period would be expected during the period Tidentify\_CGI when the UE is requested to decode an NR CGI.

For either an FR1 or FR2 serving cell, longer BFD evaluation period would be expected during the period Tidentify\_CGI,E-UTRAN when the UE is requested to decode an LTE CGI.

The values of PTRP defined in table 8.18.2.2-2 is defined as 2, if SSB/CSI-RS resource in the two sets and are overlapped, else it is 1.

Table 8.18.2.2-1: Evaluation period TEvaluate\_BFD\_SSB for FR1

|  |  |
| --- | --- |
| Configuration | TEvaluate\_BFD\_SSB (ms) |
| no DRX | Max(50, Ceil(5 × P) × TSSB) |
| DRX cycle ≤ 320ms | Max(50, Ceil(7.5 × P) × Max(TDRX,TSSB)) |
| DRX cycle > 320ms | Ceil(5 × P) × TDRX |
| Note: TSSB is the periodicity of SSB in the two sets and . TDRX is the DRX cycle length. | |

Table 8.18.2.2-2: Evaluation period TEvaluate\_BFD\_SSB for FR2

|  |  |
| --- | --- |
| Configuration | TEvaluate\_BFD\_SSB (ms) |
| no DRX | Max(50, Ceil(5 × P × N\*PTRP) × TSSB) |
| DRX cycle ≤ 320ms | Max(50, Ceil(7.5 × P × N\*PTRP) × Max(TDRX,TSSB)) |
| DRX cycle > 320ms | Ceil(5 × P × N\*PTRP) × TDRX |
| Note: TSSB is the periodicity of SSB in the two sets and . TDRX is the DRX cycle length. | |

#### 8.18.2.3 Measurement restriction for SSB based beam failure detection

The UE is required to be capable of measuring SSB for BFD without measurement gaps. The UE is required to perform the SSB measurements with measurement restrictions as described in the following scenarios.

For FR1, when the SSB for BFD measurement is in the same OFDM symbol as CSI-RS for RLM, BFD, CBD or L1-RSRP measurement,

- If SSB and CSI-RS have same SCS, UE shall be able to measure the SSB for BFD measurement without any restriction;

- If SSB and CSI-RS have different SCS,

- If UE supports *simultaneousRxDataSSB-DiffNumerology*, UE shall be able to measure the SSB for BFD measurement without any restriction.

- If UE does not support *simultaneousRxDataSSB-DiffNumerology*, UE is required to measure one of but not both SSB for BFD measurement and CSI-RS. Longer measurement period for SSB based BFD measurement is expected, and no requirements are defined.

For FR2, when the SSB for BFD measurement on one CC is in the same OFDM symbol as CSI-RS for RLM, BFD, CBD or L1-RSRP measurement on the same CC or different CCs in the same band, UE is required to measure one of but not both SSB for BFD measurement and CSI-RS. Longer measurement period for SSB based BFD measurement is expected, and no requirements are defined. When the SSB and CSI-RS for BFD measurements are from different sets and , UE shall be able to perform measure both SSB and CSI-RS for BFD measurements.

For FR2, if the network configures same or mixed numerology between SSB for BFD measurement on one FR2 band and CSI-RS for RLM, BFD, CBD, L1-RSRP or L1-SINR measurement on the other FR2 band, UE shall be able to perform the related SSB based measurements in one band without any measurement restrictions on the other band, provided that UE is capable of independent beam management on this FR2 band pair.

### 8.18.3 Requirements for CSI-RS based beam failure detection

#### 8.18.3.1 Introduction

The requirements in this clause apply for each CSI-RS resource in the two sets and of resource configurations for a serving cell, provided that the CSI-RS resource(s) in two sets and for beam failure detection are actually transmitted within the UE active DL BWP during the entire evaluation period specified in clause 8.18.3.2. UE is not expected to perform beam failure detection measurements on the CSI-RS configured for BFD if the CSI-RS is not QCL-ed, with QCL-TypeD when applicable, with the RS in the active TCI state of any CORESET configured in the UE active BWP.

Table 8.18.3.1-1: PDCCH transmission parameters for beam failure instance

|  |  |
| --- | --- |
| Attribute | Value for BLER |
| DCI format | 1-0 |
| Number of control OFDM symbols | 2 |
| Aggregation level (CCE) | 8 |
| Ratio of hypothetical PDCCH RE energy to average CSI-RS RE energy | 0dB |
| Ratio of hypothetical PDCCH DMRS energy to average CSI-RS RE energy | 0dB |
| Bandwidth (PRBs) | 48 |
| Sub-carrier spacing (kHz) | SCS of the active DL BWP |
| DMRS precoder granularity | REG bundle size |
| REG bundle size | 6 |
| CP length | Normal |
| Mapping from REG to CCE | Distributed |

#### 8.18.3.2 Minimum requirement

UE shall be able to evaluate whether the downlink radio link quality on the CSI-RS resource in two sets and estimated over the last TEvaluate\_BFD\_CSI-RS ms period becomes worse than the threshold Qout\_LR\_CSI-RS within TEvaluate\_BFD\_CSI-RS ms period.

The value of TEvaluate\_BFD\_CSI-RS is defined in Table 8.18.3.2-1 for FR1.

The value of TEvaluate\_BFD\_CSI-RS is defined in Table 8.18.3.2-2 for FR2 with N=1. The requirements of TEvaluate\_BFD\_CSI-RS apply provided that the CSI-RS for BFD is not in a resource set configured with repetition ON. The requirements shall not apply when the CSI-RS resource in the active TCI state of CORESET is the same CSI-RS resource for BFD and the TCI state information of the CSI-RS resource is not given, wherein the TCI state information means QCL Type-D to SSB for L1-RSRP or CSI-RS with repetition ON.

For FR1,

- , when in the monitored cell there are measurement gaps configured for intra-frequency, inter-frequency or inter-RAT measurements, which are overlapping with some but not all occasions of the CSI-RS.

- P = 1 when in the monitored cell there are no measurement gaps overlapping with any occasion of the CSI-RS.

For FR2,

- P = 1, when the BFD-RS resource is not overlapped with measurement gap and also not overlapped with SMTC occasion.

- , when the BFD-RS resource is partially overlapped with measurement gap and the BFD-RS resource is not overlapped with SMTC occasion (TCSI-RS < MGRP)

- , when the BFD-RS resource is not overlapped with measurement gap and the BFD-RS resource is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod).

- P = Psharing factor, when the BFD-RS resource is not overlapped with measurement gap and the BFD-RS resource is fully overlapped with SMTC occasion (TCSI-RS = TSMTCperiod).

- , when the BFD-RS resource is partially overlapped with measurement gap and the BFD-RS resource is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and

- TSMTCperiod ≠ MGRP or

- TSMTCperiod = MGRP and TCSI-RS < 0.5 × TSMTCperiod

- , when the BFD-RS resource is partially overlapped with measurement gap and the BFD-RS resource is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and TSMTCperiod = MGRP and TCSI-RS = 0.5 × TSMTCperiod

- , when the BFD-RS resource is partially overlapped with measurement gap (TCSI-RS < MGRP) and the BFD-RS resource is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is partially or fully overlapped with measurement gap.

- , when the BFD-RS resource is partially overlapped with measurement gap and the BFD-RS resource is fully overlapped with SMTC occasion (TCSI-RS = TSMTCperiod) and SMTC occasion is partially overlapped with measurement gap (TSMTCperiod < MGRP)

- Psharing factor = 1, if the BFD-RS resource outside measurement gap is

- not overlapped with the SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol before each consecutive SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol after each consecutive SSB symbols indicated by *SSB-ToMeasure*, given that *SSB-ToMeasure* is configured, where the *SSB-ToMeasure* is the union set of *SSB-ToMeasure* from all the configured measurement objects merged on the same serving carrier, and;

- not overlapped with the RSSI symbols indicated by *ss-RSSI-Measurement* and 1 data symbol before each RSSI symbol indicated by *ss-RSSI-Measurement* and 1 data symbol after each RSSI symbol indicated by *ss-RSSI-Measurement*, given that *ss-RSSI-Measurement* is configured,

- Psharing factor = 3, otherwise.

where,

If the high layer in TS 38.331 [2] signaling of *smtc2* is configured, TSMTCperiod corresponds to the value of higher layer parameter *smtc2*; Otherwise TSMTCperiod corresponds to the value of higher layer parameter *smtc1*. TSMTCperiod is the shortest SMTC period among all CCs in the same FR2 band, provided the SMTC offset of all CCs in FR2 have the same offset.

Note: The overlap between CSI-RS for BFD and SMTC means that CSI-RS for BFD is within the SMTC window duration.

Longer evaluation period would be expected if the combination of the BFD-RS resource, SMTC occasion and measurement gap configurations does not meet pervious conditions.

For either an FR1 or FR2 serving cell, longer BFD evaluation period would be expected during the period Tidentify\_CGI when the UE is requested to decode an NR CGI.

For either an FR1 or FR2 serving cell, longer BFD evaluation period would be expected during the period Tidentify\_CGI,E-UTRAN when the UE is requested to decode an LTE CGI.

The values of MBFD used in Table 8.18.3.2-1 and Table 8.18.3.2-2 are defined as

- MBFD = 10, if the CSI-RS resource(s) in the two sets and used for BFD is transmitted with Density = 3 and over the bandwidth ≥ 24 PRBs.

The values of PBFD used in Table 8.18.3.2-1 and Table 8.18.3.2-2 are defined as

For each CSI-RS resource in the two sets and configured for PCell or PSCell in EN-DC or NE-DC or SA; or PCell in NR-DC

- PBFD = 1.

For each CSI-RS resource in the two sets and configured for PSCell in NR-DC

PBFD = 2 if UE is configured for beam failure detection on SCell, 1 otherwise.

For each CSI-RS resource in the two sets and configured for a SCell

- PBFD = Z in EN-DC or NE-DC or SA.

- PBFD = 2\* Z in NR-DC.

Where Z is the number of band(s) on which UE is performing beam failure detection only for SCell.

The values of PTRP define in table 8.518.3.2-2 is defined as 2,if SSB/CSI-RS resource in the two sets and are overalapped, else it is 1.

Table 8.18.2-1: Evaluation period TEvaluate\_BFD\_CSI-RS for FR1

|  |  |
| --- | --- |
| Configuration | TEvaluate\_BFD\_CSI-RS (ms) |
| no DRX | Max(50, Ceil(MBFD × P × PBFD) × TCSI-RS) |
| DRX cycle ≤ 320ms | Max(50, Ceil(1.5 × MBFD × P × PBFD) × Max(TDRX, TCSI-RS)) |
| DRX cycle > 320ms | Ceil(MBFD × P × PBFD) × TDRX |
| Note: TCSI-RS is the periodicity of CSI-RS resource in the two sets and . TDRX is the DRX cycle length. | |

**Table 8.18.3.2-2: Evaluation period TEvaluate\_BFD\_CSI-RS for FR2**

|  |  |
| --- | --- |
| Configuration | TEvaluate\_BFD\_CSI-RS (ms) |
| no DRX | Max(50, Ceil(MBFD × P × N × PBFD\*PTRP) × TCSI-RS) |
| DRX cycle ≤ 320ms | Max(50, Ceil(1.5 × MBFD × P × N × PBFD\*PTRP) × Max(TDRX, TCSI-RS)) |
| DRX cycle > 320ms | Ceil(MBFD × P × N × PBFD\*PTRP) × TDRX |
| Note: TCSI-RS is the periodicity of CSI-RS resource in the two sets and . TDRX is the DRX cycle length. | |

#### 8.18.3.3 Measurement restrictions for CSI-RS beam failure detection

The UE is required to be capable of measuring CSI-RS for BFD without measurement gaps. The UE is required to perform the CSI-RS measurements with measurement restrictions as described in the following scenarios.

For both FR1 and FR2, when the CSI-RS for BFD measurement is in the same OFDM symbol as SSB for RLM, BFD, CBD or L1-RSRP measurement, UE is not required to receive CSI-RS for BFD measurement in the PRBs that overlap with an SSB.

For FR1, when the SSB for RLM, BFD, CBD or L1-RSRP measurement is within the active BWP and has same SCS than CSI-RS for BFD measurement, the UE shall be able to perform CSI-RS measurement without restrictions.

For FR1, when the SSB for RLM, BFD, CBD or L1-RSRP measurement is within the active BWP and has different SCS than CSI-RS for BFD measurement, the UE shall be able to perform CSI-RS measurement with restrictions according to its capabilities:

- If the UE supports *simultaneousRxDataSSB-DiffNumerology* the UE shall be able to perform CSI-RS measurement without restrictions.

- If the UE does not support *simultaneousRxDataSSB-DiffNumerology*, UE is required to measure one of but not both CSI-RS for BFD measurement and SSB. Longer measurement period for CSI-RS based BFD measurement is expected, and no requirements are defined.

For FR1, when the CSI-RS for BFD measurement is in the same OFDM symbol as another CSI-RS for RLM, BFD, CBD or L1-RSRP measurement, UE shall be able to measure the CSI-RS for BFD measurement without any restriction.

For FR2, when the CSI-RS for BFD measurement on one CC is in the same OFDM symbol as SSB for RLM, BFD or L1-RSRP measurement on the same CC or different CCs in the same band, or in the same symbol as SSB for CBD measurement on the same CC or different CCs in the same band when beam failure is detected, UE is required to measure one of but not both CSI-RS for BFD measurement and SSB. Longer measurement period for CSI-RS based BFD measurement is expected, and no requirements are defined.

For FR2, when the CSI-RS for BFD measurement on one CC is in the same OFDM symbol as another CSI-RS for RLM, BFD, CBD or L1-RSRP measurement on the same CC or different CCs in the same band,

- In the following cases, UE is required to measure one of but not both CSI-RS for BFD measurement and the other CSI-RS. Longer measurement period for CSI-RS based BFD measurement is expected, and no requirements are defined.

- The CSI-RS for BFD measurement or the other CSI-RS in a resource set configured with repetition ON, or

- The other CSI-RS is configured in two sets and and beam failure is detected, or

- The two CSI-RS-es are not QCL-ed w.r.t. QCL-TypeD, or the QCL information is not known to UE,

- Otherwise, UE shall be able to measure the CSI-RS for BFD measurement without any restriction.

When two CSI-RSs for BFD measurements are from different sets and , UE shall be able to perform measure both CSI-RSs for BFD measurements.

### 8.18.4 Minimum requirement for L1 indication

When more than one TRP is configured with different resource set for each TRP, requirements specified in 8.5.4 shall apply for each TRP.

### 8.18.5 Requirements for SSB based candidate beam detection

#### 8.18.5.1 Introduction

The requirements in this clause apply for each SSB resource in the sets and configured for a serving cell, provided that the SSBs configured for candidate beam detection (CBD) are actually transmitted within UE active DL BWP during the entire evaluation period specified in clause 8.18.5.2. The SSB(s) in set can be associated with an additional PCI other than serving PCI.

#### 8.18.5.2 Minimum requirement

Upon request the UE shall be able to evaluate whether the L1-RSRP measured on the configured SSB resource in the two sets and ,estimated over the last TEvaluate\_CBD\_SSB ms period becomes better than the threshold Qin\_LR provided SSB\_RP and SSB Ês/Iot are according to Annex Table B.2.4.1 for a corresponding band.

The UE shall monitor the configured SSB resources using the evaluation period in table 8.18.5.2-1 and 8.18.5.2-2 corresponding to the non-DRX mode, if the configured DRX cycle ≤ 320ms.

The value of TEvaluate\_CBD\_SSB is defined in Table 8.18.5.2-1 for FR1.

The value of TEvaluate\_CBD\_SSB is defined in Table 8.18.5.2-2 for FR2 with scaling factor N=8.

For FR1,

- , when in the monitored cell there are measurement gaps configured for intra-frequency, inter-frequency or inter-RAT measurements, which are overlapping with some but not all occasions of the SSB,

- P = 1 when in the monitored cell there are no measurement gaps overlapping with any occasion of the SSB.

For FR2,

- , when candidate beam detection RS is not overlapped with measurement gap and candidate beam detection RS is partially overlapped with SMTC occasion (TSSB < TSMTCperiod).

- P is Psharing factor, when candidate beam detection RS is not overlapped with measurement gap and candidate beam detection RS is fully overlapped with SMTC period (TSSB = TSMTCperiod).

- , when candidate beam detection RS is partially overlapped with measurement gap and candidate beam detection RS is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and

- TSMTCperiod ≠ MGRP or

- TSMTCperiod = MGRP and TSSB < 0.5 × TSMTCperiod

- , when candidate beam detection RS is partially overlapped with measurement gap and candidate beam detection RS is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and TSMTCperiod = MGRP and TSSB = 0.5 × TSMTCperiod

- , when candidate beam detection RS is partially overlapped with measurement gap and candidate beam detection RS is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is partially or fully overlapped with measurement gap

- , when candidate beam detection RS is partially overlapped with measurement gap and candidate beam detection RS is fully overlapped with SMTC occasion (TSSB = TSMTCperiod) and SMTC occasion is partially overlapped with measurement gap (TSMTCperiod < MGRP)

- Psharing factor = 1, if the candidate beam detection RS outside measurement gap is

- not overlapped with the SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol before each consecutive SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol after each consecutive SSB symbols indicated by *SSB-ToMeasure*, given that *SSB-ToMeasure* is configured, where the *SSB-ToMeasure* is the union set of *SSB-ToMeasure* from all the configured measurement objects merged on the same serving carrier, and;

- not overlapped with the RSSI symbols indicated by *ss-RSSI-Measurement* and 1 data symbol before each RSSI symbol indicated by *ss-RSSI-Measurement* and 1 data symbol after each RSSI symbol indicated by *ss-RSSI-Measurement*, given that *ss-RSSI-Measurement* is configured

- Psharing factor = 3, otherwise.

where,

If the high layer in TS 38.331 [2] signaling of *smtc2*is present, TSMTCperiod follows *smtc2*; Otherwise TSMTCperiod follows *smtc1.* TSMTCperiod is the shortest SMTC period among all CCs in the same FR2 band, provided the SMTC offset of all CCs in FR2 have the same offset.

Longer evaluation period would be expected if the combination of the CBD-RS resource, SMTC occasion and measurement gap configurations does not meet pervious conditions.

For either an FR1 or FR2 serving cell, longer evaluation period would be expected during the period Tidentify\_CGI when the UE is requested to decode an NR CGI.

For either an FR1 or FR2 serving cell, longer CBD evaluation period would be expected during the period Tidentify\_CGI,E-UTRAN when the UE is requested to decode an LTE CGI.

The values of PCBD used in Table 8.18.5.2-1 and Table 8.18.5.2-2 are defined as

For each SSB resource in the sets and configured for PCell or PSCell in EN-DC or NE-DC or SA; or PCell in NR-DC

- PCBD = 1.

For each SSB resource in the sets and configured for PSCell in NR-DC

- PCBD = 2 if UE is configured for candidate beam detection on SCell, 1 otherwise.

For each SSB resource in the sets and configured for a SCell

- PCBD = Z in EN-DC or NE-DC or SA.

- PCBD = 2\* Z in NR-DC.

Where Z is the number of band(s) on which UE is performing beam failure detection only for SCell

- PCBD is the number of band(s) on which UE is performing candidate beam detection only for SCell.

The values of PTRP defined in table 8.18.5.2-2 is defined as 2, if SSB/CSI-RS resource in the two sets and are overlapped, else it is 1.

**Table 8.18.5.2-1: Evaluation period TEvaluate\_CBD\_SSB for FR1**

|  |  |
| --- | --- |
| **Configuration** | **TEvaluate\_CBD\_SSB (ms)** |
| non-DRX, DRX cycle ≤ 320ms | Max(25, Ceil(3 × P × PCBD) × TSSB) |
| DRX cycle > 320ms | Ceil(3 × P × PCBD) × TDRX |
| Note: TSSB is the periodicity of SSB in the two sets and . TDRX is the DRX cycle length. | |

**Table 8.18.5.2-2: Evaluation period TEvaluate\_CBD\_SSB for FR2**

|  |  |
| --- | --- |
| **Configuration** | **TEvaluate\_CBD\_SSB (ms)** |
| non-DRX, DRX cycle ≤ 320ms | Max(25, Ceil(3 × P × N × PCBD × PTRP) × TSSB) |
| DRX cycle > 320ms | Ceil(3 × P × N × PCBD × PTRP) × TDRX |
| Note: TSSB is the periodicity of SSB in the two sets and . TDRX is the DRX cycle length. | |

#### 8.18.5.3 Measurement restriction for SSB based candidate beam detection

For FR1, when the SSB for CBD measurement is in the same OFDM symbol as CSI-RS for RLM, BFD, CBD or L1-RSRP measurement,

- If SSB and CSI-RS have same SCS, UE shall be able to measure the SSB for CBD measurement without any restrictions.

- If SSB and CSI-RS have different SCS-es,

- If UE supports *simultaneousRxDataSSB-DiffNumerology*, UE shall be able to measure the SSB for CBD measurement without any restriction.

- If UE does not support *simultaneousRxDataSSB-DiffNumerology*, UE is required to measure one of but not both SSB for CBD measurement and CSI-RS. Longer measurement period for SSB based CBD measurement is expected, and no requirements are defined.

For FR2, when the SSB for CBD measurement on one CC is in the same OFDM symbol as CSI-RS for RLM, BFD, CBD or L1-RSRP measurement on the same CC or different CCs in the same band, UE is required to measure one of but not both SSB for CBD measurement and CSI-RS. Longer measurement period for SSB based CBD measurement is expected, and no requirements are defined. When the SSB and CSI-RS for CBD measurements are from different sets and , UE shall be able to measure both SSB and CSI-RS for CBD measurements.

For FR2, if network configures same or mixed numerology between SSB for CBD measurement on one FR2 band and CSI-RS for RLM, BFD, CBD, L1-RSRP or L1-SINR measurement on the other FR2 band, UE shall be able to perform the related SSB based measurements in one band without any measurement restrictions in the other band, provided that UE is capable of independent beam management on this FR2 band pair.

### 8.18.6 Requirements for CSI-RS based candidate beam detection

#### 8.18.6.1 Introduction

The requirements in this clause apply for each CSI-RS resource in the sets and configured for a serving cell, provided that the CSI-RS resources configured for candidate beam detection are actually transmitted within UE active DL BWP during the entire evaluation period specified in clause 8.18.6.2.

#### 8.18.6.2 Minimum requirement

Upon request the UE shall be able to evaluate whether the L1-RSRP measured on the configured CSI-RS resource in sets and estimated over the last TEvaluate\_CBD\_CSI-RS [ms] period becomes better than the threshold Qin\_LR within TEvaluate\_CBD\_CSI-RS [ms] period provided CSI-RS Ês/Iot is according to Annex Table B.2.4.2 for a corresponding band.

The UE shall monitor the configured CSI-RS resources using the evaluation period in table 8.18.6.2-1 and 8.18.6.2-2 corresponding to the non-DRX mode, if the configured DRX cycle ≤ 320ms.

The value of TEvaluate\_CBD\_CSI-RS is defined in Table 8.18.6.2-1 for FR1.

The value of TEvaluate\_CBD\_CSI-RS is defined in Table 8.18.6.2-2 for FR2 with scaling factor N=8.

For FR1,

- , when in the monitored cell there are measurement gaps configured for intra-frequency, inter-frequency or inter-RAT measurements, which are overlapping with some but not all occasions of the CSI-RS; and

- P = 1 when in the monitored cell there are no measurement gaps overlapping with any occasion of the CSI-RS.

For FR2,

- P = 1, when candidate beam detection RS is not overlapped with measurement gap and also not overlapped with SMTC occasion.

- when candidate beam detection RS is partially overlapped with measurement gap and candidate beam detection RS is not overlapped with SMTC occasion (TCSI-RS < MGRP)

- , when candidate beam detection RS is not overlapped with measurement gap and candidate beam detection RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod).

- P =Psharing factor, when candidate beam detection RS is not overlapped with measurement gap and candidate beam detection RS is fully overlapped with SMTC occasion (TCSI-RS = TSMTCperiod).

- ,, when candidate beam detection RS is partially overlapped with measurement gap and candidate beam detection RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and

- TSMTCperiod ≠ MGRP or

- TSMTCperiod = MGRP and TCSI-RS < 0.5 × TSMTCperiod

- , when candidate beam detection RS is partially overlapped with measurement gap and candidate beam detection RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and TSMTCperiod = MGRP and TCSI-RS = 0.5 × TSMTCperiod

- , when candidate beam detection RS is partially overlapped with measurement gap and candidate beam detection RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is partially or fully overlapped with measurement gap

- ,, when candidate beam detection RS is partially overlapped with measurement gap and candidate beam detection RS is fully overlapped with SMTC occasion (TCSI-RS = TSMTCperiod) and SMTC occasion is partially overlapped with measurement gap (TSMTCperiod < MGRP)

- Psharing factor = 1, if the candidate beam detection RS outside measurement gap is

- not overlapped with the SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol before each consecutive SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol after each consecutive SSB symbols indicated by *SSB-ToMeasure*, given that *SSB-ToMeasure* is configured, where the *SSB-ToMeasure* is the union set of *SSB-ToMeasure* from all the configured measurement objects merged on the same serving carrier, and;

- not overlapped with the RSSI symbols indicated by *ss-RSSI-Measurement* and 1 data symbol before each RSSI symbol indicated by *ss-RSSI-Measurement* and 1 data symbol after each RSSI symbol indicated by *ss-RSSI-Measurement*, given that *ss-RSSI-Measurement* is configured.

- Psharing factor = 3, otherwise.

where,

If the high layer in TS 38.331 [2] signaling of *smtc2* is present, TSMTCperiod follows *smtc2*; Otherwise TSMTCperiod follows *smtc1*. TSMTCperiod is the shortest SMTC period among all CCs in the same FR2 band, provided the SMTC offset of all CCs in FR2 have the same offset.

Note: The overlap between CSI-RS for CBD and SMTC means that CSI-RS for CBD is within the SMTC window duration.

Longer evaluation period would be expected if the combination of the CBD-RS resource, SMTC occasion and measurement gap configurations does not meet pervious conditions.

Longer evaluation period would be expected if the CSI-RS is on the same OFDM symbols with RLM, BFD, BM-RS, or other CBD-RS, according to the measurement restrictions defined in clause 8.18.6.3.

For either an FR1 or FR2 serving cell, longer evaluation period would be expected during the period Tidentify\_CGI when the UE is requested to decode an NR CGI.

For either an FR1 or FR2 serving cell, longer CBD evaluation period would be expected during the period Tidentify\_CGI,E-UTRAN when the UE is requested to decode an LTE CGI.

The values of MCBD used in Table 8.18.6.2-1 and Table 8.18.6.2-2 are defined as

- MCBD = 3, if the CSI-RS resource configured in the sets and is transmitted with Density = 3 and over the bandwidth ≥ 24 PRBs.

The values of PCBD used in Table 8.18.6.2-1 and Table 8.18.6.2-2 are defined as

For each CSI-RS resource in the sets and configured for PCell or PSCell in EN-DC or NE-DC or SA; or PCell in NR-DC

- PCBD = 1.

For each CSI-RS resource in the sets and configured for PSCell in NR-DC

- PCBD = 2 if UE configured for candidate beam detection on SCell, 1 otherwise.

For each CSI-RS resource in the sets and configured for a SCell

- PCBD = Z in EN-DC or NE-DC or SA.

- PCBD = 2\* Z in NR-DC.

Where Z is the number of band(s) on which UE is performing beam failure detection only for SCell

- PCBD is the number of band(s) on which UE is performing candidate beam detection only for SCell.

The values of PTRP defined in table 8.18.6.2-2 is defined as 2, if SSB/CSI-RS resource in the two sets and are overlapped, else it is 1.

**Table 8.18.6.2-1: Evaluation period TEvaluate\_CBD\_CSI-RS for FR1**

|  |  |
| --- | --- |
| **Configuration** | **TEvaluateC\_CBD\_CSI-RS (ms)** |
| non-DRX, DRX cycle ≤ 320ms | Max(25, Ceil(MCBD × P × PCBD) × TCSI-RS) |
| DRX cycle > 320ms | Ceil(MCBD × P × PCBD) × TDRX |
| Note: TCSI-RS is the periodicity of CSI-RS resource in the two sets and . TDRX is the DRX cycle length. | |

**Table 8.18.6.2-2: Evaluation period TEvaluate\_CBD\_CSI-RS for FR2**

|  |  |
| --- | --- |
| **Configuration** | **TEvaluate\_CBD\_CSI-RS (ms)** |
| non-DRX, DRX cycle ≤ 320ms | Max(25, Ceil(MCBD × P × N × PCBD × PTRP) × TCSI-RS) |
| DRX cycle > 320ms | Ceil(MCBD × P × N × PCBD × PTRP) × TDRX |
| Note: TCSI-RS is the periodicity of CSI-RS resource in the two sets and . TDRX is the DRX cycle length. | |

#### 8.18.6.3 Measurement restriction for CSI-RS based candidate beam detection

For both FR1 and FR2, when the CSI-RS for CBD measurement is in the same OFDM symbol as SSB for RLM, BFD, CBD or L1-RSRP measurement, UE is not required to receive CSI-RS for CBD measurement in the PRBs that overlap with an SSB.

For FR1, when the SSB for RLM, BFD, CBD or L1-RSRP measurement is within the active BWP and has same SCS than CSI-RS for CBD measurement, the UE shall be able to perform CSI-RS based CBD measurement without restrictions.

For FR1, when the SSB for RLM, BFD, CBD or L1-RSRP measurement is within the active BWP and has different SCS than CSI-RS for CBD measurement, the UE shall be able to perform CSI-RS based CBD measurement with restrictions according to its capabilities:

- If the UE supports *simultaneousRxDataSSB-DiffNumerology* the UE shall be able to perform CSI-RS based CBD measurement for without restrictions.

- If the UE does not support *simultaneousRxDataSSB-DiffNumerology*, UE is required to measure one of but not both CSI-RS for CBD measurement and SSB. Longer measurement period for CSI-RS based CBD measurement is expected, and no requirements are defined.

For FR1, when the CSI-RS for CBD measurement is in the same OFDM symbol as another CSI-RS for RLM, BFD, CBD or L1-RSRP measurement, UE shall be able to measure the CSI-RS for CBD measurement without any restriction.

For FR2, when the CSI-RS for CBD measurement on one CC is in the same OFDM symbol as SSB for RLM, BFD, CBD or L1-RSRP measurement on the same CC or different CCs in the same band, UE is required to measure one of but not both CSI-RS for CBD measurement and SSB. Longer evaluation period for CSI-RS based CBD measurement is expected, and no requirements are defined.

For FR2, when the CSI-RS for CBD measurement on one CC is in the same OFDM symbol as another CSI-RS for RLM, BFD, CBD or L1-RSRP measurement on the same CC or different CCs in the same band, UE is required to measure one of but not both CSI-RS for CBD measurement and the other CSI-RS. Longer evaluation period for CSI-RS based CBD measurement is expected, and no requirements are defined. When two CSI-RSs for CBD measurements are from different sets and , UE shall be able to measure both CSI-RSs for CBD measurements.

### 8.18.7 Requirements for TRP specific Beam Failure Recovery

#### 8.18.7.1 Introduction

For the UE provided with a configuration of PUCCH transmission with a link recovery request (LRR) as described in clause 9.2.4 in TS 38.213 [3], if beam recovery procedure is triggered for any of the TRPs, the UE shall transmit SR for UL resouce, followed by MAC CE providing beam index for the corresponding TRP whose radio link quality is worse than Qout,LR. The index, , provided in the TRP specific BFR MAC CE is provided by higher layer for a periodic CSI-RS configuration or for a SSB, as described in clause 5.17 of TS38.321 [7].

For the UE not provided with a configuration of PUCCH transmission with a link recovery request (LRR) as described in clause 9.2.4 in TS 38.213 [3], if beam recovery procedure is triggered for any of TRPs, the UE shall transmit preamble for UL-SCH resource application, followed by MAC CE providing one index for the corresponding TRP whose radio link quality is worse than Qout,LR, and the index for a periodic CSI-RS configuration or for a SSB provided by higher layer, as described in clause 5.17 of TS38.321 [7], if any, for a corresponding TRP.

#### 8.18.7.2 Requirement

Provided that UE is configured by *schedulingRequestID-BFR-r17* and/or *schedulingRequestID-BFR2-r17*for BFR set 1 (i.e., TRP1) and BFR set 2 (i.e., TRP2) respectively*,* a configuration for LRR in a PUCCH transmission, after BFR is triggered on any of the TRPs as described in clause 5.17 of TS38.321 [7], UE shall be capable of transmit PUCCH with a LRR within a period of T on any of the TRPs where BFR running.Where:

- T = T1 x Ceil((T2+D) /T1) in which T1, T2 and D are defined as

- T1 is equal to the periodicity of PUCCH configured with *schedulingRequestID-BFR-r17 for* BFR set 1 schedulingRequestID-BFR2-r17 for BFR set 2..

- T2 = TEvaluate\_CBD is the evaluation period specified in clause 8.18.5 or 8.18.6 for SSB or CSI-RS based candidate beam detection, that is TEvaluate\_CBD\_SSB or TEvaluate\_CBD\_CSI-RS, depending on the applicable reference signal configured for candidate beam detection.

- D = [2ms] is the UE Processing time.

### 8.18.8 Scheduling availability of UE during TRP specific beam failure detection

Scheduling availability restrictions when the UE is performing TRP specific beam failure detection are described in the following clauses.

#### 8.18.8.1 Scheduling availability of UE performing TRP specific beam failure detection with a same subcarrier spacing as PDSCH/PDCCH on FR1

There are no scheduling restrictions due to TRP specific beam failure detection performed on SSB and CSI-RS configured for BFD with the same SCS as PDSCH or PDCCH in FR1.

#### 8.18.8.2 Scheduling availability of UE performing TRP specific beam failure detection with a different subcarrier spacing than PDSCH/PDCCH on FR1

For UEs which support *simultaneousRxDataSSB-DiffNumerology* [14] there are no restrictions on scheduling availability due to TRP specific beam failure detection when SSB is configured as BFD. For UEs which do not support *simultaneousRxDataSSB-DiffNumerology* [14] the following restrictions apply due to TRP specific beam failure detection when SSB is configured as BFD.

- The UE is not expected to transmit PUCCH, PUSCH or SRS or receive PDCCH, PDSCH or CSI-RS for tracking or CSI-RS for CQI on SSB symbols to be measured for TRP specific beam failure detection.

When intra-band carrier aggregation in FR1 is configured, the scheduling restrictions on FR1 serving PCell or PSCell apply to all serving cells in the same band on the symbols that fully or partially overlap with restricted symbols. When inter-band carrier aggregation within FR1 is configured, there are no scheduling restrictions on FR1 serving cell(s) configured in other bands than the bands in which PCell or PSCell is configured.

#### 8.18.8.3 Scheduling availability of UE performing TRP specific beam failure detection on FR2

The following scheduling restriction applies due to TRP specific beam failure detection.

- For the case where no RSs are provided for BFD, or when CSI-RS is configured for BFD is explicitly configured and is type-D QCLed with active TCI state for PDCCH or PDSCH, and the CSI-RS is not in a CSI-RS resource set with repetition ON

- There are no scheduling restrictions due to TRP specific beam failure detection performed based on the CSI-RS.

- Otherwise

- The UE is not expected to transmit PUCCH, PUSCH or SRS or receive PDCCH, PDSCH or CSI-RS for tracking or CSI-RS for CQI on BFD-RS resource symbols to be measured for TRP specific beam failure detection.

When intra-band carrier aggregation in FR2 is performed, the scheduling restrictions on FR2 serving PCell or PSCell apply to all serving cells in the same band on the symbols that fully or partially overlap with restricted symbols.

When inter-band carrier aggregation in FR2 is performed, there are no scheduling restrictions on FR2 serving cells in the bands due to beam failure detection performed on FR2 serving cell(s) in different band(s), provided that UE is capable of independent beam management on this FR2 band pair. Additionally, there is no scheduling restriction if the UE is configured with different numerology between SSB on one FR2 band and data on the other FR2 band provided the UE is configured for IBM operation for the band pair.

For FR2, if following conditions are met,

- UE has been notified about system information update through paging,

- The gap between UE’s reception of PDCCH that UE monitors in the Type2-PDCCH CSS set and that notifies system information update, and the PDCCH that UE monitors in the Type0-PDCCH CSS set, is greater than 2 slots,

For the SSB and CORESET for RMSI scheduling multiplexing patterns 3, UE is expected to receive the PDCCH that UE monitors in the Type0-PDCCH CSS set, and the corresponding PDSCH, on SSB symbols to be measured for BFD mesurement; and

For the SSB and CORESET for RMSI scheduling multiplexing patterns 2, UE is expected to receive PDSCH that corresponds to the PDCCH that UE monitors in the Type0-PDCCH CSS set, on SSB symbols to be measured for BFD mesurement.

#### 8.18.8.4 Scheduling availability of UE performing TRP specific beam failure detection on FR1 or FR2 in case of FR1-FR2 inter-band CA and NR DC

There are no scheduling restrictions on FR1 serving cell(s) due to TRP specific beam failure detection performed on FR2 serving PCell and/or PSCell.

There are no scheduling restrictions on FR2 serving cell(s) due to TRP specific beam failure detection performed on FR1 serving PCell and/or PSCell.

### 8.18.9 Scheduling availability of UE during TRP specific candidate beam detection

Scheduling availability restrictions when the UE is performing L1-RSRP measurement for TRP specific candidate beam detection are described in the following clauses.

#### 8.18.9.1 Scheduling availability of UE performing L1-RSRP measurement with a same subcarrier spacing as PDSCH/PDCCH on FR1

There are no scheduling restrictions due to L1-RSRP measurement performed on SSB and CSI-RS configured as TRP specific link recovery detection resource with the same SCS as PDSCH or PDCCH in FR1.

#### 8.18.9.2 Scheduling availability of UE performing L1-RSRP measurement with a different subcarrier spacing than PDSCH/PDCCH on FR1

For UEs which support *simultaneousRxDataSSB-DiffNumerology* [14] there are no restrictions on scheduling availability due to L1-RSRP measurement based on SSB as TRP specific link recovery detection resource. For UEs which do not support *simultaneousRxDataSSB-DiffNumerology* [14] the following restrictions apply due to L1-RSRP measurement based on SSB configured as TRP specific link recovery detection resource.

- The UE is not expected to transmit PUCCH, PUSCH or SRS or receive PDCCH, PDSCH, TRS, CSI-RS for tracking or CSI-RS for CQI on SSB symbols to be measured for L1-RSRP.

When intra-band carrier aggregation in FR1 is configured, the scheduling restrictions on one serving cell apply to all other serving cells in the same band on the symbols that fully or partially overlap with the restricted symbols. When inter-band carrier aggregation within FR1 is configured, there are no scheduling restrictions on FR1 serving cell(s) configured in other bands.

#### 8.18.9.3 Scheduling availability of UE performing L1-RSRP measurement on FR2

The following scheduling restriction applies due to TRP specific candidate beam detection

- The UE is not expected to transmit PUCCH, PUSCH or SRS or receive PDCCH, PDSCH, CSI-RS for tracking or CSI-RS for CQI on reference symbols to be measured for TRP specific candidate beam detection.

When intra-band carrier aggregation in FR2 is configured, the scheduling restrictions on to one serving cell apply to all serving cells in the same band on the symbols that fully or partially overlap with restricted symbols.

When inter-band carrier aggregation in FR2 is performed, there are no scheduling restrictions on FR2 serving cells in the bands due to candidate beam detection performed on FR2 serving cell(s) in different band(s), provided that the FR2 serving cell(s) and the FR2 serving cell(s) for candidate beam detection are in a FR2 band pair and UE is capable of independent beam management on this FR2 band pair. Additionally, there is no scheduling restriction if the UE is configured with different numerology between SSB on one FR2 band and data on the other FR2 band provided the UE is configured for IBM operation for the band pair.

For FR2, if following conditions are met,

- UE has been notified about system information update through paging,

- The gap between UE’s reception of PDCCH that UE monitors in the Type2-PDCCH CSS set and that notifies system information update, and the PDCCH that UE monitors in the Type0-PDCCH CSS set, is greater than 2 slots,

For the SSB and CORESET for RMSI scheduling multiplexing patterns 3, UE is expected to receive the PDCCH that UE monitors in the Type0-PDCCH CSS set, and the corresponding PDSCH, on SSB symbols to be measured for CBD mesurement; and

For the SSB and CORESET for RMSI scheduling multiplexing patterns 2, UE is expected to receive PDSCH that corresponds to the PDCCH that UE monitors in the Type0-PDCCH CSS set, on SSB symbols to be measured for CBD mesurement.

#### 8.18.9.4 Scheduling availability of UE performing L1-RSRP measurement on FR1 or FR2 in case of FR1-FR2 inter-band CA and NR-DC

There are no scheduling restrictions on FR1 serving cell(s) due to L1-RSRP measurement performed on FR2 serving cell(s).

There are no scheduling restrictions on FR2 serving cell(s) due to L1-RSRP measurement performed on FR1 serving cell(s).

## 8.19 Pre-configured measurement gap activation/deactivation delay

### 8.19.1 Introduction

The requirements in this clause apply for a UE configured with PCell or any activated SCell in standalone NR.

UE shall complete the activation/deactivation of pre-configured measurement gap within the delay defined in this clause.

### 8.19.2 Pre-configured measurement gap activation/deactivation upon DCI/timer-based BWP switch

#### 8.19.2.1 Activation/deactivation upon DCI/timer-based BWP switch delay on a single CC

The requirements in this clause only apply to the case that the DCI/timer-based BWP switch is performed on a single CC with more than one BWP configurations configured on the CC.

When BWP switch occurs, which results in status change of pre-configured measurement gap according to clause 9.1.7, UE shall be able to finish pre-configured activation or deactivation within 5 ms after the completion of the active BWP switch. The active BWP switch delay for single CC is defined in clause 8.6.2. Activation/deactivation of Pre-MG takes effect from the first complete MG occasion after the activation and deactivation delay. If the end of activation/deactivation of Pre-MG is within a gap occasion, the Pre-MG status shall not be changed immediately. Instead, the Pre-MG status shall be changed prior to the next gap occasion.

### 8.19.3 Pre-configured measurement gap activation/deactivation upon SCell activation/deactivation

The requirements in this clause apply when one SCell or multiple SCells are activated/deactivated.

When one SCell or multiple SCells are activated/deactivated, which results in status change of pre-configured measurement gap according to clause 9.1.7, UE shall be able to finish pre-configured activation or deactivation within 5 ms after the completion of SCell(s) activation/deactivation. The SCell(s) activation/deactivation delay for is defined in clause 8.3. Activation/deactivation of Pre-MG takes effect from the first complete MG occasion after the SCell(s) activation/deactivation delay. If the end of activation/deactivation of Pre-MG is within a gap occasion, the Pre-MG status shall not be changed immediately. Instead, the Pre-MG status shall be changed prior to the next gap occasion.

### 8.19.4 Pre-configured measurement gap activation/deactivation upon RRC reconfiguration

The requirements in this clause apply when UE capable of autonomous activation/deactivation mechanism receives RRC reconfiguration to:

- Add/remove of any measurement object(s), or

- Add/release/change a SCell under CA, or

- Switch active BWP or update parameters of its active BWP.

If the aforementioned RRC reconfiguration results in status change of pre-configured measurement gap according to clause 9.1.7, UE shall be able to finish pre-configured activation or deactivation within 5 ms after RRC processing delay specified in [2]. If the end of activation/deactivation of Pre-MG is within a gap occasion, the Pre-MG status shall not be changed immediately. Instead, the Pre-MG status shall be changed prior to the next gap occasion.

# 9 Measurement Procedure

## 9.1 General measurement requirement

### 9.1.1 Introduction

This clause contains general requirements on the UE regarding measurement reporting in RRC\_CONNECTED state. The requirements are split in intra-frequency, inter-frequency, inter-RAT E-UTRAN FDD, inter-RAT E-UTRAN TDD, and L1-RSRP measurements requirements. These measurements may be used by the NG-RAN. The measurement quantities are defined in TS38.215 [4], the measurement model is defined in TS38.300 [10], TS37.340 [17] and measurement accuracies are specified in clause 10. Control of measurement reporting is specified in TS 38.331 [2].

In the requirements of clause 9, the exceptions for side conditions apply as follows:

- for the UE capable of CA but not configured with any SCell, the applicable exceptions for side conditions are specified in Annex B, clause B.3.2.1 for UE supporting CA in FR1, and clause B.3.2.3 for UE supporting CA in FR2, respectively;

- for the UE capable of CA and configured with at least one SCell, the applicable exceptions for side conditions are specified in Annex B, clause B.3.2.2 for UE configured with CA in FR1, and clause B.3.2.4 for UE supporting CA in FR2, respectively;

- for the UE capable of SUL but not configured with SUL, the applicable exceptions for side conditions are specified in Annex B, clause B.3.4.1 for UE supporting SUL in FR1;

- for the UE capable of SUL and configured with at least one SUL, the applicable exceptions for side conditions are specified in Annex B, clause B.3.4.2 for UE configured with SUL in FR1.

### 9.1.2 Measurement gap

If the UE requires measurement gaps to identify and measure intra-frequency cells and/or inter-frequency cells and/or inter-RAT E-UTRAN cells, and the UE does not support independent measurement gap patterns for different frequency ranges as specified in Table 5.1-1 in [18, 19, 20], in order for the requirements in the following clauses to apply the network must provide a single per-UE measurement gap pattern for concurrent monitoring of all frequency layers.

If the UE requires measurement gaps to identify and measure intra-frequency cells and/or inter-frequency cells and/or inter-RAT E-UTRAN cells, and the UE supports independent measurement gap patterns for different frequency ranges as specified in Table 5.1-1 in [18, 19, 20], in order for the requirements in the following clauses to apply the network must provide either per-FR measurement gap patterns for frequency range where UE requires per-FR measurement gap for concurrent monitoring of all frequency layers of each frequency range independently, or a single per-UE measurement gap pattern for concurrent monitoring of all frequency layers of all frequency ranges.

If the UE is configured via LPP [34] to measure PRS for any RSTD, PRS-RSRP, and UE Rx-Tx time difference measurement defined in TS 38.215 [4], in order for the requirements in clauses 9.9.2, 9.9.3, and 9.9.4 to apply, the network must provide

- a single per-UE measurement gap pattern for concurrent monitoring of all positioning frequency layers and intra-frequency, inter-frequency and/or inter-RAT frequency layers of all frequency ranges, or

- for measurement gap patterns other than #24 and #25, if UE supports independent measurement gap patterns for different frequency ranges for PRS measurement, per-FR measurement gap pattern for the frequency range for concurrent monitoring of all positioning frequency layers and intra-frequency, inter-frequency cells and/or inter-RAT frequency layers in the corresponding frequency range.

During the per-UE measurement gaps the UE:

- is not required to conduct reception/transmission from/to the corresponding E-UTRAN PCell, E-UTRAN SCell(s) and NR serving cells for E-UTRA-NR dual connectivity except the reception of signals used for RRM measurement(s) and the signals used for random access procedure according to TS38.321 [7].

- is not required to conduct reception/transmission from/to the corresponding NR serving cells for SA (with single carrier or CA configured) except the reception of signals used for RRM measurement(s), PRS measurement(s) and the signals used for random access procedure according to [7].

- is not required to conduct reception/transmission from/to the corresponding PCell, SCell(s) and E-UTRAN serving cells for NR-E-UTRA dual connectivity except the reception of signals used for RRM measurement(s), PRS measurement(s) and the signals used for random access procedure according to [7].

- is not required to conduct reception/transmission from/to the corresponding NR serving cells for NR-DC except the reception of signals used for RRM measurement(s), PRS measurement(s) and the signals used for random access procedure according to [7].

During the per-FR measurement gaps the UE:

- is not required to conduct reception/transmission from/to the corresponding E-UTRAN PCell, E-UTRAN SCell(s) and NR serving cells in the corresponding frequency range for E-UTRA-NR dual connectivity except the reception of signals used for RRM measurement(s) and the signals used for random access procedure according to TS38.321 [7].

- is not required to conduct reception/transmission from/to the corresponding NR serving cells in the corresponding frequency range for SA (with single carrier or CA configured) except the reception of signals used for RRM measurement(s), PRS measurement(s) and the signals used for random access procedure according to TS38.321 [7].

- is not required to conduct reception/transmission from/to the corresponding PCell, SCell(s) and E-UTRAN serving cells in the corresponding frequency range for NR-E-UTRA dual connectivity except the reception of signals used for RRM measurement(s), PRS measurement(s) and the signals used for random access procedure according to TS38.321 [7].

- is not required to conduct reception/transmission from/to the corresponding NR serving cells in the corresponding frequency range for NR-DC except the reception of signals used for RRM measurement(s), PRS measurement(s) and the signals used for random access procedure according to TS38.321 [7].

UEs shall support the measurement gap patterns listed in Table 9.1.2-1 based on the applicability specified in table 9.1.2-2 and 9.1.2-3. UE determines measurement gap timing based on gap offset configuration and measurement gap timing advance configuration provided by higher layer signalling as specified in TS 38.331 [2] and TS 36.331 [16].

Table 9.1.2-1: Gap Pattern Configurations

|  |  |  |
| --- | --- | --- |
| Gap Pattern Id | Measurement Gap Length (MGL, ms) | Measurement Gap Repetition Period  (MGRP, ms) |
| 0 | 6 | 40 |
| 1 | 6 | 80 |
| 2 | 3 | 40 |
| 3 | 3 | 80 |
| 4 | 6 | 20 |
| 5 | 6 | 160 |
| 6 | 4 | 20 |
| 7 | 4 | 40 |
| 8 | 4 | 80 |
| 9 | 4 | 160 |
| 10 | 3 | 20 |
| 11 | 3 | 160 |
| 12 | 5.5 | 20 |
| 13 | 5.5 | 40 |
| 14 | 5.5 | 80 |
| 15 | 5.5 | 160 |
| 16 | 3.5 | 20 |
| 17 | 3.5 | 40 |
| 18 | 3.5 | 80 |
| 19 | 3.5 | 160 |
| 20 | 1.5 | 20 |
| 21 | 1.5 | 40 |
| 22 | 1.5 | 80 |
| 23 | 1.5 | 160 |
| 24 | 10 | 80 |
| 25 | 20 | 160 |

Table 9.1.2-2: Applicability for Gap Pattern Configurations supported by the E-UTRA-NR dual connectivity UE or NR-E-UTRA dual connectivity UE

|  |  |  |  |
| --- | --- | --- | --- |
| Measurement gap pattern configuration | Serving cell | Measurement PurposeNote 5 | Applicable Gap Pattern Id |
| Per-UE | E-UTRA + FR1, or | non-NR RAT Note1,2 | 0,1,2,3 |
| Measurement gap | E-UTRA + FR2, or E-UTRA + FR1 + FR2 | FR1 and/or FR2 Note 7 | 0-11, 24, 25 |
|  |  | non-NR RATNote1,2 and FR1 and/or FR2 Note 7 | 0, 1, 2, 3, 4, 6, 7, 8,10, 24 |
|  | E-UTRA and, FR1 if configured | non-NR RAT Note1,2 | 0,1,2,3 |
|  | FR2 if configured |  | No gap |
|  | E-UTRA and, FR1 if configured | FR1 only | 0-11 |
|  | FR2 if configured |  | No gap |
|  | E-UTRA and, FR1 if configured | FR2 only | No gap |
| Per-FR | FR2 if configured |  | 12-23 |
| measurement gap | E-UTRA and, FR1 if configured | non-NR RAT Note1,2 and FR1 | 0, 1, 2, 3, 4, 6, 7, 8,10 |
|  | FR2 if configured |  | No gap |
|  | E-UTRA and, FR1 if configured | FR1 and FR2 | 0-11 |
|  | FR2 if configured |  | 12-23 |
|  | E-UTRA and, FR1 if configured | non-NR RAT Note1,2 and FR2 | 0, 1, 2, 3, 4, 6, 7, 8,10 |
|  | FR2 if configured |  | 12-23 |
|  | E-UTRA and, FR1 if configured | non-NR RAT Note1,2 and FR1 and FR2 | 0, 1, 2, 3, 4, 6, 7, 8,10 |
|  | FR2 if configured |  | 12-23 |
| Note: In E-UTRA-NR dual connectivity mode, if GSM or UTRA TDD or UTRA FDD inter-RAT frequency layer is configured to be monitored, only measurement gap pattern #0 and #1 can be used for per-FR gap in E-UTRA and FR1 if configured, or for per-UE gap. In NR-E-UTRA dual connectivity mode, if UTRA FDD inter-RAT frequency layer is configured to be monitored for SRVCC, only measurement gap pattern #0 and #1 can be used for per-FR gap in E-UTRA and FR1 if configured, or for per-UE gap.  NOTE 1: In E-UTRA-NR dual connectivity mode, non-NR RAT includes E-UTRA, UTRA and/or GSM. In NR-E-UTRA dual connectivity mode, non-NR RAT means E-UTRA, and UTRA for SRVCC.  NOTE 2: Void  NOTE 3: When E-UTRA inter-frequency RSTD measurements are configured and the UE requires measurement gaps for performing such measurements, only Gap Pattern #0 can be used.  NOTE 4: For UE supporting *supportedGapPattern-NRonly-NEDC* or *measGapPatterns-NRonly-ENDC-r16* but not supporting *supportedGapPattern* for the corresponding gap patterns among GP2-11, the corresponding gap patterns are not applicable to measurement of non-NR RATs as defined in NOTE 1.  NOTE 5: Inclusion of positioning measurements: Measurement purpose which includes E-UTRA measurements includes also E-UTRA RSRP and E-UTRA RSRQ measurements for E-CID.  NOTE 6: Measurement gap patterns #24 and #25 can be requested [2] only when the UE is configured at least with any of RSTD, UE Rx-Tx, or PRS-RSRP measurements requiring such gaps and can only be used during the corresponding positioning measurement period  NOTE 7: Inclusion of positioning measurements for measurement gaps: Measurement purpose which includes any of FR1 and FR2 measurements includes also RSTD, UE Rx-Tx, and PRS-RSRP measurements. | | | |

In E-UTRA-NR dual connectivity mode,

- if per-UE measurement gap is configured with MG timing advance of TMG ms, the measurement gap starts at time TMG ms advanced to the end of the latest E-UTRA subframe occurring immediately before the configured measurement gap among MCG serving cells subframes.

- if per-FR measurement gap for FR1 is configured with MG timing advance of TMG ms, the measurement gap for FR1 starts at time TMG ms advanced to the end of the latest E-UTRA subframe occurring immediately before the configured measurement gap among MCG serving cells subframes.

- if per-FR measurement gap for FR2 is configured with MG timing advance of TMG ms, the measurement gap for FR2 starts at time TMG ms advanced to the end of the latest NR subframe occurring immediately before the configured measurement gap among SCG serving cells subframes in FR2.

In NR-E-UTRA dual connectivity mode,

- if per-UE measurement gap is configured with MG timing advance of TMG ms, the measurement gap starts at time TMG ms advanced to the end of the latest NR subframe occurring immediately before the configured measurement gap among MCG serving cells subframes.

- if per-FR measurement gap for FR1 is configured with MG timing advance of TMG ms and UE has NR serving cell in FR1, the measurement gap for FR1 starts at time TMG ms advanced to the end of the latest NR subframe occurring immediately before the configured measurement gap among MCG serving cells subframes in FR1.

- if per-FR measurement gap for FR1 is configured with MG timing advance of TMG ms and UE doesn’t have NR serving cell in FR1, the measurement gap for FR1 starts at time TMG ms advanced to the end of the latest E-UTRA subframe occurring immediately before the configured measurement gap among SCG serving cells subframes.

- if per-FR measurement gap for FR2 is configured with MG timing advance of TMG ms, the measurement gap for FR2 starts at time TMG ms advanced to the end of the latest NR subframe occurring immediately before the configured measurement gap among MCG serving cells subframes in FR2.

In NR-NR dual connectivity mode,

- If per-UE measurement gap is configured with MG timing advance of TMG ms, the measurement gap starts at time TMG ms advanced to the end of the latest MCG subframe occurring immediately before the configured measurement gap among MCG serving cells subframes.

- If per-FR measurement gap for FR1 is configured with MG timing advance of TMG ms, the measurement gap for FR1 starts at time TMG ms advanced to the end of the latest MCG subframe occurring immediately before the configured measurement gap among MCG serving cells subframes.

- If per-FR measurement gap for FR2 is configured with MG timing advance of TMG ms, the measurement gap for FR2 starts at time TMG ms advanced to the end of the latest SCG subframe occurring immediately before the configured measurement gap among SCG serving cells subframes in FR2.

TMG is the MG timing advance value provided in *mgta* according to TS38.331 [2].

In determining the measurement gap starting point, UE shall use the DL timing of the latest E-UTRA or NR subframe occurring immediately before the configured measurement gap among E-UTRA or NR serving cells.

For per-FR measurement gap capable UE configured with E-UTRA-NR dual connectivity or NR-E-UTRA dual connectivity, when serving cells are in E-UTRA and FR1, measurement objects are in both E-UTRA/FR1 and FR2,

- If MN indicates UE that the measurement gap from MN applies to E-UTRA/FR1/FR2 serving cells, UE fulfils the per-UE measurement requirements for both E-UTRA/FR1 and FR2 measurement objects based on the measurement gap pattern configured by MN;

- If MN indicates UE that the measurement gap from MN applies to only LTE/FR1 serving cell(s),

- UE fulfils the measurement requirements for FR1/LTE measurement objects based on the configured measurement gap pattern;

- UE fulfils the requirements for FR2 measurement objects based on effective MGRP=20ms;

For per-FR measurement gap capable configured with E-UTRA-NR dual connectivity, NR-E-UTRA dual connectivity or NR-NR dual connectivity, when serving cells are in E-UTRA, FR1 and FR2, or in E-UTRA and FR2, or in FR1 and FR2, measurement objects are in both E-UTRA /FR1 and FR2,

- If MN indicates UE that the measurement gap from MN applies to E-UTRA/FR1/FR2 serving cells, UE fulfils the per-UE measurement requirements for both E-UTRA/FR1 and FR2 measurement objects based on the measurement gap pattern configured by MN.

Table 9.1.2-3: Applicability for Gap Pattern Configurations supported by the UE with NR standalone operation (with single carrier, NR CA and NR-DC configuration)

|  |  |  |  |
| --- | --- | --- | --- |
| Measurement gap pattern configuration | Serving cell | Measurement Purpose NOTE 2 | Applicable Gap Pattern Id |
|  | FR1 NOTE5, or  FR1 + FR2 | non-NR RAT NOTE3,6 | 0,1,2,3 |
|  |  | FR1 and/or FR2 NOTE 9 | 0-11, 24, 25 |
|  |  | non-NR RATand FR1 and/or FR2 NOTE3,6,9 | 0, 1, 2, 3, 4, 6, 7, 8,10, 24 |
| Per-UE measurement | FR2 NOTE5 | non-NR RATonly  NOTE3,6 | 0,1,2,3 |
| gap |  | FR1 only NOTE 9 | 0-11, 24, 25 |
|  |  | FR1 and FR2 NOTE 9 | 0-11, 24, 25 |
|  |  | non-NR RATand FR1 and/or FR2 NOTE3,6,9 | 0, 1, 2, 3, 4, 6, 7, 8,10, 24 |
|  |  | FR2 only NOTE 9 | 12-23 |
|  | FR1 if configured | non-NR RATonly | 0,1,2,3 |
|  | FR2 if configured | NOTE3,6 | No gap |
|  | FR1 if configured | FR1 only | 0-11 |
|  | FR2 if configured |  | No gap |
|  | FR1 if configured | FR2 only | No gap |
| Per-FR | FR2 if configured |  | 12-23 |
| measurement | FR1 if configured | non-NR RATand | 0, 1, 2, 3, 4, 6, 7, 8,10 |
| gap | FR2 if configured | FR1 NOTE3,6 | No gap |
|  | FR1 if configured | FR1 and FR2 | 0-11 |
|  | FR2 if configured |  | 12-23 |
|  | FR1 if configured | non-NR RATand | 0, 1, 2, 3, 4, 6, 7, 8,10 |
|  | FR2 if configured | FR2 NOTE3,6 | 12-23 |
|  | FR1 if configured | non-NR RATand | 0, 1, 2, 3, 4, 6, 7, 8,10 |
|  | FR2 if configured | FR1 and FR2 NOTE3,6 | 12-23 |
| NOTE 1: When E-UTRA inter-RAT RSTD measurements are configured and the UE requires measurement gaps for performing such measurements, only Gap Pattern #0 can be used.  NOTE 2: Measurement purpose which includes E-UTRA measurements includes also inter-RAT E-UTRA RSRP and RSRQ measurements for E-CID; measurement purpose which includes E-UTRA measurements includes also E-UTRA RSRP and E-UTRA RSRQ measurements for E-CID.  NOTE 3: Void  NOTE4: If per-UE measurement gap is configured with MG timing advance of TMG ms, the measurement gap starts at time TMG ms advanced to the end of the latest subframe occurring immediately before the configured measurement gap among all serving cells subframes.  If per-FR measurement gap for FR1 is configured with MG timing advance of TMG ms, the measurement gap for FR1 starts at time TMG ms advanced to the end of the latest subframe occurring immediately before the configured measurement gap among serving cells subframes in FR1.  If per-FR measurement gap for FR2 is configured with MG timing advance of TMG ms, the measurement gap for FR2 starts at time TMG ms advanced to the end of the latest subframe occurring immediately before the configured measurement gap among serving cells subframes in FR2.  TMG is the MG timing advance value provided in *mgta* according to [2].  In determining the measurement gap starting point, UE shall use the DL timing of the latest subframe occurring immediately before the configured measurement gap among serving cells.  NOTE 5: NR-DC in Rel-15 only includes the scenarios where all serving cells in MCG in FR1 and all serving cells in SCG in FR2.  NOTE 6: In NR single carrier, NR CA, and NR-DC mode, non-NR RAT means E-UTRA, and UTRA for SRVCC. In NR single carrier, NR CA, and NR-DC mode, if UTRA FDD inter-RAT frequency layer is configured to be monitored for SRVCC, only measurement gap pattern #0 and #1 can be used for per-FR gap in E-UTRA and FR1 if configured, or for per-UE gap.  NOTE 7: For UE only supporting *supportedGapPattern-NRonly* for any gap patterns among GP2-11, the corresponding gap patterns are not applicable to measurement of non-NR RATs as defined in NOTE 6.  NOTE 8: Measurement gap patterns #24 and #25 can be requested [2] only when the UE is configured with any of RSTD, UE Rx-Tx, or PRS-RSRP measurements requiring such gaps and can only be used during the corresponding positioning measurement period.  NOTE 9: Inclusion of positioning measurements for measurement gaps: Measurement purpose which includes any of FR1 and FR2 measurements includes also RSTD, UE Rx-Tx, and PRS-RSRP measurements. | | | |

For per-FR measurement gap capable UE in NR standalone operation (with single carrier, NR CA and NR-DC configuration), for per-FR gap based measurement, when there is no serving cell in a particular FR, where measurement objects are configured, regardless if explicit per-FR measurement gap is configured in this FR, the effective MGRP in this FR is used to determine requirements;

- 20 ms for FR2 NR measurements

- 40 ms for FR1 NR measurements

- 40 ms for LTE measurements

- 40 ms for FR1+LTE measurements

For per-FR measurement gap capable UE in NR standalone operation (with single carrier, NR CA and NR-DC configuration), when serving cells are in FR1 or FR2, measurement objects are in both E-UTRA /FR1 and FR2,

- If MN indicates UE that the measurement gap from MN applies to E-UTRA/FR1/FR2 serving cells, UE fulfils the per-UE measurement requirements for both E-UTRA/FR1 and FR2 measurement objects based on the measurement gap pattern configured by MN;

If measurement gap is configured in one FR but measurement object is not configured in the FR, the scheduling opportunity in the FR depends on the configured measurement gap pattern.

For single carrier or CA with aligned frame boundaries,

For E-UTRA-NR dual connectivity (with NR single carrier, NR CA configuration), if UE is not capable of per-FR-gap, total interruption time on SCG during MGL is defined only when MGL(N) = 20ms, 10ms, 6ms, 4ms and 3ms. And if UE is capable of per-FR-gap, total interruption time on FR1 serving cells in SCG during MGL is defined only when MGL(N) = 20ms, 10ms, 6ms, 4ms and 3ms, and total interruption time on FR2 serving cells in SCG during MGL is defined only when MGL(N) = 20ms, 10ms, 5.5ms, 3.5ms and 1.5ms.

For NR standalone operation (with single carrier, NR CA and NR-DC configuration), if UE is not capable of per-FR-gap, total interruption time on a serving cell during MGL is defined when MGL(N) = 20ms, 10ms, 6ms, 5.5ms, 4ms, 3.5ms, 3ms, and 1.5ms. And if UE is capable of per-FR-gap, total interruption time on FR1 serving cells during MGL is defined only when MGL(N) = 20ms, 10ms, 6ms, 4ms, and 3ms, and total interruption time on FR2 serving cells during MGL is defined only when MGL(N) = 20ms, 10ms, 5.5ms, 3.5ms, and 1.5ms.

For NR-E-UTRA dual connectivity (with NR single carrier, NR CA configuration), if UE is not capable of per-FR-gap, total interruption time on MCG during MGL is defined only when MGL(N) = 20ms, 10ms, 6ms, 4ms, and 3ms. And if UE is capable of per-FR-gap, total interruption time on FR1 serving cells in MCG during MGL is defined only when MGL(N) = 20ms, 10ms, 6ms, 4ms, and 3ms, and total interruption time on FR2 serving cells in MCG during MGL is defined only when MGL(N) = 20ms, 10ms, 5.5ms, 3.5ms, and 1.5ms.

For CA with non-aligned frame boundaries,

- The total interruption time on an SCC is the same as the case CA with aligned frame boundaries, if no SCC slots are partially overlapped with the measurement gap.

- The total interruption time on an SCC will be additionally extended by one SCC slot, if there exist SCC slots partially overlapped with the measurement gap.



(a) Measurement gap with MGL = N(ms) with MG timing advance of 0ms for all serving cells in synchronous EN-DC, NR standalone operation (with single carrier, NR CA and synchronous NR-DC configuration) and synchronous NE-DC, and for serving cells in MCG in NR standalone operation (with asynchronous NR-DC configuration)



(b) Measurement gap with MGL = N(ms) with MG timing advance of 0.5ms for all serving cells in synchronous EN-DC, NR standalone operation (with single carrier, NR CA and synchronous NR-DC configuration) and synchronous NE-DC, and for serving cells in MCG in NR standalone operation (with asynchronous NR-DC configuration)



(c) Measurement gap with MGL = N(ms) with MG timing advance of 0ms for all serving cells in asynchronous EN-DC and asynchronous NE-DC, and for serving cells in SCG in NR standalone operation (with asynchronous NR-DC configuration)



(d) Measurement gap with MGL = N(ms) with MG timing advance of 0.5ms for all serving cells in asynchronous EN-DC and asynchronous NE-DC, and for serving cells in SCG in NR standalone operation (with asynchronous NR-DC configuration)

Figure 9.1.2-1: Measurement GAP and total interruption time on serving cells for EN-DC, NR standalone operation (with single carrier, NR CA and NR-DC configuration) and NE-DC

The corresponding total number of interrupted slots on serving cells is listed in Table 9.1.2-4 for all serving cells in synchronous EN-DC, NR standalone (with single carrier, NR CA and synchronous NR-DC configuration) and NE-DC, and for serving cells in MCG in NR standalone operation (with asynchronous NR-DC configuration). The corresponding total number of interrupted slots on serving cells is listed in Table 9.1.2-4a for asynchronous EN-DC, and for serving cells in SCG in NR standalone operation (with asynchronous NR-DC configuration).

Table 9.1.2-4: Total number of interrupted slots on all serving cells during MGL for Synchronous EN-DC, NR standalone operation (with single carrier, NR CA and synchronous NR-DC configuration) and NE-DC, and on all serving cells in MCG for NR standalone operation (with asynchronous NR-DC configuration) with per-UE measurement gap or per-FR measurement gap for FR1

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR | Total number of interrupted slots on serving cells | | | | | | | | | |
| SCS | When MG timing advance of 0ms is applied | | | | | When MG timing advance of 0.5ms is applied | | | | |
| (kHz) | MGL=20ms | MGL=10ms | MGL=6ms | MGL=4ms | MGL=3ms | MGL=20ms | MGL=10ms | MGL=6ms | MGL=4ms | MGL=3ms |
| 15 | 20 | 10 | 6 | 4 | 3 | 21Note3 | 11Note3 | 7Note3 | 5Note3 | 4Note3 |
| 30 | 40 | 20 | 12 | 8 | 6 | 40 | 20 | 12 | 8 | 6 |
| 60 | 80 | 40 | 24 | 16 | 12 | 80 | 40 | 24 | 16 | 12 |
| 120 | 160 | 80 | 48 | 32 | 24 | 160 | 80 | 48 | 32 | 24 |
| 480 Note4 | 640 | 320 | 192 | 128 | 96 | 640 | 320 | 192 | 128 | 96 |
| 480 Note5 | 641 | 321 | 193 | 129 | 97 | 641 | 321 | 193 | 129 | 97 |
| 960 Note4 | 1280 | 640 | 384 | 256 | 192 | 1280 | 640 | 384 | 256 | 192 |
| 960 Note5 | 1281 | 641 | 385 | 257 | 193 | 1281 | 641 | 385 | 257 | 193 |
| NOTE 1: For Gap Pattern ID 0, 1, 2 and 3, total number of interrupted subframes on MCG is MGL subframes when MG timing advance of 0ms is applied, and (MGL+1) subframes when MG timing advance of 0.5ms is applied.  NOTE 2: NR SCSs of 120 kHz, 480kHz and 960kHz are only applicable to the case with per-UE measurement gap.  NOTE 3: Non-overlapped half-slots occur before and after the measurement gap. Whether a Rel-15 UE can receive and/or transmit in those half-slots is up to UE implementation.  NOTE 4: For NR SCSs of 480kHz and 960kHz, total number of interrupted slots on all serving cells during MGL for single carrier, intra-band NR CA with per-UE measurement gap.  NOTE 5: For NR SCSs of 480kHz and 960kHz, total number of interrupted slots on all serving cells in SCG for inter-band NR-CA and synchronous NR-DC with per-UE measurement gap. | | | | | | | | | | |

Table 9.1.2-4a: Total number of interrupted slots on serving cells during MGL for Asynchronous EN-DC, and on all serving cells in SCG for NR standalone operation (with asynchronous NR-DC configuration) with per-UE measurement gap or per-FR measurement gap for FR1

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR | Total number of interrupted slots on serving cells | | | | | | | | | |
| SCS | When MG timing advance of 0ms is applied | | | | | When MG timing advance of 0.5ms is applied | | | | |
| (kHz) | MGL=20ms | MGL=10ms | MGL=6ms | MGL=4ms | MGL=3ms | MGL=20ms | MGL=10ms | MGL=6ms | MGL=4ms | MGL=3ms |
| 15 | 21 | 11 | 7 | 5 | 4 | 21 | 11 | 7 | 5 | 4 |
| 30 | 41 | 21 | 13 | 9 | 7 | 41 | 21 | 13 | 9 | 7 |
| 60 | 81 | 41 | 25 | 17 | 13 | 81 | 41 | 25 | 17 | 13 |
| 120 | 161 | 81 | 49 | 33 | 25 | 161 | 81 | 49 | 33 | 25 |
| 480 Note3 | 641 | 321 | 193 | 129 | 97 | 641 | 321 | 193 | 129 | 97 |
| 960 Note3 | 1281 | 641 | 385 | 257 | 193 | 1281 | 641 | 385 | 257 | 193 |
| NOTE 1: For Gap Pattern ID 0, 1, 2 and 3, total number of interrupted subframes on MCG is MGL subframes when MG timing advance of 0ms is applied, and (MGL+1) subframes when MG timing advance of 0.5ms is applied.  NOTE 2: NR SCSs of 120 kHz, 480kHz and 960kHz are only applicable to the case with per-UE measurement gap.  NOTE 3: For NR SCSs of 480kHz and 960kHz, total number of interrupted slots on all serving cells in SCG for asynchronous NR-DC with per-UE measurement gap. | | | | | | | | | | |

In case that UE capable of per-FR measurement gap is configured with per-FR measurement gap for FR2 serving cells, total number of interrupted slots on FR2 serving cells during MGL is listed in Table9.1.2-4b.

**Table 9.1.2-4b: Total number of interrupted slots on FR2 serving cells during MGL for EN-DC, NR standalone operation (with single carrier, NR CA and NR-DC configuration) and NE-DC with per-UE measurement gap or per-FR measurement gap for FR2**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR | Total number of interrupted slots on FR2 serving cells | | | | | | | | | |
| SCS | When MG timing advance of 0ms is applied | | | | | When MG timing advance of 0.25ms is applied | | | | |
| (kHz) | MGL=  20ms | MGL=  10ms | MGL=  5.5ms | MGL=  3.5ms | MGL=  1.5ms | MGL=  20ms | MGL=  10ms | MGL=  5.5ms | MGL=  3.5ms | MGL=  1.5ms |
| 60 | 80 | 40 | 22 | 14 | 6 | 80 | 40 | 22 | 14 | 6 |
| 120 | 160 | 80 | 44 | 28 | 12 | 160 | 80 | 44 | 28 | 12 |
| 480 Note3 | 640 | 320 | 176 | 112 | 48 | 640 | 320 | 176 | 112 | 48 |
| 960 Note3 | 1280 | 640 | 352 | 224 | 96 | 1280 | 640 | 352 | 224 | 96 |
| NOTE 1: The total number of interrupted slots is based on that SFN and subframe reference for per-FR gap in FR2 indicated by high layer parameter *refServCellIndicator* is an FR2 serving cell.  NOTE 2: Slot occurs before or after the measurement gap may be interrupted additionally if SFN and subframe reference for per-FR gap in FR2 indicated by high layer parameter refServCellIndicator is an FR1 serving cell.  NOTE 3: For NR SCSs of 480kHz and 960kHz, Total number of interrupted slots on FR2-2 serving cells during MGL for NR standalone operation (single carrier, NR CA and NR-DC) with per-UE measurement gap or per-FR measurement gap for FR2-2. | | | | | | | | | | |

It is up to UE implementation whether or not the UE is able to conduct transmission in the following slot(s),

- when MGTA is not applied, in the L consecutive UL slots with respect to the SCS of the UL carrier with the same slot indices as the DL slots occurring immediately after measurement gap

- when MGTA is applied and the SCS of the UL carrier is other than 15kHz, in the L consecutive UL slots with respect to the SCS of the UL carrier with the same slot indices as the DL slots occurring immediately after measurement gap

- when MGTA is applied and the SCS of the UL carrier is 15kHz, in the L consecutive UL slots with respect to the SCS of the UL carrier with the same slot indices as the DL slots occurring immediately after the slot partially overlapped with measurement gap

where UL slot denotes that all the symbols in the slot are uplink symbols, and L=1 if  for the UL transmission is less than the length of one slot; L=2 otherwise.

Note: Network is supposed to take into account the possible difference between the estimated TA at network and actual TA at UE when scheduling UE in the above slot(s).

Table 9.1.2-5: (Void)

If a positioning measurement gap is configured via *PosGapConfig* and activated by MAC CE, the measurement requirements do not apply for RRM measurement that requires measurement gaps.

#### 9.1.2.1 EN-DC: Measurement Gap Sharing

For E-UTRA-NR dual connectivity UE configured with per-UE measurement gap, measurement gap sharing shall be applied when UE requires measurement gaps to identify and measure cells on intra-frequency carriers for both SSB and CSI-RS based L3 measurement or when SMTC configured for intra-frequency measurement are fully overlapping with per-UE measurement gaps, and when UE requires measurement gaps to identify and measure cells on inter-frequency carriers or when all of SMTC configured for inter-frequency SSB based measurement without measurement gaps are fully overlapping with per-UE measurement gaps, E-UTRA gap-needed inter-frequency carriers and inter-RAT UTRAN carriers and/or inter-RAT GSM carriers.

For E-UTRA-NR dual connectivity UE configured with per-FR1 measurement gap, measurement gap sharing shall be applied when UE requires measurement gaps to identify and measure cells on FR1 intra-frequency carriers or when SMTC configured for FR1 intra-frequency measurement are fully overlapping with per-FR1 measurement gaps, and when UE requires measurement gaps to identify and measure cells on FR1 inter-frequency carriers for both SSB and CSI-RS based L3 measurement or when all of SMTC configured for inter-frequency SSB based measurement without measurement gaps are fully overlapping with per-FR1 measurement gaps, E-UTRA gap-needed inter-frequency carriers, inter-RAT UTRAN carriers and/or inter-RAT GSM carriers.

For E-UTRA-NR dual connectivity UE configured with per-FR2 measurement gap, measurement gap sharing shall be applied when UE requires measurement gaps to identify and measure cells on FR2 intra-frequency carriers or when SMTC configured for FR2 intra-frequency measurement are fully overlapping with per-FR2 measurement gaps, and when UE requires measurement gaps to identify and measure cells on FR2 inter-frequency carriers for both SSB and CSI-RS based L3 measurement, or when all of SMTC configured for inter-frequency SSB based measurement without measurement gaps are fully overlapping with per-FR2 measurement gaps.

When network signals “01”, “10” or “11” with RRC parameter *MeasGapSharingScheme* [2][16]and the value of X is defined as in Table 9.1.2.1-1, and

- Kintra = 1 / X \* 100,

- Kinter = 1 / (100 – X) \* 100,

When network signals “00” indicating equal splitting gap sharing, X is not applied.

The RRC parameter *MeasGapSharingScheme* shall be applied to the calculation of carrier specific scaling factor as specified in clause 9.1.5.2.1.

Table 9.1.2.1-1: Value of parameter X for EN-DC measurement gap sharing

|  |  |
| --- | --- |
| *measGapSharingScheme* | Value of X (%) |
| ‘00’ | Equal splitting |
| ‘01’ | 25 |
| ‘10’ | 50 |
| ‘11’ | 75 |
| Note: It is left to UE implementation to determine which measurement gap sharing scheme in the table *to be applied*, when *MeasGapSharingScheme is absent and there is* no stored value in the field. | |

#### 9.1.2.1a SA: Measurement Gap Sharing

For NR standalone UE without NR-DC operation and configured with per-UE measurement gap, measurement gap sharing shall be applies when UE requires measurement gaps to identify and measure cells on intra-frequency carriers or when SMTC configured for intra-frequency measurement are fully overlapping with per-UE measurement gaps, and when UE requires measurement gaps to identify and measure cells on inter-frequency carriers for both SSB and CSI-RS based L3 measurement, or when all of SMTC configured for inter-frequency SSB based measurement without measurement gaps are fully overlapping with per-UE measurement gaps, and/or inter-RAT E-UTRAN carriers, and/or inter-RAT UTRAN carriers for SRVCC, and when UE is configured to measure positioning frequency layers.

For NR standalone UE without NR-DC operation and configured with per-FR1 measurement gap, measurement gap sharing shall be applied when UE requires measurement gaps to identify and measure cells on FR1 intra-frequency carriers or when SMTC configured for FR1 intra-frequency measurement are fully overlapping with per-FR1 measurement gaps, and when UE requires measurement gaps to identify and measure cells on FR1 inter-frequency carriers for both SSB and CSI-RS based L3 measurement and/or inter-RAT E-UTRAN carriers, or when all of SMTC configured for inter-frequency SSB based measurement without measurement gaps are fully overlapping with per-FR1 measurement gaps, and/or inter-RAT UTRAN carriers for SRVCC, and when UE is configured to measure positioning frequency layers in FR1.

For NR standalone UE without NR-DC operation and configured with per-FR2 measurement gap, measurement gap sharing shall be applied when UE requires measurement gaps to identify and measure cells on FR2 intra-frequency carriers or when SMTC configured for FR2 intra-frequency measurement are fully overlapping with per-FR2 measurement gaps, and when UE requires measurement gaps to identify and measure cells on FR2 inter-frequency carriers for both SSB and CSI-RS based L3 measurement, or when all of SMTC configured for inter-frequency SSB based measurement without measurement gaps are fully overlapping with per-FR2 measurement gaps, and when UE is configured to measure positioning frequency layers in FR2.

When network signals “01”, “10” or “11” with RRC parameter *MeasGapSharingScheme* [2] and the value of X is defined as in Table 9.1.2.1a-1, and

- Kintra = 1 / X \* 100,

- Kinter = 1 / (100 – X) \* 100,

When network signals “00” indicating equal splitting gap sharing, X is not applied.

The RRC parameter *MeasGapSharingScheme* shall be applied to the calculation of carrier specific scaling factor as specified in clause 9.1.5.2.2.

Table 9.1.2.1a-1: Value of parameter X for NR standalone measurement gap sharing

|  |  |
| --- | --- |
| *measGapSharingScheme* | Value of X (%) |
| ‘00’ | Equal splitting |
| ‘01’ | 25 |
| ‘10’ | 50 |
| ‘11’ | 75 |
| Note: It is left to UE implementation to determine which measurement gap sharing scheme in the table *to be applied*, when *MeasGapSharingScheme is absent and there is* no stored value in the field. | |

#### 9.1.2.1b NE-DC: Measurement Gap Sharing

For NR-E-UTRA dual connectivity UE configured with per-UE measurement gap, measurement gap sharing shall be applied when UE requires measurement gaps to identify and measure cells on intra-frequency carriers or when SMTC configured for intra-frequency measurement are fully overlapping with per-UE measurement gaps, and when UE requires measurement gaps to identify and measure cells on inter-frequency carriers, E-UTRA gap-needed inter-frequency carriers for both SSB and CSI-RS based L3 measurement, or when all of SMTC configured for inter-frequency SSB based measurement without measurement gaps are fully overlapping with per-UE measurement gaps, and/or inter-RAT E-UTRA carriers, and/or inter-RAT UTRAN carriers for SRVCC, and when UE is configured to measure positioning frequency layers.

For NR-E-UTRA dual connectivity UE configured with per-FR1 measurement gap, measurement gap sharing shall be applied when UE requires measurement gaps to identify and measure cells on FR1 intra-frequency carriers or when SMTC configured for FR1 intra-frequency measurement are fully overlapping with per-FR1 measurement gaps, and when UE requires measurement gaps to identify and measure cells on inter-frequency carriers for both SSB and CSI-RS based L3 measurement, or when all of SMTC configured for inter-frequency SSB based measurement without measurement gaps are fully overlapping with per-FR1 measurement gaps, E-UTRA gap-needed inter-frequency carriers, and/or inter-RAT E-UTRA carriers, and/or inter-RAT UTRAN carriers for SRVCC, and when UE is configured to measure positioning frequency layers in FR1.

For NR-E-UTRA dual connectivity UE configured with per-FR2 measurement gap, measurement gap sharing shall be applied when UE requires measurement gaps to identify and measure cells on FR2 intra-frequency carriers or when SMTC configured for FR2 intra-frequency measurement are fully overlapping with per-FR2 measurement gaps, and when UE requires measurement gaps to identify and measure cells on FR2 inter-frequency carriers for both SSB and CSI-RS based L3 measurement, or when all of SMTC configured for inter-frequency SSB based measurement without measurement gaps are fully overlapping with per-FR2 measurement gaps, and when UE is configured to measure positioning frequency layers in FR2.

When network signals “01”, “10” or “11” with RRC parameter *measGapSharingConfig* [2][16] and the value of X is defined as in Table 9.1.2.1b-1, and

- Kintra = 1 / X \* 100,

- Kinter = 1 / (100 – X) \* 100,

When network signals “00” indicating equal splitting gap sharing, X is not applied.

The RRC parameter *MeasGapSharingScheme* shall be applied to the calculation of carrier specific scaling factor as specified in clause 9.1.5.2.3.

Table 9.1.2.1b-1: Value of parameter X for NE-DC measurement gap sharing

|  |  |
| --- | --- |
| *measGapSharingScheme* | Value of X (%) |
| ‘00’ | Equal splitting |
| ‘01’ | 25 |
| ‘10’ | 50 |
| ‘11’ | 75 |
| Note: It is left to UE implementation to determine which measurement gap sharing scheme in the table *to be applied*, when *MeasGapSharingScheme is absent and there is* no stored value in the field. | |

#### 9.1.2.1c NR-DC: Measurement Gap Sharing

For UE with NR-DC operation and configured with per-UE measurement gap, measurement gap sharing shall be applies when UE required measurement gaps to identify and measure cells on intra-frequency carriers or when SMTC configured for intra-frequency measurement are fully overlapping with per-UE measurement gaps, and when UE requires measurement gaps to identify and measure cells on inter-frequency carriers for both SSB and CSI-RS based L3 measurement, and/or inter-RAT E-UTRAN carriers, or when all of SMTC configured for inter-frequency SSB based measurement without measurement gaps are fully overlapping with per-UE measurement gaps, and/or inter-RAT UTRAN carriers for SRVCC, and when UE is configured to measure positioning frequency layers.

For UE with NR-DC operation and configured with per-FR1 measurement gap, measurement gap sharing shall be applied when UE requires measurement gaps to identify and measure cells on FR1 intra-frequency carriers or when SMTC configured for FR1 intra-frequency measurement are fully overlapping with per-FR1 measurement gaps, and when UE requires measurement gaps to identify and measure cells on FR1 inter-frequency carriers for both SSB and CSI-RS based L3 measurement and/or inter-RAT E-UTRAN carriers, or when all of SMTC configured for inter-frequency SSB based measurement without measurement gaps are fully overlapping with per-FR1 measurement gaps, and/or inter-RAT UTRAN carriers for SRVCC, and when UE is configured to measure positioning frequency layers in FR1.

For UE with NR-DC operation and configured with per-FR2 measurement gap, measurement gap sharing shall be applied when UE requires measurement gaps to identify and measure cells on FR2 intra-frequency carriers or when SMTC configured for FR2 intra-frequency measurement are fully overlapping with per-FR2 measurement gaps, and when UE requires measurement gaps to identify and measure cells on FR2 inter-frequency carriers for both SSB and CSI-RS based L3 measurement, or when all of SMTC configured for inter-frequency SSB based measurement without measurement gaps are fully overlapping with per-FR2 measurement gaps, and when UE is configured to measure positioning frequency layers in FR2.

When network signals “01”, “10” or “11” with RRC parameter *measGapSharingConfig* [2] and the value of X is defined as in Table 9.1.2.1c-1, and

- Kintra = 1 / X \* 100,

- Kinter = 1 / (100 – X) \* 100,

When network signals “00” indicating equal splitting gap sharing, X is not applied.

The RRC parameter *MeasGapSharingScheme* shall be applied to the calculation of carrier specific scaling factor as specified in clause 9.1.5.2..4.

Table 9.1.2.1c-1: Value of parameter X for NR-DC measurement gap sharing

|  |  |
| --- | --- |
| *measGapSharingConfig* | Value of X (%) |
| ‘00’ | Equal splitting |
| ‘01’ | 25 |
| ‘10’ | 50 |
| ‘11’ | 75 |
| Note: It is left to UE implementation to determine which measurement gap sharing scheme in the table *to be applied*, when *MeasGapSharingScheme is absent and there is* no stored value in the field. | |

### 9.1.3 UE Measurement capability

#### 9.1.3.1 EN-DC: Monitoring of multiple layers using gaps

The requirements in this clause are applicable for UE capable of and configured with the EN-DC operation mode.

When monitoring of multiple inter-frequency E-UTRAN, inter-RAT NR, GSM, UTRA FDD and UTRA TDD carriers as configured by E-UTRA PCell, and inter-frequency NR carriers (with or without CCA) as configured by PSCell using gaps (or without using gaps provided the UE supports such capability or the effective MGRP is applied for per-FR measurement gap capable UE) is configured, the UE shall be capable of performing one measurement of the configured measurement type (SS-RSRP, SS-RSRQ, SS-SINR, CSI-RSRP, CSI-RSRQ, CSI-SINR, SFTD, E-UTRAN RSRP, E-UTRAN RSRQ, E-UTRAN RS-SINR measurements, UTRAN TDD P-CCPCH RSCP, UTRAN FDD CPICH measurements, GSM carrier RSSI, etc.) of detected cells on all the layers.

For UE configured with the EN-DC operation, the effective total number of frequencies excluding the frequencies of the PSCell, SCells, E-UTRA PCell, and E-UTRA SCells being monitored is Nfreq, EN-DC, which is defined as:

Nfreq, EN-DC = Nfreq, EN-DC, NR + Nfreq, EN-DC, E-UTRA+ Nfreq, EN-DC, UTRA + MEN-DC, GSM,

where

Nfreq, EN-DC, E-UTRA is the number of E-UTRA inter-frequency carriers being monitored (FDD and TDD) as configured by E-UTRA PCell or via LPP [22],

Nfreq, EN-DC, NR ≤ Nfreq, EN-DC, NR, inter-RAT + Nfreq, EN-DC, NR, inter-freq

where

Nfreq, EN-DC, NR, inter-RAT is the number of NR inter-RAT carriers excluding NR serving carrier(s) being monitored as configured by E-UTRA PCell [15],

Nfreq, EN-DC, NR, inter-freq is the number of NR inter-frequency carriers being monitored as configured by PSCell,

Nfreq, EN-DC, UTRA is the number of UTRA inter-RAT carriers being monitored as configured by E-UTRA PCell (FDD and TDD).

MEN-DC, GSM is an integer which is a function of the number of GSM inter-RAT carriers as configured by E-UTRA PCell on which measurements are being performed. MEN-DC, GSM is equal to 0 if no GSM carrier is being monitored. For a MGRP of 40 ms, MEN-DC, GSM is equal to 1 if cells on up to 32 GSM carriers are being measured. For a MGRP of 80 ms, MEN-DC, GSM is equal to ceil(Ncarriers,GSM /20) where Ncarriers,GSM is the number of GSM carriers on which cells are being measured.

#### 9.1.3.1a SA: Monitoring of multiple layers using gaps

The requirements in this clause are applicable for UE configured with SA NR operation mode.

When monitoring of multiple inter-RAT E-UTRAN carriers, inter-frequency NR carriers (with or without CCA) and inter-RAT UTRA FDD carriers using gaps (or without using gaps provided the UE supports such capability or the effective MGRP is applied for per-FR measurement gap capable UE) is configured by PCell, the UE shall be capable of performing one measurement of the configured measurement type (SS-RSRP, SS-RSRQ, SS-SINR, CSI-RSRP, CSI-RSRQ, CSI-SINR, E-UTRAN RSRP, E-UTRAN RSRQ, E-UTRAN RS-SINR measurements, UTRAN FDD CPICH measurement, etc.) of detected cells on all the layers.

For UE configured with the NR SA operation, the effective total number of frequencies, excluding the frequencies of the PCell, PSCell and SCells being monitored, is Nfreq, SA, which is defined as:

Nfreq, SA = Nfreq, SA, NR + Nfreq, SA, E-UTRA+ Nfreq, SA, UTRA,

where

Nfreq, SA, E-UTRA is the number of E-UTRA inter-RAT carriers being monitored (FDD and TDD) as configured by PCell or via LPP [22],

- Nfreq, SA, UTRA is the number of UTRA FDD inter-RAT carriers being monitored as configured by PCell,

Nfreq, SA, NR is the number of NR inter-frequency carriers being monitored as configured by PCell.

#### 9.1.3.1b NE-DC: Monitoring of multiple layers using gaps

The requirements in this clause are applicable for UE capable of and configured with the NE-DC operation mode.

When monitoring of multiple inter-frequency E-UTRAN carriers as configured by E-UTRA PSCell, inter-RAT E-UTRAN carriers as configured by PCell, inter-RAT UTRA FDD carriers as configured by PCell, and inter-frequency NR carriers as configured by PCell using gaps (or without using gaps provided the UE supports such capability or the effective MGRP is applied for per-FR measurement gap capable UE) is configured, the UE shall be capable of performing one measurement of the configured measurement type (SS-RSRP, SS-RSRQ, SS-SINR, CSI-RSRP, CSI-RSRQ, CSI-SINR, SFTD, E-UTRAN RSRP, E-UTRAN RSRQ, and E-UTRAN RS-SINR measurements, UTRAN FDD CPICH measurements, etc.) of detected cells on all the layers.

For UE configured with the NE-DC operation, the effective total number of frequencies excluding the frequencies of the PCell, SCells, E-UTRA PSCell, and E-UTRA SCells being monitored is Nfreq, NE-DC, which is defined as:

Nfreq, NE-DC = Nfreq, NE-DC, NR + Nfreq, NE-DC, E-UTRA+ Nfreq, NE-DC, UTRA,

where

Nfreq, NE-DC, NR is the number of NR inter-frequency carriers being monitored as configured by PCell,

Nfreq, NE-DC, UTRA is the number of UTRA FDD inter-RAT carriers being monitored as configured by PCell,

Nfreq, NE-DC, E-UTRA ≤ Nfreq, NE-DC, E-UTRA, inter-RAT + Nfreq, NE-DC, E-UTRA, inter-freq

where

Nfreq, NE-DC, E-UTRA, inter-RAT is the number of E-UTRA inter-RAT carriers (FDD and TDD) excluding E-UTRA serving carrier(s) being monitored as configured by PCell or via LPP [22],

Nfreq, NE-DC, E-UTRA, inter-freq is the number of E-UTRA inter-frequency carriers (FDD and TDD) being monitored as configured by E-UTRA PSCell [15] or via LPP [22].

#### 9.1.3.1c NR-DC: Monitoring of multiple layers using gaps

The requirements in this clause are applicable for UE configured with NR-DC operation mode.

When monitoring of multiple inter-RAT E-UTRAN carriers and inter-frequency NR carriers using gaps (or without using gaps provided the UE supports such capability or the effective MGRP is applied for per-FR measurement gap capable UE) as configured by PCell, inter-RAT UTRA FDD carriers as configured by PCell, and inter-frequency NR carriers as configured by PSCell is configured, the UE shall be capable of performing one measurement of the configured measurement type (SS-RSRP, SS-RSRQ, SS-SINR, CSI-RSRP, CSI-RSRQ, CSI-SINR, E-UTRAN RSRP, E-UTRAN RSRQ, E-UTRAN RS-SINR measurements, UTRAN FDD CPICH measurements, etc.) of detected cells on all the layers.

For UE configured with the NR-DC operation, the effective total number of frequencies, excluding the frequencies of the PCell, PSCell and SCells being monitored, is Nfreq, NR-DC, which is defined as:

Nfreq, NR-DC = Nfreq, NR-DC, NR + Nfreq, NR-DC, E-UTRA+ Nfreq, NR-DC, UTRA,

where

- Nfreq, NR-DC, E-UTRA is the number of E-UTRA inter-RAT carriers being monitored (FDD and TDD) as configured by PCell or via LPP [22].

- Nfreq, NE-DC, UTRA is the number of UTRA FDD inter-RAT carriers being monitored as configured by PCell,

- Nfreq, NR-DC, NR is the number of NR inter-frequency carriers being monitored as configured by PCell and PSCell.

#### 9.1.3.2 EN-DC: Maximum allowed layers for multiple monitoring

If a UE is configured with EN-DC operation, the UE shall be capable of monitoring at least:

- Depending on UE capability, 7 NR SSB inter-frequency carriers configured by PSCell, and

- Depending on UE capability, 8 NR inter-frequency carriers including SSB and CSI-RS in total configured by PSCell, and

- Depending on UE capability, 7 NR SSB inter-RAT carriers excluding NR serving carrier(s) configured by E-UTRA PCell [15], and

- Depending on UE capability, 6 E-UTRA TDD inter-frequency carriers configured by E-UTRA PCell [15], and

- Depending on UE capability, 6 E-UTRA FDD inter-frequency carriers configured by E-UTRA PCell [15], and

- Depending on UE capability, 3 FDD UTRA carriers, and

- Depending on UE capability, 3 TDD UTRA carriers, and

- Depending on UE capability, 32 GSM carriers (one GSM layer corresponds to 32 carriers), and

- Depending on UE capability, 1 E-UTRA FDD inter-frequency carrier for RSTD measurements configured via LPP [22], and

- Depending on UE capability, 1 E-UTRA TDD inter-frequency carrier for RSTD measurements configured via LPP [22].

In addition to the requirements defined above, the UE shall be capable of monitoring a total of at least 13 effective carrier frequency layers comprising of any above defined combination of NR, E-UTRA FDD, E-UTRA TDD, UTRA FDD, UTRA TDD and GSM (one GSM layer corresponds to 32 carriers) layers. The UE shall be capable of monitoring a total of at least 7 + NCSI effective NR carrier frequency layers excluding NR serving carrier(s), comprising of any above defined combination of NR inter-RAT carriers excluding NR serving carrier(s) configured by E-UTRA PCell and NR inter-frequency carriers configured by PSCell, NCSI equals 1 if UE supports CSI-RS based L3 measurement, and NCSI =0 otherwise.

The number of SSB frequency layers configured by PSCell equals to the total number of MOs with

- *ssb-ConfigMobility* configured, or

- *ssb-ConfigMobility* not configured but *csi-rs-ResourceConfigMobility* configured with *associatedSSB*.

If *ssbfrequency, smtc1, smtc2* and *ssbSubcarrierSpacing* are same in multiple MOs, the multiple MOs are counted as one SSB frequency layer.

The number of CSI-RS frequency layers equals to the number of MOs with *csi-rs-ResourceConfigMobility* configured assuming single MO is configured per frequency layer.

When the E-UTRA PCell and PSCell configures the same NR carrier frequency layer to be monitored by the UE in synchronous intra-band EN-DC, this layer shall be counted only once to the total number of effective carrier frequency layers provided that the SFN-s and slot boundaries are aligned, unless the configured NR carrier frequency layers to be monitored have

- different RSSI measurement resourcesor

- different *deriveSSB-IndexFromCell* indications or

- different SMTC configurations or

- different *ssb-PositionQCL-Common-r16* indications or cell list of *ssb-PositionQCL* on NR carrier frequency layer with CCA or

- different *rmtc-Config-r16* indication on NR carrier frequency layer with CCA.

Note 1: The E-UTRA-NR dual connectivity capable UE configured with PSCell shall fulfil the requirements defined in only one of clause 9.1.3.2 and clause 8.1.2.1.1b.1 of TS 36.133 [15].

#### 9.1.3.2a SA: Maximum allowed layers for multiple monitoring

If a UE is configured with SA NR operation mode, the UE shall be capable of monitoring at least:

- Depending on UE capability, 7 NR SSB inter-frequency carriers configured by PCell, and

- Depending on UE capability, 8 NR inter-frequency carriers including SSB and CSI-RS in total configured by PCell, and

- Depending on UE capability, 7 E-UTRA TDD inter-RAT carriers configured by PCell, and

- Depending on UE capability, 7 E-UTRA FDD inter-RAT carriers configured by PCell, and

- Depending on UE capability, 3 UTRA FDD inter-RAT carriers configured by PCell, and

- Depending on UE capability, 1 E-UTRA FDD inter-RAT carrier for RSTD measurements configured via LPP [22], and

- Depending on UE capability, 1 E-UTRA TDD inter-RAT carrier for RSTD measurements configured via LPP [22].

In addition to the requirements defined above, the UE shall be capable of monitoring a total of at least [13] effective carrier frequency layers comprising of any above defined combination of NR, E-UTRA FDD, E-UTRA TDD and UTRA FDD layers.

The number of SSB frequency layers equals to the total number of MOs with

- *ssb-ConfigMobility* configured, or

- *ssb-ConfigMobility* not configured but *csi-rs-ResourceConfigMobility* configured with *associatedSSB*.

If *ssbfrequency, smtc1, smtc2* and *ssbSubcarrierSpacing* are same in multiple MOs, the multiple MOs are counted as one SSB frequency layer.

The number of CSI-RS frequency layers equals to the number of MOs with *csi-rs-ResourceConfigMobility* configured assuming single MO is configured per frequency layer.

#### 9.1.3.2b NE-DC: Maximum allowed layers for multiple monitoring

If a UE is configured with NE-DC operation mode, the UE shall be capable of monitoring at least:

- Depending on UE capability, 7 NR SSB inter-frequency carriers configured by PCell, and

- Depending on UE capability, 8 NR inter-frequency carriers including SSB and CSI-RS in total configured by PCell, and

- Depending on UE capability, 6 E-UTRA TDD inter-RAT carriers excluding E-UTRA serving carriers configured by PCell, and

- Depending on UE capability, 6 E-UTRA FDD inter-RAT carriers excluding E-UTRA serving carriers configured by PCell, and

- Depending on UE capability, 6 E-UTRA TDD inter-frequency carriers configured by E-UTRA PSCell [15], and

- Depending on UE capability, 6 E-UTRA FDD inter-frequency carriers configured by E-UTRA PSCell [15], and

- Depending on UE capability, 3 UTRA FDD inter-RAT carriers configured by PCell, and

- Depending on UE capability, 1 E-UTRA FDD inter-frequency carrier for RSTD measurements configured via LPP [22], and

- Depending on UE capability, 1 E-UTRA TDD inter-frequency carrier for RSTD measurements configured via LPP [22].

In addition to the requirements defined above, the UE shall be capable of monitoring a total of at least 13 effective carrier frequency layers comprising of any above defined combination of NR, E-UTRA FDD, E-UTRA TDD and UTRA FDD layers. The UE shall be capable of monitoring a total of at least 6 effective E-UTRA carrier frequency layers, excluding E-UTRA serving carrier(s), comprising of any above defined combination of E-UTRA inter-RAT carriers excluding E-UTRA serving carrier(s) configured by PCell and E-UTRA inter-frequency carriers configured by E-UTRA PSCell.

The number of SSB frequency layers configured by PCell equals to the total number of MOs with

- *ssb-ConfigMobility* configured, or

- *ssb-ConfigMobility* not configured but *csi-rs-ResourceConfigMobility* configured with *associatedSSB*.

If *ssbfrequency, smtc1, smtc2* and *ssbSubcarrierSpacing* are same in multiple MOs, the multiple MOs are counted as one SSB frequency layer.

The number of CSI-RS frequency layers equals to the number of MOs with *csi-rs-ResourceConfigMobility* configured assuming single MO is configured per frequency layer.

#### 9.1.3.2c NR-DC: Maximum allowed layers for multiple monitoring

If a UE is configured with NR-DC operation, the UE shall be capable of monitoring at least:

- Depending on UE capability, 7 NR SSB inter-frequency carriers configured by PCell, and

- Depending on UE capability, 8 NR inter-frequency carriers including SSB and CSI-RS in total configured by PCell, and

- Depending on UE capability, 7 NR SSB inter-frequency carriers configured by PSCell, and

- Depending on UE capability, 8 NR inter-frequency carriers including SSB and CSI-RS in total configured by PSCell, and

- Depending on UE capability, 7 E-UTRA TDD inter-RAT carriers configured by PCell, and

- Depending on UE capability, 7 E-UTRA FDD inter-RAT carriers configured by PCell, and

- Depending on UE capability, 3 UTRA FDD inter-RAT carriers configured by PCell, and

- Depending on UE capability, 1 E-UTRA FDD inter-RAT carrier for RSTD measurements configured via LPP [22], and

- Depending on UE capability, 1 E-UTRA TDD inter-RAT carrier for RSTD measurements configured via LPP [22].

In addition to the requirements defined above, the UE shall be capable of monitoring a total of at least 13 effective carrier frequency layers comprising of any above defined combination of NR, E-UTRA FDD, E-UTRA TDD and UTRA FDD layers. The UE shall be capable of monitoring a total of at least 7 + NCSI effective NR carrier frequency layers excluding NR serving carrier(s), which are configured by PCell and PSCell, NCSI equals 1 if UE supports CSI-RS based L3 measurement, and NCSI =0 otherwise.

The number of SSB frequency layers equals to the total number of MOs with

- *ssb-ConfigMobility* configured, or

- *ssb-ConfigMobility* not configured but *csi-rs-ResourceConfigMobility* configured with *associatedSSB*.

If *ssbfrequency, smtc1, smtc2* and *ssbSubcarrierSpacing* are same in multiple MOs, the multiple MOs are counted as one SSB frequency layer.

The number of CSI-RS frequency layers equals to the number of MOs with *csi-rs-ResourceConfigMobility* configured assuming single MO is configured per frequency layer.

When PCell and PSCell configures the same NR carrier frequency layer to be monitored by the UE in NR-DC, this layer shall be counted only once to the total number of effective carrier frequency layers provided that the SFN-s and slot boundaries are aligned, unless the configured NR carrier frequency layers to be monitored have

- different RSSI measurement resourcesor

- different *deriveSSB-IndexFromCell* indications or

- different SMTC configurations or

- different *ssb-PositionQCL-Common-r16* indications or cell list of *ssb-PositionQCL* on NR carrier frequency layer with CCA or

- different *rmtc-Config-r16* indication on NR carrier frequency layer with CCA.

#### 9.1A.3.2 Void

### 9.1.3A UE Measurement capability under operation mode with CCA

#### 9.1.3A.1 EN-DC: Monitoring of multiple layers using gaps under CCA

The requirements in clause 9.1.3.1 are also applicable for the UE capable of and configured with the EN-DC operation mode with CCA on PSCC.

#### 9.1.3A.1a SA: Monitoring of multiple layers using gaps under CCA

The requirements in clause 9.1.3.1a are also applicable for UE configured with SA NR operation mode with CCA on PCC.

#### 9.1.3A.2 EN-DC: Maximum allowed layers for multiple monitoring under CCA

If a UE is configured with EN-DC operation when CCA is used on PSCell, the UE shall be capable of monitoring at least:

- Depending on UE capability, 7 NR inter-frequency carriers configured by PScell, and

- Depending on UE capability, 7 NR inter-RAT carriers excluding NR serving carrier(s) configured by E-UTRA PCell [15], and

- Depending on UE capability, 6 E-UTRA TDD inter-frequency carriers configured by E-UTRA PCell [15], and

- Depending on UE capability, 6 E-UTRA FDD inter-frequency carriers configured by E-UTRA PCell [15], and

- Depending on UE capability, 3 FDD UTRA carriers, and

- Depending on UE capability, 3 TDD UTRA carriers, and

- Depending on UE capability, 32 GSM carriers (one GSM layer corresponds to 32 carriers), and

In addition to the requirements defined above, the UE shall be capable of monitoring a total of at least 13 effective carrier frequency layers comprising of any above defined combination of NR, E-UTRA FDD, E-UTRA TDD, UTRA FDD, UTRA TDD and GSM (one GSM layer corresponds to 32 carriers) layers. The UE shall be capable of monitoring a total of at least 7 effective NR carrier frequency layers excluding NR serving carrier(s), comprising of any above defined combination of NR inter-RAT carriers excluding NR serving carrier(s) configured by E-UTRA PCell and NR inter-frequency carriers configured by PSCell.

When the E-UTRA PCell and PSCell configures the same NR carrier frequency layer to be monitored by the UE in synchronous intra-band EN-DC, this layer shall be counted only once to the total number of effective carrier frequency layers provided that the SFN-s and slot boundaries are aligned, unless the configured NR carrier frequency layers to be monitored have

- different RSSI measurement resourcesor

- different *deriveSSB-IndexFromCell* indications or

- different SMTC configurations or

- different *ssb-PositionQCL-Common-r16* indications or cell list of *ssb-PositionQCL* on NR carrier frequency layer with CCA or

- different *rmtc-Config-r16* indication on NR carrier frequency layer with CCA.

#### 9.1.3A.2a SA: Maximum allowed layers for multiple monitoring under CCA

If a UE is configured with SA NR operation mode when CCA is used on PCell or SCell only, the UE shall be capable of monitoring at least:

- Depending on UE capability, 7 NR inter-frequency carriers configured by PCell, and

- Depending on UE capability, 7 E-UTRA TDD inter-RAT carriers configured by PCell, and

- Depending on UE capability, 7 E-UTRA FDD inter-RAT carriers configured by PCell, and

In addition to the requirements defined above, the UE shall be capable of monitoring a total of at least [13] effective carrier frequency layers comprising of any above defined combination of NR, E-UTRA FDD and E-UTRA TDD layers.

### 9.1.3C UE Measurement capability under operation mode with satellite access

*Editor’s note: Applicability of frequency range, CA, DA, duplex mode, inter-RAT measurement, etc is subject to updates/changes based on the scope of the corresponding WID.*

*Editor’s note: Terminology will be further clarified and selected between, e.g. NTN and satellite access, based on further agreements.*

#### 9.1.3C.1a SA: Monitoring of multiple layers using gaps under satellite access

The requirements in this clause are applicable for UE configured with only PCell, which is served by SAN.

When monitoring of multiple SAN carriers and TN carriers using gaps (or without using gaps provided the UE supports such capability) is configured by PCell, the UE shall be capable of performing one measurement of the configured measurement type (SS-RSRP, SS-RSRQ, SS-SINR, CSI-RSRP, CSI-RSRQ, CSI-SINR) of detected cells on all the layers.

Note: for a cell served by SAN, the UE could only be configured to measure SS-RSRP, SS-RSRQ, SS-SINR.

For the UE configured with NR SA operation mode with only PCell served by SAN, the effective total number of frequencies, excluding the frequencies of the serving cell being monitored, is Nfreq, SA, which is defined as:

Nfreq, SA = Nfreq, SA, SAN + Nfreq, SA, TN,

where

- Nfreq, SA, SAN is the number of SAN carriers being monitored as configured by the serving cell served by SAN,

Nfreq, SA, TN is the number of TN carriers being monitored as configured by the serving cell served by SAN.

#### 9.1.3C.2a SA: Maximum allowed layers for multiple monitoring for SAN

If a UE is configured with NR SA operation mode with SAN serving cell, the UE shall be capable of monitoring at least:

- Depending on UE capability, 3 NR SAN carriers including serving carrier, and

- Depending on UE capability, 7 NR SAN and TN carriers including serving carrier,

- The total number of NR SAN and TN carriers does not apply to VSAT UE.

FFS: the number of effective frequency layers UE shall be capable to monitor.

### 9.1.4 Capabilities for Support of Event Triggering and Reporting Criteria

#### 9.1.4.1 Introduction

This clause contains requirements on UE capabilities for support of event triggering and reporting criteria. As long as the measurement configuration does not exceed the requirements stated in clause 9.1.4.2, the UE shall meet all other performance requirements defined in clause 9 and clause 10. The requirements in this clause also apply for a UE in EN-DC with PSCell on a carrier frequency with CCA or SA NR with PCell on a carrier frequency with CCA.

The UE can be requested to make measurements under different measurement identities defined in TS 38.331 [2]. Each measurement identity corresponds to either event-based reporting, periodic reporting, or no reporting. In case of event-based reporting, each measurement identity is associated with an event triggering criterion. In case of periodic reporting, a measurement identity is associated with one periodic reporting criterion. In case of no reporting, a measurement identity is associated with one no reporting criterion.

The purpose of this clause is to set some limits on the number of different event triggering, periodic, and no reporting criteria the UE may be requested to track in parallel.

#### 9.1.4.2 Requirements

In this clause a reporting criterion corresponds to either one event (in the case of event-based reporting), or one periodic reporting criterion (in case of periodic reporting), or one no reporting criterion (in case of no reporting). For event-based reporting, each instance of event, with the same or different event identities, is counted as separate reporting criterion in Table 9.1.4.2-1.

The UE shall be able to support in parallel per category up to Ecat reporting criteria according to Table 9.1.4.2-1. For the measurement categories belonging to intra-frequency, inter-frequency, and inter-RAT measurements (i.e. without counting other categories that the UE shall always support in parallel), the UE need not support more than the total number of reporting criteria as follows:

- For UE configured with EN-DC: , where

is the total number of NR reporting criteria configured by PSCell (NR intra- and inter-frequency reporting criteria) and by E-UTRA PCell on NR serving frequencies (NR intra-frequency reporting criteria) applicable for UE configured with EN-DC according to Table 9.1.4.2-1, and n is the number of configured NR serving frequencies, including PSCell and SCells carrier frequencies,

is the total number of reporting criteria configured by E-UTRA PCell except PSCell and SCells carrier frequencies, as specified in TS 36.133 [15] for UE configured with EN-DC.

- For UE configured with NE-DC:, where

is the total number of NR reporting criteria according to Table 9.1.4.2-1, and n is the number of configured NR serving frequencies, including PCell and SCells carrier frequencies,

, where

is the total number of inter-RAT E-UTRA reporting criteria configured by PCell except E-UTRA PSCell and E-UTRA SCells carrier frequencies, according to Table 9.1.4.2-1,

is the total number of E-UTRA reporting criteria including E-UTRA PSCell and E-UTRA SCells carrier frequencies as specified in TS 36.133 [15] for UE configured with NE-DC.

- For UE configured with SA operation mode: , where

 is the total number of NR reporting criteria according to Table 9.1.4.2-1, and n is the number of configured NR serving frequencies, including PCell, and SCells carrier frequencies,

 is the total number of inter-RAT E-UTRA reporting criteria according to Table 9.1.4.2-1.

- For UE configured with NR-DC: , where

is the total number of NR reporting criteria according to Table 9.1.4.2-1, and n is the number of configured NR serving frequencies, including PCell, PSCell and SCells carrier frequencies,

is the total number of inter-RAT E-UTRA reporting criteria according to Table 9.1.4.2-1.

Table 9.1.4.2-1: Requirements for reporting criteria per measurement category

|  |  |  |
| --- | --- | --- |
| Measurement category | Ecat | Note |
| Intra-frequency Note 1,2,3,4,5 | 9 | Events for any one or a combination of intra-frequency SS-RSRP, SS-RSRQ, SS-SINR, CSI-RSRP, CSI-RSRQ, and CSI-SINR for NG-RAN intra-frequency cells |
| Inter-frequency Note 2,3,4,5 | 10 | Events for any one or a combination of inter-frequency SS-RSRP, SS-RSRQ, SS-SINR, CSI-RSRP, CSI-RSRQ, and CSI-SINR for NG-RAN inter-frequency cells |
| Inter-RAT (E-UTRA FDD, E-UTRA TDD) Note 2,4,5 | 10 | Only applicable for UE with this (inter-RAT) capability. These reporting criteria apply for any E-UTRA carrier frequencies other than the carrier frequency of the E-UTRA PSCell or E-UTRA SCell. |
| Inter-RAT (E-UTRA FDD, E-UTRA TDD) RSTD Note 2,4,5 | 1 | Inter-RAT RSTD measurement reporting for UE supporting OTDOA; 1 report capable of minimum 16 inter-RAT cell measurements.  Only applicable for UE with this (inter-RAT RSTD via LPP [22]) capability. These reporting criteria apply for any E-UTRA carrier frequencies other than the carrier frequency of the E-UTRA PSCell or E-UTRA SCell. |
| Inter-RAT (E-UTRA FDD, E-UTRA TDD) RSRP and RSRQ measurements for E-CID Note 2,4,5 | 1 | Inter-RAT RSRP and RSRQ measurements for E-CID reported to E-SMLC via LPP [22]. One report capable of at least in total 10 inter-RAT RSRP and RSRQ measurements. Applicable to UE capable of reporting inter-RAT RSRP and RSRQ to E-SMLC via LPP. These reporting criteria apply for any E-UTRA carrier frequencies other than the carrier frequency of the E-UTRA PSCell or E-UTRA SCell. |
| Intra-frequency RSSI and channel occupancy measurements with CCA Note 1,2,3 | 1 | One report capable of one RSSI and one channel occupancy measurements over a channel [TS 37.213] with CCA. Applicable for UE capable of performing and reporting RSSI and channel occupancy on carrier frequencies under CCA. |
| Inter-frequency RSSI and channel occupancy measurements with CCA Note 2,3 | 1 | One report capable of one RSSI and one channel occupancy measurements over a channel [TS 37.213] with CCA. Applicable for UE capable of performing and reporting RSSI and channel occupancy on carrier frequencies under CCA. |
| Intra-frequency SSB-based measurements for NR E-CID Note 1,2,3,4,5 | 1 | Intra-frequency SS-RSRP and SS-RSRQ measurements for NR E-CID reported to LMF via LPP [34]. One report capable of at least in total 9 intra-frequency SS-RSRP and SS-RSRQ measurements. Applicable to UE capable of reporting at least one of SS-RSRP and SS-RSRQ to LMF via LPP. |
| Intra-frequency CSI-RS based measurements for NR E-CID Note 1,2,3,4,5 | 1 | Intra-frequency CSI-RSRP and CSI-RSRQ measurements for NR E-CID reported to LMF via LPP [22]. One report capable of at least in total 9 intra-frequency CSI-RSRP and/or CSI-RSRQ measurements. Applicable to UE capable of reporting any of CSI-RSRP and CSI-RSRQ to LMF via LPP, as indicated in *nr-ECID-MeasSupported-r16*. |
| Inter-frequency SSB-based measurements for NR E-CID Note 2,3,4,5 | 1 | Inter-frequency SS-RSRP and SS-RSRQ measurements for NR E-CID reported to LMF via LPP [34]. One report capable of at least in total 10 inter-frequency SS-RSRP and SS-RSRQ measurements. Applicable to UE capable of reporting at least one of SS-RSRP and SS-RSRQ to LMF via LPP. |
| Inter-frequency CSI-RS based measurements for NR E-CID Note 2,3,4,5 | 1 | Inter-frequency CSI-RSRP and CSI-RSRQ measurements for NR E-CID reported to LMF via LPP [22]. One report capable of at least in total 10 inter-frequency CSI-RSRP and CSI-RSRQ measurements. Applicable to UE capable of reporting any of CSI-RSRP and CSI-RSRQ to LMF via LPP, as indicated in *nr-ECID-MeasSupported-r16*. |
| DL RSTD Note 2,4,5 | 1 | DL RSTD measurement reporting; 1 report capable of multiple (within the UE PRS measurement capability, *nr-DL-TDOA-MeasCapability*, indicated via LPP [34]) DL RSTD measurements and if supported also multiple corresponding DL PRS-RSRP measurements configured for DL-TDOA. Only applicable for UE capable of reporting measurements for DL-TDOA to LMF via LPP [34]. |
| UE Rx-Tx Note 2,4,5 | 1 | UE Rx-Tx measurement reporting; 1 report capable of multiple (within the UE PRS measurement capability, *nr-DL-PRS-MeasCapability*, indicated via LPP [34] for multi-RTT) UE Rx-Tx measurements and if supported also multiple corresponding DL PRS-RSRP measurements configured for multi-RTT. Only applicable for UE capable of reporting measurements for multi-RTT to LMF via LPP [34]. |
| DL PRS-RSRP Note 2,4,5 | 1 | DL PRS-RSRP measurement reporting; 1 report capable of multiple (within the UE PRS measurement capability, *nr-DL-PRS-MeasCapability*, indicated via LPP [34] for AoD) DL PRS-RSRP measurements configured for DL-AoD. Only applicable for UE capable of reporting measurements for DL-AoD to LMF via LPP [34]. |
| SRS-RSRP Note 2,3,4,5 | 1 | SRS-RSRP measurement reporting for CLI; 1 report capable of up to 32 SRS resources measurements. Only applicable for UE supporting *cli-SRS-RSRP-Meas-r16*. |
| CLI-RSSI Note 2,3,4,5 | 1 | CLI-RSSI measurement reporting for CLI; 1 report capable of up to 64 CLi-RSSI resources measurements. Only applicable for UE supporting *cli-RSSI-Meas-r16*. |
| NOTE 1: When the UE is configured with PSCell and SCell carrier frequencies, Ecat for Intra-frequency is applied per corresponding NR serving frequency.  NOTE 2: Applicable for UE configured with SA NR operation mode.  NOTE 3: Applicable for UE configured with EN-DC operation mode.  NOTE 4: Applicable for UE configured with NE-DC operation mode.  NOTE 5: Applicable for UE configured with NR-DC operation mode. | | |

### 9.1.5 Carrier-specific scaling factor

This clause specifies the derivation of carrier-specific scaling factor (CSSF) values, which scales the measurement delay requirements given in clause 9.2, 9.2A, 9.3, 9.3A, 9.4, and NR PRS-based positioning measurements in clause 9.9 and CSI-RS based L3 measurement in clause 9.10 when UE is configured to monitor multiple measurement objects. The CSSF values are categorized into CSSFoutside\_gap,i andCSSFwithin\_gap,i, for the measurements conducted outside measurement gaps and within measurement gaps, respectively.

If concurrent measurement gaps are configured by the network, subject to UE capability, the term concurrent measurement gap(s) in the following clauses refer to non-dropped measurement gap occasions after accounting for measurment gap collisions as specified in clause 9.1.8.3 from all the configured measurement gap patterns.

#### 9.1.5.1 Monitoring of multiple layers outside gaps

For a UE supporting concurrent gaps and when concurrent gaps are configured the carrier-specific scaling factor CSSFoutside\_gap,i for measurement object *i* derived in this chapter is applied to following measurement types :

- SSB-based intra-frequency measurement with no measurement gap in clause 9.2.5 and 9.2A.5, when none of the SMTC occasions of this intra-frequency measurement object are overlapped by the measurement gap or concurrent measurement gaps.

- SSB-based intra-frequency measurement with no measurement gap in clause 9.2.5 and 9.2A.5, when part of the SMTC occasions of this intra-frequency measurement object are overlapped by the measurement gap or concurrent measurement gaps.

- CSI-RS based intra-frequency measurement in clause 9.10.2, when none of CSI-RS resources for L3 measurement of this intra-frequency measurement object are overlapped by the measurement gap or concurrent measurement gaps.

- CSI-RS based intra-frequency measurement in clause 9.10.2, when all CSI-RS resources for L3 measurement of this intra-frequency measurement object are partially overlapped by the measurement gap or concurrent measurement gaps.

- SSB-based inter-frequency measurement with no measurement gap in clause 9.3.9, when none of the SMTC occasions of this inter-frequency measurement object are overlapped by the measurement gap or concurrent measurement gaps, if UE supports *interFrequencyMeas-NoGap-r16* and the flag *interFrequencyConfig-NoGap-r16* is configured by the Network.

- SSB-based inter-frequency measurement with no measurement gap in clause 9.3.9, when part of the SMTC occasions of this inter-frequency measurement object are overlapped by the measurement gap or concurrent measurement gaps, if UE supports *interFrequencyMeas-NoGap-r16* and the flag *interFrequencyConfig-NoGap-r16* is configured by the Network.

Otherwise, the carrier-specific scaling factor CSSFoutside\_gap,i for measurement object *i* derived in this chapter is applied to following measurement types:

- SSB-based intra-frequency measurement with no measurement gap in clause 9.2.5 and 9.2A.5, when none of the SMTC occasions of this intra-frequency measurement object are overlapped by the measurement gap or concurrent measurement gaps.

- SSB-based intra-frequency measurement with no measurement gap in clause 9.2.5 and 9.2A.5, when part of the SMTC occasions of this intra-frequency measurement object are overlapped by the measurement gap or concurrent measurement gaps.

- For a UE in E-UTRA-NR dual connectivity operation, NR SSB-based inter-RAT measurement object configured by the E-UTRAN PCell on an NR serving carrier

- the SSB is completely contained in the active BWP of the UE, and

- none or part of the SMTC occasions of this inter-RAT measurement object are overlapped by the measurement gap or concurrent measurement gaps.

- CSI-RS based intra-frequency measurement in clause 9.10.2, when none of CSI-RS resources for L3 measurement of this intra-frequency measurement object are overlapped by the measurement gap or concurrent measurement gaps.

- CSI-RS based intra-frequency measurement in clause 9.10.2, when all CSI-RS resources for L3 measurement of this intra-frequency measurement object are partially overlapped by the measurement gap or concurrent measurement gaps.

- SSB-based inter-frequency measurement with no measurement gap in clause 9.3.9, when none of the SMTC occasions of this inter-frequency measurement object are overlapped by the measurement gap or concurrent measurement gaps, if UE supports *interFrequencyMeas-NoGap-r16* and the flag *interFrequencyConfig-NoGap-r16* is configured by the Network.

- SSB-based inter-frequency measurement with no measurement gap in clause 9.3.9, when part of the SMTC occasions of this inter-frequency measurement object are overlapped by the measurement gap or concurrent measurement gaps, if UE supports *interFrequencyMeas-NoGap-r16* and the flag *interFrequencyConfig-NoGap-r16* is configured by the Network.

- For a UE in E-UTRA-NR dual connectivity operation, NR SSB-based inter-RAT measurement object configured by the E-UTRAN PCell on an NR serving carrier

- the SSB is completely contained in the active BWP of the UE, and

- none or part of the SMTC occasions of this inter-RAT measurement object are overlapped by the measurement gap;

- Intra-frequency RSSI and channel occupancy measurement with no measurement gap on a carrier subject to CCA when SMTC and RMTC are overlapping and RMTCs are not fully overlapped with measurement gap.

UE is expected to conduct the measurement of this measurement object *i* only outside the measurement gaps.

For a UE in E-UTRA-NR dual connectivity operation, if a measurement object configured by PSCell and an NR inter-RAT measurment object configured by E-UTRAN PCell are on the same serving carrier, they shall be counted as one intra-frequency measurement object, provided that they meet the measurement object merging conditions [in clause 9.1.3.2].

The number of frequency layers for SSB measurements shall include the total number of MOs with

- *ssb-ConfigMobility* configured, or

- *ssb-ConfigMobility* not configured but *csi-rs-ResourceConfigMobility* configured with *associatedSSB*.

If *ssbfrequency, smtc1, smtc2* and *ssbSubcarrierSpacing* are same in multiple MOs, the multiple MOs are counted as one SSB frequency layer.

If the higher layer signaling in TS 38.331 [2] of *smtc2* is present and *smtc1* is fully overlapping with measurement gaps and *smtc2* is partially overlapping with measurement gaps, CSSFoutside\_gap,i and requirements derived from CSSFoutside\_gap,i are not specified.

The UE cell identification and measurement periods derived based on CSSFoutside\_gap,i in clauses 9.2.5.1, 9.2.5.2 and 9.10.2 may be extended for measurement objects of which the cell identification and measurement periods are overlapped with Tmeasure\_SFTD1 specified in clause 9.3.8 when no measurement gaps are provided.

The requirements in this clause apply provided that

- The SMTC on all CCs and inter-frequency layers without measurement gap in FR2 have the same offset, and one of following conditions is met

- If *smtc2* is configured on any FR2 CC,

- All CCs have the same configuration for *smtc1*, and

- All CCs configured with *smtc2* have the same configuration for *smtc2*

- If *smtc2* is not configured on any FR2 CC,

- The total number of different SMTC periodicities on all serving CCs and inter-frequency layers without measurement gap does not exceed 4

- The starting point of the first 5ms window for CSI-RS measurement as defined in clause 9.10.1 on all CCs in FR2 is same and one of following conditions is met

- If any CSI-RS resource is configured in the second 5ms window for CSI-RS measurement as defined in clause 9.10.1 on any FR2 CC,

- All CCs with CSI-RS resources only in the first 5ms window have the same CSI-RS resource periodcity, and

- All CCs with CSI-RS resources both in the first and the second 5ms window have the same CSI-RS resource periodcity

- If no CSI-RS resource is configured in the second 5ms window for CSI-RS measurement as defined in clause 9.10.1 on any FR2 CC,

- The total number of different CSI-RS resources periodicities on all serving CCs does not exceed 3Note: Longer delays for cell identification and measurement periods derived based on CSSFoutside\_gap,i in clauses 9.2.5.1, 9.2.5.2, can be expected, if the UE is configured with more than 4 different SMTC periodicities on FR2 serving carriers. The longer delay applies for the FR2 intra-frequency measurement objects with the longest SMTC periodicity/periodicities.

##### 9.1.5.1.1 EN-DC mode: carrier-specific scaling factor for SSB-based, CSI-RS based L3 measurements and RSSI and channel occupancy measurements performed outside gaps

For UE configured with the E-UTRA-NR dual connectivity operation, the carrier-specific scaling factor CSSFoutside\_gap,i for intra-frequency SSB-based measurements, inter-frequency SSB-based measurements performed outside measurements gaps, intra-frequency CSI-RS L3 measurement and RSSI/channel occupancy measurement with no measurement gap on a carrier subject to CCA when SMTC and RMTC are overlapping will be as specified in Table 9.1.5.1.1-1.

Table 9.1.5.1.1-1: CSSFoutside\_gap,i scaling factor for EN-DC mode

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Scenario | *CSSF*outside\_gap,i for FR1 PSCC | *CSSF*outside\_gap,i for FR1 SCC | *CSSF*outside\_gap,i for FR2 PSCC | *CSSF*outside\_gap,i for FR2 SCC where neighbour cell measurement is required Note 2 | *CSSF*outside\_gap,i for FR2 SCC where neighbour cell measurement is not required | *CSSF*outside\_gap,i for inter-frequency MO with no measurement gp |
| **EN-DC with FR1 only CA** | 1+NPSCC\_CSIRS+NPSCC\_CCA\_RSSI/CO | NSCC\_SSB +Y+2x NSCC\_CSIRS+ NSCC\_CCA\_RSSI/CO | N/A | N/A | N/A | NSCC\_SSB +Y+2x NSCC\_CSIRS |
| **EN-DC with**  **FR2 only intra band CA** | N/A | N/A | 1+NPSCC\_CSIRS | N/A | NSCC\_SSB +Y+2x NSCC\_CSIRS | NSCC\_SSB +Y+2x NSCC\_CSIRS |
| **EN-DC with**  **FR2 only inter band CA** | N/A | N/A | 1+NPSCC\_CSIRS | 2x(1+ NSCC\_CSIRS\_FR2\_NCM) Note 3,5 | 2×( NSCC\_SSB +Y+2x NSCC\_CSIRS -1-NSCC\_CSIRS\_ FR2\_NCM) | 2×( NSCC\_SSB +Y+2x NSCC\_CSIRS -1-NSCC\_CSIRS\_ FR2\_NCM) |
| **EN-DC with**  **FR1 +FR2 CA (FR1 PSCell) Note 1** | 1+NPSCC\_CSIRS | 2×( NSCC\_SSB +Y+2xNSCC\_CSIRS -1-NSCC\_CSIRS\_ FR2\_NCM) | N/A | 2x(1+NSCC\_CSIRS\_FR2\_NCM) Note 3 | 2×( NSCC\_SSB +Y+2x NSCC\_CSIRS -1-NSCC\_CSIRS\_ FR2\_NCM) | 2×( NSCC\_SSB +Y+2x NSCC\_CSIRS -1-NSCC\_CSIRS\_ FR2\_NCM) |
| **EN-DC with**  **FR1 +FR2 CA (FR2 PSCell) Note 1** | N/A | NSCC\_SSB +Y+2x NSCC\_CSIRS | 1+NPSCC\_CSIRS | N/A | NSCC\_SSB+Y+2x NSCC\_CSIRS | NSCC\_SSB+Y+2x NSCC\_CSIRS |
| Note 1: Only one NR FR1 operating band and one NR FR2 operating band are included for FR1+FR2 inter-band EN-DC.  Note 2: Selection of FR2 SCC where neighbour cell measurement is required follows clause 9.2.3.2.  Note 3: CSSFoutside\_gap,i =1 if only one SCell is configured and no inter-frequency MO without gap and only SSB based L3 measurement is configured on SCC; CSSFoutside\_gap,i =2 if only one SCell is configured and no inter-frequency MO without gap and either both SSB and CSI-RS based L3 configured or only CSI-RS based L3 measurement is configured on SCC.  Note 4: Y is the number of configured inter-frequency MOs without MG that are being measured outside of MG; otherwise, it is 0.  Note 5: Only two NR FR2 operating band are included for EN-DC with FR2 only inter-band CA  Note 6: NPSCC\_CSIRS=1 if PSCC is with either both SSB and CSI-RS based L3 configured or only CSI-RS based L3 measurement configured; otherwise, NPSCC\_CSIRS =0.  Note 7: NSCC\_CSIRS=Number of configured SCell(s) with either both SSB and CSI-RS based L3 measurement configured or only CSI-RS based L3 measurement configured  Note 8: NSCC\_CSIRS\_FR2\_NCM=1 if FR2 SCC, where neighbour cell measurement is required, is with either both SSB and CSI-RS configured or only CSI-RS measurement configured; otherwise, NSCC\_CSIRS\_FR2\_NCM=0.  Note 9: NSCC\_SSB=Number of configured SCell(s) with only SSB based L3 measurement configured, which is measured without MG.  Note 10: NPSCC\_CCA\_RSSI/CO= 1 if PSCC is configured with RSSI/CO measurements without MG when RMTC and SMTC are overlapping; NSCC\_CCA\_RSSI/CO = Number of MOs for SCell(s) configured with RSSI/CO measurements without MG when RMTC and SMTC are overlapping.  Note 11 If a measurement object configured by PSCell and an NR inter-RAT measurment object configured by E-UTRAN PCell are on the same serving carrier, they shall be counted as one intra-frequency measurement object, provided that they meet the measurement object merging conditions [in clause 9.1.3.2], otherwise they are counted separately as two measurement objects. | | | | | | |

##### 9.1.5.1.2 SA mode: carrier-specific scaling factor for SSB-based, CSI-RS based L3 measurements and RSSI and channel occupancy measurements performed outside gaps

For UE in SA operation mode, the carrier-specific scaling factor CSSFoutside\_gap,i for intra-frequency SSB-based measurements, inter-frequency SSB-based measurements performed outside measurements gaps, intra-frequency CSI-RS L3 measurement and RSSI/channel occupancy measurement with no measurement gap on a carrier subject to CCA when SMTC and RMTC are overlapping will be as specified in Table 9.1.5.1.2-1, which shall also be applied for a UE configured with NE-DC operation.

Table 9.1.5.1.2-1: CSSFoutside\_gap,i scaling factor for SA mode

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Scenario | *CSSF*outside\_gap,i for FR1 PCC | *CSSF*outside\_gap,i for FR1 SCC | *CSSF*outside\_gap,i for FR2 PCC | *CSSF*outside\_gap,i for FR2 SCC where neighbour cell measurement is required | *CSSF* outside\_gap,i for FR2 SCC where neighbour cell measurement is not required | *CSSF*outside\_gap,i for inter-frequency MO with no measurement gap |
| **FR1 only CA** | 1+NPCC\_CSIRS + NPCC\_CCA\_RSSI/CO | NSCC\_SSB +Y+2x NSCC\_CSIRS+ NSCC\_CCA\_RSSI/CO | N/A | N/A | N/A | NSCC\_SSB +Y+2x NSCC\_CSIRS |
| **FR2 only intra band CA** | N/A | N/A | 1+NPCC\_CSIRS | N/A | NSCC\_SSB +Y+2x NSCC\_CSIRS | NSCC\_SSB +Y+2x NSCC\_CSIRS |
| **FR2 only inter band CA** | N/A | N/A | 1+NPCC\_CSIRS | 2\*(1+ NSCC\_CSIRS\_FR2\_NCM) Note 3,5 | 2×( NSCC\_SSB +Y+2x NSCC\_CSIRS -1-NSCC\_CSIRS\_ FR2\_NCM) | 2×( NSCC\_SSB +Y+2x NSCC\_CSIRS -1-NSCC\_CSIRS\_ FR2\_NCM) |
| **FR1 +FR2 CA (FR1 PCell) Note 1** | 1+NPCC\_CSIRS | 2×( NSCC\_SSB +Y+2\* NSCC\_CSIRS -1-NSCC\_CSIRS\_ FR2\_NCM) | N/A | 2x(1+ NSCC\_CSIRS\_FR2\_NCM) Note 3,5 | 2×( NSCC\_SSB +Y+2x NSCC\_CSIRS -1-NSCC\_CSIRS\_ FR2\_NCM) | 2×( NSCC\_SSB +Y+2x NSCC\_CSIRS -1-NSCC\_CSIRS\_ FR2\_NCM) |
| **FR1 +FR2 CA (FR2 PCell) Note 1** | N/A | NSCC\_SSB +Y+2x NSCC\_CSIRS | 1+NPCC\_CSIRS | N/A | NSCC\_SSB +Y+2x NSCC\_CSIRS | NSCC\_SSB +Y+2x NSCC\_CSIRS |
| Note 1: Only one FR1 operating band and one FR2 operating band are included for FR1+FR2 inter-band CA.  Note 2: Selection of FR2 SCC where neighbour cell measurement is required follows clause 9.2.3.2.  Note 3: CSSFoutside\_gap,i =1 if only one SCell is configured and no inter-frequency MO without gap and only SSB based L3 measurement is configured on SCC; CSSFoutside\_gap,i =2 if only one SCell is configured and no inter-frequency MO without gap and either both SSB and CSI-RS based L3 configured or only CSI-RS based L3 measurement is configured on SCC.  Note 4: Y is the number of configured inter-frequency MOs without MG that are being measured outside of MG; otherwise, it is 0.  Note 5: Only two NR FR2 operating bands are included for FR2 inter-band CA.  Note 6: NPCC\_CSIRS=1 if PCC is with either both SSB and CSI-RS based L3 configured or only CSI-RS based L3 measurement configured; otherwise, NPCC\_CSIRS =0.  Note 7: NSCC\_CSIRS=Number of configured SCell(s) with either both SSB and CSI-RS based L3 measurement configured or only CSI-RS based L3 measurement configured  Note 8: NSCC\_CSIRS\_FR2\_NCM=1 if FR2 SCC, where neighbour cell measurement is required, is with either both SSB and CSI-RS configured or only CSI-RS measurement configured; otherwise, NSCC\_CSIRS\_FR2\_NCM=0.  Note 9: NSCC\_SSB=Number of configured SCell(s) with only SSB based L3 measurement configured, which is measured without MG.  Note 10: NPCC\_CCA\_RSSI/CO= 1 if PSCC is configured with RSSI/CO measurements without MG when RMTC and SMTC are overlapping; NSCC\_CCA\_RSSI/CO = Number of MOs for SCell(s) configured with RSSI/CO measurements without MG when RMTC and SMTC are overlapping. | | | | | | |

##### 9.1.5.1.3 NR-DC mode: carrier-specific scaling factor for SSB-based and CSI-RS based L3 measurements performed outside gaps

For UE configured with NR-DC operation, the carrier-specific scaling factor CSSFoutside\_gap,i for intra-frequency SSB-based measurement, inter-frequency SSB-based measurements performed outside measurements gaps and intra-frequency CSI-RS based L3 measurement will be as specified in Table 9.1.5.1.3-1.

Table 9.1.5.1.3-1: CSSFoutside\_gap,i scaling factor for NR-DC mode

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Scenario | *CSSF*outside\_gap,i for FR1 PCC | *CSSF*outside\_gap,i for FR1 SCC | *CSSF*outside\_gap,i for FR2 PSCC | *CSSF*outside\_gap,i for FR2 SCC where neighbour cell measurement is not required | *CSSF*outside\_gap,i for inter-frequency MO with no measurement gap |
| **FR1 + FR2 NR-DC (FR1 PCell and FR2 PScell) Note 1** | 1+NPCC\_CSIRS | 2×( NSCC\_SSB +Y+2xNSCC\_CSIRS) | 2x(1+ NPSCC\_CSIRS) Note 2 | 2x(NSCC\_SSB +Y+2x NSCC\_CSIRS ) | 2x(NSCC\_SSB +Y+2x NSCC\_CSIRS ) |
| Note 1: NR-DC in Rel-15 only includes the scenarios where all serving cells in MCG in FR1 and all serving cells in SCG in FR2.  Note 2: CSSFoutside\_gap,i =1 if no SCell is configured and no inter-frequency MO without gap and only SSB based L3 measurement is configured on PSCC; CSSFoutside\_gap,i =2 if no SCell is configured and no inter-frequency MO without gap and either both SSB and CSI-RS based L3 configured or only CSI-RS based L3 measurement is configured on PSCC.  Note 3: Y is the number of configured inter-frequency SSB based frequency layers without MG that are being measured outside of MG; otherwise, it is 0.  Note 4: NPCC\_CSIRS=1 if PCC is with either both SSB and CSI-RS based L3 configured or only CSI-RS based L3 measurement configured; otherwise, NPCC\_CSIRS =0.  Note 5: NPSCC\_CSIRS=1 if PSCC is with either both SSB and CSI-RS based L3 configured or only CSI-RS based L3 measurement configured; otherwise, NPSCC\_CSIRS =0.  Note 6: NSCC\_CSIRS=Number of configured SCell(s) with either both SSB and CSI-RS based L3 measurement configured or only CSI-RS based L3 measurement configured  Note 8: NSCC\_SSB=Number of configured SCell(s) with only SSB based L3 measurement configured, which is measured without MG. | | | | | |

##### 9.1.5.1.4 NE-DC mode: carrier-specific scaling factor for SSB-based and CSI-RS based measurements performed outside gaps

For UE configured with NE-DC operation, the carrier-specific scaling factor CSSFoutside\_gap,i for intra-frequency SSB-based measurement and inter-frequency SSB-based measurements performed outside measurements gaps and intra-frequency CSI-RS based L3 measurement will be as specified in Table 9.1.5.1.4-1.

Table 9.1.5.1.4-1: CSSFoutside\_gap,i scaling factor for NE-DC mode

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Scenario | *CSSF*outside\_gap,i for FR1 PCC | *CSSF*outside\_gap,i for FR1 SCC | *CSSF*outside\_gap,i for FR2 PCC | *CSSF*outside\_gap,i for FR2 SCC where neighbour cell measurement is required | *CSSF*outside\_gap,i for FR2 SCC where neighbour cell measurement is not required | *CSSF*outside\_gap,i for inter-frequency MO with no measurement gap |
| **NE-DC with FR1 only CA** | 1+NPCC\_CSIRS | NSCC\_SSB +Y+2x NSCC\_CSIRS | N/A | N/A | N/A | NSCC\_SSB +Y+2x NSCC\_CSIRS |
| **NE-DC with FR2 only intra band CA** | N/A | N/A | 1+NPCC\_CSIRS | N/A | NSCC\_SSB +Y+2x NSCC\_CSIRS | NSCC\_SSB +Y+2x NSCC\_CSIRS |
| **NE-DC with**  **FR2 only inter band CA** | N/A | N/A | 1+NPCC\_CSIRS | 2\*(1+ NSCC\_CSIRS\_FR2\_NCM) Note 3,5 | 2×( NSCC\_SSB +Y+2x NSCC\_CSIRS -1-NSCC\_CSIRS\_ FR2\_NCM) | 2×( NSCC\_SSB +Y+2x NSCC\_CSIRS -1-NSCC\_CSIRS\_ FR2\_NCM) |
| **NE-DC with FR1 +FR2 CA (FR1 PCell) Note 1** | 1+NPCC\_CSIRS | 2×( NSCC\_SSB +Y+2\* NSCC\_CSIRS -1-NSCC\_CSIRS\_ FR2\_NCM) | N/A | 2x(1+ NSCC\_CSIRS\_FR2\_NCM) Note 3,5 | 2×( NSCC\_SSB +Y+2x NSCC\_CSIRS -1-NSCC\_CSIRS\_ FR2\_NCM) | 2×( NSCC\_SSB +Y+2x NSCC\_CSIRS -1-NSCC\_CSIRS\_ FR2\_NCM) |
| Note 1: Only one FR1 operating band and one FR2 operating band are included for FR1+FR2 inter-band CA.  Note 2: Selection of FR2 SCC where neighbour cell measurement is required follows clause 9.2.3.2.  Note 3: CSSFoutside\_gap,i =1 if only one SCell is configured and no inter-frequency MO without gap and only SSB based L3 measurement is configured on SCC; CSSFoutside\_gap,i =2 if only one SCell is configured and no inter-frequency MO without gap and either both SSB and CSI-RS based L3 configured or only CSI-RS based L3 measurement is configured on SCC.  Note 4: Y is the number of configured inter-frequency MOs without MG that are being measured outside of MG; otherwise, it is 0.  Note 5: Only two NR FR2 operating band are included for NE-DC with FR2 only inter-band CA.  Note 6: NPCC\_CSIRS=1 if PCC is with either both SSB and CSI-RS based L3 configured or only CSI-RS based L3 measurement configured; otherwise, NPCC\_CSIRS =0.  Note 7: NSCC\_CSIRS=Number of configured SCell(s) with either both SSB and CSI-RS based L3 measurement configured or only CSI-RS based L3 measurement configured  Note 8: NSCC\_CSIRS\_FR2\_NCM=1 if FR2 SCC, where neighbour cell measurement is required, is with either both SSB and CSI-RS configured or only CSI-RS measurement configured; otherwise, NSCC\_CSIRS\_FR2\_NCM=0.  Note 9: NSCC\_SSB=Number of configured SCell(s) with only SSB based L3 measurement configured, which is measured without MG. | | | | | | |

#### 9.1.5.2 Monitoring of multiple layers within gaps

For a UE supporting concurrent gaps and when concurrent gaps are configured the carrier-specific scaling factor CSSFwithin\_gap,i for a measurement object *i* derived in this chapter is applied to following measurement types for each measurement gap:

- SSB-based intra-frequency measurement object with no measurement gap in clause 9.2.5 and 9.2A.5, when all of the SMTC occasions of this intra-frequency measurement object are overlapped by the measurement gap or concurrent measurement gaps.

- SSB-based intra-frequency measurement object with measurement gap in clause 9.2.6 and 9.2A.6.

- CSI-RS based inter-frequency measurement in clause 9.10.3, when CSI-RS resources for L3 measurement of this inter-frequency measurement object are overlapped by the measurement gap or concurrent measurement gaps.

- CSI-RS based inter-frequency measurement in clause 9.10.3, when CSI-RS resources for L3 measurement of this inter-frequency measurement object are partially overlapped by the measurement gap or concurrent measurement gaps.

- SSB-based inter-frequency measurement object with measurement gap in clause 9.3.4.

- SSB-based inter-frequency measurement object without measurement gap for UE capable of *interFrequencyMeas-NoGap* in clause 9.3.9, when

- all of the SMTC occasions of this inter-frequency measurement object are overlapped by the measurement gap or concurrent measurement gaps, or

- part of the SMTC occasions of this inter-frequency measurement object are overlapped by the measurement gap or concurrent measurement gaps, but the flag *interFrequencyConfig-NoGap-r16* is not configured by the Network.

- NR PRS-based measurements for positioning in clause 9.9.

- E-UTRA Inter-RAT measurement object in clauses 9.4.2 and 9.4.3.

Otherwise, the carrier-specific scaling factor CSSFwithin\_gap,i for a measurement object *i* derived in this chapter is applied to following measurement types:

- SSB-based intra-frequency measurement object with no measurement gap in clause 9.2.5 and 9.2A.5, when all of the SMTC occasions of this intra-frequency measurement object are overlapped by the measurement gap or concurrent measurement gaps.

- SSB-based intra-frequency measurement object with measurement gap in clause 9.2.6 and 9.2A.6.

- CSI-RS based inter-frequency measurement in clause 9.10.3, when CSI-RS resources for L3 measurement of this inter-frequency measurement object are overlapped by the measurement gap or concurrent measurement gaps.

- CSI-RS based inter-frequency measurement in clause 9.10.3, when CSI-RS resources for L3 measurement of this inter-frequency measurement object are partially overlapped by the measurement gap or concurrent measurement gaps.

- SSB-based inter-frequency measurement object with measurement gap in clause 9.3.4.

- SSB-based inter-frequency measurement object without measurement gap for UE capable of *interFrequencyMeas-NoGap* in clause 9.3.9, when

- all of the SMTC occasions of this inter-frequency measurement object are overlapped by the measurement gap or concurrent measurement gaps, or

- part of the SMTC occasions of this inter-frequency measurement object are overlapped by the measurement gap or concurrent measurement gaps, but the flag *interFrequencyConfig-NoGap-r16* is not configured by the Network.

- Intra-frequency RSSI/CO measurement with measurement gap in clause 9.2A.7.

- Intra-frequency RSSI/CO measurement with no measurement gap in clause 9.2A.7 when all of the RMTC occasions of this intra-frequency RSSI/CO measurement are overlapped by the measurement gap(s).

- Inter-frequency RSSI/CO measurement in clause 9.3A.8 and 9.3A.9.

- E-UTRA Inter-RAT measurement object in clauses 9.4.2 and 9.4.3.

- NR PRS-based measurements for positioning in clause 9.9.

- E-UTRA Inter-RAT RSTD and E-CID measurements in clauses 9.4.4 and 9.4.5.

- For a UE in E-UTRA-NR dual connectivity operation, NR SSB-based Inter-RAT measurement object configured by the E-UTRAN PCell (TS 36.133 [15] clause 8.17.4) on an NR serving carrier

- the SSB is not completely contained in the active BWP of the UE, or

- all of the SMTC occasions of this inter-RAT measurement object are overlapped by the measurement gap;

- NR SSB-based Inter-RAT measurement object configured by the E-UTRAN PCell (TS 36.133 [15] clause 8.17.4) on an NR non-serving carrier.

- E-UTRAN Inter-frequency measurement object configured by the E-UTRAN PCell (TS 36.133 [15] clause 8.17.3) and by the E-UTRAN PSCell (TS 36.133 [15] clause 8.19.3).

- E-UTRAN Inter-frequency RSTD measurement configured by the E-UTRAN PCell (TS 36.133 [15] clause 8.17.15).

- UTRA Inter-RAT measurement object configured by the E-UTRAN PCell (TS 36.133 [15] clauses 8.17.5 to 8.17.12).

- GSM Inter-RAT measurements configured by the E-UTRAN PCell (TS 36.133 [15] clauses 8.17.13 and 8.17.14).

The UE is expected to conduct the measurement of this measurement object *i* only within the measurement gaps. If UE is configured with concurrent measurement gaps and an association between measurement object i and certain measurement gaps is provided, the requirements are defined assuming the UE shall conduct the measurement of this measurement object *i* at least within the associated measurement gaps.

If the higher layer signaling in TS 38.331 [2] of *smtc2* is present and *smtc1* is fully overlapping with measurement gaps and *smtc2* is partially overlapping with measurement gaps, CSSFwithin\_gap,i and requirements derived from CSSFoutside\_gap,i are not specified.

Number of SSB layers should include SSB for mobility and that as associated SSB for CSI-RS mobility. the ssbfrequency is counted only once if the ssbfrequency for mobility and associated SSB are the same, or ssbfrequency and smtc in multiple MOs are the same.

Editor’s note: FFS how to add the layer corresponding to the associated SSB for a MO with only CSI-RS measurement configured

##### 9.1.5.2.1 EN-DC mode: carrier-specific scaling factor for SSB, CSI-RS-based L3 measurements and RSSI and channel occupancy measurements performed within gaps

The scaling value CSSFwithin\_gap,i below has been derived without considering GSM inter-RAT carriers.

When one or more measurement objects are monitored within measurement gaps, the carrier specific scaling factor for a target measurement object with index *i* is designated as CSSFwithin\_gap,i and is derived as described in this clause.

For a UE in E-UTRA-NR dual connectivity operation, if a SSB-based measurement object configured by PSCell and an NR SSB-based inter-RAT measurement object configured by E-UTRAN PCell are on the same carrier, they shall be counted as one measurement object in Mtot,i,j, provided that they meet the measurement object merging conditions [in clause 9.1.3.2].

If measurement object *i* refers to an RSTD measurement with periodicity Tprs>160ms or with periodicity Tprs=160ms but *prs-MutingInfo-r9* is configured, CSSFwithin\_gap,i=1. Otherwise, the CSSFwithin\_gap,i for other measurement objects (including RSTD measurement with periodicity Tprs=160ms) participate in the gap competition are derived as below.

For each measurement gap *j* not used for an RSTD measurement with periodicity Tprs>160ms or with periodicity Tprs=160ms but *prs-MutingInfo-r9* is configured within an arbitrary 160ms period, count the total number of intra-frequency measurement objects and inter-frequency/inter-RAT measurement objects which are candidates to be measured within the gap *j*.

- An NR measurement object with SSB measurement configured is a candidate to be measured in a gap if its SMTC duration is fully covered by the MGL excluding RF switching time. For intra-frequency NR carriers, if the higher layer in TS 38.331 [2] signaling of *smtc2* is configured, the assumed periodicity of SMTC occasions corresponds to the value of higher layer parameter *smtc2*; otherwise the assumed periodicity of SMTC occasions corresponds to the value of higher layer parameter *smtc1*.

- An NR measurement object with CSI-RS measurement configured is a candidate to be measured in a gap if the window confining all CSI-RS resources are fully covered by the MGL excluding RF switching time. -

- An NR measurement object with RSSI and channel occupancy measurement is a candidate to be measurement in a gap if the RMTC duration is fully covered by MGL excluding RF switching time

- An inter-RAT UTRA measurement object configured by E-UTRA PCell [15] is a candidate to be measured in all measurement gaps.

- An inter-frequency E-UTRA measurement object configured by E-UTRA PCell [15] is a candidate to be measured in all measurement gaps.

- For UEs which support and are configured with per FR gaps, the counting is done on a per FR basis, and for UEs which are configured with per UE gaps the counting is done on a per UE basis.

- Mintra,i,j: Number of intra-frequency measurement objects, including both SSB, CSI-RS based and RSSI/CO measurement, which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise Mintra,i,j equals 0.

- Minter,i,j : Number of NR inter-frequency layers including both SSB and CSI-RS based NR inter-RAT frequency layer and RSSI/CO measurement, configured by E-UTRA PCell, EUTRA inter-frequency measurement objects configured by E-UTRA PCell, or UTRA inter-RAT measurement objects configured by E-UTRA PCell which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise Minter,i,j equals 0.

- A measurement object *i* in Mintra,i,j and in Minter,i,j is counted twice if the measurement object is configured with both RMTC and SMTC which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate

- Mtot,i,j = Mintra,i,j + Minter,i,j : Total number of intra-frequency, inter-frequency and inter-RAT frequency layers which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise Mtot,i,j equals 0.

For each measurement gap *j* used for an RSTD measurement with periodicity Tprs>160ms or with periodicity Tprs=160ms but *prs-MutingInfo-r9* is configured within an arbitrary 160ms period, Mintra,i,j = Minter,i,j = Mtot,i,j =0.

The carrier specific scaling factor CSSFwithin\_gap,i is given by:

If *measGapSharingScheme* is equal sharing, CSSFwithin\_gap,i= max(ceil(Ri×Mtot,i,j)), where *j*=0…(160/MGRP)-1

If *measGapSharingScheme* is not equal sharing and

- measurement object *i* is an intra-frequency measurement object, CSSFwithin\_gap,i is the maximum among

- ceil(Ri×Kintra×Mintra,i,j) in gaps where Minter,i,j≠0, where *j*=0…(160/MGRP)-1

- ceil(Ri×Mintra,i,j) in gaps where Minter,i,j=0, where *j*=0…(160/MGRP)-1

- measurement object *i* is an inter-frequency or inter-RAT measurement object, CSSFwithin\_gap,i is the maximum among

- ceil(Ri×Kinter×Minter,i,j) in gaps where Mintra,i,j ≠0, where *j*=0…(160/MGRP)-1

- ceil(Ri×Minter,i,j)in gaps where Mintra,i,j=0, where *j*=0…(160/MGRP)-1

Where Ri is the maximal ratio of the number of measurement gap where measurement object *i* is a candidate to be measured over the number of measurement gap where measurement object *i* is a candidate and not used for RSTD measurement with periodicity Tprs>160ms or with periodicity Tprs=160ms but *prs-MutingInfo-r9* is configured within an arbitrary 1280ms period.

##### 9.1.5.2.2 SA mode: carrier-specific scaling factor for SSB, CSI-RS-based L3 measurements and RSSI and channel occupancy measurements performed within gaps

When one or more measurement objects are monitored within measurement gaps, the carrier specific scaling factor for a target measurement object with index *i* is designated as CSSFwithin\_gap,i and is derived as described in this clause.

If a UE capable of concurrent gaps is configured with concurrent gaps, the carrier specific scaling factor is calculated separately for each gap pattern, [provided that the association between measurement objects and gap pattern is configured by network. Only the measurement objects associated to the same measurement gap pattern are counted when deriving CSSFwithin\_gap,I for a target measurement object with index *i*.]. In case of collision between concurrent measurement gaps, some measurement gap occasions may be dropped according to clause [9.1.X2.x]. The dropped gap occasions will not be used in deriving CSSFwithin\_gap,i.

Editor’s note: FFS whether to remove [ ] or revise the sentence in [ ] after RAN2 concludes the implementation on RRC association.

If measurement object *i* refers to a long-periodicity measurement which is any of:

- an E-UTRA RSTD measurement with periodicity Tprs>160ms or with periodicity Tprs=160ms but *prs-MutingInfo-r9* is configured, or

- an NR measurement for positioning frequency layer i with Tavailable\_PRS,i >160ms, where Tavailable\_PRS,i is defined in clauses 9.9.2.5, 9.9.3.5 and 9.9.4.5 for RSTD, PRS-RSRP and UE Rx-Tx time difference measurements, respectively.

then CSSFwithin\_gap,i=1. Otherwise, the CSSFwithin\_gap,i for other measurement objects (including E-UTRA RSTD measurement with periodicity Tprs=160ms) participate in the gap competition and the CSSFwithin\_gap,i are derived as below.

Table 9.1.5.2.2-1: void

When multiple positioning frequency layers are configured,

- for each positioning frequency layer i, CSSFwithin\_gap,i is derived with the following steps assuming no other positioning frequency layer is configured.

- for each RRM frequency layer i, CSSFwithin\_gap,i is derived as follows:

- an intermediate CSSFwithin\_gap,i,k is derived with the following steps assuming only positioning frequency layer *k* is configured, and

- CSSFwithin\_gap,i= max(CSSFwithin\_gap,i,k), where *k*=0…K-1, and K is the number of configured positioning frequency layers.For each measurement gap *j* not used for a long-periodicity measurement defined above, count the total number of intra-frequency measurement objects and inter-frequency/inter-RAT measurement objects and NR PRS measurements on all positioning frequency layers which are candidates to be measured within the gap *j*.

- An NR measurement object with SSB measurement configured is a candidate to be measured in a gap if its SMTC duration is fully covered by the MGL excluding RF switching time. For intra-frequency NR measurement objects, if the higher layer in TS 38.331 [2] signaling of *smtc2* is configured, the assumed periodicity of SMTC occasions corresponds to the value of higher layer parameter *smtc2*; otherwise the assumed periodicity of SMTC occasions corresponds to the value of higher layer parameter *smtc1*.

- An NR measurement object with CSI-RS measurement configured is a candidate to be measured in a gap if the window confining all CSI-RS resources are fully covered by the MGL excluding RF switching time.

- An NR measurement object with RSSI and channel occupancy measurement is a candidate to be measurement in a gap if the RMTC duration is fully covered by MGL excluding RF switching time

- An inter-frequency SFTD measurement object, if to be measured with measurement gaps, is a candidate to be measured in all measurement gaps.

- An NR PRS-based measurement is a candidate to be measured in a gap is TBD.

- A positioning frequency layer is counted as candidate for a MG occasion if at least one PRS resource on that positioning frequency layer is fully covered by the MGL excluding RF switching time.

- For UEs which support and are configured with per FR gaps, the counting is done on a per FR basis, and for UEs which are configured with per UE gaps the counting is done on a per UE basis. For UEs which support and are configured with per FR gaps, the CSSF requirements do not apply when NR PRS measurement in one FR gap collides with SSB/CSI-RS/PRS measurements in the other FR gap in time domain.

- Mintra,i,j: Number of intra-frequency measurement objects, including both SSB, CSI-RS based and RSSI/CO measurements, which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise Mintra,i,j equals 0.

- Minter,i,j : Number of NR inter-frequency layers including both SSB and CSI-RS based, EUTRA inter-RAT and UTRA inter-RAT frequency layers, up to one positioning frequency layer, RSSI/CO measurements, which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise Minter,i,j equals 0.

- A measurement object *i* in Mintra,i,j and in Minter,i,j is counted twice if the measurement object is configured with both RMTC and SMTC which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate

- Mtot,i,j = Mintra,i,j + Minter,i,j : Total number of intra-frequency, inter-frequency and inter-RAT frequncy layers and up to one NR PRS measurement on any one positioning frequency layer, which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise Mtot,i,j equals 0.

For each measurement gap *j* used for a long-periodicity measurement defined above, Mintra,i,j = Minter,i,j = Mtot,i,j =0. The carrier specific scaling factor CSSFwithin\_gap,i is given by:

If *measGapSharingScheme* is equal sharing, CSSFwithin\_gap,i= max(ceil(Ri×Mtot,i,j)), where *j*=0…(160/MGRP)-1

If *measGapSharingScheme* is not equal sharing and

- measurement object *i* is an intra-frequency measurement object, CSSFwithin\_gap,i is the maximum among

- ceil(Ri×Kintra×Mintra,i,j) in gaps where Minter,i,j≠0, where *j*=0…(160/MGRP)-1

- ceil(Ri×Mintra,i,j) in gaps where Minter,i,j=0, where *j*=0…(160/MGRP)-1

- measurement object *i* is an inter-frequency or inter-RAT measurement object or NR PRS measurement on any one positioning frequency layer, CSSFwithin\_gap,i is the maximum among

- ceil(Ri×Kinter×Minter,i,j) in gaps where Mintra,i,j ≠0, where *j*=0…(160/MGRP)-1

- ceil(Ri×Minter,i,j)in gaps where Mintra,i,j=0, where *j*=0…(160/MGRP)-1

Where Ri is the maximal ratio of the number of measurement gap where measurement object *i* is a candidate to be measured over the number of measurement gap where measurement object *i* is a candidate and not used for a long-periodicity measurement defined above.

CSSFwithin\_gap,k=1 during TDetect, E-UTRAN FDD specified in clause 9.4.4.1.2.2 and TDetect, E-UTRAN TDD specified in clause 9.4.4.2.2.2, where k is the carrier frequency where the UE is performing cell detection of the inter-RAT E-UTRA OTDOA assistance data reference cell when acquiring the subframe and slot timing of the cell according to clause 9.4.4. In this case, the UE cell identification and measurement periods derived based on CSSFwithin\_gap,i in clauses 9.2.5.1, 9.2.5.2, 9.2.6.2, 9.2.6.3, 9.3.4, 9.3.5, 9.4.2.2, 9.4.2.3 and 9.10.2 may be extended for measurement objects of which the cell identification and measurement periods are overlapped with TDetect, E-UTRAN FDD and TDetect, E-UTRAN TDD.

##### 9.1.5.2.3 NE-DC: carrier-specific scaling factor for SSB-based and CSI-RS based L3 measurements performed within gaps

When one or more measurement objects are monitored within measurement gaps, the carrier specific scaling factor for a target measurement object with index *i* is designated as CSSFwithin\_gap,i and is derived as described in this clause.

If measurement object *i* refers to a long-periodicty measurement which is any of:

- an E-UTRA RSTD measurement with periodicity Tprs>160ms or with periodicity Tprs=160ms but *prs-MutingInfo-r9* is configured, or

- an NR measurement for positioning frequency layer i with Tavailable\_PRS,i >160ms, where Tavailable\_PRS,i is defined in clauses 9.9.2.5, 9.9.3.5 and 9.9.4.5 for RSTD, PRS-RSRP and UE Rx-Tx time difference measurements, respectively.

then CSSFwithin\_gap,i=1. Otherwise, the CSSFwithin\_gap,i for other measurement objects (including E-UTRA RSTD measurement with periodicity Tprs=160ms) participate in the gap competition are derived as below.

When multiple positioning frequency layers are configured,

- for each positioning frequency layer *i*, CSSFwithin\_gap,i is derived with the following steps assuming no other positioning frequency layer is configured.

- for each RRM frequency layer *i*, CSSFwithin\_gap,i is derived as follows:

- an intermediate CSSFwithin\_gap,i,k is derived with the following steps assuming only positioning frequency layer *k* is configured, and

- CSSFwithin\_gap,i= max(CSSFwithin\_gap,i,k), where *k*=0…K-1, and K is the number of configured positioning frequency layers.

For each measurement gap *j* not used for a long-periodicity measurement defined above, count the total number of intra-frequency measurement objects and inter-frequency/inter-RAT measurement objects and NR PRS measurements on all positioning frequency layers which are candidates to be measured within the gap *j*.

- An NR measurement object with SSB measurement configured is a candidate to be measured in a gap if its SMTC duration is fully covered by the MGL excluding RF switching time. For intra-frequency NR measurement objects, if the higher layer in TS 38.331 [2] signaling of *smtc2* is configured, the assumed periodicity of SMTC occasions corresponds to the value of higher layer parameter *smtc2*; otherwise the assumed periodicity of SMTC occasions corresponds to the value of higher layer parameter *smtc1*.

- An NR measurement object with CSI-RS measurement configured is a candidate to be measured in a gap if the window confining all CSI-RS resources are fully covered by the MGL excluding RF switching time.

- An inter-RAT measurement object is a candidate to be measured in all measurement gaps.

- An inter-frequency E-UTRA measurement object is a candidate to be measured in all measurement gaps.

- A positioning frequency layer is counted as candidate for a MG occasion if at least one PRS resource on that positioning frequency layer is fully covered by the MGL excluding RF switching time.

For UEs which support and are configured with per FR gaps, the counting is done on a per FR basis, and for UEs which are configured with per UE gaps the counting is done on a per UE basis. For UEs which support and are configured with per FR gaps, the CSSF requirements do not apply when NR PRS measurement in one FR gap collides with SSB/CSI-RS/PRS measurements in the other FR gap in time domain.

If the number of configured interfrequency and interRAT measuerement objects and NR PRS measurements on all positioning frequency layers is non-zero and the UE is configured with per UE gaps, or if the UE is configured with per FR gaps:

FR1 and FR2 intrafrequency measurement objects belong to group A

Interfrequency and interRAT measurement objects belong to group B

MgroupA,i,j: Sum of the number of FR1 intra-frequency measurement objects Mintra-FR1,i,j and the number of FR2 intra-frequency measurement objects Mintra-FR2,i,j , including both SSB and CSI-RS based, which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise MgroupA,i,j equals 0.

MgroupBi,j: Number of NR inter-frequency layers including both SSB and CSI-RS based, EUTRA inter-RAT and UTRA inter-RAT measurement objects, up to one positioning frequency layer, which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise MgroupB,i,j equals 0.

If the number of configured inter-frequency and inter-RAT measuerement objects and NR PRS measurements on all positioning frequency layers is zero and the UE is configured with per UE gaps:

FR1 intrafrequency measurement objects belong to group A

FR2 intrafrequency measurement objects belong to group B

MgroupA,i,j: The number of FR1 intrafrequency measurement objects Mintra-FR1,i,j , including both SSB and CSI-RS based, which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise MgroupA,i,j equals 0.

MgroupBi,j : The number of FR2 intrafrequency measurement objects Mintra-FR2,i,j , including both SSB and CSI-RS based, which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise MgroupB,i,j equals 0.

Mtot,i,j = MgroupA,i,j + MgroupB,i,j : Total number of group A and group B measurement objects which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise Mtot,i,j equals 0.

For each measurement gap *j* used for a long-periodicity measurement defined above, Mintra,i,j = Minter,i,j = Mtot,i,j =0. The carrier specific scaling factor CSSFwithin\_gap,i is given by:

If *measGapSharingScheme* is equal sharing, CSSFwithin\_gap,i= max(ceil(Ri×Mtot,i,j)), where *j*=0…(160/MGRP)-1

If *measGapSharingScheme* is not equal sharing and

- measurement object *i* is a group A measurement object, CSSFwithin\_gap,i is the maximum among

- ceil(Ri×Kintra×MgroupA,i,j) in gaps where MgroupB,i,j≠0, where *j*=0…(160/MGRP)-1

- ceil(Ri×MgroupA,i,j) in gaps where MgroupB,i,j=0, where *j*=0…(160/MGRP)-1

- measurement object *i* is an group B measurement object, CSSFwithin\_gap,i is the maximum among

- ceil(Ri×Kinter×MgroupBi,j) in gaps where MgroupA,i,j ≠0, where *j*=0…(160/MGRP)-1

- ceil(Ri×MgroupB,i,j)in gaps where MgroupA,i,j=0, where *j*=0…(160/MGRP)-1

Where Ri is the maximal ratio of the number of measurement gap where measurement object *i* is a candidate to be measured over the number of measurement gap where measurement object *i* is a candidate and not used for a long-periodicity measurement defined above.

##### 9.1.5.2.4 NR-DC: carrier-specific scaling factor for SSB-based and CSI-RS-based L3 measurements performed within gaps

When one or more measurement objects are monitored within measurement gaps, the carrier specific scaling factor for a target measurement object with index *i* is designated as CSSFwithin\_gap,i and is derived as described in this clause.

If measurement object *i* refers to a long-periodicity measurement which is any of:

- an E-UTRA RSTD measurement with periodicity Tprs>160ms or with periodicity Tprs=160ms but *prs-MutingInfo-r9* is configured, or

- an NR measurement for positioning frequency layer i with Tavailable\_PRS,i >160ms, where Tavailable\_PRS,i is defined in clauses 9.9.2.5, 9.9.3.5 and 9.9.4.5 for RSTD, PRS-RSRP and UE Rx-Tx time difference measurements, respectively.

then CSSFwithin\_gap,i=1. Otherwise, the CSSFwithin\_gap,i for other measurement objects (including E-UTRA RSTD measurement with periodicity Tprs=160ms) participate in the gap competition and the CSSFwithin\_gap,i are derived as below.

When multiple positioning frequency layers are configured,

- for each positioning frequency layer *i*, CSSFwithin\_gap,i is derived with the following steps assuming no other positioning frequency layer is configured.

- for each RRM frequency layer *i*, CSSFwithin\_gap,i is derived as follows:

- an intermediate CSSFwithin\_gap,i,k is derived with the following steps assuming only positioning frequency layer *k* is configured, and

- CSSFwithin\_gap,i= max(CSSFwithin\_gap,i,k), where *k*=0…K-1, and K is the number of configured positioning frequency layers.

For each measurement gap *j* not used for an RSTD measurement with periodicity Tprs>160ms or with periodicity Tprs=160ms but *prs-MutingInfo-r9* is configured within an arbitrary 160ms period, count the total number of intra-frequency measurement objects and inter-frequency/inter-RAT measurement objects and NR PRS measurements on all positioning frequency layers which are candidates to be measured within the gap *j*.

- An NR measurement object with SSB measurement configured is a candidate to be measured in a gap if its SMTC duration is fully covered by the MGL excluding RF switching time. For intra-frequency NR measurement objects, if the higher layer in TS 38.331 [2] signaling of *smtc2* is configured, the assumed periodicity of SMTC occasions corresponds to the value of higher layer parameter *smtc2*; otherwise the assumed periodicity of SMTC occasions corresponds to the value of higher layer parameter *smtc1*.

- An NR measurement object with CSI-RS measurement configured is a candidate to be measured in a gap if the window confining all CSI-RS resources are fully covered by the MGL excluding RF switching time.

- A positioning frequency layer is counted as candidate for a MG occasion if at least one PRS resource on that positioning frequency layer is fully covered by the MGL excluding RF switching time.

For UEs which support and are configured with per FR gaps, the counting is done on a per FR basis, and for UEs which are configured with per UE gaps the counting is done on a per UE basis. For UEs which support and are configured with per FR gaps, the CSSF requirements do not apply when NR PRS measurement in one FR gap collides with SSB/CSI-RS/PRS measurements in the other FR gap in time domain.

If the number of configured interfrequency and interRAT measuerement objects and NR PRS measurements on all positioning frequency layers is non-zero and the UE is configured with per UE gaps, or if the UE is configured with per FR gaps:

FR1 and FR2 intrafrequency measurement objects belong to group A

Interfrequency and interRAT measurement objects and up to one NR PRS measurement on any one positioning frequency layer belong to group B

MgroupA,i,j: Sum of the number of FR1 intra-frequency measurement objects Mintra-FR1,i,j and the number of FR2 intra-frequency measurement objects Mintra-FR2,i,j , including both SSB and CSI-RS based, which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise MgroupA,i,j equals 0.

MgroupBi,j : Number of NR inter-frequency layers including both SSB and CSI-RS based, EUTRA inter-RAT and UTRA inter-RAT measurement objects and up to one positioning frequency layer, which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise MgroupB,i,j equals 0.

If the number of configured interfrequency and interRAT measuerement objects and NR PRS measurements on all positioning frequency layers is zero and the UE is configured with per UE gaps:

FR1 intrafrequency measurement objects belong to group A

FR2 intrafrequency measurement objects belong to group B

MgroupA,i,j: The number of FR1 intrafrequency measurement objects Mintra-FR1,i,j , including both SSB and CSI-RS based, which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise MgroupA,i,j equals 0.

MgroupBi,j : The number of FR2 intrafrequency measurement objects Mintra-FR2,i,j , including both SSB and CSI-RS based, which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise MgroupB,i,j equals 0.

Mtot,i,j = MgroupA,i,j + MgroupB,i,j : Total number of group A and group B measurement objects which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise Mtot,i,j equals 0.

For each measurement gap *j* used for a long-periodicity measurement defined above, Mintra,i,j = Minter,i,j = Mtot,i,j =0. The carrier specific scaling factor CSSFwithin\_gap,i is given by:

If *measGapSharingScheme* is equal sharing, CSSFwithin\_gap,i= max(ceil(Ri×Mtot,i,j)), where *j*=0…(160/MGRP)-1

If *measGapSharingScheme* is not equal sharing and

- measurement object *i* is a group A measurement object, CSSFwithin\_gap,i is the maximum among

- ceil(Ri×Kintra×MgroupA,i,j) in gaps where MgroupB,i,j≠0, where *j*=0…(160/MGRP)-1

- ceil(Ri×MgroupA,i,j) in gaps where MgroupB,i,j=0, where *j*=0…(160/MGRP)-1

- measurement object *i* is an group B measurement object, CSSFwithin\_gap,i is the maximum among

- ceil(Ri×Kinter×MgroupBi,j) in gaps where MgroupA,i,j ≠0, where *j*=0…(160/MGRP)-1

- ceil(Ri×MgroupB,i,j)in gaps where MgroupA,i,j=0, where *j*=0…(160/MGRP)-1

Ri is the maximal ratio of the number of measurement gap where measurement object *i* is a candidate to be measured over the number of measurement gap where measurement object *i* is a candidate and not used for a long-periodicity measurement defined above.

##### 9.1.5.2.5 SA mode: carrier-specific scaling factor for PRS-based measurements performed within gaps

The requirements in this clause apply for NR PRS-based measurements for positioning in clause 9.9.

When NR PRS-based measurements for positioning are configured on one or more positioning frequency layers within measurement gaps, the carrier specific scaling factor for a target PRS-based positioning measurement on a positioning frequency layer with index *i* is designated as CSSFwithin\_gap,i and is derived as described in clause 9.1.5.2.2.

NR Positioning measurement requirements for long periodicity measurements apply in case all PRS resources in the PFL are configured with periodicity > 160 ms.

##### 9.1.5.2.6 NE-DC: carrier-specific scaling factor for PRS-based measurements performed within gaps

The requirements in this clause apply for NR PRS-based measurements for positioning in clause 9.9.

When NR PRS-based measurements for positioning are configured on one or more positioning frequency layers within measurement gaps, the carrier specific scaling factor for a target measurement on a positioning frequency layer with index *i* is designated as CSSFwithin\_gap,i and is derived as described in clause 9.1.5.2.3.

NR Positioning measurement requirements for long periodicity measurements apply in case all PRS resources in the PFL are configured with periodicity > 160 ms.

##### 9.1.5.2.7 NR-DC: carrier-specific scaling factor for PRS-based measurements performed within gaps

The requirements in this clause apply for NR PRS-based measurements for positioning in clause 9.9.

When NR PRS-based measurements for positioning are configured on one or more positioning frequency layers within measurement gaps, the carrier specific scaling factor for a target measurement on a positioning frequency layer with index *i* is designated as CSSFwithin\_gap,i and is derived as described in clause 9.1.5.2.4.

NR Positioning measurement requirements for long periodicity measurements apply in case all PRS resources in the PFL are configured with periodicity > 160 ms.

#### 9.1.5.3 Monitoring of multiple layers within NCSG

The measurement requirements derived from CSSFwithin\_ncsg,i defined in this clause are applicable provided that network provides NCSG pattern for measurement.

The carrier-specific scaling factor CSSFwithin\_ncsg,i for a measurement object *i* derived in this clause is applied to following measurement types:

- SSB-based intra-frequency measurement object without measurement gap as defined in clause 9.2.1 corresponding to an activated serving cell, when all of the SMTC occasions of this intra-frequency measurement object are overlapped by the NCSG;

- SSB-based intra-frequency measurement object with NCSG as defined in clause 9.2.1 corresponding to an activated serving cell (in non-dormancy);

- SSB-based intra-frequency measurement object corresponding to a deactivated serving cell or to an activated serving cell in dormancy, when all or part of the SMTC occasions of this intra-frequency measurement object are overlapped by the NCSG;

- SSB-based inter-frequency measurement object without measurement gap as defined in clause 9.3.1, when all of the SMTC occasions of this inter-frequency measurement object are overlapped by the NCSG;

- SSB-based inter-frequency measurement object with NCSG as defined in clause 9.3.1;

- E-UTRA inter-RAT measurement object, when the measurement can be performed with no measurement gap but NCSG as defined in clause [*TBD*];

UE is expected to conduct the measurement of this measurement object *i* only within the NCSG.

If the higher layer signaling in TS 38.331 [2] of *smtc2* is present for an intra-frequency measurement object, and *smtc1* is fully overlapping with NCSG and *smtc2* is partially overlapping with NCSG, requirements derived from CSSFwithin\_ncsg,i and CSSFoutside\_gap,i are not applicable.

##### 9.1.5.3.1 SA mode: carrier-specific scaling factor for measurements performed within NCSG

When one or more measurement objects are monitored within NCSG, the carrier specific scaling factor for a target measurement object with index *i* is designated as CSSFwithin\_ncsg,i and is derived as described in this clause.

For each NCSG occasion *j*, count the total number of intra-frequency measurement objects and inter-frequency/inter-RAT measurement objects which are candidates to be measured within the occaison *j*.

- An NR measurement object with SSB measurement configured is a candidate to be measured in an NCSG occasion if its SMTC duration is fully covered by the ML. For intra-frequency NR measurement objects, if the higher layer in TS 38.331 [2] signaling of *smtc2* is configured, the assumed periodicity of SMTC occasions corresponds to the value of higher layer parameter *smtc2*; otherwise the assumed periodicity of SMTC occasions corresponds to the value of higher layer parameter *smtc1*.

- An inter-RAT E-UTRA measurement object configured is a candidate to be measured in all NCSG occasions.

- Mintra,i,j: Number of intra-frequency measurement objects which are candidates to be measured in NCSG occasion *j* where the measurement object *i* is also a candidate. Otherwise Mintra,i,j equals 0.

- Minter,i,j : Number of NR inter-frequency measurement objects and E-UTRA inter-RAT measurement objects which are candidates to be measured in NCSG occasion *j* where the measurement object *i* is also a candidate. Otherwise Minter,i,j equals 0.

- Mtot,i,j = Mintra,i,j + Minter,i,j : Total number of intra-frequency, inter-frequency and inter-RAT measurement objects which are candidates to be measured in NCSG occasion *j* where the measurement object *i* is also a candidate. Otherwise Mtot,i,j equals 0.

For UEs which support and are configured with per FR NCSG, the above counting is done on a per FR basis, and for UEs which are configured with per UE NCSG the counting is done on a per UE basis.

The carrier specific scaling factor CSSFwithin\_ncsg,i is given by:

If *measGapSharingScheme* is equal sharing, CSSFwithin\_ncsg,i= max(Mtot,i,j), where *j*=0…(160/VIRP)-1

If *measGapSharingScheme* is not equal sharing and

- measurement object *i* is an intra-frequency measurement object, CSSFwithin\_ncsg,i is the maximum among

- ceil(Kintra×Mintra,i,j) in NCSG occasions where Minter,i,j≠0, where *j*=0…(160/VIRP)-1

- Mintra,i,j in NCSG occasions where Minter,i,j=0, where *j*=0…(160/VIRP)-1

- measurement object *i* is an inter-frequency or inter-RAT measurement object, CSSFwithin\_ncsg,i is the maximum among

- ceil(Kinter×Minter,i,j) in NCSG occasions where Mintra,i,j ≠0, where *j*=0…(160/VIRP)-1

- Minter,i,j in NCSG occasions where Mintra,i,j=0, where *j*=0…(160/VIRP)-1

### 9.1.6 Minimum requirement at transitions

When the measurement on one intra-frequency measurement object transitions from measurements performed outside gaps to measurements performed within gaps or vice versa during one measurement period, the cell identification and measurement period requirements with the longer delay apply.

The carrier-specific scaling factor specified in clause 9.1.5 that applies to the other impacted measurement objects will also apply based on the longer measurement or cell identification delay before or after the transition.

When the UE transitions between DRX and non-DRX or when DRX cycle periodicity changes, the cell identification and measurement period requirements apply based on the longer delay before or after the transition.

Subsequent to this measurement period, the cell identification and measurement period requirements on each measurement object are corresponding to the second mode after transition.

### 9.1.7 Pre-configured measurement gap

#### 9.1.7.1 Introduction

A UE capable of Pre-configured measurement gap (Pre-MG) pattern can be configured with a Pre-MG pattern via RRC signalling [2].

The gap interruption requirements in Section 9.1.2 apply to Pre-MG when Pre-MG is activated, and no gap interruption is expected when Pre-MG is deactivated.

- The requirements apply for NR standalone operation with single carrier and NR CA.

#### 9.1.7.2 Requirements applicability

The requirements related to pre-configured measurement gap apply provided:

- UE indicates support of *preconfiguredUE-AutonomousMeasGap* [2] and/or *preconfiguredNW-ControlledMeasGap* [2], and

- either a single per-UE measurement gap is pre-configured by the network, or one or two per-FR measurement gaps are pre-configured by the network, and

- one of measurement gap patterns among measurement gap patterns #0 ~ #25 is configured for pre-configured measurement gap, and

- UE is in NR SA with single carrier or with NR CA.

A measurement gap is configured as pre-configured measurement gap if *preConfigInd* is indicated by network in the configuration message of the measurement gap.

If UE indicates support of only *preconfiguredNW-ControlledMeasGap* [2], UE can expect the network to configure *preConfGapStatus*.

If a measurement gap is configured as pre-configured measurement gap, the applicability of measurement gap patterns is defined in Table 9.1.2-3.

When a pre-configured measurement gap is used to perform PRS measurements, the UE will inform the network that it is going to start/stop PRS measurements with the configured pre-configured measurement gap by initiating the existing *LocationMeasurementIndication* procedure.

If the Pre-MG status changes during a measurement period of a measurement that can be performed without and within measurement gaps, the UE is allowed to restart the measurement.

If the Pre-MG status changes from activated to deactivated during a measurement period of a measurement that can only be performed within measurement gaps, the measurement requirements do not apply.

#### 9.1.7.3 Requirements

Any of the measurement Gap pattern #0 to #25 defined in Table 9.1.2-1 can be configured as Pre-MG pattern.

The UE can determine the Pre-MG status based on autonomous activation/deactivation mechanism or based on network-controlled activation/deactivation mechanism.

A UE capable of both autonomous and network-controlled mechanisms for activation/deactivation of Pre-MG pattern will not use autonomous rules to determine the activation/deactivation status of the pre-configured MG if the network provides the activation/deactivation status via RRC indication *preConfGapStatus* for all the DL BWPs of all the activated CCs, and for all the deactivated SCCs.

##### 9.1.7.3.1 Requirements for autonomous activation/deactivation mechanism

Requirements in this section apply when autonomous mechanism [1] is used for activation/deactivation of Pre-MG pattern.

The UE can autonomously change the Pre-MG status from activation to deactivation or vice versa based on any of the following triggering conditions listed below. The UE shall also autonomously determine the Pre-MG status based on all the concurrent triggering conditions occurring jointly:

- DCI, timer or RRC based active BWP switching,

- Activation/deactivation of SCell(s),

- Addition/removal of any measurement object(s)

- Addition/release/change of a SCell in carrier aggregation,

The UE shall autonomously determine the status of the per-UE Pre-MG pattern as deactivated immediately after the configuration of the per-UE Pre-MG pattern provided that all the configured measurements can be performed without measurement gaps. The UE shall autonomously determine the status of the per-FR Pre-MG pattern as deactivated immediately after the configuration of the per-FR Pre-MG pattern provided that all the configured measurements in the same FR can be performed without measurement gaps.

A measurement can be performed by the UE without measurement gaps if any of the following conditions is met:

- The UE is configured with SSB based intra-frequency measurements, and the conditions defined for SSB based intra-frequency measurement without gaps in Clause 9.2.1 are met, or

- The UE is configured with SSB based inter-frequency measurements, and the conditions defined for SSB based inter-frequency measurement without gaps in Clause 9.3.1 are met, or

- The UE is configured with CSI-RS based intra-frequency measurements.

The UE shall autonomously determine the status of the per-UE Pre-MG pattern as activated immediately after the configuration of the per-UE Pre-MG pattern provided that at least one of the configured measurements cannot be performed without measurement gaps. The UE shall autonomously determine the status of the per-FR Pre-MG pattern as activated immediately after the configuration of the per-FR Pre-MG pattern provided that at least one of the configured measurements in the same FR cannot be performed without measurement gaps.

A measurement cannot be performed by the UE without measurement gaps if any of the following conditions is met:

- The UE is configured with SSB based intra-frequency measurements, and the conditions defined for SSB based intra-frequency measurement without gaps in Clause 9.2.1 are not met, or

- The UE is configured with SSB based inter-frequency measurements, and the conditions defined for SSB based inter-frequency measurement without gaps in Clause 9.3.1 are not met, or

- The UE is configured with any of the following measurements:

- CSI-RS based inter-frequency measurements, or

- E-UTRA Inter-RAT measurements, or

- UTRA Inter-RAT measurements.

##### 9.1.7.3.2 Requirements for network-controlled activation/deactivation mechanism

The requirements in this section apply when network-controlled mechanism [1] is used for activation/deactivation The requirements in this section apply when network-controlled mechanism [1] is used for activation/deactivation of Pre-MG pattern.

For per-UE Pre-configured MG,

- the UE determines that the Pre-configured MG is activated if *preConfGapStatus* is set to ‘1’ for the corresponding gap ID for the active DL BWP of any of the activated CCs, or if *preConfGapStatus* is set to ‘1’ for the corresponding gap ID for any of the deactivated SCCs,

- otherwise, the UE determines that the Pre-configured MG is deactivated

For per-FR Pre-configured MG,

- the UE determines that the Pre-configured MG is activated if *preConfGapStatus* is set to ‘1’ for the corresponding gap ID for the active DL BWP of any of the activated CCs in the corresponding FR, or if *preConfGapStatus* is set to ‘1’ for the corresponding gap ID for any of the deactivated SCCs in the corresponding FR,

- otherwise, the UE determines that the Pre-configured MG is deactivated

9.1.7.3.3 Requirements for reception/transmission during activation/deactivation

The requirements in this section apply when autonomous mechanism or network-controlled mechanism is used for activation/deactivation [1] of Pre-MG pattern.

If per-UE Pre-MG pattern is activated then the UE is not required to conduct reception/transmission from/to the corresponding serving cells during the gap occasion according to the same principles as described for per-UE measurement gaps in clause 9.1.2. Otherwise, the UE can be scheduled for reception/transmission of signals in all the serving cells during the gap occasion.

If per-FR Pre-MG pattern is activated then the UE is not required to conduct reception/transmission from/to the corresponding serving cells during the gap occasion on the same FR according to the same principles as described for per-FR measurement gaps in clause 9.1.2. Otherwise, the UE can be scheduled for reception/transmission of signals in all the serving cells during the gap occasion in the same FR.

### 9.1.8 Concurrent measurement gaps

#### 9.1.8.1 Introduction

When UE supports concurrent measurement gap pattern capability, network can provide multiple measurement gaps configured by RRC message(s) as specified in TS 38.331 [2]. Requirements in this section applies when the UE is in SA operation mode.

#### 9.1.8.2 Requirements

If the UE requires measurement gaps to identify and measure intra-frequency cells and/or inter-frequency cells and/or inter-RAT E-UTRAN cells, and the UE supports concurrent measurement gap patterns but does not support independent measurement gap patterns for different frequency ranges as specified in Table 5.1-1 in [18, 19, 20], in order for the requirements in the following clauses to apply the network can provide at most two per-UE measurement gap patterns for monitoring of all frequency layers.

If the UE requires measurement gaps to identify and measure intra-frequency cells and/or inter-frequency cells and/or inter-RAT E-UTRAN cells, and the UE supports both concurrent measurement gap patterns and independent measurement gap patterns for different frequency ranges as specified in Table 5.1-1 in [18, 19, 20], in order for the requirements defined for concurrent measurement gaps to apply the network can provide the following measurement gap patterns’combinations for monitoring of all frequency layers. The supported measurement gap combination configurations for UE supporting both concurrent measurement gap patterns and independent measurement gap patterns for different frequency ranges are specified in Table 9.1.8-1.

Table 9.1.8-1: The number of Gap Combination Configurations by UE supporting both concurrent measurement gap patterns and independent measurement gap patterns

|  |  |  |  |
| --- | --- | --- | --- |
| Gap Combination  Configuration Id | The number of simultaneous configured measurement gap patterns | | |
| Per-FR1 measurement gap | Per-FR2 measurement gap | Per-UE measurement gap |
| 0 | 2 | 1 | 0 |
| 1 | 1 | 2 | 0 |
| 2 | 0 | 0 | 2 |
| 3Note 1 | 1 | 0 | 1 |
| 4Note 1 | 0 | 1 | 1 |
| 5Note 1 | 1 | 1 | 1 |
| 6 | 2 | 0 | 0 |
| 7 | 0 | 2 | 0 |
| Note 1: Gap Combination Configuration Id #3, #4, #5 will be only applied when the per-UE measurement gap is associated to measure PRS for any RSTD, PRS-RSRP, and UE Rx-Tx time difference measurement defined in TS 38.215 [4]. | | | |

For UE configured in the SA operation mode, when monitoring of multiple inter-RAT E-UTRAN carrier frequency layers and inter-frequency NR carrier frequency layers as configured by PCell using gaps, each monitored carrier frequency layer, including following measurement types:

- a measurement object with SSB based measurement,

- a measurement object with CSI-RS based measurement,

- E-UTRA inter-RAT measurement object,

- E-UTRAN inter-RAT RSTD measurement,

- NR PRS-based measurements,

can be only associated to one measurement gap pattern. Requirements for concurrent measurement gaps apply provided that each frequency layer is only associated with one concurrent measurement gap. There can be one or more frequency layers associated with each concurrent measurement gap.

When UE supports concurrent measurement gap patterns, each measurement gap pattern supported by the UE is listed in Table 9.1.2-1 based on the applicability specified in table 9.1.2-3.

The requirements in clause 9.1.2 are also applicable for the UE capable of and configured with multiple concurrent measurement gap patterns within each measurement gap pattern.

When UE supports concurrent measurement gap patterns and configured with more than 1 measurement gap pattern Per FR or Per-UE according to table 9.1.8-1, requirements does not apply if the UE is configured with more than one measurement gap pattern (MGP) with measurement gap repetition period (MGRP) of 20ms in an FR.

#### 9.1.8.3 Collision between concurrent measurement gaps

Collisions between occasions of two concurrent measurement gaps may occur as specified in this clause if the two measurement gaps are

- two per-UE measurement gaps, or

- two per-FR measurement gaps in the same FR, or

- one per-UE measurement gap and one per-FR measurement gap.

When UE is configured with concurrent measurement gaps, two measurement gap occasions are considered colliding if at least one of the following conditions is met:

- the two occasions are fully or partially overlapping in time domain, or

- the distance between the two occasions is equal to or smaller than 4ms.

The distance between two measurement gap occasions is defined as the time difference between the ending point of the first occasion and the starting point of the second occasion, where the first measurement gap occasion occurs earlier in time than the second measurement gap occasion.

*Editor Notes: RAN4 is further discussing the issue when more than two measurement gap occasions are overlapped sequentially.*

In case of collision between two measurement gap occasions, the UE shall perform measurements in the occasion of the measurement gap with higher priority, and the occasion of the measurement gap with lower priority shall be dropped. The UE shall be able to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI in the corresponding NR serving cells in the slots that are not interrupted according to requirements in clause 9.1.8.4.

The requirements of concurrent measurement gaps in section 9 shall not apply when a gap without assigned priority is configured simultaneously with any other gap(s) that affect serving carriers in the same FR and the measurement gaps are colliding with each other.

The priority for a measurement gap is configured by networks via *gapPriority* in *GapConfig*. The requirements with concurrent measurement gaps apply provided that two measurement gaps colliding with each other are configured with different priorities.

#### 9.1.8.4 Measurement gap related requirements of concurrent measurement gaps

A slot is considered as interrupted if it is interrupted by an occasion of any of the configured concurrent measurement gaps following the measurement gap interruption requirements in clause 9.1.2, except for a dropped measurement gap occasion.

### 9.1.9 Network controlled small gap

#### 9.1.9.1 Introduction

The UE capable of network controlled small gap (NCGG) pattern can be configured with a NCSG pattern via RRC signalling [2].

This clause contains the general requirements on the UE regarding to Network Controlled Small Gap (NCSG).

The requirements in this clause are applicable for UE configured with SA NR (with single carrier or NR CA) operation mode.

It is up to UE implementation whether or not the UE is able to conduct transmission in the following slot(s),

- when *mgta* is not applied, in the L consecutive UL slots with respect to the SCS of the UL carrier with the same slot indices as the DL slots occurring immediately after the last each of the interrupted slots after VIL1 and VIL2.

- when *mgta*is applied and the SCS of the UL carrier is other than 15kHz, in the L consecutive UL slots with respect to the SCS of the UL carrier with the same slot indices as the DL slots occurring immediately after the last each of the interrupted slots after VIL1 and VIL2.

- when *mgta*is applied and the SCS of the UL carrier is 15kHz, in the L consecutive UL slots with respect to the SCS of the UL carrier with the same slot indices as the DL slots occurring immediately after the slot partially overlapped with each of the interrupted slots after VIL1 and VIL2.

where UL slot denotes that all the symbols in the slot are uplink symbols, and L=1 if  for the UL transmission is less than the length of one slot; L=2 otherwise.

Note: Network is supposed to take into account the possible difference between the estimated TA at network and actual TA at UE when scheduling UE in the above slot(s).

The interruptions of NCSG in number of slots are listed in Table 9.1.9-1 on all serving cells when per-UE NCSG is configured or on FR1 serving cells when per-FR FR1 NCSG is configured to *ncsg-MeasGapPerFR-r17*capable UE. In case that the UE capable of *ncsg-MeasGapPerFR-r17* is configured with per-FR FR2 NCSG, numbers of interrupted slots on FR2 serving cells are listed in Table 9.1.9-2. There are two interruptions in each NCSG occasion, VIL1 before ML and VIL2 after ML, in NR standalone (with single carrier or NR CA). Each of them has number of interrupted slots captured in Table 9.1.9-1 and Table 9.1.9-2.

Table 9.1.9-1: Number of interrupted slots on all serving cells for per-UE NCSG or FR1 serving cells for FR1 NCSG during each VIL in NR standalone operation (with single carrier, NR CA)

|  |  |
| --- | --- |
| NR | Number of interrupted slots on serving cells |
| SCS | When MG timing advance of 0ms is applied |
| (kHz) | VIL=1ms |
| 15 | 1 |
| 30 | 2 |
| 60 | 4 |
| 120 | 8 |
| NOTE 1: NR SCS of 120 kHz is only applicable to the case with per-UE NCSG.  NOTE 2: Non-overlapped half-slots occur before and after the VIL. Whether a UE can receive and/or transmit in those half-slots is up to UE implementation. | |

**Table 9.1.9-2: Number of interrupted slots on FR2 serving cells for FR2 NCSG during each VIL in NR standalone operation (with single carrier, NR CA)**

|  |  |  |
| --- | --- | --- |
| NR | Number of interrupted slots on serving cells | |
| SCS | When MG timing advance of 0ms is applied | When MG timing advance of 0.75ms is applied |
| (kHz) | VIL=0.75ms | VIL=0.75ms |
| 60 | 3 | 3 |
| 120 | 6 | 6 |
| NOTE 1: Non-overlapped half-slots occur before and after the VIL. Whether a UE can receive and/or transmit in those half-slots is up to UE implementation. | | |

#### 9.1.9.2 Requirements applicability

Requirements in clause 9.1.9 apply for UE capable of NCSG in standalone NR in both FR1 and FR2 (including FR1+FR2 CA), provided UE is configured with only NCSG and no other measurement gap is configured, and UE is configured with

SSB based intra-frequency measurement (including measurement on de-activated SCC and measurement on dormant SCell), and/or

SSB based inter-frequency measurement, and/or

Inter-RAT E-UTRAN measurement.

Requirements in clause 9.1.9 do not apply if UE is configured with

Inter-RAT GSM measurement, or

Inter-RAT UTRAN measurement, or

PRS measurement.

9.1.9.3 Requirements

The UE shall support NCSG patterns defined in Table 9.1.9.3-1 that are relevant to the UE’s measurement capabilities. ML is the measurement length. During the VIL1 and VIL2, the UE is not expected to transmit and receive any data. Where, VIL1 is the visible interruption length before the ML and VIL2 is the visible interruption length after the ML. During ML, whether the UE is expected to transmit and receive data on the corresponding serving carrier(s) depends on the scheduling restriction requirements specified in clauses 9.2.7.3 and 9.3.10.3. The NCSG configuration parameters VIL1, ML, VIL2 and VIRP are illustrated in Figure 9.1.9.3-1. The applicability of the NCSG patterns in Table 9.1.9.3-1 is specified in Table 9.1.9.3-2.

**VIL1**

**VIL2**

**ML**

**…**

**…**

**VIL1**

**VIL2**

**Time**

**VIRP**

**ML**

**Figure 9.1.9.3-1: Illustration of NCSG configuration parameters: VIL1, ML, VIL2 and VIRP**

Table 9.1.9.3-1: NCSG Configurations supported by the UE

|  |  |  |
| --- | --- | --- |
| NCSG Pattern Id | Measurement Length during which there is no gap (ML, ms) | Visible interruption Repetition Period  (VIRP, ms) |
| 0 | 5 | 40 |
| 1 | 5 | 80 |
| 2 | 2 | 40 |
| 3 | 2 | 80 |
| 4 | 5 | 20 |
| 5 | 5 | 160 |
| 6 | 3 | 20 |
| 7 | 3 | 40 |
| 8 | 3 | 80 |
| 9 | 3 | 160 |
| 10 | 2 | 20 |
| 11 | 2 | 160 |
| 12 | 5 | 20 |
| 13 | 5 | 40 |
| 14 | 5 | 80 |
| 15 | 5 | 160 |
| 16 | 3 | 20 |
| 17 | 3 | 40 |
| 18 | 3 | 80 |
| 19 | 3 | 160 |
| 20 | 1 | 20 |
| 21 | 1 | 40 |
| 22 | 1 | 80 |
| 23 | 1 | 160 |

Table 9.1.9.3-2: Applicability for NCSG pattern configurations supported by the UE for NR standalone operation with single carrier or NR CA configuration

|  |  |  |  |
| --- | --- | --- | --- |
| NCSG pattern configuration | Serving cell | Measurement Purpose NOTE 2 | Applicable NCSG Pattern Id |
|  | FR1, or  FR1 + FR2 | E-UTRA | 0,1,2,3 |
|  |  | FR1 and/or FR2 | 0-11, 24 |
|  |  | E-UTRA and FR1 and/or FR2 | 0, 1, 2, 3, 4, 6, 7, 8,10 |
| Per-UE NCSG | FR2 | E-UTRA only | 0,1,2,3 |
|  |  | FR1 only | 0-11 |
|  |  | FR1 and FR2 | 0-11 |
|  |  | E-UTRA and FR1 and/or FR2 | 0, 1, 2, 3, 4, 6, 7, 8,10 |
|  |  | FR2 only | 12-23 |
|  | FR1 if configured | E-UTRA only | 0,1,2,3 |
|  | FR2 if configured |  | No gap |
|  | FR1 if configured | FR1 only | 0-11 |
|  | FR2 if configured |  | No gap |
|  | FR1 if configured | FR2 only | No gap |
| Per-FR NCSG | FR2 if configured |  | 12-23 |
|  | FR1 if configured | E-UTRA and | 0, 1, 2, 3, 4, 6, 7, 8,10 |
|  | FR2 if configured | FR1 | No gap |
|  | FR1 if configured | FR1 and FR2 | 0-11 |
|  | FR2 if configured |  | 12-23 |
|  | FR1 if configured | E-UTRA and | 0, 1, 2, 3, 4, 6, 7, 8,10 |
|  | FR2 if configured | FR2 | 12-23 |
|  | FR1 if configured | E-UTRA and  FR1 and FR2 | 0, 1, 2, 3, 4, 6, 7, 8,10 |
|  | FR2 if configured | 12-23 |
| NOTE 1: When E-UTRA inter-RAT RSTD measurements are configured and the UE requires measurement gaps for performing such measurements, only Gap Pattern #0 can be used.  NOTE 2: Measurement purpose which includes E-UTRA measurements includes also inter-RAT E-UTRA RSRP and RSRQ measurements for E-CID; measurement purpose which includes E-UTRA measurements includes also E-UTRA RSRP and E-UTRA RSRQ measurements for E-CID.  NOTE 3: If per-UE NCSG is configured with MG timing advance of TMG ms, the measurement gap starts at time TMG ms advanced to the end of the latest subframe occurring immediately before the configured measurement gap among all serving cells subframes.  If per-FR NCSG for FR1 is configured with MG timing advance of TMG ms, the measurement gap for FR1 starts at time TMG ms advanced to the end of the latest subframe occurring immediately before the configured measurement gap among serving cells subframes in FR1.  If per-FR NCSG for FR2 is configured with MG timing advance of TMG ms, the measurement gap for FR2 starts at time TMG ms advanced to the end of the latest subframe occurring immediately before the configured measurement gap among serving cells subframes in FR2.  TMG is the MG timing advance value provided in *mgta* according to [2].  In determining the measurement gap starting point, UE shall use the DL timing of the latest subframe occurring immediately before the configured measurement gap among serving cells.  NOTE 4: For UE only supporting *ncsg-MeasGapNR-Patterns-r17* for any gap patterns among NCSG pattern # 2-11, the corresponding gap patterns are not applicable to measurement of E-UTRA. | | | |

### 9.1.10 MUSIM gaps

If the UE requires gap patterns for MUSIM purpose, such as cell identification and measurement, paging monitoring, SIB acquisition, and/or on-demand SI request of the target cell in the target network, then the network may provide one or more per-UE MUSIM gap pattern(s) for concurrent monitoring of all frequency layers for MUSIM via *MUSIM-GapConfig* [2]. The UE can be configured with no more than three periodic MUSIM gap patterns and/or one aperiodic MUSIM gap pattern for MUSIM via *MUSIM-GapConfig* [2]. The MUSIM gap patterns specified in Table 9.1.10-1 are applicable only for MUSIM operation.

The UE is not required to perform cell identification and measurement, paging monitoring, SIB acquisition, and/or on-demand SI request of the target cell in the target network that is outside the MUSIM gaps.

UE supporting MUSIM capability shall support the MUSIM gap patterns listed in Table 9.1.10-1 based on UE’s capability specified in TS38.306[14] and the applicability specified in Table 9.1.10-2.

UE determines MUSIM gap timing based on gap offset configuration from serving cell provided by higher layer signalling as specified in TS 38.331 [2].

Table 9.1.10-1: MUSIM Gap Pattern Configurations

|  |  |  |
| --- | --- | --- |
| **MUSIM Gap Pattern Id** | **MUSIM Gap Length (MGL, ms)** | MUSIM Gap Repetition Period (MGRP, ms) |
| 0 | 6 | 40 |
| 1 | 6 | 80 |
| 2 | 3 | 40 |
| 3 | 3 | 80 |
| 4 | 6 | 20 |
| 5 | 6 | 160 |
| 6 | 4 | 20 |
| 7 | 4 | 40 |
| 8 | 4 | 80 |
| 9 | 4 | 160 |
| 10 | 3 | 20 |
| 11 | 3 | 160 |
| 12 | 10 | 80 |
| 13 | 20 | 160 |
| 14 | 6 | 320 |
| 15 | 6 | 640 |
| 16 | 6 | 1280 |
| 17 | 6 | 2560 |
| 18 | 10 | 320 |
| 19 | 10 | 640 |
| 20 | 10 | 1280 |
| 21 | 10 | 2560 |
| 22 | 20 | 320 |
| 23 | 20 | 640 |
| 24 | 20 | 1280 |
| 25 | 20 | 2560 |
| 26 | 20 | 5120 |
| 27 | 10 | NA |
| 28 | 20 | NA |
| Note 1: Measurement gap pattern #27, #28 are the aperiodic gap pattern without MGRP. | | |

Table 9.1.10-2: Applicability for MUSIM Gap Pattern Configurations supported by the UE with NR standalone operation (with single carrier, NR CA configuration)

|  |  |  |  |
| --- | --- | --- | --- |
| MUSIM gap pattern configuration | Serving cell | Gap Purpose | Applicable MUSIM Gap Pattern Id |
| Per-UE | FR1, FR2, or | MUSIM Note1 | 0-13, 14-26, 27, 28 |
| MUSIM gap | FR1 + FR2 |
|  |  |
| NOTE 1: Inclusion of MUSIM procedures for per-UE MUSIM gaps only in NR single carrier, NR CA mode: MUSIM purpose which includes cell identification and measurement, paging monitoring, SIB acquisition, and/or on-demand SI request of the target cell in the target network. | | | |

### 9.1.11 UL gap for Tx power management

The UL gap patterns for TX power management are listed in Table 9.1.11-1 if UE supports the UL gap for Tx power management, and the UE shall support at least one of UL MGP#1 and UL MGP#3. All other UL MGPs are optional.

Table 9.1.11-1: UL Gap Pattern Configurations

|  |  |  |
| --- | --- | --- |
|  | UL Gap Length (UGL) [ms] | UL gap repetition periodicity (UGRP) [ms] |
| UL MGP #0 | 1.0 | 20 |
| UL MGP #1 | 1.0 | 40 |
| UL MGP #2 | 0.5 | 160 |
| UL MGP #3 | 0.125 when SCS of active UL BWP =120kHz  0.25 when SCS of active UL BWP =60kHz | 5 |

An uplink gap consists of consecutive static UL slot(s) in one or more *TDD-UL-DL-Pattern* duration, starting from the first static UL slot of an UL gap repetition period. UGL is the aggregated length of consecutive UL slots used as the UL gap within an UL gap repetition period. That means, there can be a DL slot and/or special slot but no static UL slot between the two consecutive static UL slots within the UL gap length.

When an UL gap overlaps with an uplink transmission in NR serving cells in FR2 single CC or FR2 intra-band CA or FR2 inter-band CA where UE does not support tx-Support-UL-GapFR2-r17, then the UE is not required to conduct any transmission during the UL gap on the NR serving cells other than those listed in Clause 5.30 in TS 38.321 [7].

## 9.1A General measurement requirement for RedCap

### 9.1A.1 Introduction

This clause contains general requirements on the RedCap UE regarding measurement reporting in RRC\_CONNECTED state. The requirements are split in intra-frequency, inter-frequency, inter-RAT E-UTRAN FDD, inter-RAT E-UTRAN TDD, and L1-RSRP measurements requirements. These measurements may be used by the NG-RAN. The measurement quantities are defined in TS38.215 [4], the measurement model is defined in TS38.300 [10], TS37.340 [17] and measurement accuracies are specified in clause 10. Control of measurement reporting is specified in TS 38.331 [2].

The SSB and SMTC in this section applies for both CD-SSB and NCD-SSB if it is not additional specified.

### 9.1A.2 Measurement gap

If the UE requires measurement gaps to identify and measure intra-frequency cells and/or inter-frequency cells and/or inter-RAT E-UTRAN cells, and the UE does not support independent measurement gap patterns for different frequency ranges as specified in Table 5.1-1 in [18, 19, 20], in order for the requirements in the following clauses to apply the network must provide a single per-UE measurement gap pattern for concurrent monitoring of all frequency layers.

If the UE requires measurement gaps to identify and measure intra-frequency cells and/or inter-frequency cells and/or inter-RAT E-UTRAN cells, and the UE supports independent measurement gap patterns for different frequency ranges as specified in Table 5.1-1 in [18, 19, 20], in order for the requirements in the following clauses to apply the network must provide either per-FR measurement gap patterns for frequency range where UE requires per-FR measurement gap for concurrent monitoring of all frequency layers of each frequency range independently, or a single per-UE measurement gap pattern for concurrent monitoring of all frequency layers of all frequency ranges.

During the per-UE or per-FR measurement gaps the UE:

- is not required to conduct reception/transmission from/to the corresponding NR serving cell for SA (with single carrier) except the reception of signals used for RRM measurement(s), and the signals used for random access procedure according to [7].

UEs shall support the measurement gap patterns listed in Table 9.1A.2-1 based on the applicability specified in Table 9.1A.2-2. UE determines measurement gap timing based on gap offset configuration and measurement gap timing advance configuration provided by higher layer signalling as specified in TS 38.331 [2] and TS 36.331 [16].

Table 9.1A.2-1: Gap Pattern Configurations

|  |  |  |
| --- | --- | --- |
| Gap Pattern Id | Measurement Gap Length (MGL, ms) | Measurement Gap Repetition Period  (MGRP, ms) |
| 0 | 6 | 40 |
| 1 | 6 | 80 |
| 2 | 3 | 40 |
| 3 | 3 | 80 |
| 4 | 6 | 20 |
| 5 | 6 | 160 |
| 6 | 4 | 20 |
| 7 | 4 | 40 |
| 8 | 4 | 80 |
| 9 | 4 | 160 |
| 10 | 3 | 20 |
| 11 | 3 | 160 |
| 12 | 5.5 | 20 |
| 13 | 5.5 | 40 |
| 14 | 5.5 | 80 |
| 15 | 5.5 | 160 |
| 16 | 3.5 | 20 |
| 17 | 3.5 | 40 |
| 18 | 3.5 | 80 |
| 19 | 3.5 | 160 |
| 20 | 1.5 | 20 |
| 21 | 1.5 | 40 |
| 22 | 1.5 | 80 |
| 23 | 1.5 | 160 |

Table 9.1A.2-2: Applicability for Gap Pattern Configurations supported by the RedCap UE with NR standalone operation (with single carrier)

|  |  |  |  |
| --- | --- | --- | --- |
| Measurement gap pattern configuration | Serving cell | Measurement Purpose | Applicable Gap Pattern Id |
|  | FR1 | non-NR RAT NOTE2 | 0,1,2,3 |
|  |  | FR1 and/or FR2 | 0-11 |
|  |  | non-NR RATand FR1 and/or FR2 NOTE2 | 0, 1, 2, 3, 4, 6, 7, 8,10 |
| Per-UE measurement | FR2 | non-NR RATonly  NOTE2 | 0,1,2,3 |
| gap |  | FR1 only | 0-11 |
|  |  | FR1 and FR2 | 0-11 |
|  |  | non-NR RATand FR1 and/or FR2 NOTE2 | 0, 1, 2, 3, 4, 6, 7, 8,10 |
|  |  | FR2 only | 12-23 |
|  | FR1 if configured | non-NR RATonly | 0,1,2,3 |
|  | FR2 if configured | NOTE2 | No gap |
|  | FR1 if configured | FR1 only | 0-11 |
|  | FR2 if configured |  | No gap |
|  | FR1 if configured | FR2 only | No gap |
| Per-FR | FR2 if configured |  | 12-23 |
| measurement | FR1 if configured | non-NR RATand | 0, 1, 2, 3, 4, 6, 7, 8,10 |
| gap | FR2 if configured | FR1 NOTE2 | No gap |
|  | FR1 if configured | FR1 and FR2 | 0-11 |
|  | FR2 if configured |  | 12-23 |
|  | FR1 if configured | non-NR RATand | 0, 1, 2, 3, 4, 6, 7, 8,10 |
|  | FR2 if configured | FR2 NOTE2 | 12-23 |
|  | FR1 if configured | non-NR RATand  FR1 and FR2 NOTE2 | 0, 1, 2, 3, 4, 6, 7, 8,10 |
|  | FR2 if configured | 12-23 |
| NOTE1: If per-UE measurement gap is configured with MG timing advance of TMG ms, the measurement gap starts at time TMG ms advanced to the end of the latest subframe occurring immediately before the configured measurement gap among all serving cells subframes.  If per-FR measurement gap for FR1 is configured with MG timing advance of TMG ms, the measurement gap for FR1 starts at time TMG ms advanced to the end of the latest subframe occurring immediately before the configured measurement gap among serving cells subframes in FR1.  If per-FR measurement gap for FR2 is configured with MG timing advance of TMG ms, the measurement gap for FR2 starts at time TMG ms advanced to the end of the latest subframe occurring immediately before the configured measurement gap among serving cells subframes in FR2.  TMG is the MG timing advance value provided in *mgta* according to [2].  In determining the measurement gap starting point, UE shall use the DL timing of the latest subframe occurring immediately before the configured measurement gap among serving cells.  NOTE 2: In RedCap, non-NR RAT means E-UTRA only.  NOTE 3: For UE only supporting *supportedGapPattern-NRonly* for any gap patterns among GP2-11, the corresponding gap patterns are not applicable to measurement of non-NR RAT as defined in NOTE 2. | | | |

If measurement gap is configured in one FR but measurement object is not configured in the FR, the scheduling opportunity in the FR depends on the configured measurement gap pattern.

For NR standalone operation (with single carrier), if UE is not capable of per-FR-gap, total interruption time on a serving cell during MGL is defined when MGL(N) = 6ms, 5.5ms, 4ms, 3.5ms, 3ms, and 1.5ms. And if UE is capable of per-FR-gap, total interruption time on FR1 serving cell during MGL is defined only when MGL(N) = 6ms, 4ms, and 3ms, and total interruption time on FR2 serving cell during MGL is defined only when MGL(N) = 5.5ms, 3.5ms, and 1.5ms.



(a) Measurement gap with MGL = N(ms) with MG timing advance of 0ms for serving cell in synchronous NR standalone operation (with single carrier)



(b) Measurement gap with MGL = N(ms) with MG timing advance of 0.5ms for serving cell in synchronous NR standalone operation (with single carrier)

Figure 9.1A.2-1: Measurement GAP and total interruption time on serving cell for NR standalone operation (with single carrier)

The corresponding total number of interrupted slots on serving cell is listed in Table 9.1A.2-3 for serving cell in NR standalone (with single carrier).

Table 9.1A.2-3: Total number of interrupted slots on serving cell during MGL for NR standalone operation (with single carrier) with per-UE measurement gap or per-FR measurement gap for FR1

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| NR | Total number of interrupted slots on serving cell | | | | | |
| SCS | When MG timing advance of 0ms is applied | | | When MG timing advance of 0.5ms is applied | | |
| (kHz) | MGL=6ms | MGL=4ms | MGL=3ms | MGL=6ms | MGL=4ms | MGL=3ms |
| 15 | 6 | 4 | 3 | 7Note3 | 5Note3 | 4Note3 |
| 30 | 12 | 8 | 6 | 12 | 8 | 6 |
| 60 | 24 | 16 | 12 | 24 | 16 | 12 |
| 120 | 48 | 32 | 24 | 48 | 32 | 24 |
| NOTE 1: For Gap Pattern ID 0, 1, 2 and 3, total number of interrupted subframes on serving cell is MGL subframes when MG timing advance of 0ms is applied, and (MGL+1) subframes when MG timing advance of 0.5ms is applied.  NOTE 2: NR SCS of 120 kHz is only applicable to the case with per-UE measurement gap.  NOTE 3: Non-overlapped half-slots occur before and after the measurement gap. Whether a RedCap UE can receive and/or transmit in those half-slots is up to UE implementation. | | | | | | |

In case that UE capable of per-FR measurement gap is configured with per-UE measurement gap or per-FR measurement gap for FR2 serving cell, total number of interrupted slots on FR2 serving cells during MGL is listed in Table 9.1A.2-3a.

Table 9.1A.2-3a: Total number of interrupted slots on FR2 serving cell during MGL for NR standalone operation (with single carrier) with per-UE measurement gap or per-FR measurement gap for FR2

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| NR | Total number of interrupted slots on FR2 serving cell | | | | | |
| SCS | When MG timing advance of 0ms is applied | | | When MG timing advance of 0.25ms is applied | | |
| (kHz) | MGL=  5.5ms | MGL=  3.5ms | MGL=  1.5ms | MGL=  5.5ms | MGL=  3.5ms | MGL=  1.5ms |
| 60 | 22 | 14 | 6 | 22 | 14 | 6 |
| 120 | 44 | 28 | 12 | 44 | 28 | 12 |
| NOTE 1: The total number of interrupted slots is based on that SFN and subframe reference for per-FR gap in FR2 indicated by high layer parameter *refServCellIndicator* is an FR2 serving cell.  NOTE 2: Slot occurs before or after the measurement gap may be interrupted additionally if SFN and subframe reference for per-FR gap in FR2 indicated by high layer parameter refServCellIndicator is an FR1 serving cell. | | | | | | |

It is up to UE implementation whether or not the UE is able to conduct transmission in the following slot(s),

- when MGTA is not applied, in the L consecutive UL slots with respect to the SCS of the UL carrier with the same slot indices as the DL slots occurring immediately after measurement gap

- when MGTA is applied and the SCS of the UL carrier is other than 15kHz, in the L consecutive UL slots with respect to the SCS of the UL carrier with the same slot indices as the DL slots occurring immediately after measurement gap

- when MGTA is applied and the SCS of the UL carrier is 15kHz, in the L consecutive UL slots with respect to the SCS of the UL carrier with the same slot indices as the DL slots occurring immediately after the slot partially overlapped with measurement gap

where UL slot denotes that all the symbols in the slot are uplink symbols, and L=1 if  for the UL transmission is less than the length of one slot; L=2 otherwise.

#### 9.1A.2.1 SA: Measurement Gap Sharing

For NR standalone UE configured with per-UE measurement gap, measurement gap sharing shall be applies when UE requires measurement gaps to identify and measure cells on an intra-frequency carrier or when SMTC configured for intra-frequency measurement are fully overlapping with per-UE measurement gaps, and when UE requires measurement gaps to identify and measure cells on inter-frequency carriers for SSB based L3 measurement, or when all of SMTC configured for inter-frequency SSB based measurement without measurement gaps are fully overlapping with per-UE measurement gaps or per-FR measurement gap, and/or inter-RAT E-UTRAN carriers.

For NR standalone UE configured with per-FR1 measurement gap, measurement gap sharing shall be applied when UE requires measurement gaps to identify and measure cells on FR1 intra-frequency carriers or when SMTC configured for FR1 intra-frequency measurement are fully overlapping with per-FR1 measurement gaps, and when UE requires measurement gaps to identify and measure cells on FR1 inter-frequency carriers for SSB based L3 measurement and/or inter-RAT E-UTRAN carriers, or when all of SMTC configured for inter-frequency SSB based measurement without measurement gaps are fully overlapping with per-FR1 measurement gaps.

For NR standalone UE configured with per-FR2 measurement gap, measurement gap sharing shall be applied when UE requires measurement gaps to identify and measure cells on FR2 intra-frequency carriers or when SMTC configured for FR2 intra-frequency measurement are fully overlapping with per-FR2 measurement gaps, and when UE requires measurement gaps to identify and measure cells on FR2 inter-frequency carriers for SSB based L3 measurement, or when all of SMTC configured for inter-frequency SSB based measurement without measurement gaps are fully overlapping with per-UE measurement gaps.

When network signals “01”, “10” or “11” with RRC parameter *MeasGapSharingScheme* [2] and the value of X is defined as in Table 9.1.2.1a-1, and

- Kintra = 1 / X \* 100,

- Kinter = 1 / (100 – X) \* 100,

When network signals “00” indicating equal splitting gap sharing, X is not applied.

The RRC parameter *MeasGapSharingScheme* shall be applied to the calculation of carrier specific scaling factor as specified in clause 9.1A.5.2.1.

### 9.1A.3 UE Measurement capability

#### 9.1A.3.1 SA: Monitoring of multiple layers using gaps

The requirements in this clause are applicable for UE configured with SA NR operation mode.

When monitoring of multiple inter-RAT E-UTRAN carriers and inter-frequency NR carriers with gaps(or without using gaps provided the UE supports such capability or the effective MGRP is applied for per-FR measurement gap capable UE) is configured by PCell, the UE shall be capable of performing one measurement of the configured measurement type (SS-RSRP, SS-RSRQ, SS-SINR, E-UTRAN RSRP, E-UTRAN RSRQ, E-UTRAN RS-SINR measurements, etc.) of detected cells on all the layers.

For UE configured with the NR SA operation, the effective total number of frequencies, excluding the frequencies of the PCell being monitored, is Nfreq, SA, RedCap, which is defined as:

Nfreq, SA, RedCap = Nfreq, SA, NR, RedCap + Nfreq, SA, E-UTRA, RedCap ,

where

Nfreq, SA, E-UTRA, RedCap is the number of E-UTRA inter-RAT carriers being monitored (FDD and TDD) as configured by PCell,

Nfreq, SA, NR, RedCap is the number of NR inter-frequency carriers being monitored as configured by PCell.

#### 9.1A.3.2 SA: Maximum allowed layers for multiple monitoring

If a UE is configured with SA NR operation mode, the UE shall be capable of monitoring at least:

- Depending on UE capability, 6 NR SSB inter-frequency carriers configured by PCell, and

- Depending on UE capability, 6 E-UTRA TDD inter-RAT carriers configured by PCell, and

- Depending on UE capability, 6 E-UTRA FDD inter-RAT carriers configured by PCell.

In addition to the requirements defined above, the UE shall be capable of monitoring a total of at least [10] effective carrier frequency layers comprising of any above defined combination of NR, E-UTRA FDD, and E-UTRA TDD layers.

If *ssbfrequency, smtc1, smtc2* and *ssbSubcarrierSpacing* are same in multiple MOs, the multiple MOs are counted as one SSB frequency layer.

### 9.1A.4 Capabilities for Support of Event Triggering and Reporting Criteria

#### 9.1A.4.1 Introduction

This clause contains requirements on UE capabilities for support of event triggering and reporting criteria. As long as the measurement configuration does not exceed the requirements stated in clause 9.1A.4.2, the UE shall meet all other performance requirements defined in clause 9 and clause 10.

The UE can be requested to make measurements under different measurement identities defined in TS 38.331 [2]. Each measurement identity corresponds to either event-based reporting, periodic reporting, or no reporting. In case of event-based reporting, each measurement identity is associated with an event triggering criterion. In case of periodic reporting, a measurement identity is associated with one periodic reporting criterion. In case of no reporting, a measurement identity is associated with one no reporting criterion.

The purpose of this clause is to set some limits on the number of different event triggering, periodic, and no reporting criteria the UE may be requested to track in parallel.

#### 9.1A.4.2 Requirements

In this clause a reporting criterion corresponds to either one event (in the case of event-based reporting), or one periodic reporting criterion (in case of periodic reporting), or one no reporting criterion (in case of no reporting). For event-based reporting, each instance of event, with the same or different event identities, is counted as separate reporting criterion in Table 9.1A.4.2-1.

The UE shall be able to support in parallel per category up to Ecat reporting criteria according to Table [9.1A.4.2-1]. For the measurement categories belonging to intra-frequency, inter-frequency, and inter-RAT measurements (i.e. without counting other categories that the UE shall always support in parallel), the UE need not support more than the total number of reporting criteria as follows:

- For UE configured with SA operation mode: , where

is the total number of NR reporting criteria according to Table 9.1A.4.2-1,

 is the total number of inter-RAT E-UTRA reporting criteria according to Table 9.1A.4.2-1.

Table 9.1A.4.2-1: Requirements for reporting criteria per measurement category

|  |  |  |
| --- | --- | --- |
| Measurement category | Ecat | Note |
| Intra-frequency Note 1 | 9 | Events for any one or a combination of intra-frequency SS-RSRP, SS-RSRQ, and SS-SINR for NG-RAN intra-frequency cells |
| Inter-frequency Note 1 | 10 | Events for any one or a combination of inter-frequency SS-RSRP, SS-RSRQ, and SS-SINRfor NG-RAN inter-frequency cells |
| Inter-RAT (E-UTRA FDD, E-UTRA TDD) Note 1 | 10 | Only applicable for UE with this (inter-RAT) capability. These reporting criteria apply for any E-UTRA carrier frequencies. |
| NOTE 1: Applicable for UE configured with SA NR operation mode. | | |

### 9.1A.5 Carrier-specific scaling factor

This clause specifies the derivation of carrier-specific scaling factor (CSSF) values, which scales the measurement delay requirements given in clause 9.2B, 9.3Band 9.4A when UE is configured to monitor multiple measurement objects. The CSSF values are categorized into CSSFoutside\_gap\_RedCap,i andCSSFwithin\_gap\_RedCap,i, for the measurements conducted outside measurement gaps and within measurement gaps, respectively.

#### 9.1A.5.1 Monitoring of multiple layers outside gaps

The carrier-specific scaling factor CSSFoutside\_gap\_RedCap,i for measurement object *i* derived in this chapter is applied to following measurement types:

- SSB-based intra-frequency measurement with no measurement gap in clause 9.2B.5, when none of the SMTC occasions of this intra-frequency measurement object are overlapped by the measurement gap.

- SSB-based intra-frequency measurement with no measurement gap in clause 9.2B.5, when part of the SMTC occasions of this intra-frequency measurement object are overlapped by the measurement gap.

- SSB-based inter-frequency measurement with no measurement gap in clause 9.3B.7, when none of the SMTC occasions of this inter-frequency measurement object are overlapped by the measurement gap, if UE supports *interFrequencyMeas-NoGap-r16* and the flag *interFrequencyConfig-NoGap-r16* is configured by the Network.

- SSB-based inter-frequency measurement with no measurement gap in clause [9.3B.7], when part of the SMTC occasions of this inter-frequency measurement object are overlapped by the measurement gap, if UE supports *interFrequencyMeas-NoGap-r16* and the flag *interFrequencyConfig-NoGap-r16* is configured by the Network.

UE is expected to conduct the measurement of this measurement object *i* only outside the measurement gaps.

If *ssbfrequency, smtc1, smtc2* and *ssbSubcarrierSpacing* are same in multiple MOs, the multiple MOs are counted as one SSB frequency layer.

If the higher layer signaling in TS 38.331 [2] of *smtc2* is present and *smtc1* is fully overlapping with measurement gaps and *smtc2* is partially overlapping with measurement gaps, CSSFoutside\_gap\_RedCap,i and requirements derived from CSSFoutside\_gap\_RedCap,i are not specified.

##### 9.1A.5.1.1 SA mode: carrier-specific scaling factor for SSB-based measurements performed outside gaps

For UE in SA operation mode, the carrier-specific scaling factor CSSFoutside\_gap\_RedCap,i for intra-frequency SSB-based measurements, inter-frequency SSB-based measurements performed outside measurements gaps, will be specified as follows:

CSSFoutside\_gap,i =1, if only one measurement object is configured to be measured outside of MG for RedCap.

CSSFoutside\_gap,i =2 for intra-frequency measurement, and CSSFoutside\_gap,i = 2\*Y for inter-frequency measurement with no measurement gap, Y is the number of configured inter-frequency MOs without MG that are being measured outside of MG.

If intra-frequency measurement is with measurement gap, CSSFoutside\_gap,i = Y for inter-frequency measurement with no measurement gap, Y is the number of configured inter-frequency MOs without MG that are being measured outside of MG.

#### 9.1A.5.2 Monitoring of multiple layers within gaps

The carrier-specific scaling factor CSSFwithin\_gap\_RedCap,i for a measurement object *i* derived in this chapter is applied to following measurement types:

- SSB-based intra-frequency measurement object with no measurement gap in clause 9.2B.5, when all of the SMTC occasions of this intra-frequency measurement object are overlapped by the measurement gap.

- SSB-based intra-frequency measurement object with measurement gap in clause 9.2B.6.

- SSB-based inter-frequency measurement object with measurement gap in clause 9.3B.4.

- SSB-based inter-frequency measurement object without measurement gap for UE capable of *interFrequencyMeas-NoGap* in clause 9.3B.7, when

-all of the SMTC occasions of this inter-frequency measurement object are overlapped by the measurement gap, or

- part of the SMTC occasions of this inter-frequency measurement object are overlapped by the measurement gap but the flag *interFrequencyConfig-NoGap-r16* is not configured by the Network- E-UTRA Inter-RAT measurement object in clauses 9.4A.2 and 9.4A.3.

UE is expected to conduct the measurement of this measurement object *i* only within the measurement gaps.

If the higher layer signaling in TS 38.331 [2] of *smtc2* is present and *smtc1* is fully overlapping with measurement gaps and *smtc2* is partially overlapping with measurement gaps, CSSFwithin\_gap\_RedCap,i and requirements derived from CSSFoutside\_gap\_RedCap,i are not specified.

##### 9.1A.5.2.1 SA mode: carrier-specific scaling factor for SSB measurements performed within gaps

When one or more measurement objects are monitored within measurement gaps, the carrier specific scaling factor for a target measurement object with index *i* is designated as CSSFwithin\_gap\_RedCap,i and is derived as described in this clause.

For each measurement gap *j* count the total number of intra-frequency measurement object and inter-frequency/inter-RAT measurement objects which are candidates to be measured within the gap *j*.

- An NR measurement object with SSB measurement configured is a candidate to be measured in a gap if its SMTC duration is fully covered by the MGL excluding RF switching time. For intra-frequency NR measurement object, if the higher layer in TS 38.331 [2] signaling of *smtc2* is configured, the assumed periodicity of SMTC occasions corresponds to the value of higher layer parameter *smtc2*; otherwise the assumed periodicity of SMTC occasions corresponds to the value of higher layer parameter *smtc1*.

- For UEs which support and are configured with per FR gaps, the counting is done on a per FR basis, and for UEs which are configured with per UE gaps the counting is done on a per UE basis.

- Mintra\_RedCap,i,j: Number of intra-frequency measurement objects, which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise Mintra,i,j equals 0.

- Minter\_RedCap,i,j : Number of NR inter-frequency layers and EUTRA inter-RAT, which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise Minter\_RedCap,i,j equals 0.

- Mtot\_RedCap,i,j = Mintra\_RedCap,i,j + Minter\_RedCap,i,j : Total number of intra-frequency, inter-frequency and inter-RAT frequncy layers, which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise Mtot\_RedCap,i,j equals 0.

The carrier specific scaling factor CSSFwithin\_gap\_RedCap,i is given by:

If *measGapSharingScheme* is equal sharing, CSSFwithin\_gap\_RedCap,i= max(ceil(Ri×Mtot\_RedCap,i,j)), where *j*=0…(160/MGRP)-1

If *measGapSharingScheme* is not equal sharing and

- measurement object *i* is an intra-frequency measurement object, CSSFwithin\_gap\_RedCap,i is the maximum among

- ceil(Kintra×Mintra\_RedCap,i,j) in gaps where Minter\_RedCap,i,j≠0, where *j*=0…(160/MGRP)-1

- ceil(Mintra\_RedCap,i,j) in gaps where Minter\_RedCap,i,j=0, where *j*=0…(160/MGRP)-1

- measurement object *i* is an inter-frequency or inter-RAT measurement object, CSSFwithin\_gap\_RedCap,i is the maximum among

- ceil(Kinter×Minter\_RedCap,i,j) in gaps where Mintra\_RedCap,i,j ≠0, where *j*=0…(160/MGRP)-1

- ceil(Minter\_RedCap,i,j)in gaps where Mintra\_RedCap,i,j=0, where *j*=0…(160/MGRP)-1

### 9.1A.6 Minimum requirement at transitions

When the measurement on one intra-frequency measurement object transitions from measurements performed outside gaps to measurements performed within gaps or vice versa during one measurement period, the cell identification and measurement period requirements with the longer delay apply.

The carrier-specific scaling factor specified in clause 9.1A.5 that applies to the other impacted measurement objects will also apply based on the longer measurement or cell identification delay before or after the transition.

When the UE transitions between DRX and non-DRX or when DRX cycle periodicity changes, the cell identification and measurement period requirements apply based on the longer delay before or after the transition.

Subsequent to this measurement period, the cell identification and measurement period requirements on each measurement object are corresponding to the second mode after transition.

When the intra-frequency measurement transitions from measurements performed by CD-SSB to measurements performed by NCD-SSB or vice versa during one measurement period, the UE is allowed to restart the cell identification and measurement after BWP switching.

When the measurement on one measurement object transitions from inter-frequency measurement to intra-frequency measurement or vice versa during one measurement period, the UE is allowed to restart the cell identification and measurement after BWP switching.

Subsequent to this measurement period, the cell identification and measurement period requirements on each measurement object are corresponding to the second SSB type after transition.

## 9.1C General measurement requirement

*Editor’s note: Applicability of frequency range, CA, DA, duplex mode, inter-RAT measurement, etc is subject to updates/changes based on the scope of the corresponding WID.*

*Editor’s note: Terminology will be further clarified and selected between, e.g. NTN and satellite access, based on further agreements.*

### 9.1C.1 Introduction

This clause contains general requirements on the UE regarding measurement reporting in RRC\_CONNECTED state. The requirements are split in intra-frequency, inter-frequency and L1-RSRP measurements requirements. These measurements may be used by the NG-RAN. The measurement quantities are defined in TS38.215 [4], the measurement model is defined in TS38.300 [10], TS37.340 [17] and measurement accuracies are specified in clause 10. Control of measurement reporting is specified in TS 38.331 [2].

In the requirements of clause 9, the exceptions for side conditions apply as follows:

- for the UE configured with only PCell, which is served by SAN, the applicable exceptions for side conditions are specified in Annex B, clause [B.3.x.x] for UE supporting satellite access operation.

### 9.1C.2 Measurement gap

If the UE requires measurement gaps to identify and measure intra-frequency cells and/or inter-frequency cells, and the UE does not support independent measurement gap patterns for different frequency ranges as specified in Table 5.1-1 in [18, 19, 20], in order for the requirements in the following clauses to apply the network must provide a single per-UE measurement gap pattern for concurrent monitoring of all frequency layers.

If the UE requires measurement gaps to identify and measure intra-frequency cells and/or inter-frequency cells, and the UE supports independent measurement gap patterns for different frequency ranges as specified in Table 5.1-1 in [18, 19, 20], in order for the requirements in the following clauses to apply the network must provide a single per-UE measurement gap pattern for concurrent monitoring of all frequency layers of all frequency ranges.

For the UE configured with only PCell, which is served by SAN, if the UE requires measurement gaps to identify and measure cells operating in satellite access network and/or TN cells, and the UE does not support independent measurement gap patterns for different frequency ranges as specified in Table 5.1-1 in [18, 19, 20], in order for the requirements in the following clauses to apply the network must provide at most [N] per-UE measurement gap pattern for concurrent monitoring of all frequency layers

During the per-UE measurement gaps the UE:

- is not required to conduct reception/transmission from/to the PCell except the reception of signals used for RRM measurement(s) and the signals used for random access procedure according to [7].

UEs shall support the measurement gap patterns listed in Table 9.1C.2-1. UE determines measurement gap timing based on gap offset configuration and measurement gap timing advance configuration provided by higher layer signalling as specified in TS 38.331 [2] and TS 36.331 [16].

Table 9.1C.2-1: Gap Pattern Configurations

|  |  |  |
| --- | --- | --- |
| Gap Pattern Id | Measurement Gap Length (MGL, ms) | Measurement Gap Repetition Period  (MGRP, ms) |
| 0 | 6 | 40 |
| 1 | 6 | 80 |
| 2 | 3 | 40 |
| 3 | 3 | 80 |
| 4 | 6 | 20 |
| 5 | 6 | 160 |
| 6 | 4 | 20 |
| 7 | 4 | 40 |
| 8 | 4 | 80 |
| 9 | 4 | 160 |
| 10 | 3 | 20 |
| 11 | 3 | 160 |



(a) Measurement gap with MGL = N(ms) with MG timing advance of 0ms for NR standalone operation configured with only single carrier



(b) Measurement gap with MGL = N(ms) with MG timing advance of 0.5ms for NR standalone operation configured with only single carrier

Figure 9.1C.2-1: Measurement GAP and total interruption time for NR standalone operation confgigured with only single carrier

The corresponding total number of interrupted slots on PCell is listed in Table 9.1C.2-2 for NR standalone configured with only single carrier.

Table 9.1C.2-2: Total number of interrupted slots on PCell in NR standalone operation configured with only single carrier

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR | Total number of interrupted slots on serving cells | | | | | | | | | |
| SCS | When MG timing advance of 0ms is applied | | | | | When MG timing advance of 0.5ms is applied | | | | |
| (kHz) | MGL=20ms | MGL=10ms | MGL=6ms | MGL=4ms | MGL=3ms | MGL=20ms | MGL=10ms | MGL=6ms | MGL=4ms | MGL=3ms |
| 15 | 20 | 10 | 6 | 4 | 3 | 21Note3 | 11Note3 | 7Note3 | 5Note3 | 4Note3 |
| 30 | 40 | 20 | 12 | 8 | 6 | 40 | 20 | 12 | 8 | 6 |
| 60 | 80 | 40 | 24 | 16 | 12 | 80 | 40 | 24 | 16 | 12 |
| NOTE 1: For Gap Pattern ID 0, 1, 2 and 3, total number of interrupted subframes on MCG is MGL subframes when MG timing advance of 0ms is applied, and (MGL+1) subframes when MG timing advance of 0.5ms is applied.  NOTE 2: Non-overlapped half-slots occur before and after the measurement gap. Whether a UE can receive and/or transmit in those half-slots is up to UE implementation. | | | | | | | | | | |

It is up to UE implementation whether or not the UE is able to conduct transmission in the following slot(s),

- when MGTA is not applied, in the L consecutive UL slots with respect to the SCS of the UL carrier with the same slot indices as the DL slots occurring immediately after measurement gap

- when MGTA is applied and the SCS of the UL carrier is other than 15kHz, in the L consecutive UL slots with respect to the SCS of the UL carrier with the same slot indices as the DL slots occurring immediately after measurement gap

- when MGTA is applied and the SCS of the UL carrier is 15kHz, in the L consecutive UL slots with respect to the SCS of the UL carrier with the same slot indices as the DL slots occurring immediately after the slot partially overlapped with measurement gap

where UL slot denotes that all the symbols in the slot are uplink symbols, and L=1 if  for the UL transmission is less than the length of one slot; L=2 otherwise.

Note: Network is supposed to take into account the possible difference between the estimated TA at network and actual TA at UE when scheduling UE in the above slot(s).

### 9.1C.8 Concurrent measurement gaps for SAN

#### 9.1C.8.1 Introduction

When UE supports concurrent measurement gap pattern capability, network can provide multiple measurement gaps configured by RRC message(s) as specified in TS 38.331 [2].

#### 9.1C.8.2 Requirements

If the UE requires measurement gaps to identify and measure intra-frequency cells and/or inter-frequency cells, and the UE supports concurrent measurement gap patterns (*parallelMeasurementGap*), in order for the requirements in the following clauses to apply the network can provide at most two per-UE measurement gap patterns for monitoring of all frequency layers.

For UE configured with the SA operation, when monitoring of multiple inter-frequency NR carrier frequency layers as configured by PCell using gaps, each monitored carrier frequency layer, including following measurement types:

- a measurement object with SSB based measurement,

can be associated to one or two measurement gap pattern provided the network configures the concurrent measurement gap patterns.

When UE supports concurrent measurement gap patterns, each measurement gap pattern supported by the UE is listed in Table 9.1.2-1 based on the applicability specified in table 9.1.2-3.

The requirements in clause 9.1.2 are also applicable for the UE capable of and configured with multiple concurrent measurement gap patterns within each measurement gap pattern.

#### 9.1C.8.3 Collision between concurrent measurement gaps

Collisions between occasions of two concurrent measurement gaps may occur as specified in this clause if the two measurement gaps are

- two per-UE measurement gaps, or

When UE is configured with concurrent measurement gaps, two measurement gap occasions are considered colliding if at least one of the following conditions is met:

- the two occasions are fully or partially overlapping in time domain, or

- the distance between the two occasions is [equal to or] smaller than 4ms.

The distance between two measurement gap occasions is defined as the time difference between the ending point of the first occasion and the starting point of the second occasion, where the first measurement gap occasion occurs earlier in time than the second measurement gap occasion.

If two colliding measurement gaps are not fully overlapping, in case of collision between two measurement gap occasions, the UE shall perform measurements in the occasion of the measurement gap with higher priority, and the occasion of the measurement gap with lower priority is considered to be dropped. The UE shall be able to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI in the corresponding NR serving cells in the slots that are not interrupted according to requirements in clause 9.1C.8.4.

If two colliding measurement gaps are fully overlapping with MGRP=160ms, in case of collision between two measurement gap occasions, the UE shall perform measurements in the occasion of one of the measurement gaps, and it is up to UE implementation which occasion is used for measurement, provided that UE can meet the requirements in clause 9.2C and 9.3C.

If two measurement gaps are fully overlapping with MGRP<160ms, no measurement requirements apply.

#### 9.1C.8.4 Measurement gap related requirements of concurrent measurement gaps

A slot is considered as interrupted if it is interrupted by an occasion of any of the configured concurrent measurement gaps following the measurement gap interruption requirements in clause 9.1.2, except for a dropped measurement gap occasion.

### 9.1C.9 Collision between SMTC and measurement gap for SAN

#### 9.1C.9.1 Introduction

This clause contains definition of collision between SMTCs and measurement gap for SAN.

#### 9.1C.9.1 Collision between SMTCs and measurement gap

Collision between occasions of SMTC and measurement gap may occur as specified in this clause.

When UE is configured with one or more than one measurement gap pattern, an SMTC occasion outside measurement gap and a measurement gap occasion are considered colliding if at least one of the following conditions is met:

- the SMTC occasion is fully or partially overlapping in time domain with the measurement gap occasion, or

- the magnitude of the distance between the SMTC occasion and the measurement gap occasion in time domain is less than or equals to 4ms.

The distance between a SMTC occasion and a measurement gap occasion is defined as:

- the time difference between the ending point of the SMTC occasion and the starting point of the measurement gap occasion, where the SMTC occasion occurs earlier in time than the MG occasion, or

- the time difference between the ending point of the measurement gap occasion and the starting point of the SMTC occasion, where the measurement gap occasion occurs earlier in time than the SMTC occasion.

## 9.2 NR intra-frequency measurements

### 9.2.1 Introduction

A measurement is defined as a SSB based intra-frequency measurement provided the centre frequency of the SSB of the serving cell indicated for measurement and the centre frequency of the SSB of the neighbour cell are the same, and the subcarrier spacing of the two SSBs are also the same.

The UE shall be able to identify new intra-frequency cells and perform SS-RSRP, SS-RSRQ, and SS-SINR measurements of identified intra-frequency cells if carrier frequency information is provided by PCell or the PSCell, even if no explicit neighbour list with physical layer cell identities is provided.

The UE can perform intra-frequency SSB based measurements without measurement gaps (either legacy measurement gap or NCSG) if

- the UE indicates ‘no-gap’ via *intraFreq-needForGap* for intra-frequency measurement, or

- the SSB is completely contained in the active BWP of the UE, or

- the active downlink BWP is initial BWP[3].

For UE supporting *nr-NeedForGapNCSG-reporting-r17* and indicating *NeedForGapNCSG-InfoNR* for intra-frequency measurement,

- An intra-frequency SSB measurement is defined as measurement without gap if

- the UE indicates ‘nogap-noncsg’ via *NeedForGapNCSG-InfoNR* for the intra-frequency measurement, and

- the SSB is not completely contained in the active BWP of the UE, and

- the active downlink BWP is not an initial BWP [3]

The delay requirements are specified in clause 9.2.5

An intra-frequency SSB measurement is defined as measurement with NCSG if

- the UE indicates ‘ncsg’ via *NeedForGapNCSG-InfoNR* for the intra-frequency measurement, and

- the SSB is not completely contained in the active BWP of the UE, and

- the active downlink BWP is not an initial BWP [3]

When network configures NCSG, the delay requirements are specified in clause 9.2.7

When network configures measurement gap, the delay requirements are specified in clause 9.2.6

- An intra-frequency SSB measurement is defined as measurement with gap if

- the UE indicates ‘gap’ via *NeedForGapNCSG-InfoNR* for the intra-frequency measurement, and

- the SSB is not completely contained in the active BWP of the UE, and

- the active downlink BWP is not an initial BWP [3]

When network configures measurement gap, the delay requirements are specified in clause 9.2.6

- The UE can perform intra-frequency SSB based measurement corresponding to a deactivated SCell or dormant SCell with NCSG.

- For intra-frequency SSB based measurements with NCSG, UE may cause scheduling restriction as specified in clause 9.2.7.3.

For intra-frequency SSB based measurements without measurement gaps, UE may cause scheduling restriction as specified in clause 9.2.5.3.SSB based measurements are configured along with one or two measurement timing configuration(s) (SMTC(s)) which provides periodicity, duration and offset information on a window of up to 5ms where the measurements are to be performed. For intra-frequency connected mode measurements, up to two measurement window periodicities may be configured. A single measurement window offset and measurement duration are configured per intra-frequency measurement object.

When measurement gaps are needed, the UE is not expected to detect SSB and measure RSSI of RSRQ which start earlier than the gap starting time + switching time, nor detect SSB and measure RSSI of RSRQ which end later than the gap end – switching time. Switching time is 0.5ms for frequency range FR1 and 0.25ms for frequency range FR2.

The requirements in this clause shall also apply, when the UE is configured to perform SRS carrier based switching and using measurement gaps.

The measurement requirements defined for an activated SCell with a non-dormant active BWP defined in this clause shall also apply to an activated SCell with dormant BWP as active BWP.

### 9.2.2 Requirements applicability

The requirements in clause 9.2 apply, provided:

- The cell being identified or measured is detectable.

An intra-frequency cell shall be considered detectable when for each relevant SSB:

- SS-RSRP related side conditions given in clauses 10.1.2 and 10.1.3 for FR1 and FR2, respectively, for a corresponding Band,

- SS-RSRQ related side conditions given in clauses 10.1.7 and 10.1.8 for FR1 and FR2, respectively, for a corresponding Band,

- SS-SINR related side conditions given in clauses 10.1.12 and 10.1.13 for FR1 and FR2, respectively, for a corresponding Band,

- SSB\_RP and SSB Ês/Iot according to Annex B.2.2 for a corresponding Band.

### 9.2.3 Number of cells and number of SSB

#### 9.2.3.1 Requirements for FR1

For each intra-frequency layer, during each layer 1 measurement period, the UE shall be capable of performing SS-RSRP, SS-RSRQ, and SS-SINR measurements for at least:

- 8 identified cells, and

- 14 SSBs with different SSB index and/or PCI on the intra-frequency layer, where the number of SSBs in the serving cell (except for the SCell) is not smaller than the number of configured RLM-RS SSB resources.

#### 9.2.3.2 Requirements for FR2

For one single intra-frequency layer in a band, during each layer 1 measurement period, the UE shall be capable of performing SS-RSRP, SS-RSRQ, and SS-SINR measurements for at least:

- 6 identified cells, and

- 24 SSBs with different SSB index and/or PCI,

where this single intra-frequency layer shall be:

- PCC when UE is configured with SA NR operation mode with PCC in the band; or

- PSCC when UE is configured with EN-DC with PSCC in the band; or

- PSCC when UE is configured with NR-DC with PSCC in the band; or

- One of the SCCs on which UE is configured to report SSB based measurements when neither PCC nor PSCC is in the same band, so that the selected SCC shall be an SCC where the UE is configured with SS-RSRP measurement reporting if such SCC exists, otherwise the selected SCC is determined by UE implementation.

The UE shall also be capable of performing SS-RSRP, SS-RSRQ, and SS-SINR measurements for at least 2 SSBs on serving cell for each of the other intra-frequency layer(s) in the same band.

### 9.2.4 Measurement Reporting Requirements

#### 9.2.4.1 Periodic Reporting

Reported RSRP, RSRQ, and RS-SINR measurements contained in periodic measurement reports shall meet the requirements in clauses 10.1.2.1 (RSRP for FR1), 10.1.3.1 (RSRP for FR2), 10.1.7.1 (RSRQ for FR1), 10.1.8.1 (RSRQ for FR2), 10.1.12.1 (RS-SINR for FR1) and 10.1.13.1 (RS-SINR for FR2).

#### 9.2.4.2 Event-triggered Periodic Reporting

Reported RSRP, RSRQ, and RS-SINR measurements contained in event-triggered periodic measurement reports shall meet the requirements in clauses 10.1.2.1 (RSRP for FR1), 10.1.3.1 (RSRP for FR2), 10.1.7.1 (RSRQ for FR1), 10.1.8.1 (RSRQ for FR2), 10.1.12.1 (RS-SINR for FR1) and 10.1.13.1 (RS-SINR for FR2).

The first report in event triggered periodic measurement reporting shall meet the requirements specified in clause 9.2.4.3.

#### 9.2.4.3 Event Triggered Reporting

Reported RSRP, RSRQ, and RS-SINR measurements contained in event triggered measurement reports shall meet the requirements in clauses 10.1.2.1 (RSRP for FR1), 10.1.3.1 (RSRP for FR2), 10.1.7.1 (RSRQ for FR1), 10.1.8.1 (RSRQ for FR2), 10.1.12.1 (RS-SINR for FR1) and 10.1.13.1 (RS-SINR for FR2).

The UE shall not send any event triggered measurement reports as long as no reporting criteria is fulfilled.

The measurement reporting delay is defined as the time between an event that will trigger a measurement report and the point when the UE starts to transmit the measurement report over the air interface. This requirement assumes that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 x TTIDCCH. This measurement reporting delay excludes a delay which caused by no UL resources being available for UE to send the measurement report on.

The event triggered measurement reporting delay, measured without L3 filtering shall be less than Tidentify intra with index or T identify intra without index defined in clause 9.2.5.1 or clause 9.2.6.2.When L3 filtering is used an additional delay can be expected. In EN-DC and NE-DC operation, when the UE is configured to perform E-UTRA SRS carrier-based switching an additional delay can be expected in FR1 if the UE is capable of per-FR gap, or an additional delay can be expected in both FR1 and FR2 if the UE is not capable of per-FR gap.

A cell is detectable only if at least one SSBs measured from the Cell being configured remains detectable during the time period Tidentify\_intra\_without\_index or Tidentify\_intra\_with\_index as defined in clause 9.2.5.1 or clause 9.2.6.2. If a cell which has been detectable at least for the time period Tidentify intra without index or Tidentify intra with index defined in clause 9.2.5.1 or clause 9.2.6.2 becomes undetectable for a period ≤ 5 seconds and then the cell becomes detectable again with the same spatial reception parameter and triggers an event, the event triggered measurement reporting delay shall be less than TSSB\_measurement\_period\_intra provided the timing to that cell has not changed more than ± 3200/ Tc while the measurement gap has not been available and L3 filtering has not been used, where *µ* is the SCS configuration as defined in clause 4.2 of TS 38.211 [3]. When L3 filtering is used, an additional delay can be expected. In EN-DC and NE-DC operation, when the UE is configured to perform E-UTRA SRS carrier-based switching an additional delay can be expected in FR1 if the UE is capable of per-FR gap, or an additional delay can be expected in both FR1 and FR2 if the UE is not capable of per-FR gap.

### 9.2.5 Intrafrequency measurements without measurement gaps

#### 9.2.5.1 Intrafrequency cell identification

The UE shall be able to identify a new detectable intra-frequency cell within Tidentify\_intra\_without\_index if the UE is not indicated to report SSB based RRM measurement result with the associated SSB index(*reportQuantityRsIndexes* or *maxNrofRSIndexesToReport* is not configured), or the UE is indicated that the neighbour cell is synchronous with the serving cell (*deriveSSB-IndexFromCell* is enabled). Otherwise UE shall be able to identify a new detectable intra frequency cell within Tidentify\_intra\_with\_index. The UE shall be able to identify a new detectable intra frequency SS block of an already detected cell within Tidentify\_intra\_without\_index. It is assumed that *deriveSSB-IndexFromCell* is always enabled for FR1 TDD and FR2 with SCS smaller or equal to 480 kHz.

Tidentify\_intra\_without\_index = (TPSS/SSS\_sync\_intra + T SSB\_measurement\_period\_intra) ms

Tidentify\_intra\_with\_index = (TPSS/SSS\_sync\_intra + T SSB\_measurement\_period\_intra + TSSB\_time\_index\_intra) ms

Where:

TPSS/SSS\_sync\_intra: it is the time period used in PSS/SSS detection given in table 9.2.5.1-1, 9.2.5.1-2, 9.2.5.1-4 (deactivated SCell) or 9.2.5.1-5 (deactivated SCell) or 9.2.5.1-9 (deactivated SCell) or 9.2.5.1-11 or 9.2.5.1-12 (deactivated PSCell) or 9.2.5.1-13 (deactivated PSCell).

- For UE supporting power class 6 with *highSpeedMeasFlagFR2-r17* configured, if SMTC <= 40ms, TPSS/SSS\_sync\_intra is given in Table 9.2.5.1-11; otherwise, TPSS/SSS\_sync\_intra is given in Table 9.2.5.1-2.

TSSB\_time\_index\_intra: it is the time period used to acquire the index of the SSB being measured given in table 9.2.5.1-3, 9.2.5.1-15 (FR2-2), 9.2.5.1-6 (deactivated SCell), 9.2.5.1-10(deactivated SCell) or 9.2.5.1-14 (deactivated PSCell).

T SSB\_measurement\_period\_intra: equal to a measurement period of SSB based measurement given in table 9.2.5.2-1, table 9.2.5.2-2 table 9.2.5.2-3 (deactivated SCell), 9.2.5.2-4(deactivated SCell), 9.2.5.2-5 or 9.2.5.2-6(deactivated SCell), 9.2.5.2-8(deactivated PSCell) or 9.2.5.2-9(deactivated PSCell).

- For UE supporting power class 6 with *highSpeedMeasFlagFR2-r17* configured, if SMTC <= 40ms, TSSB\_measurement\_period\_intra is given in Table 9.2.5.2-7; otherwise, T SSB\_measurement\_period\_intra is given in Table 9.2.5.2-2.

CSSFintra: it is a carrier specific scaling factor and is determined

according to CSSFoutside\_gap,i in clause 9.1.5.1 for measurement conducted outside measurement gaps, i.e. when intra-frequency SMTC is fully non overlapping or partially overlapping with measurement gaps or NCSG, or according to CSSFwithin\_gap,i in clause 9.1.5.2 for measurement conducted within measurement gaps, i.e. when intra-frequency SMTC is fully overlapping with measurement gaps, or according to CSSFwithin\_ncsg,i in clause 9.1.5.3 for measurement conducted within NCSG, i.e. when intra-frequency SMTC is fully overlapping with NCSG.

For a UE that supports Pre-MG, an SMTC occasion is only considered to be overlapped by Pre-MG if the Pre-MG is activated.

if the high layer in TS 38.331 [2] signalling of *smtc2* is configured, the assumed periodicity of intra-frequency SMTC occasions corresponds to the value of higher layer parameter *smtc2*; Otherwise the assumed periodicity of intra-frequency SMTC occasions corresponds to the value of higher layer parameter *smtc1*.

Mpss/sss\_sync\_w/o\_gaps: For a UE supporting FR2-1 power class 1 or 5, Mpss/sss\_sync\_w/o\_gaps =40. For a UE supporting power class 2, Mpss/sss\_sync\_w/o\_gaps =24. For a UE supporting FR2-1 power class 3, Mpss/sss\_sync\_w/o\_gaps =24. For a UE supporting FR2-1 power class 4, Mpss/sss\_sync\_w/o\_gaps =24. For a UE supporting FR2-2 power class 1, Mpss/sss\_sync\_w/o\_gaps = 60. For a UE supporting FR2-2 power class 2, Mpss/sss\_sync\_w/o\_gaps = 36. For a UE supporting FR2-2 power class 3, Mpss/sss\_sync\_w/o\_gaps = 36.

Mmeas\_period\_w/o\_gaps: For a UE supporting FR2-1 power class 1 or 5, Mmeas\_period\_w/o\_gaps =40. For a UE supporting FR2-1 power class 2, Mmeas\_period\_w/o\_gaps =24. For a UE supporting FR2-1 power class 3, Mmeas\_period\_w/o\_gaps =24. For a UE supporting power class 4, Mmeas\_period\_w/o\_gaps =24. For a UE supporting FR2-2 power class 1, Mmeas\_period\_w/o\_gaps = 60. For a UE supporting FR2-2 power class 2, Mmeas\_period\_w/o\_gaps = 36. For a UE supporting FR2-2 power class 3, Mmeas\_period\_w/o\_gaps = 36.

MSSB\_index\_intra: For a UE supporting FR2-2 power class 1, MSSB\_index\_intra = 72 samples. For a UE supporting FR2-2 power class 2, MSSB\_index\_intra = 48 samples. For a UE supporting FR2 power class 3, MSSB\_index\_intra = 48 samples.

When UE supports *concurrentMeasGap-r17* and is configured with concurrent measurement gaps,

Kp is the scaling factor for an SSB frequency layer to be measured without measurement gaps. Kp = Ntotal / Navailable, where Navailable and Ntotal are calculated as follows:

- For a window W of duration max(SMTC period, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE measurement gap and/or per-FR measurement gap within the same FR as the SSB frequency layer, and starting from the beginning of any SMTC occasion:

- Ntotal is the total number of SMTC occasions within the window, including those overlapped with measurement gap occasions within the window, and

- Navailable is the number of SMTC occasions that are not overlapped with any non-dropped MG occasion within the window W, after accounting for measurement gap collisions by applying the measurement gap collision rule in section 9.1.8.3.

Kp = 1 when Navailable = 0.

- Otherwise, when UE is not configured with or UE does not support concurrent measurement gaps:

When intra-frequency SMTC is fully non overlapping with measurement gaps or intra-frequency SMTC is fully overlapping with MGs, Kp=1

When intra-frequency SMTC is partially overlapping with measurement gaps, Kp = 1/(1- (SMTC period /MGRP)), where SMTC period < MGRP. When intra-frequency SMTC is partially overlapping with the ML of NCSG, Kp = 1/(1- (SMTC period /VIRP)), where SMTC period < VIRP. For calculation of Kp, if the high layer signalling (TS 38.331 [2]) of *smtc2* is configured, for cells indicated in the *pci-List* parameter in *smtc2*, the SMTC periodicity corresponds to the value of higher layer parameter *smtc2*; for the other cells, the SMTC periodicity corresponds to the value of higher layer parameter *smtc1.*

If the higher layer signaling in TS38.331 [2] signalling of *smtc2* is present and smtc1 is fully overlapping with measurement gaps and smtc2 is partially overlapping with measurement gaps, requirements are not specified for Tidentify\_intra\_without\_index or Tidentify\_intra\_with\_index

For FR2,

Klayer1\_measurement=1,

- if all of the reference signals configured for RLM, BFD, CBD or L1-RSRP for beam reporting on any FR2 serving frequency in the same band outside measurement gap are not fully overlapped by intra-frequency SMTC occasions, or

- if all of the reference signal configured for RLM, BFD, CBD or L1-RSRP for beam reporting on any FR2 serving frequency in the same band outside measurement gap and fully-overlapped by intra-frequency SMTC occasions are not overlapped with any of the SSB symbols and the RSSI symbols, and 1 symbol before each consecutive SSB symbols and the RSSI symbols, and 1 symbol after each consecutive SSB symbols and the RSSI symbols, given that *SSB-ToMeasure* and *SS-RSSI-Measurement* are configured, where SSB symbols are indicated by the union set of SSB-ToMeasure from all the configured measurement objects on the same serving carrier which can be merged.and RSSI symbols are indicated by *SS-RSSI-Measurement*;

Klayer1\_measurement=1.5, otherwise.

If the above-mentioned reference signal configured for L1-RSRP measurement is aperiodic CSI-RS resource, longer cell identification delay would be expected.

If MCG DRX is in use, cell identification requirements for intra-frequency measurement in MCG specified in Table 9.2.5.1-1, Table 9.2.5.1-2, Table 9.2.5.1-3, Table 9.2.5.1-4, Table 9.2.5.1-5 and Table 9.2.5.1-6 shall depend on the MCG DRX cycle. If SCG DRX is in use, cell identification requirements for intra-frequency measurement in SCG specified in Table 9.2.5.1-1, Table 9.2.5.1-2, Table 9.2.5.1-3, Table 9.2.5.1-4, Table 9.2.5.1-5, Table 9.2.5.1-6, Table 9.2.5.1-12, Table 9.2.5.1-13 and Table 9.2.5.1-14 shall depend on the SCG DRX cycle. Otherwise, the requirements for when DRX is not in use shall apply.

Table 9.2.5.1-1: Time period for PSS/SSS detection, (Frequency range FR1)

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra |
| No DRX | max( 600ms, ceil( 5 x Kp) x SMTC period )Note 1 x CSSFintra |
| DRX cycle≤ 320ms | max( 600ms, ceil(M2 Note 2x 5 x Kp) x max(SMTC period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | ceil(5 x Kp) x DRX cycle x CSSFintra |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified  NOTE 2: When *highSpeedMeasFlag-r16* is not configured, M2 = 1.5; When *highSpeedMeasFlag-r16* is configured, M2 = 1.5 if SMTC periodicity > 40 ms;,otherwise M2=1.  NOTE 3: When *highSpeedMeasFlag-r16* is configured, the requirements apply only to UE supporting either *measurementEnhancement-r16* or *intraNR-MeasurementEnhancement-r16* on measurements of the primary component carrier and do not apply to measurements of a secondary component carrier with active SCell.  NOTE 4: When *highSpeedMeasCA-Scell-r17* is configured and UE supports *measurementEnhancementCA-r17*, M2 = 1.5 if SMTC periodicity > 40 ms; otherwise M2=1. | |

Table 9.2.5.1-2: Time period for PSS/SSS detection, (Frequency range FR2)

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra |
| No DRX | max(600ms, ceil(Mpss/sss\_sync\_w/o\_gaps x KFR x Kp x Klayer1\_measurement)x SMTC period)Note 1 x CSSFintra |
| DRX cycle≤ 320ms | max(600ms, ceil(1.5 x Mpss/sss\_sync\_w/o\_gaps x KFR x Kp x Klayer1\_measurement)x max(SMTC period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | ceil(Mpss/sss\_sync\_w/o\_gaps x KFR x Kp x Klayer1\_measurement) x DRX cycle x CSSFintra |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified  NOTE 2: KFR is a scaling factor depending on the frequency range and the SSB SCS. For FR2-1, KFR = 1. For FR2-2: KFR = 1 if the SCS of the SSB of the cell being detected is 120 kHz, KFR = 2 if the SCS of the SSB of the cell being detected is 480 kHz, and KFR = 3 if the SCS of the SSB of the cell being detected is 960 kHz. | |

Table 9.2.5.1-3: Time period for time index detection (FR1)

|  |  |
| --- | --- |
| DRX cycle | TSSB\_time\_index\_intra |
| No DRX | max(120ms, ceil( 3 x Kp )x SMTC period)Note 1 x CSSFintra |
| DRX cycle≤ 320ms | max(120ms, ceil (M2 Note 2 x 3 x Kp) x max(SMTC period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | Ceil(3 x Kp) x DRX cycle x CSSFintra |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified  NOTE 2: When *highSpeedMeasFlag-r16* is not configured, M2 = 1.5; When *highSpeedMeasFlag-r16* is configured, M2 = 1.5 if SMTC periodicity > 40 ms;,otherwise M2=1  NOTE 3: When *highSpeedMeasFlag-r16* is configured, the requirements apply only to UE supporting either *measurementEnhancement-r16* or *intraNR-MeasurementEnhancement-r16* on measurements of the primary component carrier and do not apply to measurements of a secondary component carrier with active SCell.  NOTE 4: When *highSpeedMeasCA-Scell-r17* is configured and UE supports *measurementEnhancementCA-r17*, M2 = 1.5 if SMTC periodicity > 40 ms; otherwise M2=1 | |

Table 9.2.5.1-4: Time period for PSS/SSS detection, deactivated SCell (FR1)

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra |
| No DRX | Ceil(5 x Kp) x measCycleSCell x CSSFintra |
| DRX cycle≤ 320ms | Ceil(5 x Kp) x max(measCycleSCell, 1.5xDRX cycle) x CSSFintra |
| DRX cycle> 320ms | Ceil(5 x Kp) x max(measCycleSCell, DRX cycle) x CSSFintra |
| NOTE 1: The requirements also apply to deactivated SCG SCell. | |

Table 9.2.5.1-5: Time period for PSS/SSS detection, deactivated SCell (FR2)

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra |
| No DRX | Ceil(Mpss/sss\_sync\_w/o\_gaps x Kp) x measCycleSCell x CSSFintra |
| DRX cycle≤ 320ms | Ceil(Mpss/sss\_sync\_w/o\_gaps x Kp) x max(measCycleSCell, 1.5xDRX cycle) x CSSFintra |
| DRX cycle> 320ms | Ceil(Mpss/sss\_sync\_w/o\_gaps x Kp) x max(measCycleSCell, DRX cycle) x CSSFintra |
| NOTE 1: The requirements also apply to deactivated SCG SCell. | |

Table 9.2.5.1-6: Time period for time index detection, deactivated SCell (FR1)

|  |  |
| --- | --- |
| DRX cycle | TSSB\_time\_index\_intra |
| No DRX | Ceil(3 x Kp) x measCycleSCell x CSSFintra |
| DRX cycle≤ 320ms | Ceil(3 x Kp) x max(measCycleSCell, 1.5xDRX cycle) x CSSFintra |
| DRX cycle> 320ms | Ceil(3 x Kp) x max(measCycleSCell, DRX cycle) x CSSFintra |
| NOTE 1: The requirements also apply to deactivated SCG SCell. | |

Table 9.2.5.1-7: Void

Table 9.2.5.1-8: Void

Table 9.2.5.1-9: Time period for PSS/SSS detection, deactivated SCell (FR1), when *highSpeedMeasCA-Scell-r17* is configured

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra |
| No DRX | Ceil(5 x Kp) x measCycleSCell x CSSFintra |
| DRX cycle≤ 320ms | Ceil(5 x Kp) x max(measCycleSCell, M2 Note 1xDRX cycle) x CSSFintra |
| DRX cycle> 320ms | Ceil(5 x Kp) x max(measCycleSCell, DRX cycle) x CSSFintra |
| NOTE 1: M2 = 1.5 if SMTC periodicity > 40 ms; otherwise M2=1 | |

Table 9.2.5.1-10: Time period for time index detection, deactivated SCell (FR1)，when *highSpeedMeasCA-Scell-r17* is configured

|  |  |
| --- | --- |
| DRX cycle | TSSB\_time\_index\_intra |
| No DRX | Ceil(3 x Kp) x measCycleSCell x CSSFintra |
| DRX cycle≤ 320ms | Ceil(3 x Kp) x max(measCycleSCell, M2 Note 1xDRX cycle) x CSSFintra |
| DRX cycle> 320ms | Ceil(3 x Kp)x max(measCycleSCell, DRX cycle) x CSSFintra |
| NOTE 1: M2 = 1.5 if SMTC periodicity > 40 ms; otherwise M2=1 | |

Table 9.2.5.1-11: Time period for PSS/SSS detection when *highSpeedMeasFlagFR2-r17* is configured, (Frequency range FR2) when SMTC period <= 40ms

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra |
| No DRX | max(600ms, ceil(M1Note 2 x Kp x Klayer1\_measurement)x SMTC period)Note 1 x CSSFintra |
| DRX cycle≤ 80ms | max(600ms, ceil(M1Note 2 x Kp x Klayer1\_measurement)x max(SMTC period,DRX cycle)) x CSSFintra |
| 80ms< DRX cycle≤ 320ms | ceil(1.5x Mpss/sss\_sync\_w/o\_gaps Note 3 x Kp x Klayer1\_measurement)x max(SMTC period,DRX cycle) x CSSFintra |
| DRX cycle>320ms | ceil(Mpss/sss\_sync\_w/o\_gaps Note 3 x Kp x Klayer1\_measurement) x DRX cycle x CSSFintra |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified  NOTE 2: For UE supporting power class 6, M1= 6 if *highSpeedMeasFlagFR2-r17* = set1 or M1= 18 if *highSpeedMeasFlagFR2-r17* = set2  NOTE 3: Void | |

Table 9.2.5.1-12: Time period for PSS/SSS detection, deactivated PSCell (FR1)

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra |
| No DRX | Ceil(5 x Kp) x measCyclePSCell x CSSFintra |
| DRX cycle≤ 320ms | Ceil(5 x Kp) x max(measCyclePSCell, 1.5xDRX cycle) x CSSFintra |
| DRX cycle> 320ms | Ceil(5 x Kp) x max(measCyclePSCell, DRX cycle) x CSSFintra |

Table 9.2.5.1-13: Time period for PSS/SSS detection, deactivated PSCell (FR2)

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra |
| No DRX | Ceil(Mpss/sss\_sync\_w/o\_gaps x Kp) x measCyclePSCell x CSSFintra |
| DRX cycle≤ 320ms | Ceil(Mpss/sss\_sync\_w/o\_gaps x Kp) x max(measCyclePSCell, 1.5xDRX cycle) x CSSFintra |
| DRX cycle> 320ms | Ceil(Mpss/sss\_sync\_w/o\_gaps x Kp) x max(measCyclePSCell, DRX cycle) x CSSFintra |

Table 9.2.5.1-14: Time period for time index detection, deactivated PSCell (FR1)

|  |  |
| --- | --- |
| DRX cycle | TSSB\_time\_index\_intra |
| No DRX | Ceil(3 x Kp) x measCyclePSCell x CSSFintra |
| DRX cycle≤ 320ms | Ceil(3 x Kp) x max(measCyclePSCell, 1.5xDRX cycle) x CSSFintra |
| DRX cycle> 320ms | Ceil(3 x Kp) x max(measCyclePSCell, DRX cycle) x CSSFintra |

Table 9.2.5.1-15: Time period for time index detection (Frequency range FR2-2)

|  |  |
| --- | --- |
| DRX cycle | TSSB\_time\_index\_intra |
| No DRX | max(200ms, ceil(MSSB\_index\_intra x Kp x SMTC period) x CSSFintra |
| DRX cycle≤ 320ms | max(200ms, ceil(1.5 x MSSB\_index\_intra x Kp) x max(SMTC period, DRX cycle) x CSSFintra) |
| DRX cycle>320ms | Ceil(MSSB\_index\_intra x Kp )x DRX cycle x CSSFintra |

#### 9.2.5.2 Measurement period

The measurement period for intra-frequency measurements without gaps is as shown in table 9.2.5.2-1, 9.2.5.2-2, 9.2.5.2-3 (deactivated SCell), 9.2.5.2-4 (deactivated SCell), 9.2.5.2-8 (deactivated SCG applicable for PSCell) or 9.2.5.2-9 (deactivated SCG applicable for PSCell). When *highSpeedMeasFlag-r16* is configured, T SSB\_measurement\_period\_intra is specified in Table 9.2.5.2-5.

If the higher layer signaling in TS38.331 [2] signalling of *smtc2* is present and smtc1 is fully overlapping with measurement gaps and smtc2 is partially overlapping with measurement gaps, requirements are not specified for TSSB\_measurement\_period\_intra

For a UE that supports Pre-MG, an SMTC occasion is only considered to be overlapped by Pre-MG if the Pre-MG is activated.

If MCG DRX is in use, measurement period requirements for intra-frequency measurement in MCG specified in Table 9.2.5.2-1, Table 9.2.5.2-2, Table 9.2.5.2-3 and Table 9.2.5.2-4 shall depend on the MCG DRX cycle. If SCG DRX is in use, measurement period requirements for intra-frequency measurement in SCG specified in Table 9.2.5.2-1, Table 9.2.5.2-2, Table 9.2.5.2-3, Table 9.2.5.2-4, Table 9.2.5.2-8 and Table 9.2.5.2-9, shall depend on the SCG DRX cycle. Otherwise, the requirements for when DRX is not in use shall apply.

For FR2, a longer measurement period is allowed, if aperiodic CSI-RS resource is measured for L1-RSRP measurement on any FR2 serving frequency in the same band, and the CSI-RS resource is outside measurement gap and overlapped with any of the SSB symbols and the RSSI symbols, and 1 symbol before each consecutive SSB symbols and the RSSI symbols, and 1 symbol after each consecutive SSB symbols and the RSSI symbols. If *SSB-ToMeasure* or *SS-RSSI-Measurement* is configured, the SSB symbols are indicated by the union set of *SSB-ToMeasure* from all the configured measurement objects on the same band which can be merged and the RSSI symbols are indicated by *SS-RSSI-Measurement*.

Table 9.2.5.2-1: Measurement period for intra-frequency measurements without gaps (FR1)

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra |
| No DRX | max(200ms, ceil( 5 x Kp) x SMTC period)Note 1 x CSSFintra |
| DRX cycle≤ 320ms | max(200ms, ceil(1.5x 5 x Kp) x max(SMTC period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | ceil( 5 x Kp ) x DRX cycle x CSSFintra |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified | |

Table 9.2.5.2-2: Measurement period for intra-frequency measurements without gaps (FR2)

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra |
| No DRX | max(400ms, ceil(Mmeas\_period\_w/o\_gaps x Kp x Klayer1\_measurement) x SMTC period)Note 1 x CSSFintra |
| DRX cycle≤ 320ms | max(400ms, ceil(1.5x Mmeas\_period\_w/o\_gaps x Kp x Klayer1\_measurement) x max(SMTC period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | ceil(Mmeas\_period\_w/o\_gaps xKp x Klayer1\_measurement ) x DRX cycle x CSSFintra |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified | |

Table 9.2.5.2-3: Measurement period for intra-frequency measurements without gaps (deactivated SCell) (FR1)

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra |
| No DRX | Ceil(5 x Kp) x measCycleSCell x CSSFintra |
| DRX cycle≤ 320ms | Ceil(5 x Kp) x max(measCycleSCell, 1.5xDRX cycle) x CSSFintra |
| DRX cycle> 320ms | Ceil(5 x Kp) x max(measCycleSCell, DRX cycle) x CSSFintra |
| NOTE 1: The requirements also apply to deactivated SCG SCel | |

Table 9.2.5.2-4: Measurement period for intra-frequency measurements without gaps (deactivated SCell) (FR2)

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra |
| No DRX | Ceil(Mmeas\_period\_w/o\_gaps x Kp) x measCycleSCell x CSSFintra |
| DRX cycle≤ 320ms | Ceil(Mmeas\_period\_w/o\_gaps x Kp) x max(measCycleSCell, 1.5xDRX cycle) x CSSFintra |
| DRX cycle> 320ms | Ceil(Mmeas\_period\_w/o\_gaps x Kp) x max(measCycleSCell, DRX cycle) x CSSFintra |
| NOTE 1: The requirements also apply to deactivated SCG SCell. | |

Table 9.2.5.2-5: T SSB\_measurement\_period\_intra When *highSpeedMeasFlag-r16* and/or highSpeedMeasCA-Scell-r17 is configured (Frequency range FR1

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra |
| No DRX Note 2 | max(200ms, ceil( 5 x Kp) x SMTC period)Note 1 x CSSFintra |
| DRX cycle≤ 160ms | max(200ms, ceil(5 x M2 Note 2 x Kp) x max(SMTC period,DRX cycle)) x CSSFintra |
| 160ms < DRX cycle≤ 320ms | ceil(4 x M2 Note 2 x Kp) x DRX cycle x CSSFintra |
| DRX cycle>320ms | ceil( Y Note 3 x Kp ) x DRX cycle x CSSFintra |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified  NOTE 2: M2 = 1.5 if SMTC period > 40 ms, otherwise M2=1  NOTE 3: Y=3 when SMTC period <= 40ms, Y=5 when SMTC period > 40ms  NOTE 4: When *highSpeedMeasFlag-r16* is configured, the requirements apply only to UE supporting either *measurementEnhancement-r16* or *intraNR-MeasurementEnhancement-r16* on measurements of the primary component carrier and do not apply to measurements of a secondary component carrier with active SCell.  NOTE 5: When highSpeedMeasCA-Scell-r17 is configured, the requirements apply to measurements of secondary component carrier with active SCell. | |

Table 9.2.5.2-6: Measurement period for intra-frequency measurements without gaps (deactivated SCell) (FR1), when highSpeedMeasCA-Scell-r17 is configured

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra |
| No DRX | ceil( 5 x Kp) x measCycleSCell x CSSFintra |
| DRX cycle≤ 160ms | ceil(5 x Kp) x max(measCycleSCell, M2 Note 1 x DRX cycle) x CSSFintra |
| 160ms < DRX cycle≤ 320ms | ceil(4 x Kp) x max(measCycleSCell, M2 Note 1 x DRX cycle) |
| DRX cycle>320ms | ceil( Y Note 2 x Kp ) x max(measCycleSCell, DRX cycle) x CSSFintra |
| NOTE 1: M2 = 1.5 if SMTC periodicity > 40 ms, otherwise M2=1  NOTE 2: Y=3 when SMTC <= 40ms, Y=5 when SMTC > 40ms | |

Table 9.2.5.2-7: Measurement period for intra-frequency measurements without gaps when *highSpeedMeasFlagFR2-r17* is configured (FR2) when SMTC period <= 40ms

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra |
| No DRX | max(400ms, ceil(M1Note 2 x Kp x Klayer1\_measurement) x SMTC period)Note 1 x CSSFintra |
| DRX cycle≤ 80ms | max(400ms, ceil(M1Note 2 x Kp x Klayer1\_measurement) x max(SMTC period,DRX cycle)) x CSSFintra |
| 80ms< DRX cycle≤ 320ms | ceil(1.5x Mmeas\_period\_w/o\_gaps Note 3 x Kp x Klayer1\_measurement) x max(SMTC period,DRX cycle) x CSSFintra |
| DRX cycle>320ms | ceil(Mmeas\_period\_w/o\_gaps Note 3 xKp x Klayer1\_measurement ) x DRX cycle x CSSFintra |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified  NOTE 2: For UE supporting power class 6, M1= 6 if *highSpeedMeasFlagFR2-r17* = set1 or M1= 18 if *highSpeedMeasFlagFR2-r17* = set2 | |

Table 9.2.5.2-8 Measurement period for intra-frequency measurements without gaps (deactivated SCG applicable for PSCell) (FR1)

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra |
| No DRX | Ceil(5 x Kp) x measCyclePSCell x CSSFintra |
| DRX cycle≤ 320ms | Ceil(5 x Kp) x max(measCyclePSCell, 1.5xDRX cycle) x CSSFintra |
| DRX cycle> 320ms | Ceil(5 x Kp) x max(measCyclePSCell, DRX cycle) x CSSFintra |

**Table 9.2.5.2-9: Measurement period for intra-frequency measurements without gaps (deactivated SCG applicable for PSCell) (FR2)**

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra |
| No DRX | Ceil(Mmeas\_period\_w/o\_gaps x Kp) x measCyclePSCell x CSSFintra |
| DRX cycle≤ 320ms | Ceil(Mmeas\_period\_w/o\_gaps x Kp) x max(measCyclePSCell, 1.5xDRX cycle) x CSSFintra |
| DRX cycle> 320ms | Ceil(Mmeas\_period\_w/o\_gaps x Kp) x max(measCyclePSCell, DRX cycle) x CSSFintra |

#### 9.2.5.3 Scheduling availability of UE during intra-frequency measurements

UE shall be capable of measuring without measurement gaps when the SSB is completely contained in the active bandwidth part of the UE. When any of the conditions in the following clauses is met, there are restrictions on the scheduling availability; otherwise, there is no scheduling restriction. Note that the SSB symbols indicated by the union set of SSB-ToMeasure from all the configured measurement objects on the same serving carrier which can be merged[2], if it is configured; otherwise, all *L* SSB symbols within the SMTC window duration defined in clause 4.1 of TS 38.213 [3] are included.

For a UE that supports Pre-MG, the requirements in 9.2.5.3 also apply when a Pre-MG is deactivated.

For UE supporting concurrent measurement gaps, when concurrent gaps are configured, the requirements in 9.2.5.3 are also applied to the slots that are not interrupted according to requirements in clause 9.1.X2.3.

##### 9.2.5.3.1 Scheduling availability of UE performing measurements in TDD bands on FR1

When the UE performs intra-frequency measurements in a TDD band, the following restrictions apply due to SS-RSRP or SS-SINR measurement

- The UE is not expected to transmit PUCCH/PUSCH/SRS on SSB symbols to be measured, and on 1 data symbol before each consecutive SSB symbols to be measured and 1 data symbol after each consecutive SSB symbols to be measured within SMTC window duration. If the high layer in TS 38.331 [2] signalling of *smtc2*is configured, the SMTC periodicityfollows *smtc2*; Otherwise SMTC periodicity follows *smtc1.*

When the UE performs intra-frequency measurements in a TDD band, the following restrictions apply due to SS-RSRQ measurement

- The UE is not expected to transmit PUCCH/PUSCH/SRS on SSB symbols to be measured, RSSI measurement symbols, and on 1 data symbol before each consecutive SSB to be measured/RSSI symbols and 1 data symbol after each consecutive SSB to be measured/RSSI symbols within SMTC window duration. If the high layer signalling of *smtc2*is configured in TS 38.331 [2], the SMTC periodicityfollows *smtc2*; Otherwise the SMTC periodicity follows *smtc1.*

When TDD intra-band carrier aggregation is performed, the scheduling restrictions due to a given serving cell should also apply to all other serving cells in the same band on the symbols that fully or partially overlap with the aforementioned restricted symbols.

When TDD inter-band carrier aggregation is performed, the scheduling restrictions due to a given serving cell should also apply to another serving cell in a different band on the symbols that fully or partially overlap with the aforementioned restricted symbols, if UE does not have the capability of supporting *simultaneousRxTxInterBandCA* for this band pair.

##### 9.2.5.3.2 Scheduling availability of UE performing measurements with a different subcarrier spacing than PDSCH/PDCCH on FR1

For UE which do not support *simultaneousRxDataSSB-DiffNumerology* [14] the following restrictions apply due to SS-RSRP/RSRQ/SINR measurement

- If *deriveSSB\_IndexFromCell* is enabled the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on SSB symbols to be measured, and on 1 data symbol before each consecutive SSB symbols to be measured and 1 data symbol after each consecutive SSB symbols to be measured within SMTC window duration. If the high layer signalling of *smtc2*is configured(in TS 38.331 [2]), the SMTC periodicityfollows *smtc2*; Otherwise the SMTC periodicity follows *smtc1.*

- If *deriveSSB\_IndexFromCell* is not enabled the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on all symbols within SMTC window duration. If the high layer signalling of *smtc2*is configured in TS 38.331 [2], the SMTC periodicityfollows *smtc2*; Otherwise the SMTC periodicity follows *smtc1.*

If the following conditions are met:

- The UE has been notified about system information update through paging,

- The gap between the UE’s reception of PDCCH that UE monitors in the Type 2-PDCCH CSS set that notifies system information update, and the PDCCH that UE monitors in the Type0-PDCCH CSS set, is greater than 2 slots

The UE is expected to receive the PDCCH that the UE monitors in the Type0-PDCCH CSS set, and/or the corresponding PDSCH, on SSB symbols to be measured.

When intra-band carrier aggregation is performed, the scheduling restrictions due to a given serving cell should also apply to all other serving cells in the same band on the symbols that fully or partially overlap with the aforementioned restricted symbols.

##### 9.2.5.3.3 Scheduling availability of UE performing measurements on FR2

The following scheduling restriction applies due to SS-RSRP or SS-SINR measurement on an FR2 intra-frequency cell

- If *deriveSSB-IndexFromCell* is enabled the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on SSB symbols to be measured, and on K data symbol(s) before each consecutive SSB symbols to be measured and K data symbol(s) after each consecutive SSB symbols to be measured within SMTC window duration.

- If *deriveSSB-IndexFromCell* is not enabled and the SCS of data and SSB symbols are smaller than 960kHz, the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on all symbols within SMTC window duration.

- If *deriveSSB-IndexFromCell* is not enabled and the SCS of data or SSB symbols is 960kHz, the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI SSB symbols to be measured, and on K’ data symbol(s) before each consecutive SSB symbols to be measured and K’ data symbol(s) after each consecutive SSB symbols to be measured within SMTC window duration.

The following scheduling restriction applies to SS-RSRQ measurement on an FR2 intra-frequency cell

- If *deriveSSB-IndexFromCell* is enabled the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on SSB symbols to be measured, RSSI measurement symbols, and on K data symbol(s) before each consecutive SSB to be measured/RSSI symbols and K data symbol(s) after each consecutive SSB to be measured/RSSI symbols within SMTC window duration

*-* If *deriveSSB-IndexFromCell* is not enabled and the SCS of data and SSB symbols are smaller than 960kHz, the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on all symbols within SMTC window duration.

*-* If *deriveSSB-IndexFromCell* is not enabled and the SCS of SSB symbols is 960kHz, the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on SSB symbols to be measured, RSSI measurement symbols, and on K’ data symbol(s) before each consecutive SSB to be measured/RSSI symbols and K’ data symbol(s) after each consecutive SSB to be measured/RSSI symbols within SMTC window duration.

where

- If the high layer signalling of *smtc2*is configured in TS 38.331 [2], the SMTC periodicityfollows *smtc2*; Otherwise the SMTC periodicity follows *smtc1.*

- The signaling *deriveSSB-IndexFromCell* is always enabled for FR2-1 and FR2-2 when SSB is using 120 kHz SCS and 480 kHz SCS.

- K=1 for a serving cell with data symbols of 120 kHz SCS

- K=4 for a serving cell with data symbols of 480 kHz SCS and SSB symbols of 120kHz or 480kHz SCS

- K=3 for a serving cell with data symbols of 480 kHz SCS and SSB symbols of 960kHz SCS

- K=7 for a serving cell with data symbols of 960 kHz SCS and SSB symbols of 120kHz or 480kHz SCS

- K=4 for a serving cell with data symbols of 960 kHz SCS and SSB symbols of 960kHz SCS

- K’=[2] for a serving cell with data symbols of 120 kHz SCS and SSB symbols of 960kHz SCS

- K’=[4] for a serving cell with data symbols of 480 kHz SCS and SSB symbols of 960kHz SCS

- K’=[7] for a serving cell with data symbols of 960 kHz SCS and SSB symbols of 960kHz SCS

When intra-band carrier aggregation in FR2 is performed, the scheduling restrictions due to a given serving cell should also apply to all other serving cells in the same band on the symbols that fully or partially overlap with aforementioned restricted symbols.

When inter-band carrier aggregation in FR2 is performed, there are no scheduling restrictions on FR2 serving cells in the bands due to SS-RSRP, SS-RSRQ or SS-SINR measurement on an FR2 intra-frequency cell in different bands, provided that UE is capable of independent beam management on this FR2 band pair. Additionally, there is no scheduling restriction if the UE is configured with different numerology between SSB on one FR2 band and data on the other FR2 band provided the UE is configured for IBM operation for the band pair.

Note: When inter-band carrier aggregation in FR2 is performed, the scheduling restrictions as defined in clause 9.2.5.3.1 due to a given serving cell should also apply to another serving cell in a different FR2 band on the symbols that fully or partially overlap with the aforementioned restricted symbols, if UE does not have the capability of supporting *simultaneousRxTxInterBandCA* for this FR2 band pair.

If following conditions are met:

- The UE has been notified about system information update through paging,

- The gap between the UE’s reception of PDCCH that UE monitors in the Type 2-PDCCH CSS set that notifies system information update, and the PDCCH that UE monitors in the Type0-PDCCH CSS set, is greater than 2 slots

For the SSB and CORESET for RMSI scheduling multiplexing patterns 3, the UE is expected to receive the PDCCH that the UE monitors in the Type0-PDCCH CSS set, and the corresponding PDSCH, on SSB symbols to be measured; and

For the SSB and CORESET for RMSI scheduling multiplexing patterns 2, the UE is expected to receive PDSCH that corresponds to the PDCCH that the UE monitors in the Type0-PDCCH CSS set, on SSB symbols to be measured.

##### 9.2.5.3.4 Scheduling availability of UE performing measurements on FR1 or FR2 in case of FR1-FR2 inter-band CA

There are no scheduling restrictions on FR1 serving cell(s) due to measurements performed on FR2 serving cell frequency layer. However, the scheduling restrictions as defined in clause 9.2.5.3.1 due to a given serving cell in FR2 should also apply to another serving cell in an FR1 band on the symbols that fully or partially overlap with the aforementioned restricted symbols, if UE does not have the capability of supporting *simultaneousRxTxInterBandCA* for this FR1-FR2 band pair.

There are no scheduling restrictions on FR2 serving cell(s) due to measurements performed on FR1 serving cell frequency layer. However, the scheduling restrictions as defined in clause 9.2.5.3.1 due to a given serving cell in FR1 should also apply to another serving cell in an FR2 band on the symbols that fully or partially overlap with the aforementioned restricted symbols, if UE does not have the capability of supporting *simultaneousRxTxInterBandCA* for this FR1-FR2 band pair.

#### 9.2.5.4 SFTD Measurements between PCell and PSCell

##### 9.2.5.4.1 Introduction

This clause contains SFTD measurement requirements for UE which supports NR-DC and is configured with a PSCell in RRC\_CONNECTED state. The UE shall perform SFTD measurement between PCell and PSCell, and report the SFTD result with/without SS-RSRP after the network requests with *reportType* for the associated *reportConfig* set to *reportSFTD*. The overall delay includes RRC procedure delay defined in clause 12 in TS 38.331 [2], and SFTD measurement reporting delay in clause 9.2.5.4.3..

##### 9.2.5.4.2 SFTD Measurement delay

When no DRX is used in either of PCell and PSCell, the physical layer measurement period of the SFTD measurement shall be Tmeasure\_SFTD1 = max(200, 5 x SMTC period) ms, where the SMTC period refers to the maximum between the configured SMTC period in PCell and PSCell.

When DRX is used in either of the PCell or the PSCell, or in both PCell and PSCell, the physical layer measurement period (Tmeasure\_SFTD1) of the SFTD measurement shall be as specified in Table 9.2.5.4.2-1.

Table 9.2.5.4.2-1: SFTD measurement requirement when DRX is used

|  |  |
| --- | --- |
| DRX cycle length (s) Note 3 | Tmeasure\_SFTD1 (s) |
| ≤0.04 | max(0.2, 5 x SMTC period) (Note2) |
| 0.04<DRX cycle≤0.32 | 8 x max(DRX cycle, SMTC period) |
| 0.32<DRX cycle≤10.24 | 5 x DRX cycle |
| Note 1: SMTC period in this table refers to the maximum between the configured SMTC period in PCell and PSCell.  Note 2: Number of DRX cycles depends upon the DRX cycle in use  Note 3: DRX cycle length in this table refers to the DRX cycle length configured for PCell or PSCell. When DRX is used in both PCell and PSCell, DRX cycle length in this table refers to the longer of the DRX cycle lengths for PCell and PSCell. | |

If PSCell is changed without changing carrier frequency of PSCell, while the UE is performing SFTD measurements, the UE shall still meet SFTD measurement and accuracy requirements for the new PSCell. In this case the UE shall restart the SFTD measurement, and the total physical layer measurement period shall not exceed Tmeasure\_SFTD2 as defined by the following expression:

Tmeasure\_SFTD2 = (M+1)\*(Tmeasure\_SFTD1) + M\*TPSCell\_change\_NRDC

where:

M is the number of times the NR PSCell is changed over the measurement period (Tmeasure\_SFTD2), and

TPSCell\_change\_NRDC is the time necessary to change the PSCell; it can be up to 25ms.

If PCell is changed, or if PSCell is changed with different carrier frequency from PSCell, the UE shall terminate SFTD measurements.

The measurement accuracy for the SFTD measurement when DRX is used as well as when no DRX is used shall be as specified in the clause 10.1.21.

##### 9.2.5.4.3 SFTD Measurement Reporting Delay

The SFTD measurement reporting delay is defined as the time between a command that will trigger an SFTD measurement report and the point when the UE starts to transmit the measurement report over the air interface. This requirement assumes that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 x TTIDCCH. This measurement reporting delay excludes any delay caused by no UL resources available for UE to send the measurement report.

The SFTD measurement reporting delay shall be less than measurement period defined in clause 9.2.5.4.2 plus the RRC procedure delay defined in TS 38.331 [2].

### 9.2.6 Intra-frequency measurements with measurement gaps

#### 9.2.6.1 Void

#### 9.2.6.2 Intra-frequency cell identification

When a measurement gap is provided or an activated Pre-MG is provided without any pre-MG status changed during the measurement period, the UE shall be able to identify a new detectable intra frequency cell within Tidentify\_intra\_without\_index if UE is not indicated to report SSB based RRM measurement result with the associated SSB index (*reportQuantityRsIndexes* or *maxNrofRSIndexesToReport* is not configured), or the UE has been indicated that the neighbour cell is synchronous with the serving cell (*deriveSSB-IndexFromCell* is enabled). Otherwise UE shall be able to identify a new detectable intra frequency cell within Tidentify\_intra\_with\_index. The UE shall be able to identify a new detectable intra frequency SS block of an already detected cell within Tidentify\_intra\_without\_index. It is assumed that *deriveSSB-IndexFromCell* is always enabled for FR1 TDD and FR2 with SCS smaller or equal to 480 kHz.

Tidentify\_intra\_without\_index = TPSS/SSS\_sync\_intra + T SSB\_measurement\_period\_intra ms

Tidentify\_intra\_with\_index = TPSS/SSS\_sync\_ntra + T SSB\_measurement\_period\_intra + TSSB\_time\_index\_intra ms

Where:

TPSS/SSS\_sync\_intra: it is the time period used in PSS/SSS detection given in table 9.2.6.2-1, 9.2.6.2-2 or 9.2.6.2-9.

- For UE supporting power class 6 with *highSpeedMeasFlagFR2-r17* configured, if SMTC <= 40ms, TPSS/SSS\_sync\_intra is given in Table 9.2.6.2-9; otherwise, TPSS/SSS\_sync\_intra is given in Table 9.2.6.2-2.

TSSB\_time\_index\_intra: it is the time period used to acquire the index of the SSB being measured given in table 9.2.6.2-3 or 9.2.6.2-10 (for FR2-2).

T SSB\_measurement\_period\_intra: equal to a measurement period of SSB based measurement given in table 9.2.6.3-1 or 9.2.6.3-2.

- For UE supporting power class 6 with *highSpeedMeasFlagFR2-r17* configured, if SMTC <= 40ms, TSSB\_measurement\_period\_intra is given in Table 9.2.6.3-4; otherwise, T SSB\_measurement\_period\_intra is given in Table 9.2.6.3-2.

CSSFintra: it is a carrier specific scaling factor and is determined according to CSSFwithin\_gap,i in clause 9.1.5.2 for measurement conducted within measurement gaps.

Kgap is the scaling factor for a SSB frequency layer to be measured within an associated measurement gap pattern. Kgap = 1 when the UE is not configured with concurrent measurement gaps or not supporting [concurrent measurement gaps]. Otherwise, Kgap = Ntotal / Navailable, where Navailable and Ntotal are calculated as follows:

For a window W of duration max(SMTC period, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE measurement gap and per-FR measurement gap within the same FR as the SSB frequency layer, and starting from the beginning of any SMTC occasion:

-- Ntotal is the total number of SMTC occasions that are covered by instances of the associated measurement gap within the window W, including those overlapped with other measurement gap occasions within the window, and

Navailable is the number of SMTC occasions that are covered by instances of the non-dropped associated measurement gap within the window W after accounting for measurement gap collisions by applying the measurement gap collision rule in section 9.1.8.3.

When concurrent measurement gaps are configured, requirements in this clause do not apply if Navailable =0.

Mpss/sss\_sync\_with\_gaps : For a UE supporting FR2-1 power class 1 or 5, Mpss/sss\_sync with\_gaps=40. For a UE supporting FR2-1 power class 2, Mpss/sss\_sync with\_gaps =24. For a UE supporting FR2-1 power class 3, Mpss/sss\_sync with\_gaps =24. For a UE supporting FR2-1 power class 4, Mpss/sss\_sync with\_gaps =24. For a UE supporting FR2-2 power class 1, Mpss/sss\_sync with\_gaps = 60. For a UE supporting FR2-2 power class 2, Mpss/sss\_sync with\_gaps = 36. For a UE supporting FR2-2 power class 3, Mpss/sss\_sync with\_gaps = 36.

Mmeas\_period\_ with\_gaps: For a UE supporting FR2-1 power class 1 or 5, Mmeas\_period\_ with\_gaps =40. For a UE supporting FR2-1 power class 2, Mmeas\_period\_ with\_gaps =24. For a UE supporting FR2-1 power class 3, Mmeas\_period\_ with\_gaps =24. For a UE supporting FR2-1 power class 4, Mmeas\_period with\_gaps =24. For a UE supporting FR2-2 power class 1, Mmeas\_period\_ with\_gaps = 60. For a UE supporting FR2-2 power class 2, Mmeas\_period\_ with\_gaps = 36. For a UE supporting FR2-2 power class 3, Mmeas\_period\_ with\_gaps = 36.

- MSSB\_index\_intra: For a UE supporting FR2-2 power class 1, MSSB\_index\_intra = 72. For a UE supporting FR2-2 power class 2, MSSB\_index\_intra = 48. For a UE supporting FR2 power class 3, MSSB\_index\_intra = 48.

If the higher layer signaling in TS 38.331 [2] of *smtc2* is present and smtc1 is fully overlapping with measurement gaps and smtc2 is partially overlapping with measurement gaps, requirements are not specified for Tidentify\_intra\_without\_index or Tidentify\_intra\_with\_index.

If MCG DRX is in use, cell identification requirements for intra-frequency measurement in MCG specified in Table 9.2.6.2-1, Table 9.2.6.2-2, and Table 9.2.6.2-3 shall depend on the MCG DRX cycle. If SCG DRX is in use, cell identification requirements for intra-frequency measurement in SCG specified in Table 9.2.6.2-1, Table 9.2.6.2-2, and Table 9.2.6.2-3 shall depend on the SCG DRX cycle. Otherwise, the requirements for when DRX is not in use shall apply.

Table 9.2.6.2-1: Time period for PSS/SSS detection (FR1)

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra |
| No DRX | max(600ms, 5 x Kgap x max(MGRP, SMTC period)) x CSSFintra |
| DRX cycle≤ 320ms | max(600ms, ceil(M2Note 1x 5 x Kgap) x max(MGRP, SMTC period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | Ceil( 5 x Kgap ) x max(MGRP, DRX cycle) x CSSFintra |
| NOTE 1: When *highSpeedMeasFlag-r16* is not configured, M2 = 1.5; When *highSpeedMeasFlag-r16* is configured, M2 = 1.5 if SMTC periodicity > 40 ms, otherwise M2=1.  NOTE 2: When *highSpeedMeasFlag-r16* is configured, the requirements apply only to UE supporting either *measurementEnhancement-r16* or *intraNR-MeasurementEnhancement-r16* on measurements of the primary component carrier and do not apply to measurements of a secondary component carrier with active SCell.  NOTE 3: For a UE supporting concurrent measurement gaps, if multiple concurrent gaps are configured, the MGRP is the periodicity of the MG pattern associated to the intra-frequency layer.  NOTE 4: When highSpeedMeasCA-Scell-r17 is configured, the requirements apply to UE on measurements of secondary component carrier with active SCell. | |

**Table 9.2.6.2-2: Time period for PSS/SSS detection (FR2)**

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra |
| No DRX | max(600ms, Mpss/sss\_sync\_with\_gaps x KFR x Kgap x max(MGRP, SMTC period)) x CSSFintra |
| DRX cycle≤ 320ms | max(600ms, ceil(1.5x Mpss/sss\_sync\_with\_gaps x KFR x Kgap) x max(MGRP, SMTC period, DRX cycle))x CSSFintra |
| DRX cycle>320ms | Ceil( Mpss/sss\_sync\_with\_gaps x KFR x Kgap ) x max(MGRP, DRX cycle) x CSSFintra |
| NOTE 1: For a UE supporting concurrent gaps, if multiple concurrent gaps are configured, the MGRP is the periodicity of the MG pattern associated to the intra-frequency layer.  NOTE 2: KFR is a scaling factor depending on the frequency range and the SSB SCS. For FR2-1, KFR = 1. For FR2-2: KFR = 1 if the SCS of the SSB of the cell being detected is 120 kHz, KFR = 2 if the SCS of the SSB of the cell being detected is 480 kHz, and KFR = 3 if the SCS of the SSB of the cell being detected is 960 kHz. | |

Table 9.2.6.2-3: Time period for time index detection (Frequency range FR1)

|  |  |
| --- | --- |
| DRX cycle | TSSB\_time\_index\_intra |
| No DRX | max(120ms, ceil(3 x Kgap ) x max(MGRP, SMTC period)) x CSSFintra |
| DRX cycle≤ 320ms | max(120ms, ceil(M2Note 1x 3 x Kgap) x max(MGRP, SMTC period,DRX cycle) x CSSFintra) |
| DRX cycle>320ms | Ceil(3 x Kgap )x max(MGRP, DRX cycle) x CSSFintra |
| NOTE 1: When *highSpeedMeasFlag-r16* is not configured, M2 = 1.5; When *highSpeedMeasFlag-r16* is configured, M2 = 1.5 if SMTC periodicity > 40 ms, otherwise M2=1.  NOTE 2: When *highSpeedMeasFlag-r16* is configured, the requirements apply only to UE supporting either *measurementEnhancement-r16* or *intraNR-MeasurementEnhancement-r16* on measurements of the primary component carrier and do not apply to measurements of a secondary component carrier with active SCell.  NOTE 3: For a UE supporting concurrent gaps, if multiple concurrent gaps are configured, the MGRP is the periodicity of the MG pattern associated to the intra-frequency layer.  NOTE 4: When highSpeedMeasCA-Scell-r17 is configured, the requirements apply to UE on measurements of secondary component carrier with active SCell. | |

Table 9.2.6.2-7: Void

Table 9.2.6.2-8: Void

Table 9.2.6.2-8: Void

Table 9.2.6.2-9: Time period for PSS/SSS detection when *highSpeedMeasFlagFR2-r17* is configured, (FR2) when SMTC period <=40ms

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra |
| No DRX | max(600ms, M1Note 2 x Kgap x max(MGRP, SMTC period)) x CSSFintra |
| DRX cycle≤ 80ms | max(600ms, ceil(M1Note2 x Kgap) x max(MGRP, SMTC period, DRX cycle))x CSSFintra |
| 80ms< DRX cycle≤ 320ms | max(600ms, ceil(Mpss/sss\_sync\_with\_gaps x Kgap) x max(MGRP, SMTC period, DRX cycle))x CSSFintra |
| DRX cycle>320ms | Ceil( Mpss/sss\_sync\_with\_gaps x Kgap ) x max(MGRP, DRX cycle) x CSSFintra |
| NOTE 1: For a UE supporting concurrent gaps, if multiple concurrent gaps are configured, the MGRP is the periodicity of the MG pattern associated to the intra-frequency layer.  NOTE 2: For UE supporting power class 6, M1= 6 if *highSpeedMeasFlagFR2-r17* = set1 or M1= 18 if *highSpeedMeasFlagFR2-r17* = set2  NOTE 3: Void | |

Table 9.2.6.2-10: Time period for time index detection (Frequency range FR2-2)

|  |  |
| --- | --- |
| DRX cycle | TSSB\_time\_index\_intra |
| No DRX | max(200ms, ceil(MSSB\_index\_intra x Kgap x max(MGRP, SMTC period)) x CSSFintra |
| DRX cycle≤ 320ms | max(200ms, ceil(1.5 x MSSB\_index\_intra x Kgap) x max(MGRP, SMTC period, DRX cycle) x CSSFintra) |
| DRX cycle>320ms | Ceil(MSSB\_index\_intra x Kgap)x DRX cycle x CSSFintra |

#### 9.2.6.3 Intrafrequency Measurement Period

The requirements in this clause apply when a measurement gap is provided or when an activated Pre-MG is provided without any pre-MG status changed during the measurement period.

The measurement period for FR1 intrafrequency measurements with gaps is as shown in table 9.2.6.3-1.

The measurement period for FR2 intrafrequency measurements with gaps is as shown in table 9.2.6.3-2.

When *highSpeedMeasFlag-r16* is configured, T SSB\_measurement\_period\_intra is specified in Table 9.2.6.3-3.

If MCG DRX is in use, measurement period requirements for intra-frequency measurement in MCG specified in Table 9.2.6.3-1 and Table 9.2.6.3-2, shall depend on the MCG DRX cycle. If SCG DRX is in use, measurement period requirements for intra-frequency measurement in SCG specified in Table 9.2.6.3-1and Table 9.2.6.3-2, shall depend on the SCG DRX cycle. Otherwise, the requirements for when DRX is not in use shall apply.

For either an FR1 or FR2 serving cell, longer measurement period would be expected during the period Tidentify\_CGI when the UE is requested to decode an NR CGI.

Table 9.2.6.3-1: Measurement period for intra-frequency measurements with gaps(FR1)

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra |
| No DRX | max(200ms, ceil(5 x Kgap )x max(MGRP, SMTC period)) x CSSFintra |
| DRX cycle≤ 320ms | max(200ms, ceil(1.5x 5 x Kgap) x max(MGRP, SMTC period,DRX cycle))x CSSFintra |
| DRX cycle>320ms | Ceil(5 x Kgap ) x max(MGRP, DRX cycle) x CSSFintra |
| NOTE 1: For a UE supporting concurrent gaps, if multiple concurrent gaps are configured, the MGRP is the periodicity of the MG pattern associated to the intra-frequency layer. | |

Table 9.2.6.3-2: Measurement period for intra-frequency measurements with gaps(FR2)

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra |
| No DRX | max(400ms, ceil(Mmeas\_period with\_gaps x Kgap ) x max(MGRP, SMTC period)) x CSSFintra |
| DRX cycle≤ 320ms | max(400ms, ceil(1.5 x Mmeas\_period with\_gaps x Kgap) x max(MGRP, SMTC period, DRX cycle)) Note 1 x CSSFintra |
| DRX cycle>320ms | Ceil( Mmeas\_period with\_gaps x Kgap ) x max(MGRP, DRX cycle) x CSSFintra |
| NOTE 1: For a UE supporting concurrent gaps, if multiple concurrent gaps are configured, the MGRP is the periodicity of the MG pattern associated to the intra-frequency layer. | |

Table 9.2.6.3-3: Measurement period When *highSpeedMeasFlag-r16* is configured (Frequency Range FR1)

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra |
| No DRX | max(200ms, ceil( 5 x Kgap ) x max(MGRP, SMTC period)) Note 1 x CSSFintra |
| DRX cycle≤ 160ms | max(200ms, ceil(M2Note 2 x 5 x Kgap) x max(MGRP, SMTC period,DRX cycle)) x CSSFintra |
| 160ms < DRX cycle≤ 320ms | max(200ms, ceil(M2Note 2 x 4 x Kgap) x max(MGRP, DRX cycle)) x CSSFintra |
| DRX cycle>320ms | Ceil(Y Note 3 x Kgap ) x max(MGRP, DRX cycle) x CSSFintra |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified  NOTE 2: M2 = 1.5 if SMTC periodicity > 40 ms, otherwise M2=1  NOTE 3: Y=3 when SMTC <= 40ms, Y=5 when SMTC > 40ms  NOTE 4: When *highSpeedMeasFlag-r16* is configured, the requirements apply only to UE supporting either *measurementEnhancement-r16* or *intraNR-MeasurementEnhancement-r16* on measurements of the primary component carrier and do not apply to measurements of a secondary component carrier with active SCell.  NOTE 5: For a UE supporting concurrent gaps, if multiple concurrent gaps are configured, the MGRP is the periodicity of the MG pattern associated to the intra-frequency layer.  NOTE 6: When highSpeedMeasCA-Scell-r17 is configured, the requirements also apply to UE on measurements of secondary component carrier with active SCell. | |

Table 9.2.6.3-4: Measurement period for intra-frequency measurements with gaps when *highSpeedMeasFlagFR2-r17* is configured (FR2) when SMTC period<=40ms

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra |
| No DRX | max(400ms, ceil(M1Note 2 x Kgap ) x max(MGRP, SMTC period)) x CSSFintra |
| DRX cycle≤ 80ms | max(400ms, ceil(M1Note 2 x Kgap) x max(MGRP, SMTC period, DRX cycle)) Note 1 x CSSFintra |
| 80ms< DRX cycle≤ 320ms | max(400ms, ceil(Mmeas\_period with\_gaps x Kgap) x max(MGRP, SMTC period, DRX cycle)) Note 1 x CSSFintra |
| DRX cycle>320ms | Ceil( Mmeas\_period with\_gaps x Kgap ) x max(MGRP, DRX cycle) x CSSFintra |
| NOTE 1: For a UE supporting concurrent gaps, if multiple concurrent gaps are configured, the MGRP is the periodicity of the MG pattern associated to the intra-frequency layer.  NOTE 2: For UE supporting power class 6, M1= 6 if *highSpeedMeasFlagFR2-r17* = set1 or M1= 18 if *highSpeedMeasFlagFR2-r17* = set2  NOTE 3: Void | |

### 9.2.7 Intra-frequency measurements with NCSG

#### 9.2.7.1 Intra-frequency cell identification

For the UE supporting NCSG, if NCSG is provided, the UE shall be able to identify a new detectable intra frequency cell within Tidentify\_intra\_without\_index if UE is not indicated to report SSB based RRM measurement result with the associated SSB index (*reportQuantityRsIndexes* or *maxNrofRSIndexesToReport* is not configured), or the UE has been indicated that the neighbour cell is synchronous with the serving cell (*deriveSSB-IndexFromCell* is enabled). Otherwise UE shall be able to identify a new detectable intra frequency cell within Tidentify\_intra\_with\_index. The UE shall be able to identify a new detectable intra frequency SS block of an already detected cell within Tidentify\_intra\_without\_index. It is assumed that *deriveSSB-IndexFromCell* is always enabled for FR1 TDD and FR2.

Tidentify\_intra\_without\_index = TPSS/SSS\_sync\_intra + T SSB\_measurement\_period\_intra ms

Tidentify\_intra\_with\_index = TPSS/SSS\_sync\_ntra + T SSB\_measurement\_period\_intra + TSSB\_time\_index\_intra ms

Where:

TPSS/SSS\_sync\_intra: it is the time period used in PSS/SSS detection given in table 9.2.7.1-1, 9.2.7.1-2, 9.2.7.1-4 (deactivated Scell) or 9.2.7.1-5 (deactivated Scell).

TSSB\_time\_index\_intra: it is the time period used to acquire the index of the SSB being measured given in table 9.2.7.1-3 or 9.2.7.1-6 (deactivated Scell).

T SSB\_measurement\_period\_intra: equal to a measurement period of SSB based measurement given in table 9.2.7.2-1, 9.2.7.2-2, 9.2.7.2-3, 9.2.7.2-4 (deactivated Scell) or 9.2.7.2-5 (deactivated Scell).

CSSFintra: it is a carrier specific scaling factor and is determined according to CSSFwithin\_ncsg,i in clause 9.1.5.3 for measurement conducted within NCSG.

Mpss/sss\_sync\_with\_gaps : For a UE supporting FR2 power class 1 or 5, Mpss/sss\_sync with\_gaps=40. For a UE supporting FR2 power class 2, Mpss/sss\_sync with\_gaps =24. For a UE supporting FR2 power class 3, Mpss/sss\_sync with\_gaps =24. For a UE supporting power class 4, Mpss/sss\_sync with\_gaps =24

Mmeas\_period\_ with\_gaps: For a UE supporting power class 1 or 5, Mmeas\_period\_ with\_gaps =40. For a UE supporting power class 2, Mmeas\_period\_ with\_gaps =24. For a UE supporting power class 3, Mmeas\_period\_ with\_gaps =24. For a UE supporting power class 4, Mmeas\_period with\_gaps =24.

If the higher layer signaling in TS 38.331 [2] of *smtc2* is present and smtc1 is fully overlapping with NCSG and smtc2 is partially overlapping with NCSG, requirements are not specified for Tidentify\_intra\_without\_index or Tidentify\_intra\_with\_index.

Table 9.2.7.1-1: Time period for PSS/SSS detection with NCSG (FR1)

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra |
| No DRX | max(600ms, 5 x max(VIRP, SMTC period)) x CSSFintra |
| DRX cycle≤ 320ms | max(600ms, ceil(M2Note 1x 5) x max(VIRP, SMTC period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | 5 x max(VIRP, DRX cycle) x CSSFintra |
| NOTE 1: When *highSpeedMeasFlag-r16* is not configured, M2 = 1.5; When *highSpeedMeasFlag-r16* is configured, M2 = 1.5 if SMTC periodicity > 40 ms, otherwise M2=1.  NOTE 2: When *highSpeedMeasFlag-r16* is configured, the requirements apply only to UE supporting either *measurementEnhancement-r16* or *[intraRAT-MeasurementEnhancement-r16]* on measurements of the primary component carrier and do not apply to measurements of a secondary component carrier with active SCell. | |

**Table 9.2.7.1-2: Time period for PSS/SSS detection with NCSG (FR2)**

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra |
| No DRX | max(600ms, Mpss/sss\_sync\_with\_gaps x max(VIRP, SMTC period)) x CSSFintra |
| DRX cycle≤ 320ms | max(600ms, ceil(1.5x Mpss/sss\_sync\_with\_gaps) x max(VIRP, SMTC period, DRX cycle))x CSSFintra |
| DRX cycle>320ms | Mpss/sss\_sync\_with\_gaps x max(VIRP, DRX cycle) x CSSFintra |

Table 9.2.7.1-3: Time period for time index detection with NCSG (FR1)

|  |  |
| --- | --- |
| DRX cycle | TSSB\_time\_index\_intra |
| No DRX | max(120ms, 3 x max(VIRP, SMTC period)) x CSSFintra |
| DRX cycle≤ 320ms | max(120ms, ceil(M2Note 1x 3) x max(VIRP, SMTC period,DRX cycle) x CSSFintra) |
| DRX cycle>320ms | 3 x max(VIRP, DRX cycle) x CSSFintra |
| NOTE 1: *highSpeedMeasFlag-r16* is not configured, M2 = 1.5; When *highSpeedMeasFlag-r16* is configured, M2 = 1.5 if SMTC periodicity > 40 ms, otherwise M2=1.  NOTE 2: When *highSpeedMeasFlag-r16* is configured, the requirements apply only to UE supporting either *measurementEnhancement-r16* or *[intraRAT-MeasurementEnhancement-r16]* on measurements of the primary component carrier and do not apply to measurements of a secondary component carrier with active SCell. | |

Table 9.2.7.1-4: Time period for PSS/SSS detection with NCSG (deactivated SCell) (FR1)

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra |
| No DRX | 5 x max(measCycleSCell, VIRP) x CSSFintra |
| DRX cycle≤ 320ms | 5 x max(measCycleSCell, VIRP, 1.5xDRX cycle) x CSSFintra |
| DRX cycle> 320ms | 5 x max(measCycleSCell, VIRP, DRX cycle) x CSSFintra |

**Table 9.2.7.1-5: Time period for PSS/SSS detection with NCSG (deactivated SCell) (FR2)**

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra |
| No DRX | Mpss/sss\_with\_ncsg x max(measCycleSCell, VIRP) x CSSFintra |
| DRX cycle≤ 320ms | Mpss/sss\_with\_ncsg x max(measCycleSCell, VIRP, 1.5xDRX cycle) x CSSFintra |
| DRX cycle> 320ms | Mpss/sss\_with\_ncsg x max(measCycleSCell, VIRP, DRX cycle) x CSSFintra |

Table 9.2.7.1-6: Time period for time index detection with NCSG (deactivated SCell) (FR1)

|  |  |
| --- | --- |
| DRX cycle | TSSB\_time\_index\_intra |
| No DRX | 3 x max(measCycleSCell, VIRP) x CSSFintra |
| DRX cycle≤ 320ms | 3 x max(measCycleSCell, VIRP, 1.5xDRX cycle) x CSSFintra |
| DRX cycle> 320ms | 3 x max(measCycleSCell, VIRP,DRX cycle) x CSSFintra |

#### 9.2.7.2 Measurement period

When *highSpeedMeasFlag-r16* is configured, the measurement period with NCSG is specified in Table 9.2.7.2-3.

For either an FR1 or FR2 serving cell, longer measurement period would be expected during the period Tidentify\_CGI when the UE is requested to decode an NR CGI.

Table 9.2.7.2-1: Measurement period for intra-frequency measurements with NCSG (FR1)

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra |
| No DRX | max(200ms, 5 x max(VIRP, SMTC period)) x CSSFintra |
| DRX cycle≤ 320ms | max(200ms, ceil(1.5x 5) x max(VIRP, SMTC period,DRX cycle))x CSSFintra |
| DRX cycle>320ms | 5 x max(VIRP, DRX cycle) x CSSFintra |

Table 9.2.7.2-2: Measurement period for intra-frequency measurements with NCSG (FR2)

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra |
| No DRX | max(400ms, Mmeas\_period with\_gaps x max(VIRP, SMTC period)) x CSSFintra |
| DRX cycle≤ 320ms | max(400ms, ceil(1.5 x Mmeas\_period with\_gaps) x max(VIRP, SMTC period, DRX cycle)) Note 1 x CSSFintra |
| DRX cycle>320ms | Mmeas\_period with\_gaps x max(VIRP, DRX cycle) x CSSFintra |

Table 9.2.7.2-3: Measurement period with NCSG When *highSpeedMeasFlag-r16* is configured (FR1)

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra |
| No DRX | max(200ms, 5 x max(VIRP, SMTC period)) Note 1 x CSSFintra |
| DRX cycle≤ 160ms | max(200ms, ceil(M2Note 2 x 5) x max(VIRP, SMTC period,DRX cycle)) x CSSFintra |
| 160ms < DRX cycle≤ 320ms | max(200ms, ceil(M2Note 2 x 4) x max(VIRP, DRX cycle)) x CSSFintra |
| DRX cycle>320ms | Y Note 3 x max(VIRP, DRX cycle) x CSSFintra |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified  NOTE 2: M2 = 1.5 if SMTC periodicity > 40 ms, otherwise M2=1  NOTE 3: Y=3 when SMTC <= 40ms, Y=5 when SMTC > 40ms  NOTE 4: When *highSpeedMeasFlag-r16* is configured, the requirements apply only to UE supporting either *measurementEnhancement-r16* or *[intraRAT-MeasurementEnhancement-r16]* on measurements of the primary component carrier and do not apply to measurements of a secondary component carrier with active SCell. | |

**Table 9.2.7.2-4: Measurement period for intra-frequency measurements with NCSG (deactivated SCell) (FR1)**

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra |
| No DRX | 5 x max(measCycleSCell, VIRP) x CSSFintra |
| DRX cycle≤ 320ms | 5 x max(measCycleSCell, VIRP, 1.5xDRX cycle) x CSSFintra |
| DRX cycle> 320ms | 5 x max(measCycleSCell, VIRP, DRX cycle) x CSSFintra |

**Table 9.2.7.2-5: Measurement period for intra-frequency measurements with NCSG (deactivated SCell) (FR2)**

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra |
| No DRX | Mmeas\_period with\_gaps x max(measCycleSCell, VIRP) x CSSFintra |
| DRX cycle≤ 320ms | Mmeas\_period with\_gaps x max(measCycleSCell, VIRP, 1.5xDRX cycle) x CSSFintra |
| DRX cycle> 320ms | Mmeas\_period with\_gaps x max(measCycleSCell, VIRP, DRX cycle) x CSSFintra |

Note: Requirements for measurement on deactivated SCC in this clause do not apply if SMTC on the deactivated SCC is fully non-overlapped with NCSG, and the requirements for measurement on deactivated SCC specified in clause 9.2.5 apply.

#### 9.2.7.3 Scheduling availability during intra-frequency measurement with NCSG

Scheduling availability specified in 9.2.5.3 applies to scheduling availability during intra-frequency measurement with NCSG.

## 9.2A NR intra-frequency measurements with CCA

### 9.2A.1 Introduction

The requirements in clause 9.2.A apply for intra-frequency measurements on carrier frequency with CCA.

When the intra-frequency measurement is performed on a neighbour cell in FR2-2 with shared spectrum channel access, UE shall determine the CCA mode of the neighbour cell according to *channelAccessMode2-r17*of the cell configured in *MeasObjectNR*. If *channelAccessMode2-r17* of the cell is enabled, UE shall assume that CCA applies to the cell and perform measurement accordingly, and the requirements in clause 9.2A shall apply; otherwise, UE shall assume that CCA does not apply to the cell and perform measurement accordingly, and requirements in 9.2 shall apply.

A measurement is defined as a SSB based intra-frequency measurement provided the centre frequency of the SSB of the serving cell indicated for measurement and the centre frequency of the SSB of the neighbour cell are the same, and the subcarrier spacing of the two SSBs are also the same.

The UE shall be able to identify new intra-frequency cells and perform SS-RSRP, SS-RSRQ, and SS-SINR measurements of identified intra-frequency cells if carrier frequency information is provided by PCell or the PSCell, even if no explicit neighbour list with physical layer cell identities is provided.

The UE can perform intra-frequency SSB based measurements without measurement gaps if

- the SSB is completely contained in the active BWP of the UE, or

- the active downlink BWP is initial BWP[3].

For intra-frequency SSB based measurements without measurement gaps, UE may cause scheduling restriction as specified in clause 9.2A.5.3.

SSB based measurements are configured along with one or two measurement timing configuration(s) (SMTC(s)) which provides periodicity, duration and offset information on a window of up to 5ms where the measurements are to be performed. For intra-frequency connected mode measurements, up to two measurement window periodicities may be configured. A single measurement window offset and measurement duration are configured per intra-frequency measurement object.

When measurement gaps are needed, the UE is not expected to detect SSB which start earlier than the gap starting time + switching time, nor detect SSB which end later than the gap end – switching time. Switching time is 0.5ms for frequency range FR1 and 0.25 ms for frequency range FR2-2.

In the requirements of clause 9.2A, the term SMTC occasion not available at the UE refers to when the SMTC contains SSBs configured by gNB in a cell on a carrier frequency subject to CCA, but *NSSB* candidate SSB positions for the same SSB index within the discovery burst transmission window are not available at the UE due to DL CCA failures at gNB during the corresponding period, where:

- For the cell detection procedure: *NSSB* is at least one candidate SSB position (NOTE: the one candidate SSB position for the cell detection shall not be impacted by the set of candidate SSB positions which are already being measured by the UE within the current measurement period of the on-going measurements), and

- For other procedures in clause 9.2A: *NSSB* are the first two successive candidate SSB positions when two or more candidate SSB positions are configured for this SSB index in one discovery burst transmission window, otherwise *NSSB* is one candidate SSB position;

otherwise the SMTC occasion is considered as available at the UE.

For the FR2-2 requirements of clause 9.2A, an SMTC occasion group consists of N consecutive SMTC occasions, where N is the UE Rx beam sweeping scaling factor. An SMTC occasion group is not available, when at least one SMTC occasion in the group is not transmitted by the gNB.

### 9.2A.2 Requirements applicability

The requirements in clause 9.2A apply, provided:

- The cell being identified or measured is detectable.

An intra-frequency cell shall be considered detectable when for each relevant SSB:

- SS-RSRP related side conditions given in clause 10.1.27 and TBD for FR1 and FR2-2, respectively, for a corresponding Band,

- SS-RSRQ related side conditions given in clause 10.1.29 and TBD for FR1 and FR2-2, respectively, for a corresponding Band,

- SS-SINR related side conditions given in clause 10.1.31 and TBD for FR1 and FR2-2, respectively, for a corresponding Band,

- SSB\_RP and SSB Ês/Iot according to Annex B.2.8 for a corresponding Band.

### 9.2A.3 Number of cells and number of SSB

#### 9.2A.3.1 Requirements for FR1

For each intra-frequency layer, during each layer 1 measurement period, the UE shall be capable of performing SS-RSRP, SS-RSRQ, and SS-SINR measurements for at least:

- 8 identified cells, and

- 14 SSBs with different SSB index and/or PCI on the intra-frequency layer, where the number of SSBs in the serving cell (except for the SCell) is not smaller than the number of configured RLM-RS SSB resources.

#### 9.2A.3.2 Requirements for FR2-2

For one single intra-frequency layer in a band, during each layer 1 measurement period, the UE shall be capable of performing SS-RSRP, SS-RSRQ, and SS-SINR measurements for at least:

- 6 identified cells, and

- 24 SSBs with different SSB index and/or PCI,

where this single intra-frequency layer shall be:

- PCC when UE is configured with SA NR operation mode with PCC in the band; or

- PSCC when UE is configured with NR-DC with PSCC in the band; or

- One of the SCCs on which UE is configured to report SSB based measurements when neither PCC nor PSCC is in the same band, so that the selected SCC shall be an SCC where the UE is configured with SS-RSRP measurement reporting if such SCC exists, otherwise the selected SCC is determined by UE implementation.

The UE shall also be capable of performing SS-RSRP, SS-RSRQ, and SS-SINR measurements for at least 2 SSBs on serving cell for each of the other intra-frequency layer(s) in the same band.

### 9.2A.4 Measurement Reporting Requirements

9.2A.4.1 Periodic Reporting

Reported RSRP, RSRQ, and RS-SINR measurements contained in periodically triggered measurement reports shall meet the requirements in clauses 10.1. 36 (RSRP for FR1), TBD (RSRP for FR2-2),10.1.29(RSRQ for FR1), TBD (RSRQ for FR2-2), 10.1.31 (RS-SINR for FR1) and TBD (RS-SINR for FR2-2), respectively.

9.2A.4.2 Event-triggered Periodic Reporting

Reported RSRP, RSRQ, and RS-SINR measurements contained in periodically triggered measurement reports shall meet the requirements in clauses 10.1.36 (RSRP for FR1), TBD (RSRP for FR2-2), 10.1.29 (RSRQ for FR1), TBD (RSRQ for FR2-2), 10.1.31 (RS-SINR for FR1) and TBD (RS-SINR for FR2-2) , respectively.

The first report in event triggered periodic measurement reporting shall meet the requirements specified in clause 9.2A.4.3.

9.2A.4.3 Event Triggered Reporting

Reported RSRP, RSRQ, and RS-SINR measurements contained in periodically triggered measurement reports shall meet the requirements in clauses 10.1.36 (RSRP for FR1), TBD (RSRP for FR2-2), 10.1.29 (RSRQ for FR1), TBD (RSRQ for FR2-2), 10.1.31 (RS-SINR for FR1) and TBD (RS-SINR for FR2-2), respectively.

The UE shall not send any event triggered measurement reports as long as no reporting criteria is fulfilled.

The measurement reporting delay is defined as the time between an event that will trigger a measurement report and the point when the UE starts to transmit the measurement report over the air interface. This requirement assumes that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 x TTIDCCH. This measurement reporting delay excludes a delay which caused by no UL resources being available for UE to send the measurement report on, and all delays due to UL CCA failures until the successful transmission of the report.

The event triggered measurement reporting delay, measured without L3 filtering shall be less than T identify intra with index\_CCA or T identify intra without index\_CCA defined in clause 9.2A.5.1 or clause 9.2A.6.2.When L3 filtering is used an additional delay can be expected.

A cell is detectable only if at least one SSBs measured from the Cell being configured remains detectable during the time period T identify\_intra\_without\_index\_CCA or T identify\_intra\_with\_index\_CCA as defined in clause 9.2A.5.1 or clause 9.2A.6.2. If a cell which has been detectable at least for the time period T identify intra without index\_CCA or T identify intra with index\_CCA defined in clause 9.2A.5.1 or clause 9.2A.6.2 becomes undetectable for a period≤ 8 seconds and then the cell becomes detectable again with the same spatial reception parameter and triggers an event, the event triggered measurement reporting delay shall be less than TSSB\_measurement\_period\_intra\_CCA provided the timing to that cell has not changed more than ± 3200/ Tc while the measurement gap has not been available and the L3 filter has not been used, where *µ* is the SCS configuration as defined in clause 4.2 of TS 38.211 [3]. When L3 filtering is used, an additional delay can be expected.

### 9.2A.5 Intra-frequency measurements without measurement gaps

9.2A.5.1 Intra-frequency cell identification

The UE shall be able to identify a new detectable intra frequency cell within Tidentify\_intra\_without\_index\_CCA if UE is not indicated to report SSB based RRM measurement result with the associated SSB index(*reportQuantityRsIndexes* or *maxNrofRSIndexesToReport* is not configured), or the UE is indicated that the neighbour cell is synchronous with the serving cell (*deriveSSB-IndexFromCell* is enabled). Otherwise UE shall be able to identify a new detectable intra frequency cell within Tidentify\_intra\_with\_index\_CCA. The UE shall be able to identify a new detectable intra frequency SS block of an already detected cell within Tidentify\_intra\_without\_index\_CCA.

Tidentify\_intra\_without\_index\_CCA = (TPSS/SSS\_sync\_intra\_CCA + T SSB\_measurement\_period\_intra\_CCA) ms

Tidentify\_intra\_with\_index CCA = (TPSS/SSS\_sync\_intra\_CCA + T SSB\_measurement\_period\_intra\_CCA + TSSB\_time\_index\_intra\_CCA) ms

Where:

TPSS/SSS\_sync\_intra\_CCA: it is the time period used in PSS/SSS detection given in table 9.2A.5.1-1, 9.2A.5.1-3 (deactivated Scell) .

TSSB\_time\_index\_intra\_CCA: it is the time period used to acquire the index of the SSB being measured given in table 9.2A.5.1-2 or 9.2A.5.1-4 (deactivated SCell).

T SSB\_measurement\_period\_intra\_CCA: equal to a measurement period of SSB based measurement given in table 9.2A.5.2-1, 9.2A.5.2-2 (deactivated Scell). CSSFintra: it is a carrier specific scaling factor and is determined

- according to CSSFoutside\_gap,i in clause 9.1.5.1 for measurement conducted outside measurement gaps, i.e. when intra-frequency SMTC is fully non overlapping or partially overlapping with measurement gaps, or according to CSSFwithin\_gap,i in clause 9.1.5.2 for measurement conducted within measurement gaps, i.e. when intra-frequency SMTC is fully overlapping with measurement gaps.

- Mpss/sss\_sync\_w/o\_gaps\_CCA: For a UE supporting FR2-2 power class 1, Mpss/sss\_sync\_w/o\_gaps CCA = 60. For a UE supporting FR2-2 power class 2, Mpss/sss\_sync\_w/o\_gaps CCA = 36. For a UE supporting FR2-2 power class 3, Mpss/sss\_sync\_w/o\_gaps CCA = 36.

- Mmeas\_period\_w/o\_gaps\_CCA: For a UE supporting FR2-2 power class 1, Mmeas\_period\_w/o\_gaps CCA = 60. For a UE supporting FR2-2 power class 2, Mmeas\_period\_w/o\_gaps CCA = 36. For a UE supporting FR2-2 power class 3, Mmeas\_period\_w/o\_gaps CCA = 36.

- MSSB\_index\_intra\_CCA: For a UE supporting FR2-2 power class 1, MSSB\_index\_intra CCA = 72 samples. For a UE supporting FR2-2 power class 2, MSSB\_index\_intra CCA = 48 samples. For a UE supporting FR2 power class 3, MSSB\_index\_intra CCA = 48 samples.

N: is the UE Rx beam sweeping scaling factor. N= 12.

When intra-frequency SMTC is fully non overlapping with measurement gaps or intra-frequency SMTC is fully overlapping with MGs, Kp=1

When intra-frequency SMTC is partially overlapping with measurent gaps, Kp = 1/(1- (SMTC period /MGRP)), where SMTC period < MGRP.

For FR2-2,

Klayer1\_measurement=TBD

If MCG DRX is in use, intra-frequency cell identification requirements specified in Table 9.2A.5.1-1, Table 9.2A.5.1-2, Table 9.2A.5.1-3, Table 9.2A.5.1-4, Table 9.2A.5.1-5 and Table 9.2A.5.1-6 shall depend on the MCG DRX cycle. If SCG DRX is in use, intra-frequency cell identification requirements specified in Table 9.2A.5.1-1, Table 9.2A.5.1-2, Table 9.2A.5.1-3, Table 9.2A.5.1-4, Table 9.2A.5.1-5 and Table 9.2A.5.1-6 shall depend on the SCG DRX cycle. Otherwise, the requirements for when DRX is not in use shall apply.

The requirements apply provided any two closest SMTC occasions available at the UE for the measurement shall be separated by no more than the maximum time requirement for the cell to remain known defined in clause 9.2A.4.3.

Table 9.2A.5.1-1: Time period for PSS/SSS detection (FR1)

|  |  |
| --- | --- |
| Condition | TPSS/SSS\_sync\_intra\_CCA |
| No DRX | max( 600ms, ceil((5+LPSS/SSS) x Kp) x SMTC period)Note 1 x CSSFintra |
| DRX cycle≤ 320ms | max( 600ms, ceil(1.5x (5+LPSS/SSS) x Kp) x max(SMTC period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | ceil((5+LPSS/SSS) x Kp) x DRX cycle x CSSFintra |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified  NOTE 2: When DRX is not configured, LPSS/SSS is the number of SMTC occasions not available at the UE during TPSS/SSS\_sync\_intra\_CCA for PSS/SSS detection, where LPSS/SSS< LPSS/SSS,max. When DRX is configured, LPSS/SSS is the number of DRX cycles in which at least one SMTC occasion is not available at the UE during TPSS/SSS\_sync\_intra\_CCA for PSS/SSS detection, where LPSS/SSS< LPSS/SSS,max. When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle. FFS: The UE is not required to determine the availability of SMTC occasions more frequent than what is required by CSSFintra.  NOTE 3: LPSS/SSS,max =7 for Max(DRX cycle,SMTC period)≤40ms where DRX cycle is 0 for non-DRX, LPSS/SSS,max =5 for 40ms<Max(DRX cycle,SMTC period)≤320ms, LPSS/SSS,max = 3 for DRX cycle>320ms.  NOTE 4: Upon exceeding LPSS/SSS,max, the UE is not required to meet the requirements for PSS/SSS detection. | |

Table 9.2A.5.1-2: Time period for time index detection (FR1)

|  |  |
| --- | --- |
| Condition | TSSB\_time\_index\_intra\_CCA |
| No DRX | max(120ms, ceil((3+Lind) x Kp )x SMTC period)Note 1 x CSSFintra |
| DRX cycle≤ 320ms | max(120ms, ceil (1.5 x (3+Lind) x Kp) x max(SMTC period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | Ceil((3+Lind) x Kp) x DRX cycle x CSSFintra |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified  NOTE 2: When DRX is not configured, Lind is the number of SMTC occasions not available at the UE during TSSB\_time\_index\_intra\_CCA for index detection, where Lind ≤ Lind,max. When DRX is configured, Lind is the number of DRX cycles in which at least one SMTC occasion is not available at the UE during TSSB\_time\_index\_intra\_CCA for index detection, where Lind ≤ Lind,max. When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle. FFS: The UE is not required to determine the availability of SMTC occasions more frequent than what is required by CSSFintra.  NOTE 3: Lind,max = 5 for Max(DRX cycle,SMTC period)≤40ms where DRX cycle is 0 for non-DRX, Lind,max = 3 for 40ms<Max(DRX cycle,SMTC period)≤320ms, Lind,max =2 for DRX cycle>320ms.  NOTE 4: Upon exceeding Lind,max over the period of time TSSB\_time\_index\_intra\_CCA, the UE has to restart the time index detection procedure. | |

Table 9.2A.5.1-3: Time period for PSS/SSS detection, deactivated SCell (FR1)

|  |  |
| --- | --- |
| Condition | TPSS/SSS\_sync\_intra\_CCA |
| No DRX | (5 + LPSS/SSS,deact) x measCycleSCell x CSSFintra |
| DRX cycle≤ 320ms | (5 + LPSS/SSS, deact) x max(measCycleSCell, 1.5xDRX cycle) x CSSFintra |
| DRX cycle>320ms | (5 + LPSS/SSS, deact) x max(measCycleSCell, DRX cycle) x CSSFintra |
| NOTE 1: When DRX is not configured, LPSS/SSS, deact is the number of SMTC occasions not available at the UE during TPSS/SSS\_sync\_intra\_CCA for PSS/SSS detection, where LPSS/SSS, deact< LPSS/SSS, deact,max. When DRX is configured, LPSS/SSS, deact is the number of DRX cycles in which at least one SMTC occasion is not available at the UE during TPSS/SSS\_sync\_intra\_CCA for PSS/SSS detection, where LPSS/SSS, deact< LPSS/SSS, deact,max.When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle. When configured with measurement cycles, the UE is not required to determine the availability of SMTC occasions more frequent than once per measurement cycle. FFS: The UE is not required to determine the availability of SMTC occasions more frequent than what is required by CSSFintra.  NOTE 2: LPSS/SSS, deact,max, = 7 for Max(DRX cycle, measCycleSCell)≤40ms where DRX cycle is 0 for non-DRX, LPSS/SSS, deact,max = 5 for 40ms<Max(DRX cycle, measCycleSCell)≤320ms, LPSS/SSS, deact,max = 3 for DRX cycle>320ms.  NOTE 3: Upon exceeding LPSS/SSS, deact,max,, the UE is not required to meet the requirements for PSS/SSS detection. | |

Table 9.2A.5.1-4: Time period for time index detection, deactivated SCell (FR1)

|  |  |
| --- | --- |
| Condition | TSSB\_time\_index\_intra\_CCA |
| No DRX | (3+Lind,deact) x measCycleSCell x CSSFintra |
| DRX cycle≤ 320ms | (3+Lind,deact) x max(measCycleSCell, 1.5xDRX cycle) x CSSFintra |
| DRX cycle>320ms | (3+Lind,deact) x max(measCycleSCell, DRX cycle) x CSSFintra |
| NOTE 1: When DRX is not configured, Lind,deact is the number of SMTC occasions not available at the UE during TSSB\_time\_index\_intra\_CCA for index detection, where Lind,deact < Lind,deact,max. When DRX is configured, Lind,deact is the number of DRX cycles in which at least one SMTC occasion is not available at the UE during TSSB\_time\_index\_intra\_CCA for index detection, where Lind,deact < Lind,deact,max. When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle. When configured with measurement cycles, the UE is not required to determine the availability of SMTC occasions more frequent than once per measurement cycle. FFS: The UE is not required to determine the availability of SMTC occasions more frequent than what is required by CSSFintra.  NOTE 2: Lind,deact,max, = 5 for Max(DRX cycle, measCycleSCell)≤40ms where DRX cycle is 0 for non-DRX, Lind,deact,max = 3 for 40ms<Max(DRX cycle, measCycleSCell)≤320ms, Lind,deact,max = 2 for DRX cycle>320ms.  NOTE 3: Upon exceeding Lind,deact,max over the period of time TSSB\_time\_index\_intra\_CCA,the UE has to restart the time index detection procedure. | |

Table 9.2A.5.1-5: Time period for PSS/SSS detection, (Frequency range FR2-2)

|  |  |
| --- | --- |
| Condition | TPSS/SSS\_sync\_intra\_CCA |
| No DRX | max(600ms, ceil((Mpss/sss\_sync\_w/o\_gaps\_CCA x KFR + N x LPSS/SSS) x Kp x Klayer1\_measurement)x SMTC period)Note 1 x CSSFintra |
| DRX cycle≤ 320ms | max(600ms, ceil(1.5 x (Mpss/sss\_sync\_w/o\_gaps\_CCA x KFR + N x LPSS/SSS) x Kp x Klayer1\_measurement)x max(SMTC period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | ceil((Mpss/sss\_sync\_w/o\_gaps\_CCA x KFR + N  x LPSS/SSS) x Kp x Klayer1\_measurement) x DRX cycle x CSSFintra |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified  NOTE 2: When DRX is not configured, LPSS/SSS is the number of SMTC occasion groups not available at the UE during TPSS/SSS\_sync\_intra\_CCA for PSS/SSS detection, where LPSS/SSS< LPSS/SSS,max. A SMTC occasion group consists of N consecutive SMTC occasions. An SMTC occasion group is not available, when at least one SMTC occasion in the group is not transmitted by the gNB. When DRX is configured, LPSS/SSS is the number of [DRX cycle groups] in which at least one SMTC occasion is not available at the UE during TPSS/SSS\_sync\_intra\_CCA for PSS/SSS detection, where LPSS/SSS< LPSS/SSS,max. [A [DRX occasion group consists of N consecutive DRX cycles. A DRX occasion group occasion group is not available, when at least one SMTC occasion in the group is not transmitted by the gNB.] When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle.  NOTE 3: LPSS/SSS,max =[7] for Max(DRX cycle,SMTC period)≤40ms where DRX cycle is 0 for non-DRX, LPSS/SSS,max =[5] for 40ms<Max(DRX cycle,SMTC period)≤320ms, LPSS/SSS,max = [3] for DRX cycle>320ms.  NOTE 4: Upon exceeding LPSS/SSS,max, the UE is not required to meet the requirements for PSS/SSS detection.  NOTE 5: KFR is a scaling factor depending on the frequency range and SSB SCS. KFR = 1 if the SCS of the SSB of the cell being detected is 120 kHz, KFR = 2 if the SCS of the SSB of the cell being detected is 480 kHz, and KFR= 3 if the SCS of the SSB of the cell being detected is 960 kHz. | |

Table 9.2A.5.1-6: Time period for PSS/SSS detection, deactivated SCell (FR2-2)

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra\_CCA |
| No DRX | Ceil((Mpss/sss\_sync\_w/o\_gaps x KFR + N x LPSS/SSS,deact) x Kp) x measCycleSCell x CSSFintra |
| DRX cycle≤ 320ms | Ceil((Mpss/sss\_sync\_w/o\_gaps x KFR + N x LPSS/SSS,deact) x Kp) x max(measCycleSCell, 1.5xDRX cycle) x CSSFintra |
| DRX cycle> 320ms | Ceil((Mpss/sss\_sync\_w/o\_gaps x KFR + N x LPSS/SSS,deact) x Kp) x max(measCycleSCell, DRX cycle) x CSSFintra |
| NOTE 1: When DRX is not configured, LPSS/SSS, deact is the number of SMTC occasions groups not available at the UE during TPSS/SSS\_sync\_intra\_CCA for PSS/SSS detection, where LPSS/SSS, deact< LPSS/SSS, deact,max. A SMTC occasion group consists of N consecutive SMTC occasions. An SMTC occasion group is not available, when at least one SMTC occasion in the group is not transmitted by the gNB. When DRX is configured, LPSS/SSS, deact is the number of [DRX cycle groups] in which at least one SMTC occasion is not available at the UE during TPSS/SSS\_sync\_intra\_CCA for PSS/SSS detection, where LPSS/SSS, deact< LPSS/SSS, deact,max.When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle. [A DRX occasion group consists of N consecutive DRX cycles. A DRX occasion group occasion group is not available, when at least one SMTC occasion in the group is not transmitted by the gNB.] When configured with measurement cycles, the UE is not required to determine the availability of SMTC occasions more frequent than once per measurement cycle.  NOTE 2: LPSS/SSS, deact,max, = [7] for Max(DRX cycle, measCycleSCell)≤40ms where DRX cycle is 0 for non-DRX, LPSS/SSS, deact,max = [5] for 40ms<Max(DRX cycle, measCycleSCell)≤320ms, LPSS/SSS, deact,max = [3] for DRX cycle>320ms.  NOTE 3: Upon exceeding LPSS/SSS, deact,max,, the UE is not required to meet the requirements for PSS/SSS detection.  NOTE 4: Void  NOTE 5: KFR is a scaling factor depending on the frequency range and SSB SCS. KFR = 1 if the SCS of the SSB of the cell being detected is 120 kHz, KFR = 2 if the SCS of the SSB of the cell being detected is 480 kHz, and KFR= 3 if the SCS of the SSB of the cell being detected is 960 kHz. | |

Table 9.2A.5.1-7: Time period for time index detection (FR2-2)

|  |  |
| --- | --- |
| DRX cycle | TSSB\_time\_index\_intra\_CCA |
| No DRX | Max(200ms, ceil((MSSB\_index\_intra\_CCA + N ´ Lind) ´ Kp) ´ SMTC period) ´ CSSFintra |
| DRX cycle≤ 320ms | Max(200ms, ceil(1.5 ´ ((MSSB\_index\_intra + N ´ Lind) ´ Kp) ´ Max(SMTC period, DRX cycle)) ´ CSSFintra |
| DRX cycle> 320ms | ceil((MSSB\_index\_intra + N ´ Lind) ´ Kp) ´ DRX cycle ´ CSSFintra |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified  NOTE 2: When DRX is not configured, Lind is the number of SMTC occasion groups not available at the UE during TSSB\_time\_index\_intra\_CCA for index detection, where Lind ≤ Lind,max. When DRX is configured, Lind is the number of DRX cycles groups in which at least one SMTC occasion is not available at the UE during TSSB\_time\_index\_intra\_CCA for index detection, where Lind ≤ Lind,max. When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle.  NOTE 3: Lind,max = 5 for Max(DRX cycle,SMTC period)≤40ms where DRX cycle is 0 for non-DRX, Lind,max = 3 for 40ms<Max(DRX cycle,SMTC period)≤320ms, Lind,max =2 for DRX cycle>320ms.  NOTE 4: Upon exceeding Lind,max over the period of time TSSB\_time\_index\_intra\_CCA, the UE has to restart the time index detection procedure. | |

Table 9.2A.5.1-8: Time period for time index detection, deactivated SCell (FR2-2)

|  |  |
| --- | --- |
| DRX cycle | TSSB\_time\_index\_intra\_CCA |
| No DRX | Max(200ms, ceil((MSSB\_index\_intra\_CCA + N ´ Lind,deact) ´ Kp) ´ SMTC period) ´ CSSFintra |
| DRX cycle≤ 320ms | Max(200ms, ceil(1.5 ´ ((MSSB\_index\_intra + N ´ Lind,deact) ´ Kp) ´ Max(SMTC period, DRX cycle)) ´ CSSFintra |
| DRX cycle> 320ms | ceil((MSSB\_index\_intra + N ´ Lind,deact) ´ Kp) ´ DRX cycle ´ CSSFintra |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified  NOTE 2: When DRX is not configured, Lind,deact is the number of SMTC occasion groups not available at the UE during TSSB\_time\_index\_intra\_CCA for index detection, where Lind,deact ≤ Lind,deact,max. When DRX is configured, Lind,deact is the number of DRX cycles groups in which at least one SMTC occasion is not available at the UE during TSSB\_time\_index\_intra\_CCA for index detection, where Lind,deact ≤ Lind,deact,max. When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle.  NOTE 3: Lind,deact,max = 5 for Max(DRX cycle,SMTC period)≤40ms where DRX cycle is 0 for non-DRX, Lind,deact,max = 3 for 40ms<Max(DRX cycle,SMTC period)≤320ms, Lind,deact,max =2 for DRX cycle>320ms.  NOTE 4: Upon exceeding Lind,deact,max over the period of time TSSB\_time\_index\_intra\_CCA, the UE has to restart the time index detection procedure. | |

#### 9.2A.5.2 Measurement period

The measurement period for intra-frequency measurements without gaps is as shown in table 9.2A.5.2-1, 9.2A.5.2-2 (deactivated SCell).

If SCG DRX is in use, intra-frequency measurement period requirements specified in Table 9.2A.5.2-1, Table 9.2A.5.2-2 shall depend on the SCG DRX cycle. Otherwise, the requirements for when DRX is not in use shall apply.

The requirements apply provided any two closest SMTC occasions available at the UE for the measurement shall be separated by no more than the maximum time requirement for the cell to remain known defined in clause 9.2A.4.3.

When the time period of unsuccessful measurement attempts due to exceeding the maximum number of unavailable at the UE SMTC occasions of an already identified cell exceeds the maximum time requirement for the cell to remain known defined in clause 9.2A.4.3, UE shall stop the measurement attempts on this SSB and perform the detection procedure again like for any other SSB.

Table 9.2A.5.2-1: Measurement period for intra-frequency measurements without gaps (FR1)

|  |  |
| --- | --- |
| Condition | T SSB\_measurement\_period\_intra\_CCA |
| No DRX | max(200ms, ceil((5+Lmeas) x Kp) x SMTC period)Note 1 x CSSFintra |
| DRX cycle≤ 320ms | max(200ms, ceil(1.5x (5+Lmeas) x Kp) x max(SMTC period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | ceil((5+Lmeas) x Kp ) x DRX cycle x CSSFintra |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified  NOTE 2: When DRX is not configured, Lmeas is the number of SMTC occasions not available at the UE during T SSB\_measurement\_period\_intra\_CCA for measurement, where Lmeas <Lmeas,max. When DRX is configured, Lmeas is the number of DRX cycles in which at least one SMTC occasion is not available at the UE during T SSB\_measurement\_period\_intra\_CCA for measurement, where Lmeas <Lmeas,max. When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle. FFS: The UE is not required to determine the availability of SMTC occasions more frequent than what is required by CSSFintra.  NOTE 3: Lmeas,max = 7 for Max(DRX cycle,SMTC period)≤40ms where DRX cycle is 0 for non-DRX, Lmeas,max = 5 for 40ms<Max(DRX cycle,SMTC period)≤320ms, Lmeas,max = 3 for DRX cycle>320ms.  NOTE 4: Upon exceeding Lmeas,max over the period of time T SSB\_measurement\_period\_intra\_CCA, the UE has to restart the measurement procedure. | |

Table 9.2A.5.2-2: Measurement period for intra-frequency measurements without gaps, deactivated SCell (FR1)

|  |  |
| --- | --- |
| Condition | T SSB\_measurement\_period\_intra\_CCA |
| No DRX | (5+Lmeas,deact) x measCycleSCell x CSSFintra |
| DRX cycle≤ 320ms | (5+Lmeas, deact) x max(measCycleSCell, 1.5xDRX cycle) x CSSFintra |
| DRX cycle>320ms | (5+Lmeas, deact) x max(measCycleSCell, DRX cycle) x CSSFintra |
| NOTE 1: When DRX is not configured, Lmeas,deact is the number of SMTC occasions not available at the UE during T SSB\_measurement\_period\_intra\_CCA for measurement, where Lmeas,deact <Lmeas, ,deact ,max. When DRX is configured, Lmeas,deact is the number of DRX cycles in which at least one SMTC occasion is not available at the UE during T SSB\_measurement\_period\_intra\_CCA for measurement, where Lmeas,deact <Lmeas, ,deact ,max. When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle. When configured with measurement cycles, the UE is not required to determine the availability of SMTC occasions more frequent than once per measurement cycle. FFS: The UE is not required to determine the availability of SMTC occasions more frequent than what is required by CSSFintra.  NOTE 2: Lmeas, ,deact ,max, = 7 for Max(DRX cycle, measCycleSCell)≤40ms where DRX cycle is 0 for non-DRX, Lmeas, ,deact ,max = 5 for 40ms<Max(DRX cycle, measCycleSCell)≤320ms, Lmeas, ,deact ,max = 3 for DRX cycle>320ms.  NOTE 3: Upon exceeding Lmeas,deact,max over the period of time T SSB\_measurement\_period\_intra\_CCA, the UE has to restart the measurement procedure. | |

Table 9.2A.5.2-3: Measurement period for intra-frequency measurements without gaps (FR2-2)

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra\_CCA |
| No DRX | max(400ms, ceil((Mmeas\_period\_w/o\_gaps\_CCA + N x Lmeas) x Kp x Klayer1\_measurement) x SMTC period)Note 1 x CSSFintra |
| DRX cycle≤ 320ms | max(400ms, ceil(1.5x (Mmeas\_period\_w/o\_gaps\_CCA + N x Lmeas) x Kp x Klayer1\_measurement) x max(SMTC period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | ceil((Mmeas\_period\_w/o\_gaps\_CCA + N x Lmeas) x Kp x Klayer1\_measurement ) x DRX cycle x CSSFintra |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified  NOTE 2: When DRX is not configured, Lmeas is the number of SMTC occasion groups not available at the UE during T SSB\_measurement\_period\_intra\_CCA for measurement, where Lmeas <Lmeas,max. A SMTC occasion group consists of N consecutive SMTC occasions. An SMTC occasion group is not available, when at least one SMTC occasion in the group is not transmitted by the gNB. When DRX is configured, Lmeas is the number of [DRX cycle groups] in which at least one SMTC occasion is not available at the UE during T SSB\_measurement\_period\_intra\_CCA for measurement, where Lmeas <Lmeas,max. . [A DRX occasion group consists of N consecutive DRX cycles. A DRX occasion group occasion group is not available, when at least one SMTC occasion in the group is not transmitted by the gNB.] When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle.  NOTE 3: Lmeas,max = [7] for Max(DRX cycle,SMTC period)≤40ms where DRX cycle is 0 for non-DRX, Lmeas,max = [5] for 40ms<Max(DRX cycle,SMTC period)≤320ms, Lmeas,max = [3] for DRX cycle>320ms.  NOTE 4: Upon exceeding Lmeas,max over the period of time T SSB\_measurement\_period\_intra\_CCA, the UE has to restart the measurement procedure. | |

Table 9.2.5.2-4: Measurement period for intra-frequency measurements without gaps, deactivated Scell (FR2-2)

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra\_CCA |
| No DRX | Ceil((Mmeas\_period\_w/o\_gaps\_CCA + N x Lmeas,deact) x Kp) x measCycleSCell x CSSFintra |
| DRX cycle≤ 320ms | Ceil((Mmeas\_period\_w/o\_gaps\_CCA + N x Lmeas,deact) x Kp) x max(measCycleSCell, 1.5xDRX cycle) x CSSFintra |
| DRX cycle> 320ms | Ceil((Mmeas\_period\_w/o\_gaps\_CCA + N x Lmeas,deact) x Kp) x max(measCycleSCell, DRX cycle) x CSSFintra |
| NOTE 1: When DRX is not configured, Lmeas,deact is the number of SMTC occasion groups not available at the UE during T SSB\_measurement\_period\_intra\_CCA for measurement, where Lmeas,deact <Lmeas, ,deact ,max. A SMTC occasion group consists of N consecutive SMTC occasions. An SMTC occasion group is not available, when at least one SMTC occasion in the group is not transmitted by the gNB. When DRX is configured, Lmeas,deact is the number of [DRX cycle groups] in which at least one SMTC occasion is not available at the UE during T SSB\_measurement\_period\_intra\_CCA for measurement, where Lmeas,deact <Lmeas, ,deact ,max. [A DRX occasion group consists of N consecutive DRX cycles. A DRX occasion group occasion group is not available, when at least one SMTC occasion in the group is not transmitted by the gNB.] When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle. When configured with measurement cycles, the UE is not required to determine the availability of SMTC occasions more frequent than once per measurement cycle. FFS: The UE is not required to determine the availability of SMTC occasions more frequent than what is required by CSSFintra.  NOTE 2: Lmeas, ,deact ,max, = [7] for Max(DRX cycle, measCycleSCell)≤40ms where DRX cycle is 0 for non-DRX, Lmeas, ,deact ,max = [5] for 40ms<Max(DRX cycle, measCycleSCell)≤320ms, Lmeas, ,deact ,max = [3] for DRX cycle>320ms.  NOTE 3: Upon exceeding Lmeas,deact,max over the period of time T SSB\_measurement\_period\_intra\_CCA, the UE has to restart the measurement procedure. | |

#### 9.2A.5.3 Scheduling availability of UE during intra-frequency measurements

UE shall be capable of measuring without measurement gaps when the SSB is completely contained in the active bandwidth part of the UE. When any of the conditions in the following clauses is met, there are restrictions on the scheduling availability; otherwise, there is no scheduling restriction. Note that the SSB symbols indicated by the union set of *SSB-ToMeasure* from all the configured measurement objects on the same serving carrier which can be merged[2], if it is configured; otherwise, all *L* SSB symbols within SMTC window duration defined in clause 4.1 of TS 38.213 [3] are included.

##### 9.2A.5.3.1 Scheduling availability of UE performing measurements in TDD bands on FR1

When UE performs intra-frequency measurements in a TDD band, the following restrictions apply due to SS-RSRP or SS-SINR measurement

- The UE is not expected to transmit PUCCH/PUSCH/SRS on SSB symbols configured to be measured, and on 1 data symbol before each consecutive SSB symbols configured to be measured and 1 data symbol after each consecutive SSB symbols configured to be measured within SMTC window duration if *deriveSSB-IndexFromCell* is enabled. If the high layer in TS 38.331[2] signaling of smtc2 is configured, the SMTC periodicity follows smtc2; Otherwise SMTC periodicity follows smtc1.

- The UE is not expected to transmit PUCCH/PUSCH/SRS on all symbols within SMTC window duration if *deriveSSB-IndexFromCell* is not enabled. If the high layer in TS 38.331 [2] signaling of smtc2 is configured, the SMTC periodicity follows smtc2; Otherwise SMTC periodicity follows smtc1.

When the UE performs intra-frequency measurements in a TDD band, the following restrictions apply due to SS-RSRQ measurement

- The UE is not expected to transmit PUCCH/PUSCH/SRS on SSB symbols configured to be measured, RSSI measurement symbols, and on 1 data symbol before each consecutive SSB configured to be measured/RSSI symbols and 1 data symbol after each consecutive SSB configured to be measured/RSSI symbols within SMTC window duration if *deriveSSB-IndexFromCell* is enabled. If the high layer signaling of smtc2 is configured (in TS 38.331), the SMTC periodicity follows smtc2; Otherwise the SMTC periodicity follows smtc1.

- The UE is not expected to transmit PUCCH/PUSCH/SRS on all symbols within SMTC window duration if *deriveSSB-IndexFromCell* is not enabled. If the high layer in TS 38.331 signaling of smtc2 is configured, the SMTC periodicity follows smtc2; Otherwise SMTC periodicity follows smtc1.

When intra-band carrier aggregation in unlicensed spectrum is performed, the scheduling restrictions due to a given serving cell should also apply to all other serving cells in the same band on the symbols that fully or partially overlap with the aforementioned restricted symbols.

##### 9.2A.5.3.2 Scheduling availability of UE performing measurements with a different subcarrier spacing than PDSCH/PDCCH on FR1

For UE which do not support *simultaneousRxDataSSB-DiffNumerology* [14] the following restrictions apply due to SS-RSRP/RSRQ/SINR measurement

- If *deriveSSB-IndexFromCell* is enabled the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on SSB symbols to be measured, and on 1 data symbol before each consecutive SSB symbols to be measured and 1 data symbol after each consecutive SSB symbols to be measured within SMTC window duration.

- If *deriveSSB-IndexFromCell* is not enabled the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on all symbols within SMTC window duration.

When intra-band carrier aggregation is performed, the scheduling restrictions due to a given serving cell should also apply to all other serving cells in the same band on the symbols that fully or partially overlap with aforementioned restricted symbols.

##### 9.2A.5.3.3 Scheduling availability of UE performing measurements in TDD bands on FR2-2

The requirements in clause 9.2.5.3.3 apply.

### 9.2A.6 Intra-frequency measurements with measurement gaps

#### 9.2A.6.1 Intra-frequency cell identification

The UE shall be able to identify a new detectable intra frequency cell within Tidentify\_intra\_without\_index\_CCA if UE is not indicated to report SSB based RRM measurement result with the associated SSB index (*reportQuantityRsIndexes* or *maxNrofRSIndexesToReport* is not configured), or the UE has been indicated that the neighbour cell is synchronous with the serving cell (*deriveSSB-IndexFromCell* is enabled). Otherwise UE shall be able to identify a new detectable intra frequency cell within Tidentify\_intra\_with\_index\_CCA. The UE shall be able to identify a new detectable intra frequency SS block of an already detected cell within Tidentify\_intra\_without\_index CCA.

Tidentify\_intra\_without\_index CCA = TPSS/SSS\_sync\_intra\_CCA + T SSB\_measurement\_period\_intra\_CCA ms

Tidentify\_intra\_with\_index\_CCA = TPSS/SSS\_sync\_intra\_CCA + T SSB\_measurement\_period\_intra\_CCA + TSSB\_time\_index\_intra\_CCA

Where:

TPSS/SSS\_sync\_intra\_CCA: it is the time period used in PSS/SSS detection given in table 9.2A.6.1-1.

TSSB\_time\_index\_intra\_CCA: it is the time period used to acquire the index of the SSB being measured given in table 9.2A.6.1-2.

T SSB\_measurement\_period\_intra\_CCA: equal to a measurement period of SSB based measurement given in table 9.2A.6.2-1 or 9.2A.6.1-3.

CSSFintra: it is a carrier specific scaling factor and is determined according to CSSFwithin\_gap,i in clause 9.1.5.2 for measurement conducted within measurement gaps.

Mpss/sss\_sync\_w/o\_gaps\_CCA: For a UE supporting FR2-2 power class 1, Mpss/sss\_sync\_w/o\_gaps CCA = 60. For a UE supporting FR2-2 power class 2, Mpss/sss\_sync\_w/o\_gaps CCA = 36. For a UE supporting FR2-2 power class 3, Mpss/sss\_sync\_w/o\_gaps CCA = 36.

Mmeas\_period\_w/o\_gaps\_CCA: For a UE supporting FR2-2 power class 1, Mmeas\_period\_w/o\_gaps CCA = 60. For a UE supporting FR2-2 power class 2, Mmeas\_period\_w/o\_gaps CCA = 36. For a UE supporting FR2-2 power class 3, Mmeas\_period\_w/o\_gaps CCA = 36.

- MSSB\_index\_intra\_CCA: For a UE supporting FR2-2 power class 1, MSSB\_index\_intra CCA = 72 samples. For a UE supporting FR2-2 power class 2, MSSB\_index\_intra CCA = 48 samples. For a UE supporting FR2 power class 3, MSSB\_index\_intra CCA = 48 samples.

N: is the UE Rx beam sweeping scaling factor. N= 12.

If MCG DRX is in use, intra-frequency cell identification requirements specified in Table 9.2A.6.1-1, Table 9.2A.6.1-2 and Table 9.2A.6.1-3 shall depend on the MCG DRX cycle. If SCG DRX is in use, intra-frequency cell identification requirements specified in Table 9.2A.6.1-1, Table 9.2A.6.1-2 and Table 9.2A.6.1-3 shall depend on the SCG DRX cycle. Otherwise, the requirements for when DRX is not in use shall apply.

The requirements apply provided any two closest SMTC occasions available at the UE for the measurement shall be separated by no more than the maximum time requirement for the cell to remain known defined in clause 9.2A.4.3.

Table 9.2A.6.1-1: Time period for PSS/SSS detection (FR1)

|  |  |
| --- | --- |
| Condition | TPSS/SSS\_sync\_intra\_CCA |
| No DRX | max(600ms, (5+LPSS/SSS,gaps) x max(MGRP, SMTC period)) x CSSFintra |
| DRX cycle≤ 320ms | max(600ms, ceil(1.5x (5+LPSS/SSS,gaps)) x max(DRX cycle, MGRP, SMTC period)) x CSSFintra |
| DRX cycle>320ms | (5+LPSS/SSS,gaps) x (MGRP, DRX cycle) x CSSFintra |
| NOTE 1: When DRX is not configured, LPSS/SSS,gaps is the number of SMTC occasions not available at the UE during TPSS/SSS\_sync\_intra\_CCA for PSS/SSS detection, where LPSS/SSS,gaps <LPSS/SSS,gaps,max. When DRX is configured, LPSS/SSS,gaps is the number of DRX cycles in which at least one SMTC occasion is not available at the UE during TPSS/SSS\_sync\_intra\_CCA for PSS/SSS detection, where LPSS/SSS,gaps <LPSS/SSS,gaps,max. When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle. When configured with measurement gaps, the UE is not required to determine the availability of SMTC occasions more frequent than once during MGRP. FFS: The UE is not required to determine the availability of SMTC occasions more frequent than what is required by CSSFintra.  NOTE 2: LPSS/SSS,gaps,max, =7 for Max(DRX cycle, SMTC period, MGRP)≤40ms where DRX cycle is 0 for non-DRX, LPSS/SSS,gaps,max =5 for 40ms<Max(DRX cycle, SMTC period, MGRP)≤320ms, LPSS/SSS,gaps,max =3 for DRX cycle>320ms.  NOTE 3: Upon exceeding LPSS/SSS,gaps,max, the UE is not required to meet the requirements for PSS/SSS detection. | |

Table 9.2A.6.1-2: Time period for time index detection (FR1)

|  |  |
| --- | --- |
| Condition | TSSB\_time\_index\_intra\_CCA |
| No DRX | max(120ms, (3+Lind,gaps) x max(MGRP, SMTC period)) x CSSFintra |
| DRX cycle≤ 320ms | max(120ms, ceil(1.5x (3+Lind,gaps)) x max(MGRP, SMTC period,DRX cycle) x CSSFintra) |
| DRX cycle>320ms | (3+Lind,gaps) x (MGRP, DRX cycle) x CSSFintra |
| NOTE 1: When DRX is not configured, Lind,gaps is the number of SMTC occasions not available at the UE during TSSB\_time\_index\_intra\_CCA forindex detection where Lind,gaps < Lind,gaps,max. When DRX is configured, Lind,gaps is the number of DRX cycles in which at least one SMTC occasion is not available at the UE during TSSB\_time\_index\_intra\_CCA forindex detection where Lind,gaps < Lind,gaps,max. When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle. When configured with measurement gaps, the UE is not required to determine the availability of SMTC occasions more frequent than once during MGRP. FFS: The UE is not required to determine the availability of SMTC occasions more frequent than what is required by CSSFintra.  NOTE 2: Lind,gaps,max, = 5 for Max(DRX cycle, SMTC period, MGRP)≤40ms where DRX cycle is 0 for non-DRX, Lind,gaps,max = 3 for 40ms<Max(DRX cycle, SMTC period, MGRP)≤320ms, Lind,gaps,max = 2 for DRX cycle>320ms.  NOTE 3: Upon exceeding Lind,gaps,max over the TSSB\_time\_index\_intra\_CCA period of time, the UE has to restart the time index detection procedure. | |

Table 9.2A.6.1-3: Time period for PSS/SSS detection (FR2-2)

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra\_CCA |
| No DRX | max(600ms, (Mpss/sss\_sync\_with\_gaps\_CCA x KFR + N x Lind,gaps ) x max(MGRP, SMTC period)) x CSSFintra |
| DRX cycle≤ 320ms | max(600ms, ceil(1.5x (Mpss/sss\_sync\_with\_gaps\_CCA x KFR + N x Lind,gaps )) x max(MGRP, SMTC period, DRX cycle))x CSSFintra |
| DRX cycle>320ms | (Mpss/sss\_sync\_with\_gaps\_CCA x KFR + N x Lind,gaps ) x max(MGRP, DRX cycle) x CSSFintra |
| NOTE 1: When DRX is not configured, Lind,gaps is the number of SMTC occasion groups not available at the UE during TSSB\_time\_index\_intra\_CCA forindex detection where Lind,gaps < Lind,gaps,max. A SMTC occasion group consists of N consecutive SMTC occasions. An SMTC occasion group is not available, when at least one SMTC occasion in the group is not transmitted by the gNB. When DRX is configured, Lind,gaps is the number of [DRX cycle groups] in which at least one SMTC occasion is not available at the UE during TSSB\_time\_index\_intra\_CCA forindex detection where Lind,gaps < Lind,gaps,max.[A DRX occasion group consists of N consecutive DRX cycles. A DRX occasion group occasion group is not available, when at least one SMTC occasion in the group is not transmitted by the gNB.] When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle. When configured with measurement gaps, the UE is not required to determine the availability of SMTC occasions more frequent than once during MGRP.  NOTE 2: Lind,gaps,max, = [5] for Max(DRX cycle, SMTC period, MGRP)≤40ms where DRX cycle is 0 for non-DRX, Lind,gaps,max = [3] for 40ms<Max(DRX cycle, SMTC period, MGRP)≤320ms, Lind,gaps,max = [2] for DRX cycle>320ms.  NOTE 3: Upon exceeding Lind,gaps,max over the TSSB\_time\_index\_intra\_CCA period of time, the UE has to restart the time index detection procedure.  NOTE 4: KFR is a scaling factor depending on the frequency range and SSB SCS. KFR = 1 if the SCS of the SSB of the cell being detected is 120 kHz, KFR = 2 if the SCS of the SSB of the cell being detected is 480 kHz, and KFR = 3 if the SCS of the SSB of the cell being detected is 960 kHz. | |

Table 9.2A.5.1-7: Time period for time index detection (FR2-2)

|  |  |
| --- | --- |
| DRX cycle | TSSB\_time\_index\_intra\_CCA |
| No DRX | Max(200ms, ceil((MSSB\_index\_intra + (Lind,gaps ´N)) ´ Kp) ´ Max(MGRP, SMTC period)) ´ CSSFintra |
| DRX cycle≤ 320ms | Max(200ms, ceil(1.5 ´ (MSSB\_index\_intra + (Lind,gaps ´N)) ´ Kp) ´ Max(MGRP, SMTC period, DRX cycle)) ´ CSSFintra |
| DRX cycle> 320ms | ceil((MSSB\_index\_intra + (Lind,gaps ´N)) ´ Kp) ´ DRX cycle ´ CSSFintra |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified  NOTE 2: When DRX is not configured, Lind is the number of SMTC occasion groups not available at the UE during TSSB\_time\_index\_intra\_CCA for index detection, where Lind,gaps ≤ Lind,gaps,max. When DRX is configured, Lind,gaps is the number of DRX cycles groups in which at least one SMTC occasion is not available at the UE during TSSB\_time\_index\_intra\_CCA for index detection, where Lind,gaps ≤ Lind,gaps,max. When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle.  NOTE 3: Lind,gaps,max = 5 for Max(DRX cycle,SMTC period)≤40ms where DRX cycle is 0 for non-DRX, Lind,gaps,max = 3 for 40ms<Max(DRX cycle,SMTC period)≤320ms, Lind,max =2 for DRX cycle>320ms.  NOTE 4: Upon exceeding Lind,gaps,max over the period of time TSSB\_time\_index\_intra\_CCA, the UE has to restart the time index detection procedure. | |

#### 9.2A.6.2 Intra-frequency Measurement Period

The measurement period for intra-frequency measurements with gaps is as shown in table 9.2A.6.2-1.

If MCG DRX is in use, intra-frequency cell identification requirements specified in Table 9.2A.6.2-1 and 9.2A.6.2-2 shall depend on the MCG DRX cycle. If SCG DRX is in use, intra-frequency measurement period requirements specified in Table 9.2A.6.2-1 and 9.2A.6.2-2 shall depend on the SCG DRX cycle. Otherwise, the requirements for when DRX is not in use shall apply.

The requirements apply provided any two closest SMTC occasions available at the UE for the measurement shall be separated by no more than the maximum time requirement for the cell to remain known defined in clause 9.2A.4.3.

When the time period of unsuccessful measurement attempts due to exceeding the maximum number of unavailable at the UE SMTC occasions of an already identified cell exceeds the maximum time requirement for the cell to remain known defined in clause 9.2A.4.3, UE shall stop the measurement attempts on this SSB and perform the detection procedure again like for any other SSB.

Table 9.2A.6.2-1: Measurement period for intra-frequency measurements with gaps (FR1)

|  |  |
| --- | --- |
| Condition | T SSB\_measurement\_period\_intra\_CCA |
| No DRX | max(200ms, (5+Lmeas,gaps) x max(MGRP, SMTC period)) x CSSFintra |
| DRX cycle≤ 320ms | max(200ms, ceil(1.5x (5+Lmeas,gaps)) x max(MGRP, SMTC period,DRX cycle))x CSSFintra |
| DRX cycle>320ms | (5+Lmeas,gaps) x (MGRP, DRX cycle) x CSSFintra |
| NOTE 1: When DRX is not configured, Lmeas,gaps is the number of SMTC occasions not available at the UE during TSSB\_time\_index\_intra\_CCA for measurement where Lmeas,gaps < Lmeas,gaps,max. When DRX is configured, Lmeas,gaps is the number of DRX cycles in which at least one SMTC occasion is not available at the UE during TSSB\_time\_index\_intra\_CCA for measurement where Lmeas,gaps < Lmeas,gaps,max. When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle. When configured with measurement gaps, the UE is not required to determine the availability of SMTC occasions more frequent than once during MGRP. FFS: The UE is not required to determine the availability of SMTC occasions more frequent than what is required by CSSFintra.  NOTE 2: Lmeas,gaps,max = 7 for Max(DRX cycle, SMTC period, MGRP)≤40ms where DRX cycle is 0 for non-DRX, Lmeas,gaps,max = 5 for 40ms<Max(DRX cycle, SMTC period, MGRP)≤320ms, Lmeas,gaps,max = 3 for DRX cycle>320ms.  NOTE 3: Upon exceeding Lmeas,gaps,max over the T SSB\_measurement\_period\_intra\_CCAperiod of time, the UE has to restart the measurement procedure. | |

Table 9.2A.6.2-2: Measurement period for intra-frequency measurements with gaps (FR2-2)

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra\_CCA |
| No DRX | max(400ms, (Mmeas\_period with\_gaps\_CCA + N x Lmeas,gaps ) x max(MGRP, SMTC period)) x CSSFintra |
| DRX cycle≤ 320ms | max(400ms, ceil(1.5 x (Mmeas\_period with\_gaps\_CCA + N x Lmeas,gaps )) x max(MGRP, SMTC period, DRX cycle)) Note 1 x CSSFintra |
| DRX cycle>320ms | (Mmeas\_period with\_gaps\_CCA + N x Lmeas,gaps ) x max(MGRP, DRX cycle) x CSSFintra |
| NOTE 1: When DRX is not configured, Lmeas,gaps is the number of SMTC occasion groups not available at the UE during TSSB\_time\_index\_intra\_CCA for measurement where Lmeas,gaps < Lmeas,gaps,max. A SMTC occasion group consists of N consecutive SMTC occasions. An SMTC occasion group is not available, when at least one SMTC occasion in the group is not transmitted by the gNB. When DRX is configured, Lmeas,gaps is the number of DRX cycle groups in which at least one SMTC occasion is not available at the UE during TSSB\_time\_index\_intra\_CCA for measurement where Lmeas,gaps < Lmeas,gaps,max. A DRX occasion group consists of N consecutive DRX cycles. A DRX occasion group occasion group is not available, when at least one SMTC occasion in the group is not transmitted by the gNB. When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle. When configured with measurement gaps, the UE is not required to determine the availability of SMTC occasions more frequent than once during MGRP.  NOTE 2: Lmeas,gaps,max = 7 for Max(DRX cycle, SMTC period, MGRP)≤40ms where DRX cycle is 0 for non-DRX, Lmeas,gaps,max = 5 for 40ms<Max(DRX cycle, SMTC period, MGRP)≤320ms, Lmeas,gaps,max = 3 for DRX cycle>320ms.  NOTE 3: Upon exceeding Lmeas,gaps,max over the T SSB\_measurement\_period\_intra\_CCAperiod of time, the UE has to restart the measurement procedure. | |

### 9.2A.7 Intra-frequency RSSI and Channel occupancy measurements

#### 9.2A.7.1 Intra-frequency RSSI measurements

An RSSI measurement is defined as an intra-frequency measurement provided that the RSSI measurement bandwidth is fully contained within the current carrier bandwidth of the UE.

The UE physical layer shall be capable of performing the RSSI measurements, defined in TS 38.215 [4] on one or more serving carriers operating with CCA, TS 37.213 [33], if the carrier(s) are indicated by higher layers [2], and report the RSSI measurements to higher layers. The UE physical layer shall provide to higher layers a single RSSI sample for each OFDM symbol within each configured RSSI measurement duration [2] occurring with a configured RSSI measurement timing configuration periodicity [2], *rmtc-Periodicity*.

The UE can perform RSSI measurements without measurement gaps if RSSI measurement bandwidth is fully within the active DL BWP of the UE.

For performing intra-frequency RSSI measurement in FR2-2, UE shall assume the configured RSSI measurement resources are QCL-ed with TypeD to the DL RS associated with the TCI state provided in the RMTC configuration. If no TCI state is provided in the RMTC configuration, UE shall assume the configured RSSI measurement resources are QCL-ed with TypeD to one of the latest received PDSCH and the latest monitored CORESET in the active BWP of the current carrier in FR2-2.

For RSSI measurement in FR2-2 with SCS of 480 kHz or 960 kHz, the RSSI measurement results shall be derived based on symbols configured by RMTC except for the first symbol and the last symbol in RMTC, and there is no requirement when *measDurationSymbols* is configured as 1.

The measurement period for intra-frequency RSSI measurements without measurement gaps is as shown in Table 9.2A.7.1-1 and Table 9.2A.7.1-2, for FR1, and in Table 9.2A.7.4-1 and Table 9.2A.7.5-1 for FR2-2. The measurement period for intra-frequency RSSI measurements with measurement gaps is as shown in Table 9.2A.7.1-3, for FR1 and in Table 9.2A.7.1-6 for FR2-2.

Table 9.2A.7.1-1: Measurement period for intra-frequency RSSI measurements without measurement gaps when SMTC and RMTC are overlapping (FR1)

|  |  |
| --- | --- |
| Condition NOTE1,2 | T RSSI\_measurement\_period\_intra\_cca |
| No DRX | max(*reportInterval*, *rmtc-Periodicity*\*CSSFoutside\_gap,i) |
| DRX | max(*reportInterval*, max(*rmtc-Periodicity*, DRX cycle) \*CSSFoutside\_gap,i) |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: CSSFoutside\_gap, i is a carrier specific scaling factor and is determined according to CSSF outside\_gap,i in clause 9.1.5.1 for measurement conducted outside measurement gap. | |

Table 9.2A.7.1-2: Measurement period for intra-frequency RSSI measurements without measurement gaps when SMTC and RMTC are not overlapping (FR1)

|  |  |
| --- | --- |
| Condition NOTE1,2 | T RSSI\_measurement\_period\_intra\_cca |
| No DRX | max(*reportInt*erval, Nintra-MO\**rmtc-Periodicity*) |
| DRX | max(*reportInt*erval, Nintra-MO\*max(*rmtc-Periodicity*, DRXcycle length)) |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: Nintra-MO is defined as the number of measurement objects that can be measured without gaps | |

Table 9.2A.7.1-3: Measurement period for intra-frequency RSSI measurements with measurement gaps (FR1)

|  |  |
| --- | --- |
| Condition NOTE1,2 | T RSSI\_measurement\_period\_intra\_cca |
| No DRX | max(*reportInterval*, max(*rmtc-Periodicity, MGRP*) x CSSFintra) |
| DRX | max(*reportInterval*, max(*rmtc-Periodicity*, MGRP,DRX cycle length) x CSSFintra) |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: CSSFintra is a carrier specific scaling factor and is determined according to CSSFwithin\_gap,i in clause 9.1.5.2 for measurement conducted within measurement gaps. | |

Table 9.2A.7.1-4: Measurement period for intra-frequency RSSI measurements without measurement gaps when SMTC and RMTC are overlapping (FR2-2)

|  |  |
| --- | --- |
| Condition NOTE1,2 | T RSSI\_measurement\_period\_intra\_cca |
| No DRX | max(*reportInterval*, *rmtc-Periodicity*\*CSSFoutside\_gap,i) |
| DRX | max(*reportInterval*, max(*rmtc-Periodicity*, DRX cycle) \*CSSFoutside\_gap,i) |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: CSSFoutside\_gap, i is a carrier specific scaling factor and is determined according to CSSF outside\_gap,i in clause 9.1.5.1 for measurement conducted outside measurement gap. | |

Table 9.2A.7.1-5: Measurement period for intra-frequency RSSI measurements without measurement gaps when SMTC and RMTC are not overlapping (FR2-2)

|  |  |
| --- | --- |
| Condition NOTE1,2 | T RSSI\_measurement\_period\_intra\_cca |
| No DRX | max(*reportInt*erval, Nintra-MO\**rmtc-Periodicity*) |
| DRX | max(*reportInt*erval, Nintra-MO\*max(*rmtc-Periodicity*, DRX cycle)) |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: Nintra-MO is defined as the number of measurement objects that can be measured without gaps | |

Table 9.2A.7.1-6: Measurement period for intra-frequency RSSI measurements with measurement gaps (FR2-2)

|  |  |
| --- | --- |
| Condition NOTE1,2 | T RSSI\_measurement\_period\_intra\_cca |
| No DRX | max(*reportInterval*, max(*rmtc-Periodicity, MGRP*) x CSSFintra) |
| DRX | max(*reportInterval*, max(*rmtc-Periodicity*, MGRP,DRX cycle) x CSSFintra) |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: CSSFintra is a carrier specific scaling factor and is determined according to CSSFwithin\_gap,i in clause 9.1.5.2 for measurement conducted within measurement gaps. | |

If the UE requires measurement gaps to perform intra-frequency measurements, a single measurement gap pattern is used for all concurrent intra-frequency measurements, including intra-frequency RSSI measurements. The RSSI measurement duration and the measurement gap should be aligned, and the following additional condition should be fulfilled:

- Entire RSSI measurement duration should be contained in the measurement gap.

The RSSI measurement performed and reported according to this clause shall meet the RSSI measurement accuracy requirement in Clause 10.1.34.1. The reported RSSI measurement values contained in measurement reports shall be based on the measurement report mapping requirements specified in Clause 10.1.34.3.

#### 9.2A.7.2 Intra-frequency Channel occupancy measurements

The UE shall be capable of estimating the channel occupancy on one or more serving carrier frequencies indicated by higher layers [2], based on RSSI samples provided by the physical layer.

The UE can perform channel occupancy measurements without measurement gaps if RSSI measurement bandwidth is fully within the active DL BWP of the UE.

The measurement period for intra-frequency channel occupancy measurements without measurement gap is as shown in Table 9.2A.7.2-1 and Table 9.2A.7.1-2 for FR1, and in Table 9.2A.7.2-4 and Table 9.2A.7.1-5 for FR2-2. The measurement period for intra-frequency RSSI measurements with measurement gaps is as shown in Table 9.2A.7.2-3 for FR1, and in Table 9.2A.7.2-6 for FR2-2 .

Table 9.2A.7.2-1: Measurement period for intra-frequency Channel Occupancy measurements without measurement gaps when SMTC and RMTC are overlapping (FR1)

|  |  |
| --- | --- |
| Condition NOTE1,2 | T RSSI\_measurement\_period\_intra\_cca |
| No DRX | max(*reportInterval*, *rmtc-Periodicity*\*CSSFoutside\_gap,i) |
| DRX | max(*reportInterval*, max(*rmtc-Periodicity*, DRX cycle) \*CSSFoutside\_gap,i) |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: CSSFoutside\_gap, iis a carrier specific scaling factor and is determined according to CSSFwithin\_gap,i in clause 9.1.5.1 for measurement conducted outside measurement gap. | |

Table 9.2A.7.2-2: Measurement period for intra-frequency Channel Occupancy measurements without measurement gaps when SMTC and RMTC are not overlapping (FR1)

|  |  |
| --- | --- |
| Condition NOTE1,2 | T RSSI\_measurement\_period\_intra\_cca |
| No DRX | max(*reportInt*erval, Nintra-MO\**rmtc-Periodicity*) |
| DRX | max(*reportInt*erval, Nintra-MO\*max(*rmtc-Periodicity*, DRXcycle length)) |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: Nintra-MO is defined as the number of measurement objects that can be measured without gaps | |

Table 9.2A.7.2-3: Measurement period for intra-frequency Channel Occupancy measurements with measurement gaps (FR1)

|  |  |
| --- | --- |
| Condition NOTE1,2 | T RSSI\_measurement\_period\_intra\_cca |
| No DRX | max(*reportInterval*, max(*rmtc-Periodicity, MGRP*) x CSSFintra) |
| DRX | max(*reportInterval*, max(*rmtc-Periodicity*, MGRP,DRX cycle length) x CSSFintra) |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: CSSFintra is a carrier specific scaling factor and is determined according to CSSFwithin\_gap,i in clause 9.1.5.2 for measurement conducted within measurement gaps. | |

Table 9.2A.7.2-4: Measurement period for intra-frequency Channel Occupancy measurements without measurement gaps when SMTC and RMTC are overlapping (FR2-2)

|  |  |
| --- | --- |
| **Condition NOTE1,2** | **T RSSI\_measurement\_period\_intra\_cca** |
| No DRX | max(*reportInterval*, *rmtc-Periodicity*\*CSSFoutside\_gap,i) |
| DRX | max(*reportInterval*, max(*rmtc-Periodicity*, DRX cycle) \*CSSFoutside\_gap,i) |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: CSSFoutside\_gap, i is a carrier specific scaling factor and is determined according to CSSF outside\_gap,i in clause 9.1.5.1 for measurement conducted outside measurement gap. | |

Table 9.2A.7.2-5: Measurement period for intra-frequency Channel Occupancy measurements without measurement gaps when SMTC and RMTC are not overlapping (FR2-2)

|  |  |
| --- | --- |
| **Condition NOTE1,2** | **T RSSI\_measurement\_period\_intra\_cca** |
| No DRX | max(*reportInt*erval, Nintra-MO\**rmtc-Periodicity*) |
| DRX | max(*reportInt*erval, Nintra-MO\*max(*rmtc-Periodicity*, DRX cycle)) |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: Nintra-MO is defined as the number of measurement objects that can be measured without gaps | |

Table 9.2A.7.2-6: Measurement period for intra-frequency Channel Occupancy measurements with measurement gaps (FR2-2)

|  |  |
| --- | --- |
| **Condition NOTE1,2** | **T RSSI\_measurement\_period\_intra\_cca** |
| No DRX | max(*reportInterval*, max(*rmtc-Periodicity, MGRP*) x CSSFintra) |
| DRX | max(*reportInterval*, max(*rmtc-Periodicity*, MGRP,DRX cycle) x CSSFintra) |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: CSSFintra is a carrier specific scaling factor and is determined according to CSSFwithin\_gap,i in clause 9.1.5.2 for measurement conducted within measurement gaps. | |

If the UE requires measurement gaps to perform intra-frequency measurements, a single measurement gap pattern is used for all concurrent intra-frequency measurements, including intra-frequency RSSI measurements. The RSSI measurement duration and the measurement gap should be aligned, and the following additional condition should be fulfilled:

- Entire RSSI measurement duration should be contained in the measurement gap.

The channel occupancy measurement performed and reported according to this clause shall meet the channel occupancy measurement accuracy requirements in Clause 10.1.35.1. The reported channel occupancy measurement values contained in measurement reports shall be based on the measurement reporting range specified in TS 38.331 [2].

#### 9.2A.7.3 Scheduling restriction during RSSI and Channel Occupancy measurements in FR1

When the UE performs intra-frequency RSSI/CO measurements in unlicensed spectrum, the following restrictions apply due to RSSI/CO measurements:

- The UE is not expected to transmit PUCCH/PUSCH/SRS on UL symbols which are overlapping in time with the RSSI measurement symbols configured by RMTC.

When intra-band carrier aggregation in unlicensed spectrum is performed, the scheduling restrictions due to a given serving cell should also apply to all other serving cells in the same band on the symbols that fully or partially overlap with the aforementioned restricted symbols.

#### 9.2A.7.4 Scheduling restriction during RSSI measurements in FR2-2

When the UE performs intra-frequency RSSI measurements in unlicensed spectrum, the following restrictions apply due to RSSI measurements:

- The UE is not expected to transmit PUCCH/PUSCH/SRS on UL symbols which are overlapping in time with the RSSI measurement symbols configured by RMTC.

- The UE is not expected to receive PDCCH/PDSCH/TRS/CSI-RS for CQI on symbols which are overlapping in time with RSSI measurement symbols configured by RMTC if the RSSI measurement resources are not QCL-ed with typeD to the DL RS in the active TCI state of PDCCH/PDSCH.

- For 480 kHz and 960 kHz, The UE is not expected to receive PDCCH/PDSCH/TRS/CSI-RS for CQI on symbols which are overlapping in time with the first and last RSSI measurement symbols configured by RMTC.

When intra-band carrier aggregation in unlicensed spectrum is performed, the scheduling restrictions due to a given serving cell should also apply to all other serving cells in the same band on the symbols that fully or partially overlap with the aforementioned restricted symbols.

## 9.2B NR intra-frequency measurements for RedCap

### 9.2B.1 Introduction

A measurement is defined as a SSB based intra-frequency measurement provided the centre frequency of the reference SSB of the serving cell and the centre frequency of the SSB of the neighbour cell are the same, and the subcarrier spacing of the two SSBs are also the same. The reference SSB is the SSB defined in BWP-specific *servingCellMO* under *BWP-DownlinkDedicated* of active DL BWP. If the field is absent, the reference SSB is the SSB defined in *servingCellMO* under *ServingCellConfig* [2].

The UE shall be able to identify new intra-frequency cells and perform SS-RSRP, SS-RSRQ, and SS-SINR measurements of identified intra-frequency cells if carrier frequency information is provided by PCell, even if no explicit neighbour list with physical layer cell identities is provided.

The UE can perform intra-frequency SSB based measurements without measurement gaps if

- the SSB is completely contained in the active BWP of the UE, or

- the active downlink BWP is initial BWP [3].

For intra-frequency SSB based measurements without measurement gaps, UE may cause scheduling restriction as specified in clause 9.2B.5.3.

SSB based measurements are configured along with one or two measurement timing configuration(s) (SMTC(s)) which provides periodicity, duration and offset information on a window of up to 5ms where the measurements are to be performed. For intra-frequency connected mode measurements, up to two measurement window periodicities may be configured. A single measurement window offset and measurement duration are configured per intra-frequency measurement object.

When measurement gaps are needed, the UE is not expected to detect SSB which start earlier than the gap starting time + switching time, nor detect SSB which end later than the gap end – switching time. Switching time is 0.5ms for frequency range FR1 and 0.25ms for frequency range FR2.

### 9.2B.2 Requirements applicability

The requirements in clause 9.2B apply, provided:

- The cell being identified or measured is detectable.

An intra-frequency cell shall be considered detectable when for each relevant SSB:

- For 2Rx RedCap:

- SS-RSRP related side conditions given in clauses 10.1.2 and 10.1.3 for FR1 and FR2, respectively, for a corresponding Band,

- SS-RSRQ related side conditions given in clauses 10.1.7 and 10.1.8 for FR1 and FR2, respectively, for a corresponding Band,

- SS-SINR related side conditions given in clauses 10.1.12 and 10.1.13 for FR1 and FR2, respectively, for a corresponding Band,

- SSB\_RP and SSB Ês/Iot according to Annex B.2.2 for a corresponding Band.

- For 1Rx RedCap:

- SS-RSRP related side conditions given in clauses [x.y.z] and [x.y.z] for FR1 and FR2, respectively, for a corresponding Band,

- SS-RSRQ related side conditions given in clauses [x.y.z] and [x.y.z] for FR1 and FR2, respectively, for a corresponding Band,

- SS-SINR related side conditions given in clauses [x.y.z] and [x.y.z] for FR1 and FR2, respectively, for a corresponding Band,

- SSB\_RP and SSB Ês/Iot according to Annex [x.y.z] for a corresponding Band.

### 9.2B.3 Number of cells and number of SSB

#### 9.2B.3.1 Requirements for FR1

For each intra-frequency layer, during each layer 1 measurement period, the UE shall be capable of performing SS-RSRP, SS-RSRQ, and SS-SINR measurements for at least:

- 8 identified cells, and

- 14 SSBs with different SSB index and/or PCI on the intra-frequency layer, where the number of SSBs in the serving cell is not smaller than the number of configured RLM-RS SSB resources.

#### 9.2B.3.2 Requirements for FR2

For one single intra-frequency layer in a band, during each layer 1 measurement period, the UE shall be capable of performing SS-RSRP, SS-RSRQ, and SS-SINR measurements for at least:

- 6 identified cells, and

- 24 SSBs with different SSB index and/or PCI,

where this single intra-frequency layer shall be:

- PCC when UE is configured with SA NR operation mode with PCC in the band.

### 9.2B.4 Measurement Reporting Requirements

#### 9.2B.4.1 Periodic Reporting

For 2Rx RedCap: The requirements in clause 9.2.4.1 shall apply.

For 1Rx RedCap: Reported RSRP, RSRQ, and RS-SINR measurements contained in periodic measurement reports shall meet the requirements in clauses 10.1.2.1 (RSRP for FR1), 10.1.3.1 (RSRP for FR2), 10.1.7.1 (RSRQ for FR1), 10.1.8.1 (RSRQ for FR2), 10.1.12.1 (RS-SINR for FR1) and 10.1.13.1 (RS-SINR for FR2).

#### 9.2B.4.2 Event-triggered Periodic Reporting

For 2Rx RedCap: The requirements in clause 9.2.4.2 shall apply.

For 1Rx RedCap: Reported RSRP, RSRQ, and RS-SINR measurements contained in event-triggered periodic measurement reports shall meet the requirements in clauses 10.1.2.1 (RSRP for FR1), 10.1.3.1 (RSRP for FR2), 10.1.7.1 (RSRQ for FR1), 10.1.8.1 (RSRQ for FR2), 10.1.12.1 (RS-SINR for FR1) and 10.1.13.1 (RS-SINR for FR2).

The first report in event triggered periodic measurement reporting shall meet the requirements specified in clause 9.2B.4.3.

#### 9.2B.4.3 Event Triggered Reporting

For 2Rx RedCap: The requirements in clause 9.2.4.3 shall apply.

For 1Rx RedCap: Reported RSRP, RSRQ, and RS-SINR measurements contained in event triggered measurement reports shall meet the requirements in clauses 10.1.2.1 (RSRP for FR1), 10.1.3.1 (RSRP for FR2), 10.1.7.1 (RSRQ for FR1), 10.1.8.1 (RSRQ for FR2), 10.1.12.1 (RS-SINR for FR1) and 10.1.13.1 (RS-SINR for FR2).

The UE shall not send any event triggered measurement reports as long as no reporting criteria are fulfilled.

The measurement reporting delay is defined as the time between an event that will trigger a measurement report and the point when the UE starts to transmit the measurement report over the air interface. This requirement assumes that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 x TTIDCCH. This measurement reporting delay excludes a delay which caused by no UL resources being available for UE to send the measurement report on.

The event triggered measurement reporting delay, measured without L3 filtering shall be less than Tidentify intra with index\_RedCap or T identify intra without index\_RedCap defined in clause 9.2B.5.1 or clause 9.2B.6.2.When L3 filtering is used an additional delay can be expected.

A cell is detectable only if at least one SSBs measured from the Cell being configured remains detectable during the time period Tidentify\_intra\_without\_index\_RedCap or Tidentify\_intra\_with\_index\_RedCap as defined in clause 9.2B.5.1 or clause 9.2B.6.2. If a cell which has been detectable at least for the time period Tidentify intra without index\_RedCap or Tidentify intra with index\_RedCap defined in clause 9.2B.5.1 or clause 9.2B.6.2 becomes undetectable for a period ≤ 5 seconds and then the cell becomes detectable again with the same spatial reception parameter and triggers an event, the event triggered measurement reporting delay shall be less than TSSB\_measurement\_period\_intra\_RedCap provided the timing to that cell has not changed more than ± 3200/ Tc while the measurement gap has not been available and L3 filtering has not been used, where *µ* is the SCS configuration as defined in clause 4.2 of TS 38.211 [3]. When L3 filtering is used, an additional delay can be expected.

### 9.2B.5 Intra-frequency measurements without measurement gaps for RedCap

#### 9.2B.5.1 Intra-frequency cell identification

The UE shall be able to identify a new detectable intra-frequency cell within Tidentify\_intra\_without\_index\_RedCap if the UE is not indicated to report SSB based RRM measurement result with the associated SSB index(*reportQuantityRsIndexes* or *maxNrofRSIndexesToReport* is not configured), or the UE is indicated that the neighbour cell is synchronous with the serving cell (*deriveSSB-IndexFromCell* is enabled). Otherwise UE shall be able to identify a new detectable intra frequency cell within Tidentify\_intra\_with\_index\_RedCap. The UE shall be able to identify a new detectable intra frequency SS block of an already detected cell within Tidentify\_intra\_without\_index\_RedCap. It is assumed that *deriveSSB-IndexFromCell* is always enabled for FR1 TDD and FR2.

Tidentify\_intra\_without\_index\_RedCap = (TPSS/SSS\_sync\_intra\_RedCap + T SSB\_measurement\_period\_intra\_RedCap) ms

Tidentify\_intra\_with\_index\_RedCap = (TPSS/SSS\_sync\_intra\_RedCap + T SSB\_measurement\_period\_intra\_RedCap + TSSB\_time\_index\_intra\_RedCap) ms

Where:

TPSS/SSS\_sync\_intra\_RedCap: it is the time period used in PSS/SSS detection given in tables 9.2B.5.1-1, 9.2B.5.1-2, 9.2B.5.1-3.

TSSB\_time\_index\_intra\_RedCap: it is the time period used to acquire the index of the SSB being measured given in tables 9.2B.5.1-4, 9.2B.5.1-5

T SSB\_measurement\_period\_intra\_RedCap: equal to a measurement period of SSB based measurement given in table 9.2B.5.2-1, table 9.2B.5.2-2, table 9.2B.5.2-3.

CSSFintra\_RedCap: it is a carrier specific scaling factor and is determined

according to CSSFoutside\_gap\_RedCap,i in clause 9.1A.5.1 for measurement conducted outside measurement gaps, i.e. when intra-frequency SMTC is fully non overlapping or partially overlapping with measurement gaps, or according to CSSFwithin\_gap\_RedCap,i in clause 9.1A.5.2 for measurement conducted within measurement gaps, i.e. when intra-frequency SMTC is fully overlapping with measurement gaps.

if the high layer in TS 38.331 [2] signalling of *smtc2* is configured, the assumed periodicity of intra-frequency SMTC occasions corresponds to the value of higher layer parameter *smtc2*; Otherwise the assumed periodicity of intra-frequency SMTC occasions corresponds to the value of higher layer parameter *smtc1*.

For 2Rx RedCap:

Mpss/sss\_sync\_w/o\_gaps\_RedCap : For a UE supporting FR2 power class 1 or 5, Mpss/sss\_sync\_w/o\_gaps\_RedCap =40. For a UE supporting power class 2, Mpss/sss\_sync\_w/o\_gaps\_RedCap =24. For a UE supporting FR2 power class 3, Mpss/sss\_sync\_w/o\_gaps\_RedCap =24. For a UE supporting FR2 power class 4, Mpss/sss\_sync\_w/o\_gaps\_RedCap =24, For a UE supporting FR2 power class 7, Mpss/sss\_sync\_w/o\_gaps\_RedCap = 24.

Mmeas\_period\_w/o\_gaps\_RedCap : For a UE supporting power class 1 or 5, Mmeas\_period\_w/o\_gaps\_RedCap =40. For a UE supporting FR2 power class 2, Mmeas\_period\_w/o\_gaps\_RedCap =24. For a UE supporting power class 3, Mmeas\_period\_w/o\_gaps\_RedCap =24. For a UE supporting power class 4, Mmeas\_period\_w/o\_gaps\_RedCap =24, For a UE supporting power class 7, Mmeas\_period\_w/o\_gaps\_RedCap = 24.

When intra-frequency SMTC is fully non overlapping with measurement gaps or intra-frequency SMTC is fully overlapping with MGs, Kp=1

When intra-frequency SMTC is partially overlapping with measurement gaps, Kp = 1/(1- (SMTC period /MGRP)), where SMTC period < MGRP. For calculation of Kp, if the high layer signalling (TS 38.331 [2]) of *smtc2* is configured, for cells indicated in the *pci-List* parameter in *smtc2*, the SMTC periodicity corresponds to the value of higher layer parameter *smtc2*; for the other cells, the SMTC periodicity corresponds to the value of higher layer parameter *smtc1.*

If the higher layer signaling in TS38.331 [2] signalling of *smtc2* is present and smtc1 is fully overlapping with measurement gaps and smtc2 is partially overlapping with measurement gaps, requirements are not specified for Tidentify\_intra\_without\_index\_RedCap or Tidentify\_intra\_with\_index\_RedCap

For FR2,

Klayer1\_measurement=1,

- if all of the reference signals configured for RLM, BFD, CBD or L1-RSRP for beam reporting on any FR2 serving frequency in the same band outside measurement gap are not fully overlapped by intra-frequency SMTC occasions, or

- if all of the reference signal configured for RLM, BFD, CBD or L1-RSRP for beam reporting on any FR2 serving frequency in the same band outside measurement gap and fully-overlapped by intra-frequency SMTC occasions are not overlapped with any of the SSB symbols and the RSSI symbols, and 1 symbol before each consecutive SSB symbols and the RSSI symbols, and 1 symbol after each consecutive SSB symbols and the RSSI symbols, given that *SSB-ToMeasure* and *SS-RSSI-Measurement* are configured, where SSB symbols are indicated by the union set of SSB-ToMeasure from all the configured measurement objects on the same serving carrier which can be merged.and RSSI symbols are indicated by *SS-RSSI-Measurement*;

Klayer1\_measurement=1.5, otherwise.

If the above-mentioned reference signal configured for L1-RSRP measurement is aperiodic CSI-RS resource, longer cell identification delay would be expected.

Table 9.2B.5.1-1: Time period for PSS/SSS detection, (Frequency range FR1) for 2Rx RedCap UE

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra\_RedCap |
| No DRX | max(600ms, ceil(5 x Kp) x SMTC period )Note 1 x CSSFintra\_RedCap |
| DRX cycle≤ 320ms | max(600ms, ceil(1.5 x 5 x Kp) x max(SMTC period,DRX cycle)) x CSSFintra\_RedCap |
| DRX cycle>320ms | ceil(5 x Kp) x DRX cycle x CSSFintra\_RedCap |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified | |

Table 9.2B.5.1-2: Time period for PSS/SSS detection, (Frequency range FR2) for 2Rx RedCap UE

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra\_RedCap |
| No DRX | max(600ms, ceil(Mpss/sss\_sync\_w/o\_gaps\_RedCap x Kp x Klayer1\_measurement)x SMTC period)Note 1 x CSSFintra\_RedCap |
| DRX cycle≤ 320ms | max(600ms, ceil(1.5 x Mpss/sss\_sync\_w/o\_gaps\_RedCap x Kp x Klayer1\_measurement)x max(SMTC period,DRX cycle)) x CSSFintra\_RedCap |
| DRX cycle>320ms | ceil(Mpss/sss\_sync\_w/o\_gaps\_RedCap x Kp x Klayer1\_measurement) x DRX cycle x CSSFintra\_RedCap |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified | |

Table 9.2B.5.1-3: Time period for PSS/SSS detection, (Frequency range FR1) for 1Rx RedCap UE

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra\_RedCap |
| No DRX | max(600ms, ceil( 7 x Kp) x SMTC period )Note 1 x CSSFintra\_RedCap |
| DRX cycle≤ 320ms | max(600ms, ceil(1.5 x 7 x Kp) x max(SMTC period,DRX cycle)) x CSSFintra\_RedCap |
| DRX cycle>320ms | ceil(7 x Kp) x DRX cycle x CSSFintra\_RedCap |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified | |

Table 9.2B.5.1-4: Time period for time index detection (FR1) for 2Rx RedCap UE

|  |  |
| --- | --- |
| DRX cycle | TSSB\_time\_index\_intra\_RedCap |
| No DRX | max(120ms, ceil( 3 x Kp )x SMTC period)Note 1 x CSSFintra\_RedCap |
| DRX cycle≤ 320ms | max(120ms, ceil (1.5 x 3 x Kp) x max(SMTC period,DRX cycle)) x CSSFintra\_RedCap |
| DRX cycle>320ms | Ceil(3 x Kp) x DRX cycle x CSSFintra\_RedCap |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified | |

Table 9.2B.5.1-5: Time period for time index detection (FR1) for 1Rx RedCap UE

|  |  |
| --- | --- |
| DRX cycle | TSSB\_time\_index\_intra\_RedCap |
| No DRX | max(160ms, ceil( 6 x Kp )x SMTC period)Note 1 x CSSFintra\_RedCap |
| DRX cycle≤ 320ms | max(160ms, ceil (1.5 x 6 x Kp) x max(SMTC period,DRX cycle)) x CSSFintra\_RedCap |
| DRX cycle>320ms | Ceil(6 x Kp) x DRX cycle x CSSFintra\_RedCap |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified | |

#### 9.2B.5.2 Measurement period

The measurement period for intra-frequency measurements without gaps is as shown in table 9.2B.5.2-1, 9.2B.5.2-2, 9.2B.5.2-3.

If the higher layer signaling in TS38.331 [2] signalling of *smtc2* is present and smtc1 is fully overlapping with measurement gaps and smtc2 is partially overlapping with measurement gaps, requirements are not specified for TSSB\_measurement\_period\_intra\_RedCap.

For FR2, a longer measurement period is allowed, if aperiodic CSI-RS resource is measured for L1-RSRP measurement on any FR2 serving frequency in the same band, and the CSI-RS resource is outside measurement gap and overlapped with any of the SSB symbols and the RSSI symbols, and 1 symbol before each consecutive SSB symbols and the RSSI symbols, and 1 symbol after each consecutive SSB symbols and the RSSI symbols. If *SSB-ToMeasure* or *SS-RSSI-Measurement* is configured, the SSB symbols are indicated by the union set of *SSB-ToMeasure* from all the configured measurement objects on the same band which can be merged and the RSSI symbols are indicated by *SS-RSSI-Measurement*.

Table 9.2B.5.2-1: Measurement period for intra-frequency measurements without gaps (FR1) for 2Rx RedCap UE

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra\_RedCap |
| No DRX | max(200ms, ceil( 5 x Kp) x SMTC period)Note 1 x CSSFintra\_RedCap |
| DRX cycle≤ 320ms | max(200ms, ceil(1.5x 5 x Kp) x max(SMTC period,DRX cycle)) x CSSFintra\_RedCap |
| DRX cycle>320ms | ceil( 5 x Kp ) x DRX cycle x CSSFintra\_RedCap |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified | |

Table 9.2B.5.2-2: Measurement period for intra-frequency measurements without gaps (FR2) for 2Rx RedCap UE

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra\_RedCap |
| No DRX | max(400ms, ceil(Mmeas\_period\_w/o\_gaps\_RedCap x Kp x Klayer1\_measurement) x SMTC period)Note 1 x CSSFintra\_RedCap |
| DRX cycle≤ 320ms | max(400ms, ceil(1.5x Mmeas\_period\_w/o\_gaps\_RedCap x Kp x Klayer1\_measurement) x max(SMTC period,DRX cycle)) x CSSFintra\_RedCap |
| DRX cycle>320ms | ceil(Mmeas\_period\_w/o\_gaps\_RedCap xKp x Klayer1\_measurement ) x DRX cycle x CSSFintra\_RedCap |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified | |

Table 9.2B.5.2-3: Measurement period for intra-frequency measurements without gaps (FR1) for 1Rx RedCap UE

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra\_RedCap |
| No DRX | max([200]ms, ceil( [5] x Kp) x SMTC period)Note 1 x CSSFintra\_RedCap |
| DRX cycle≤ 320ms | max([200]ms, ceil(1.5x [5] x Kp) x max(SMTC period,DRX cycle)) x CSSFintra\_RedCap |
| DRX cycle>320ms | ceil( [5] x Kp ) x DRX cycle x CSSFintra\_RedCap |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified | |

#### 9.2B.5.3 Scheduling availability of UE during intra-frequency measurements

UE shall be capable of measuring without measurement gaps when the SSB is completely contained in the active bandwidth part of the UE. When any of the conditions in the following clauses is met, there are restrictions on the scheduling availability; otherwise, there is no scheduling restriction. Note that the SSB symbols indicated by the union set of SSB-ToMeasure from all the configured measurement objects on the same serving carrier which can be merged[2], if it is configured; otherwise, all *L* SSB symbols within the SMTC window duration defined in clause 4.1 of TS 38.213 [3] are included.

##### 9.2B.5.3.1 Scheduling availability of UE performing measurements in TDD bands on FR1

When the UE performs intra-frequency measurements in a TDD band, the following restrictions apply due to SS-RSRP or SS-SINR measurement

- The UE is not expected to transmit PUCCH/PUSCH/SRS on SSB symbols to be measured, and on 1 data symbol before each consecutive SSB symbols to be measured and 1 data symbol after each consecutive SSB symbols to be measured within SMTC window duration. If the high layer in TS 38.331 [2] signalling of *smtc2*is configured, the SMTC periodicityfollows *smtc2*; Otherwise SMTC periodicity follows *smtc1.*

When the UE performs intra-frequency measurements in a TDD band, the following restrictions apply due to SS-RSRQ measurement

- The UE is not expected to transmit PUCCH/PUSCH/SRS on SSB symbols to be measured, RSSI measurement symbols, and on 1 data symbol before each consecutive SSB to be measured/RSSI symbols and 1 data symbol after each consecutive SSB to be measured/RSSI symbols within SMTC window duration. If the high layer signalling of *smtc2*is configured in TS 38.331 [2], the SMTC periodicityfollows *smtc2*; Otherwise the SMTC periodicity follows *smtc1.*

##### 9.2B.5.3.2 Scheduling availability of UE performing measurements with a different subcarrier spacing than PDSCH/PDCCH on FR1

For UE which do not support *simultaneousRxDataSSB-DiffNumerology* [14] the following restrictions apply due to SS-RSRP/RSRQ/SINR measurement

- If *deriveSSB\_IndexFromCell* is enabled the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on SSB symbols to be measured, and on 1 data symbol before each consecutive SSB symbols to be measured and 1 data symbol after each consecutive SSB symbols to be measured within SMTC window duration. If the high layer signalling of *smtc2*is configured in TS 38.331 [2], the SMTC periodicityfollows *smtc2*; Otherwise the SMTC periodicity follows *smtc1.*

- If *deriveSSB\_IndexFromCell* is not enabled the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on all symbols within SMTC window duration. If the high layer signalling of *smtc2*is configured in TS 38.331 [2], the SMTC periodicityfollows *smtc2*; Otherwise the SMTC periodicity follows *smtc1.*

- If the following conditions are met:

- The UE has been notified about system information update through paging,

- The gap between the UE’s reception of PDCCH that UE monitors in the Type 2-PDCCH CSS set that notifies system information update, and the PDCCH that UE monitors in the Type0-PDCCH CSS set, is greater than 2 slots

- The UE is expected to receive the PDCCH that the UE monitors in the Type0-PDCCH CSS set, and/or the corresponding PDSCH, on SSB symbols to be measured.

##### 9.2B.5.3.3 Scheduling availability of UE performing measurements on FR2

The following scheduling restriction applies due to SS-RSRP or SS-SINR measurement on an FR2 intra-frequency cell

The UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on SSB symbols to be measured, and on 1 data symbol before each consecutive SSB symbols to be measured and 1 data symbol after each consecutive SSB symbols to be measured within SMTC window duration (The signaling *deriveSSB\_IndexFromCell* is always enabled for FR2). If the high layer signalling of *smtc2*is configured in TS 38.331 [2], the SMTC periodicityfollows *smtc2*; Otherwise the SMTC periodicity follows *smtc1.*

The following scheduling restriction applies to SS-RSRQ measurement on an FR2 intra-frequency cell

- The UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on SSB symbols to be measured, RSSI measurement symbols, and on 1 data symbol before each consecutive SSB to be measured/RSSI symbols and 1 data symbol after each consecutive SSB to be measured/RSSI symbols within SMTC window duration (The signaling *deriveSSB\_IndexFromCellc* is always enabled for FR2). If the high layer signalling of *smtc2*is configured in TS 38.331 [2], the SMTC periodicityfollows *smtc2*; Otherwise the SMTC periodicity follows *smtc1.*

If following conditions are met:

- The UE has been notified about system information update through paging,

- The gap between the UE’s reception of PDCCH that UE monitors in the Type 2-PDCCH CSS set that notifies system information update, and the PDCCH that UE monitors in the Type0-PDCCH CSS set, is greater than 2 slots.

For the SSB and CORESET for RMSI scheduling multiplexing patterns 3, the UE is expected to receive the PDCCH that the UE monitors in the Type0-PDCCH CSS set, and the corresponding PDSCH, on SSB symbols to be measured; and

For the SSB and CORESET for RMSI scheduling multiplexing patterns 2, the UE is expected to receive PDSCH that corresponds to the PDCCH that the UE monitors in the Type0-PDCCH CSS set, on SSB symbols to be measured.

##### 9.2B.5.3.4 Scheduling availability of UE performing measurements in HD-FDD bands on FR1

When the UE performs intra-frequency measurements in a HD-FDD band, the following restrictions apply due to SS-RSRP or SS-SINR measurement

- The UE is not expected to transmit PUCCH/PUSCH/SRS on SSB symbols to be measured, and on 1 data symbol before each consecutive SSB symbols to be measured and 1 data symbol after each consecutive SSB symbols to be measured within SMTC window duration. If the high layer in TS 38.331 [2] signalling of *smtc2*is configured, the SMTC periodicityfollows *smtc2*; Otherwise SMTC periodicity follows *smtc1.*

When the UE performs intra-frequency measurements in a HD-FDD band, the following restrictions apply due to SS-RSRQ measurement

- The UE is not expected to transmit PUCCH/PUSCH/SRS on SSB symbols to be measured, RSSI measurement symbols, and on 1 data symbol before each consecutive SSB to be measured/RSSI symbols and 1 data symbol after each consecutive SSB to be measured/RSSI symbols within SMTC window duration. If the high layer signalling of *smtc2*is configured in TS 38.331 [2], the SMTC periodicityfollows *smtc2*; Otherwise the SMTC periodicity follows *smtc1.*

### 9.2B.6 Intra-frequency measurements with measurement gaps

#### 9.2B.6.1 Intra-frequency cell identification

The UE shall be able to identify a new detectable intra frequency cell within Tidentify\_intra\_without\_index\_RedCap if UE is not indicated to report SSB based RRM measurement result with the associated SSB index (*reportQuantityRsIndexes* or *maxNrofRSIndexesToReport* is not configured), or the UE has been indicated that the neighbour cell is synchronous with the serving cell (*deriveSSB-IndexFromCell* is enabled). Otherwise UE shall be able to identify a new detectable intra frequency cell within Tidentify\_intra\_with\_index\_RedCap. The UE shall be able to identify a new detectable intra frequency SS block of an already detected cell within Tidentify\_intra\_without\_index\_RedCap. It is assumed that *deriveSSB-IndexFromCell* is always enabled for FR1 TDD and FR2.

Tidentify\_intra\_without\_index\_RedCap = TPSS/SSS\_sync\_intra\_RedCap + T SSB\_measurement\_period\_intra\_RedCap ms

Tidentify\_intra\_with\_index\_RedCap = TPSS/SSS\_sync\_intra\_RedCap + T SSB\_measurement\_period\_intra\_RedCap + TSSB\_time\_index\_intra\_RedCap ms

Where:

TPSS/SSS\_sync\_intra\_RedCap: it is the time period used in PSS/SSS detection given in table 9.2B.6.1-1 or 9.2B.6.1-2 or 9.2B.6.1-3.

TSSB\_time\_index\_intra\_RedCap: it is the time period used to acquire the index of the SSB being measured given in table 9.2B.6.1-4 or 9.2B.6.1-5.

T SSB\_measurement\_period\_intra\_RedCap: equal to a measurement period of SSB based measurement given in table 9.2B.6.2-1 or 9.2B.6.2-2 or 9.2B.6.2-3.

CSSFintra\_RedCap: it is a carrier specific scaling factor and is determined according to CSSFwithin\_gap\_RedCap,i in clause 9.1A.5.2 for measurement conducted within measurement gaps.

For 2Rx RedCap:

Mpss/sss\_sync\_with\_gaps\_RedCap : For a UE supporting FR2 power class 1 or 5, Mpss/sss\_sync with\_gaps\_RedCap =40. For a UE supporting FR2 power class 2, Mpss/sss\_sync with\_gaps\_RedCap =24. For a UE supporting FR2 power class 3, Mpss/sss\_sync with\_gaps\_RedCap =24. For a UE supporting power class 4, Mpss/sss\_sync with\_gaps\_RedCap =24, For a UE supporting FR2 power class 7, Mpss/sss\_sync with\_gaps\_RedCap =24.

Mmeas\_period\_ with\_gaps\_RedCap: For a UE supporting power class 1 or 5, Mmeas\_period\_ with\_gaps\_RedCap =40. For a UE supporting power class 2, Mmeas\_period\_ with\_gaps\_RedCap =24. For a UE supporting power class 3, Mmeas\_period\_ with\_gaps\_RedCap =24. For a UE supporting power class 4, Mmeas\_period with\_gaps\_RedCap =24, For a UE supporting power class 7, Mmeas\_period\_ with\_gaps\_RedCap =24.

If the higher layer signaling in TS 38.331 [2] of *smtc2* is present and smtc1 is fully overlapping with measurement gaps and smtc2 is partially overlapping with measurement gaps, requirements are not specified for Tidentify\_intra\_without\_index\_RedCap or Tidentify\_intra\_with\_index\_RedCap.

Table 9.2B.6.1-1: Time period for PSS/SSS detection (FR1) for 2Rx RedCap UE

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra\_RedCap |
| No DRX | max(600ms, 5 x max(MGRP, SMTC period)) x CSSFintra\_RedCap |
| DRX cycle≤ 320ms | max(600ms, ceil(1.5 x 5) x max(MGRP, SMTC period,DRX cycle)) x CSSFintra\_RedCap |
| DRX cycle>320ms | 5 x max(MGRP, DRX cycle) x CSSFintra\_RedCap |

Table 9.2B.6.1-2: Time period for PSS/SSS detection (FR2) for 2Rx RedCap UE

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra\_RedCap |
| No DRX | max(600ms, Mpss/sss\_sync\_with\_gaps\_RedCap x max(MGRP, SMTC period)) x CSSFintra\_RedCap |
| DRX cycle≤ 320ms | max(600ms, ceil(1.5x Mpss/sss\_sync\_with\_gaps\_RedCap) x max(MGRP, SMTC period, DRX cycle))x CSSFintra\_RedCap\_RedCap |
| DRX cycle>320ms | Mpss/sss\_sync\_with\_gaps\_RedCap x max(MGRP, DRX cycle) x CSSFintra\_RedCap |

Table 9.2B.6.1-3: Time period for PSS/SSS detection (FR1) for 1Rx RedCap UE

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra\_RedCap |
| No DRX | max(600 ms, 7 x max(MGRP, SMTC period)) x CSSFintra\_RedCap |
| DRX cycle≤ 320ms | max(600 ms, ceil(1.5 x 7) x max(MGRP, SMTC period,DRX cycle)) x CSSFintra\_RedCap |
| DRX cycle>320ms | 7 x max(MGRP, DRX cycle) x CSSFintra\_RedCap |

Table 9.2B.6.1-4: Time period for time index detection (Frequency range FR1) for 2Rx RedCap UE

|  |  |
| --- | --- |
| DRX cycle | TSSB\_time\_index\_intra\_RedCap |
| No DRX | max(120ms, 3 x max(MGRP, SMTC period)) x CSSFintra\_RedCap |
| DRX cycle≤ 320ms | max(120ms, ceil(1.5 x 3) x max(MGRP, SMTC period,DRX cycle) x CSSFintra\_RedCap) |
| DRX cycle>320ms | 3 x max(MGRP, DRX cycle) x CSSFintra\_RedCap |

Table 9.2B.6.1-5: Time period for time index detection (Frequency range FR1) for 1Rx RedCap UE

|  |  |
| --- | --- |
| DRX cycle | TSSB\_time\_index\_intra\_RedCap |
| No DRX | max(160ms, 6 x max(MGRP, SMTC period)) x CSSFintra\_RedCap |
| DRX cycle≤ 320ms | max(160ms, ceil(1.5 x 6) x max(MGRP, SMTC period,DRX cycle) x CSSFintra\_RedCap) |
| DRX cycle>320ms | [6] x max(MGRP, DRX cycle) x CSSFintra\_RedCap |

#### 9.2B.6.2 Intra-frequency Measurement Period

The measurement period for FR1 intra-frequency measurements with gaps is as shown in table 9.2B.6.2-1 and in table 9.2B.6.2-3 for 1 Rx RedCap.

The measurement period for FR2 intra-frequency measurements with gaps is as shown in table 9.2B.6.2-2.

For either an FR1 or FR2 serving cell, longer measurement period would be expected during the period Tidentify\_CGI\_RedCap when the UE is requested to decode an NR CGI.

Table 9.2B.6.2-1: Measurement period for intra-frequency measurements with gaps (FR1) for 2Rx RedCap UE

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra\_RedCap |
| No DRX | max(200ms, 5 x max(MGRP, SMTC period)) x CSSFintra\_RedCap |
| DRX cycle≤ 320ms | max(200ms, ceil(1.5x 5) x max(MGRP, SMTC period,DRX cycle))x CSSFintra\_RedCap |
| DRX cycle>320ms | 5 x max(MGRP, DRX cycle) x CSSFintra\_RedCap |

Table 9.2B.6.2-2: Measurement period for intra-frequency measurements with gaps (FR2) for 2Rx RedCap UE

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra\_RedCap |
| No DRX | max(400ms, Mmeas\_period with\_gaps\_RedCap x max(MGRP, SMTC period)) x CSSFintra\_RedCap |
| DRX cycle≤ 320ms | max(400ms, ceil(1.5 x Mmeas\_period with\_gaps\_RedCap) x max(MGRP, SMTC period, DRX cycle)) Note 1 x CSSFintra\_RedCap |
| DRX cycle>320ms | Mmeas\_period with\_gaps\_RedCap x max(MGRP, DRX cycle) x CSSFintra\_RedCap |

Table 9.2B.6.2-3: Measurement period for intra-frequency measurements with gaps (FR1) for 1Rx RedCap UE

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra\_RedCap |
| No DRX | max([200] ms, [5] x max(MGRP, SMTC period)) x CSSFintra\_RedCap |
| DRX cycle≤ 320ms | max([200] ms, ceil(1.5x [5]) x max(MGRP, SMTC period,DRX cycle))x CSSFintra\_RedCap |
| DRX cycle>320ms | [5] x max(MGRP, DRX cycle) x CSSFintra\_RedCap |

## 9.2C NR intra-frequency measurements for SAN

### 9.2C.1 Introduction

The requirements in clause 9.2C apply for intra-frequency measurements on an SAN carrier frequency.

A measurement is defined as a SSB based intra-frequency measurement provided the centre frequency of the SSB of the serving cell indicated for measurement and the centre frequency of the SSB of the neighbour cell are the same, and the subcarrier spacing of the two SSBs are also the same.

The UE shall be able to identify new intra-frequency cells and perform SS-RSRP, SS-RSRQ, and SS-SINR measurements of identified intra-frequency cells if carrier frequency information is provided by PCell, even if no explicit neighbour list with physical layer cell identities is provided.

The UE can perform intra-frequency SSB based measurements without measurement gaps if

- the UE indicates ‘no-gap’ via *intraFreq-needForGap* for intra-frequency measurement, or

- the SSB is completely contained in the active BWP of the UE, or

- the active downlink BWP is initial BWP[3].

For intra-frequency SSB based measurements without measurement gaps, UE may cause scheduling restriction as specified in clause 9.2C.5.3.

SSB based measurements are configured along with one or more measurement timing configuration(s) (SMTC(s)) which provides periodicity, duration and offset information on a window of up to 5ms where the measurements are to be performed. For intra-frequency connected mode measurements,

- when *SSB-MTC4List-r17* is not configured, up to two measurement window periodicities may be configured with *SSB-MTC* and *SSB-MTC2*

- when *SSB-MTC4List-r17* is configured, multiple measurement window offsets may be configured with *SSB-MTC* and *SSB-MTC4List-r17*, and the requriements in 9.2C apply provided that the total number of measurement window offsets does not exceed the UE capability [TBD]

When measurement gaps are needed, the UE is not expected to detect SSB which start earlier than the gap starting time + switching time, nor detect SSB which end later than the gap end – switching time. Switching time is 0.5ms for frequency range FR1.

### 9.2C.2 Requirements applicability

The requirements in clause 9.2C apply, provided:

- The cell being identified or measured is detectable.

- Valid information for the satellite serving the target cell has been provided- The number of configured SMTCs is no greater than [UE capability]

An intra-frequency cell shall be considered detectable when for each relevant SSB:

- SS-RSRP related side conditions given in clauses 10.1.2C for FR1, for a corresponding Band,

- SS-RSRQ related side conditions given in clauses 10.1.7C for FR1, for a corresponding Band,

- SS-SINR related side conditions given in clauses 10.1.12C for FR1, for a corresponding Band,

- SSB\_RP and SSB Ês/Iot according to Annex B.2.2 for a corresponding Band.

### 9.2C.3 Number of cells and number of SSB

#### 9.2C.3.1 Requirements for FR1

For each intra-frequency layer, during each layer 1 measurement period, the UE shall be capable of performing SS-RSRP, SS-RSRQ, and SS-SINR measurements for at least:

- 8 SSBs with different SSB index and/or PCI on the intra-frequency layer, where the number of SSBs in the serving cell (except for the SCell) is not smaller than the number of configured RLM-RS SSB resources.

- 4 SSBs with different SSB index and/or PCI from neighbour cells in GEO deployment.

- cells from 2 satellites including the satellite serving the PCell if UE does not support capability [TBD], cells from [4] satellites including the satellite serving the PCell, in LEO deployments

### 9.2C.4 Measurement Reporting Requirements

#### 9.2C.4.1 Periodic Reporting

Reported RSRP, RSRQ, and RS-SINR measurements contained in periodic measurement reports shall meet the requirements in clauses TBD (RSRP for FR1), TBD (RSRQ for FR1) and TBD (RS-SINR for FR1).

#### 9.2C.4.2 Event-triggered Periodic Reporting

Reported RSRP, RSRQ, and RS-SINR measurements contained in event-triggered periodic measurement reports shall meet the requirements in clauses TBD (RSRP for FR1), TBD (RSRQ for FR1) and TBD (RS-SINR for FR1)..

The first report in event triggered periodic measurement reporting shall meet the requirements specified in clause 9.2C.4.3.

#### 9.2C.4.3 Event Triggered Reporting

Reported RSRP, RSRQ, and RS-SINR measurements contained in event triggered measurement reports shall meet the requirements in clauses TBD (RSRP for FR1), TBD (RSRQ for FR1) and TBD (RS-SINR for FR1)..

The UE shall not send any event triggered measurement reports as long as no reporting criteria is fulfilled.

The measurement reporting delay is defined as the time between an event that will trigger a measurement report and the point when the UE starts to transmit the measurement report over the air interface. This requirement assumes that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 x TTIDCCH. This measurement reporting delay excludes a delay which caused by no UL resources being available for UE to send the measurement report on.

The event triggered measurement reporting delay, measured without L3 filtering shall be less than Tidentify intra with index or T identify intra without index defined in clause 9.2C.5.1 or clause 9.2C.6.2.When L3 filtering is used an additional delay can be expected.

A cell is detectable only if at least one SSBs measured from the Cell being configured remains detectable during the time period Tidentify\_intra\_without\_index or Tidentify\_intra\_with\_index as defined in clause 9.2C.5.1 or clause 9.2C.6.2. When L3 filtering is used, an additional delay can be expected.

### 9.2C.5 Intra frequency measurements without measurement gaps

#### 9.2C.5.1 Intra frequency cell identification

The UE shall be able to identify a new detectable intra-frequency cell within Tidentify\_intra\_without\_index if the UE is not indicated to report SSB based RRM measurement result with the associated SSB index(*reportQuantityRsIndexes* or *maxNrofRSIndexesToReport* is not configured), or the UE is indicated that the neighbour cell is synchronous with the serving cell (*deriveSSB-IndexFromCell* is enabled). Otherwise UE shall be able to identify a new detectable intra frequency cell within Tidentify\_intra\_with\_index. The UE shall be able to identify a new detectable intra frequency SS block of an already detected cell within Tidentify\_intra\_without\_index.

Tidentify\_intra\_without\_index = (TPSS/SSS\_sync\_intra + T SSB\_measurement\_period\_intra) ms

Tidentify\_intra\_with\_index = (TPSS/SSS\_sync\_intra + T SSB\_measurement\_period\_intra + TSSB\_time\_index\_intra) ms

Where:

TPSS/SSS\_sync\_intra: it is the time period used in PSS/SSS detection given in table 9.2C.5.1-1

TSSB\_time\_index\_intra: it is the time period used to acquire the index of the SSB being measured given in table 9.2C.5.1-2

TSSB\_measurement\_period\_intra: equal to a measurement period of SSB based measurement given in table 9.2C.5.2-1

Kmulti\_SMTC is the scaling factor for measurement of multiple SMTCs or multiple satellites, and

if SMTCs do not overlap with each other,

- , if GEO satellites are measured on the carrier;

- , if LEO satellites are measured on the carrier;

if SMTCs partially overlap with each other,

- , if only GEO satellites are measured on the carrier;

- , if only LEO satellites are measured on the carrier;

where

- is the number of LEO satellites to be measured within i-th SMTC,

- is the number of LEO satellites that UE can measure in parallel within an SMTC,

- is the number of SMTCs that partially overlap with each other.

CSSFintra: it is a carrier specific scaling factor and is determined

according to CSSFoutside\_gap,i in clause 9.1.5.1 for measurement conducted outside measurement gaps, i.e. when intra-frequency SMTC is fully non overlapping or partially overlapping with measurement gaps, or according to CSSFwithin\_gap,i in clause 9.1.5.2 for measurement conducted within measurement gaps, i.e. when intra-frequency SMTC is fully overlapping with measurement gaps.

if the high layer in TS 38.331 [2] signalling of *smtc2* is configured, the assumed periodicity of intra-frequency SMTC occasions corresponds to the value of higher layer parameter *smtc2*; Otherwise the assumed periodicity of intra-frequency SMTC occasions corresponds to the value of higher layer parameter *smtc1*.

Kp is the scaling factor for an SSB frequency layer to be measured without measurement gaps. Kp = Ntotal\_SAN / Navailable\_SAN, where Navailable\_SAN and Ntotal\_SAN are calculated as follows:

- For a window W of duration max(SMTC period, MGRP\_max), where

- If UE supports *parallelMeasurementGap-r17* and is configured with concurrent measurement gaps, MGRP max is the maximum MGRP across all configured per-UE measurement gap. Otherwise, MGRP max is the MGRP of configured measurement gap.

- Starting from the beginning of any SMTC occasion:

- Ntotal\_SAN is the total number of SMTC occasions within the window, including those overlapped and non-overlapped with measurement gap occasions within the window, and

- Navailable\_SAN is the number of SMTC occasions within the window W that don’t collide with any non-dropped MG occasion within or outside the window W, after accounting for measurement gap collisions by applying the measurement gap collision rule in section 9.1C.8.3. The collision rule between SMTC occasion and measurement gap occasion is defined in section 9.1C.9.1

Kp = [1] when Navailable\_SAN = 0 and measurement gap sharing in clause 9.1.2.1a shall apply.

Kp = 1 when intra-frequency SMTC is fully non overlapping with measurement gaps.

For calculation of Kp, if the high layer signalling (TS 38.331 [2]) of *smtc2* is configured, for cells indicated in the *pci-List* parameter in *smtc2*, the SMTC periodicity corresponds to the value of higher layer parameter *smtc2*; for the other cells, the SMTC periodicity corresponds to the value of higher layer parameter *smtc1.*

Klayer1\_measurement: it is scaling factor for sharing between L3 and L1 measurement, and Klayer1\_measurement =1, if GEO satellites are measured on the carrier, or if LEO satellites are measured on the carrier and UE supports *parallelMeasurementWithoutRestriction*, otherwise

Klayer1\_measurement =1,

- if all of the reference signals configured for RLM, BFD, CBD or L1-RSRP for beam reporting outside measurement gap are not fully overlapped by intra-frequency SMTC occasions, or

- if all of the reference signal configured for RLM, BFD, CBD or L1-RSRP for beam reporting outside measurement gap and fully-overlapped by intra-frequency SMTC occasions are not overlapped with any of the SSB symbols and the RSSI symbols, and 1 symbol before each consecutive SSB symbols and the RSSI symbols, and 1 symbol after each consecutive SSB symbols and the RSSI symbols, given that *SSB-ToMeasure* and *SS-RSSI-Measurement* are configured, and RSSI symbols are indicated by *SS-RSSI-Measurement*;

Klayer1\_measurement =1.5, otherwise.

If the above-mentioned reference signal configured for L1-RSRP measurement is aperiodic CSI-RS resource, longer cell identification delay would be expected.

If the higher layer signaling in TS38.331 [2] signalling of *smtc2* is present and smtc1 is fully overlapping with measurement gaps and smtc2 is partially overlapping with measurement gaps, requirements are not specified for Tidentify\_intra\_without\_index or Tidentify\_intra\_with\_index

Table 9.2C.5.1-1: Time period for PSS/SSS detection, (Frequency range FR1)

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra |
| No DRX | max( 600ms, ceil( 5 x Kp x Klayer1\_measurement) x Kmulti\_SMTC x SMTC period )Note 1 x CSSFintra |
| DRX cycle≤ 320ms | max( 600ms, ceil(1.5x 5 x Kp x Klayer1\_measurement) x Kmulti\_SMTC x max(SMTC period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | ceil(5 x Kp x Klayer1\_measurement) x Kmulti\_SMTC x DRX cycle x CSSFintra |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified | |

Table 9.2C.5.1-2: Time period for time index detection (FR1)

|  |  |
| --- | --- |
| DRX cycle | TSSB\_time\_index\_intra |
| No DRX | max(120ms, ceil( 3 x Kp x Klayer1\_measurement)x Kmulti\_SMTC x SMTC period)Note 1 x CSSFintra |
| DRX cycle≤ 320ms | max(120ms, ceil (1.5 x 3 x Kp x Klayer1\_measurement) x Kmulti\_SMTC x max(SMTC period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | Ceil(3 x Kp x Klayer1\_measurement) x Kmulti\_SMTC x DRX cycle x CSSFintra |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified | |

The requirements in clause 9.2C.5.1 and 9.2C.5.2 are not applicable when the overall overhead ratio due to scheduling restriction caused by all configured SMTCs (i.e. scheduling restriction overhead of all SMTCs in one SMTC periodicity), is larger than 75%.

#### 9.2C.5.2 Measurement period

The measurement period for intra-frequency measurements without gaps is as shown in table 9.2C.5.2-1.

If the higher layer signaling in TS38.331 [2] signalling of *smtc2* is present and smtc1 is fully overlapping with measurement gaps and smtc2 is partially overlapping with measurement gaps, requirements are not specified for TSSB\_measurement\_period\_intra

Table 9.2C.5.2-1: Measurement period for intra-frequency measurements without gaps (FR1)

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra |
| No DRX | max(200ms, ceil( 5 x Kp x Klayer1\_measurement) x Kmulti\_SMTC x SMTC period)Note 1 x CSSFintra |
| DRX cycle≤ 320ms | max(200ms, ceil(1.5x 5 x Kp x Klayer1\_measurement) x Kmulti\_SMTC x max(SMTC period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | ceil( 5 x Kp x Klayer1\_measurement) x Kmulti\_SMTC x DRX cycle x CSSFintra |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified | |

#### 9.2C.5.3 Scheduling availability of UE during intra-frequency measurements

When any of the conditions in the following clauses is met, there are restrictions on the scheduling availability; otherwise, there is no scheduling restriction. Note that the SSB symbols indicated by the union set of SSB-ToMeasure from all the configured measurement objects on the same serving carrier which can be merged[2], if it is configured; otherwise, all *L* SSB symbols within the SMTC window duration defined in clause 4.1 of TS 38.213 [3] are included.

##### 9.2C.5.3.1 Scheduling availability of UE performing measurements with a different subcarrier spacing than PDSCH/PDCCH on FR1

For UE which do not support *simultaneousRxDataSSB-DiffNumerology* [14] the following restrictions apply due to SS-RSRP/RSRQ/SINR measurement

- If *deriveSSB\_IndexFromCell* is enabled the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on SSB symbols to be measured, and on 1 data symbol before each consecutive SSB symbols to be measured and 1 data symbol after each consecutive SSB symbols to be measured within SMTC window duration. If the high layer signalling of *smtc2*is configured(in TS 38.331 [2]), the SMTC periodicityfollows *smtc2*; Otherwise the SMTC periodicity follows *smtc1.*

- If *deriveSSB\_IndexFromCell* is not enabled the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on all symbols within SMTC window duration. If the high layer signalling of *smtc2*is configured in TS 38.331 [2], the SMTC periodicityfollows *smtc2*; Otherwise the SMTC periodicity follows *smtc1.*

##### 9.2C.5.3.2 Scheduling availability of UE performing measurements on a neighbor cell served by a different satellite in LEO

For UE which do not support *TBD* the following restrictions apply due to SS-RSRP/RSRQ/SINR measurement on a neighbor cell served by a different satellite in LEO.

- If *deriveSSB\_IndexFromCell* is enabled the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on SSB symbols to be measured, and on 1 data symbol before each consecutive SSB symbols to be measured and 1 data symbol after each consecutive SSB symbols to be measured within SMTC window duration. If the high layer signalling of *smtc2*is configured(in TS 38.331 [2]), the SMTC periodicityfollows *smtc2*; Otherwise the SMTC periodicity follows *smtc1.*

- If *deriveSSB\_IndexFromCell* is not enabled the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on all symbols within SMTC window duration. If the high layer signalling of *smtc2*is configured in TS 38.331 [2], the SMTC periodicityfollows *smtc2*; Otherwise the SMTC periodicity follows *smtc1.*

- If the following conditions are met:

- The UE has been notified about system information update through paging,

- The gap between the UE’s reception of PDCCH that UE monitors in the Type 2-PDCCH CSS set that notifies system information update, and the PDCCH that UE monitors in the Type0-PDCCH CSS set, is greater than 2 slots

- The UE is expected to receive the PDCCH that the UE monitors in the Type0-PDCCH CSS set, and/or the corresponding PDSCH, on SSB symbols to be measured.

### 9.2C.6 Intra-frequency measurements with measurement gaps

#### 9.2C.6.1 Intra-frequency cell identification

The UE shall be able to identify a new detectable intra frequency cell within Tidentify\_intra\_without\_index if UE is not indicated to report SSB based RRM measurement result with the associated SSB index (*reportQuantityRsIndexes* or *maxNrofRSIndexesToReport* is not configured), or the UE has been indicated that the neighbour cell is synchronous with the serving cell (*deriveSSB-IndexFromCell* is enabled). Otherwise UE shall be able to identify a new detectable intra frequency cell within Tidentify\_intra\_with\_index. The UE shall be able to identify a new detectable intra frequency SS block of an already detected cell within Tidentify\_intra\_without\_index.

Tidentify\_intra\_without\_index = TPSS/SSS\_sync\_intra + T SSB\_measurement\_period\_intra ms

Tidentify\_intra\_with\_index = TPSS/SSS\_sync\_ntra + T SSB\_measurement\_period\_intra + TSSB\_time\_index\_intra ms

Where:

TPSS/SSS\_sync\_intra: it is the time period used in PSS/SSS detection given in table 9.2C.6.2-1.

TSSB\_time\_index\_intra: it is the time period used to acquire the index of the SSB being measured given in table 9.2C.6.2-2.

T SSB\_measurement\_period\_intra: equal to a measurement period of SSB based measurement given in table 9.2C.6.3-1.

Kgap is the scaling factor for a SSB frequency layer to be measured within an associated measurement gap pattern, and Kgap = TBD

CSSFintra: it is a carrier specific scaling factor and is determined according to CSSFwithin\_gap,i in clause 9.1.5.2 for measurement conducted within measurement gaps.

Kmulti\_SMTC is the scaling factor for measurement of multiple SMTCs or multiple satellites, and

if SMTCs do not overlap with each other,

- , if GEO satellites are measured on the carrier;

- , if LEO satellites are measured on the carrier;

if SMTCs partially overlap with each other,

- , if only GEO satellites are measured on the carrier;

- , if only LEO satellites are measured on the carrier;

where

- is the number of LEO satellites to be measured within i-th SMTC,

- is the number of LEO satellites that UE can measure in parallel within an SMTC,

- is the number of SMTCs that partially overlap with each other.

If the higher layer signaling in TS 38.331 [2] of *smtc2* is present and smtc1 is fully overlapping with measurement gaps and smtc2 is partially overlapping with measurement gaps, requirements are not specified for Tidentify\_intra\_without\_index or Tidentify\_intra\_with\_index.

Table 9.2C.6.2-1: Time period for PSS/SSS detection (FR1)

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra |
| No DRX | max(600ms, 5 x Kgap x Kmulti\_SMTC x max(MGRP, SMTC period)) x CSSFintra |
| DRX cycle≤ 320ms | max(600ms, ceil(1.5x 5) x Kgap x Kmulti\_SMTC x max(MGRP, SMTC period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | 5 x Kgap x Kmulti\_SMTC x max(MGRP, DRX cycle) x CSSFintra |

Table 9.2C.6.2-2: Time period for time index detection (Frequency range FR1)

|  |  |
| --- | --- |
| DRX cycle | TSSB\_time\_index\_intra |
| No DRX | max(120ms, 3 x Kgap x Kmulti\_SMTC x max(MGRP, SMTC period)) x CSSFintra |
| DRX cycle≤ 320ms | max(120ms, ceil(1.5 x 3) x Kgap x Kmulti\_SMTC x max(MGRP, SMTC period,DRX cycle) x CSSFintra) |
| DRX cycle>320ms | 3 x Kgap x Kmulti\_SMTC x max(MGRP, DRX cycle) x CSSFintra |

#### 9.2C.6.3 Intrafrequency Measurement Period

The measurement period for FR1 intrafrequency measurements with gaps is as shown in table 9.2C.6.3-1.

Table 9.2C.6.3-1: Measurement period for intra-frequency measurements with gaps (FR1)

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra |
| No DRX | max(200ms, 5 x Kgap x Kmulti\_SMTC x max(MGRP, SMTC period)) x CSSFintra |
| DRX cycle≤ 320ms | max(200ms, ceil(1.5x 5) x Kmulti\_SMTC x Kgap x max(MGRP, SMTC period,DRX cycle))x CSSFintra |
| DRX cycle>320ms | 5 x Kgap x Kmulti\_SMTC x max(MGRP, DRX cycle) x CSSFintra |

## 9.3 NR inter-frequency measurements

### 9.3.1 Introduction

A measurement is defined as an SSB based inter-frequency measurement provided it is not defined as an intra-frequency measurement according to clause 9.2.

The UE shall be able to identify new inter-frequency cells and perform SS-RSRP, SS-RSRQ, and SS-SINR measurements of identified inter-frequency cells if carrier frequency information is provided by PCell or PSCell, even if no explicit neighbour list with physical layer cell identities is provided.

A measurement is defined as an inter-frequency SSB based measurements without measurement gaps (either legacy measurement gap or NCSG) for UE capable of *interFrequencyMeas-NoGap* provided

- the UE supports *interFrequencyMeas-Nogap-r16* [15], and

- the SSB is completely contained in the active BWP of the UE.

For UE supporting *nr-NeedForGapNCSG-reporting-r17* and indicating *NeedForGapNCSG-InfoNR* for inter-frequency measurement,

- An inter-frequency SSB measurement is defined as measurement without gap if

- the UE indicates ‘nogap-noncsg’ via *NeedForGapNCSG-InfoNR* for the inter-frequency measurement, and

- the SSB is not completely contained in the active BWP of the UE

The delay requirements are specified in clause 9.3.9.

- An inter-frequency SSB measurement is defined as measurement with NCSG if

- the UE indicates ‘ncsg’ via *NeedForGapNCSG-InfoNR* for the inter-frequency measurement, and

- the SSB is not completely contained in the active BWP of the UE

When network configures NCSG, the delay requirements are specified in clause 9.3.10.

When network configures measurement gap, the delay requirements are specified in clauses 9.3.4 and 9.3.5.

- An inter-frequency SSB measurement is defined as measurement with gap if

- the UE indicates ‘gap’ via *NeedForGapNCSG-InfoNR* for the inter-frequency measurement, and

- the SSB is not completely contained in the active BWP of the UE

When network configures measurement gap, the delay requirements are specified in clauses 9.3.4 and 9.3.5.

- For inter-frequency SSB based measurements with NCSG, UE may cause scheduling restriction as specified in clause 9.3.10.3.

For inter-frequency SSB based measurements without measurement gaps, UE may cause scheduling restriction as specified in clause 9.3.5.3.

Note: Non-CA capable UE is not expected to indicate support of *interFrequencyMeas-Nogap-r16* [15].

SSB based measurements are configured along with a measurement timing configuration (SMTC) per carrier, which provides periodicity, duration and offset information on a window of up to 5ms where the measurements on the configured inter-frequency carrier are to be performed. For inter-frequency connected mode measurements, one measurement window periodicity may be configured per inter-frequency measurement object.

When measurement gaps are needed, the UE is not expected to detect SSB and measure RSSI of RSRQ on an inter-frequency measurement object which start earlier than the gap starting time + switching time, nor detect SSB and measure RSSI of RSRQ which ends later than the gap end – switching time. When the inter-frequency cells are in FR2 and the per-FR gap is configured to the UE in EN-DC, SA NR, NE-DC and NR-DC, or the serving cells are in FR2, the inter-frequency cells are in FR2 and the per-UE gap is configured to the UE in SA NR and NR-DC, the switching time is 0.25ms. Otherwise the switching time is 0.5ms.

The requirements in this clause shall also apply, when the UE is configured to perform SRS carrier based switching and using measurement gaps.

Longer measurement period would be expected during the period Tidentify\_CGI when the UE is requested to decode an NR CGI.

### 9.3.2 Requirements applicability

The requirements in clause 9.3 apply, provided:

- The cell being identified or measured is detectable.

An inter-frequency cell shall be considered detectable when for each relevant SSB:

- SS-RSRP related side conditions given in clauses 10.1.4 and 10.1.5 for FR1 and FR2, respectively, for a corresponding Band,

- SS-RSRQ related side conditions given in clauses 10.1.9 and 10.1.10 for FR1 and FR2, respectively, for a corresponding Band,

- SS-SINR related side conditions given in clauses 10.1.14 and 10.1.15 for FR1 and FR2, respectively, for a corresponding Band,

- SSB\_RP and SSB Ês/Iot according to Annex B.2.3 for a corresponding Band.

#### 9.3.2.1 Void

#### 9.3.2.2 Void

### 9.3.3 Number of cells and number of SSB

#### 9.3.3.1 Requirements for FR1

For each inter-frequency layer, during each layer 1 measurement period, the UE shall be capable of performing SS-RSRP, SS-RSRQ, and SS-SINR measurements for at least:

- 4 identified cells, and

- 7 SSBs with different SSB index and/or PCI on the inter-frequency layer.

#### 9.3.3.2 Requirements for FR2

For each inter-frequency layer, during each layer 1 measurement period, the UE shall be capable of performing SS-RSRP, SS-RSRQ, and SS-SINR measurements for at least:

- 4 identified cells, and

- 10 SSBs with different SSB index and/or PCI on the inter-frequency layer, and

- 1 SSB per identified cell.

### 9.3.4 Inter-frequency measurement with measurement gaps

When measurement gaps are provided, or the UE supports capability of conducting such measurements without gaps, the UE shall be able to identify a new detectable inter frequency cell within Tidentify\_inter\_without\_index if UE is not indicated to report SSB based RRM measurement result with the associated SSB index (*reportQuantityRsIndexes* or *maxNrofRSIndexesToReport* is not configured) or *deriveSSB-IndexFromCellInter-r17* is configured for the FR1 and FR2-1 target frequency layers and and UE supporting [recognition of *deriveSSB-IndexFromCellInter*]. Otherwise UE shall be able to identify a new detectable inter frequency cell within Tidentify\_inter\_with\_index. The UE shall be able to identify a new detectable inter frequency SS block of an already detected cell within Tidentify\_inter\_without\_index.

Tidentify\_inter\_without\_index = (TPSS/SSS\_sync\_inter + T SSB\_measurement\_period\_inter) ms

Tidentify\_inter\_with\_index = (TPSS/SSS\_sync\_inter + T SSB\_measurement\_period\_inter + TSSB\_time\_index\_inter) ms

Where:

TPSS/SSS\_sync\_inter: it is the time period used in PSS/SSS detection given in table 9.3.4-1, table 9.3.4-2, and table 9.3.4-5 when *highSpeedMeasInterFreq-r17* is configured and UE supports measurementEnhancementInterFreq-r17.

TSSB\_time\_index\_inter: it is the time period used to acquire the index of the SSB being measured given in table 9.3.4-3, and table 9.3.4-6 when *highSpeedMeasInterFreq* is configured and UE supports measurementEnhancementInterFreq-r17.

TSSB\_measurement\_period\_inter: equal to a measurement period of SSB based measurement given in table 9.3.5-1, table 9.3.5-2 and table 9.3.5-3 when *highSpeedMeasInterFreq* is configured and UE supports [measurementEnhancementInterFreq-r17.

Mpss/sss\_sync\_inter: For a UE supporting FR2-1 power class 1 or 5, Mpss/sss\_sync\_inter = 64 samples. For a UE supporting FR2-1 power class 2, Mpss/sss\_sync\_inter = 40 samples. For a UE supporting FR2-1 power class 3, Mpss/sss\_sync\_inter = 40 samples. For a UE supporting FR2-1 power class 4, Mpss/sss\_sync\_inter = 40 samples. For a UE supporting FR2-2 power class 1, Mpss/sss\_sync\_inter = 96. For a UE supporting FR2-2 power class 2, Mpss/sss\_sync\_inter = 60. For a UE supporting FR2-2 power class 3, Mpss/sss\_sync\_inter = 60.

MSSB\_index\_inter: For a UE supporting FR2-1 power class 1 or 5, MSSB\_index\_inter = 40 samples. For a UE supporting FR2 power class 2, MSSB\_index\_inter = 24 samples. For a UE supporting FR2-1 power class 3, MSSB\_index\_inter = 24 samples. For a UE supporting FR2-1 power class 4, MSSB\_index\_inter = 24 samples. For a UE supporting FR2-2 power class 2 or 3, MSSB\_index\_inter = 48 samples. For a UE supporting FR2 power class 1, MSSB\_index\_inter = 72 samples.

Mmeas\_period\_inter: For a UE supporting FR2-1 power class 1 or 5, Mmeas\_period\_inter =64. For a UE supporting FR2-1 power class 2, Mmeas\_period\_inter=40. For a UE supporting FR2-1 power class 3, Mmeas\_period\_inter =40. For a UE supporting FR2-1 power class 4, Mmeas\_period\_inter = 40. For a UE supporting FR2-2 power class 1, Mmeas\_period\_inter = 96. For a UE supporting FR2-2 power class 2, Mmeas\_period\_inter = 60. For a UE supporting FR2-2 power class 3, Mmeas\_period\_inter = 60.

CSSFinter: it is a carrier specific scaling factor and is determined according to CSSFwithin\_gap,i in clause 9.1.5.2 for measurement conducted within measurement gaps.

Kgap is a scaling factor for a SSB frequency layer to be measured within an associated measurement gap pattern. Kgap = 1 when the UE is not configured with concurrent measurement gaps. Otherwise, Kgap = Ntotal / Navailable, where Navailable and Ntotal are calculated as follows:

- For a window W of duration max(SMTC period, MGRP\_max), where MGRP\_max is the maximum MGRP across all configured per-UE measurement gap(s) and per-FR measurement gap(s) within the same FR, and starting from the beginning of any SMTC occasion:

- Ntotal is the total number of SMTC occasions that are covered by instances of the associated measurement gap within the window W, including those overlapped with other measurement gap occasions within the window, and

- Navailable is the number of SMTC occasions that are covered by instances of the non-dropped associated measurement gap within the window W, after accounting for collisions between the measurement gaps by applying the measurement gap collision rule in section 9.1.8.3.

Kgap is only applicable for UE supporting *concurrentMeasGap-r17*. When concurrent measurement gaps are configured, requirements in this clause do not apply if Navailable =0.

Table 9.3.4-1: Time period for PSS/SSS detection (Frequency range FR1)

|  |  |
| --- | --- |
| Condition NOTE1,2 | TPSS/SSS\_sync\_inter |
| No DRX | Max(600ms, Ceil(8 \* Kgap) × Max(MGRP, SMTC period)) × CSSFinter |
| DRX cycle ≤ 320ms | Max(600ms, Ceil(8\*1.5 \* Kgap) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter |
| DRX cycle > 320ms | Ceil(8 \* Kgap) × DRX cycle × CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: In EN-DC operation, the parameters, timers and scheduling requests referred to in clause 3.6.1 are for the secondary cell group. The DRX cycle is the DRX cycle of the secondary cell group.  NOTE 3: For a UE supporting concurrent gaps, the MRGP above is the MRGP of the measurement gap associated with the target frequency layer to be measured if concurrent measurement gaps are configured. | |

Table 9.3.4-2: Time period for PSS/SSS detection, (Frequency range FR2)

|  |  |
| --- | --- |
| Condition NOTE1,2 | TPSS/SSS\_sync\_inter |
| No DRX | Max(600ms, Ceil(Kgap × Mpss/sss\_sync\_inter x KFR) × Max(MGRP, SMTC period)) × CSSFinter |
| DRX cycle ≤ 320ms | Max(600ms, Ceil(1.5 \* Kgap × Mpss/sss\_sync\_inter x KFR) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter |
| DRX cycle > 320ms | Ceil(Kgap × Mpss/sss\_sync\_inter x KFR) × DRX cycle × CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: In EN-DC operation, the parameters, timers and scheduling requests referred to in clause 3.6.1 are for the secondary cell group. The DRX cycle is the DRX cycle of the secondary cell group.  NOTE 3: For a UE supporting concurrent gaps, the MRGP above is the MRGP of the measurement gap associated with the target frequency layer to be measured if concurrent measurement gaps are configured.  NOTE 4: KFR is a scaling factor depending on the frequency range and the SSB SCS. For FR2-1, KFR = 1. For FR2-2: KFR = 1 if the SCS of the SSB of the cell being detected is 120 kHz, KFR = 2 if the SCS of the SSB of the cell being detected is 480 kHz, and KFR = 3 if the SCS of the SSB of the cell being detected is 960 kHz. | |

Table 9.3.4-3: Time period for time index detection (Frequency range FR1)

|  |  |
| --- | --- |
| **Condition NOTE1,2** | **TSSB\_time\_index\_inter** |
| No DRX | Max(120ms, Ceil(3 \* Kgap)× Max(MGRP, SMTC period)) × CSSFinter |
| DRX cycle ≤ 320ms | Max(120ms, Ceil(3 × 1.5 \* Kgap) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter |
| DRX cycle > 320ms | Ceil(3 \* Kgap)× DRX cycle × CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: In EN-DC operation, the parameters, timers and scheduling requests referred to in clause 3.6.1 are for the secondary cell group. The DRX cycle is the DRX cycle of the secondary cell group.  NOTE 3: For a UE supporting concurrent gaps, the MRGP above is the MRGP of the measurement gap associated with the target frequency layer to be measured if concurrent measurement gaps are configured. | |

Table 9.3.4-4: Time period for time index detection (Frequency range FR2)

|  |  |
| --- | --- |
| **Condition NOTE1,2** | **TSSB\_time\_index\_inter** |
| No DRX | Max(200ms, Ceil(Kgap × MSSB\_index\_inter)× Max(MGRP, SMTC period)) × CSSFinter |
| DRX cycle ≤ 320ms | Max(200ms, Ceil(1.5 \* Kgap × MSSB\_index\_inter) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter |
| DRX cycle > 320ms | Ceil(Kgap ×MSSB\_index\_inter) × DRX cycle × CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: In EN-DC operation, the parameters, timers and scheduling requests referred to in clause 3.6.1 are for the secondary cell group. The DRX cycle is the DRX cycle of the secondary cell group.  NOTE 3: For a UE supporting concurrent gaps, the MRGP above is the MRGP of the measurement gap associated with the target frequency layer to be measured if concurrent measurement gaps are configured. | |

Table 9.3.4-5: Time period for PSS/SSS detection when highSpeedMeasInterFreq-r17 is configured (Frequency range FR1)

|  |  |
| --- | --- |
| Condition NOTE1,2 | TPSS/SSS\_sync\_inter |
| No DRX | max(600ms, N1 × Max(MGRP, SMTC period)) × CSSFinter  N1 = 7 |
| DRX cycle ≤ 160ms | max(600ms, ceil(N2) x max(MGRP, SMTC period, DRX cycle)) x CSSFinter  N2 = 7 x M2 |
| 160ms < DRX cycle ≤ 320ms | ceil(N3) x DRX cycle x CSSFinter  N3 = 7 x M2 |
| DRX cycle>320ms | N4 x DRX cycle x CSSFinter |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified  NOTE 2: M2 = 1.5 if SMTC periodicity > 40 ms, otherwise M2=1  NOTE 3: N4=6 if SMTC periodicity > 40 ms, otherwise N4=5 | |

Table 9.3.4-6: Time period for time index detection when highSpeedMeasInterFreq-r17 is configured (Frequency range FR1)

|  |  |
| --- | --- |
| Condition NOTE1,2 | TSSB\_time\_index\_inter |
| No DRX | Max(120ms, 3 × Max(MGRP, SMTC period)) × CSSFinter |
| DRX cycle ≤ 320ms | Max(120ms, Ceil(3 × M2 NOTE3) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter |
| DRX cycle > 320ms | 3 × DRX cycle × CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: In EN-DC operation, the parameters, timers and scheduling requests referred to in clause 3.6.1 are for the secondary cell group. The DRX cycle is the DRX cycle of the secondary cell group.  NOTE 3: M2 = 1.5 if SMTC periodicity > 40 ms, otherwise M2=1. | |

#### 9.3.4.1 Void

#### 9.3.4.2 Void

### 9.3.5 Inter-frequency measurements

When measurement gaps are provided for inter frequency measurements, or the UE supports capability of conducting such measurements without gaps, the UE physical layer shall be capable of reporting SS-RSRP, SS-RSRQ and SS-SINR measurements to higher layers with measurement accuracy as specified in clauses 10.1.4, 10.1.5, 10.1.9, 10.1.10, 10.1.14 and 10.1.15, respectively, as shown in table 9.3.5-1 and 9.3.5-2. When *highSpeedMeasInterFreq-r17* is configured, and UE supports *measurementEnhancementInterFreq-r17*, T SSB\_measurement\_period\_inter is specified in Table 9.3.5-3.

Table 9.3.5-1: Measurement period for inter-frequency measurements with gaps (Frequency FR1)

|  |  |
| --- | --- |
| **Condition NOTE1,2** | **T SSB\_measurement\_period\_inter** |
| No DRX | Max(200ms, Ceil(8 \* Kgap) × Max(MGRP, SMTC period)) × CSSFinter |
| DRX cycle ≤ 320ms | Max(200ms, Ceil(8 × 1.5 \* Kgap) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter |
| DRX cycle > 320ms | Ceil(8 \* Kgap) × DRX cycle × CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: In EN-DC operation, the parameters, timers and scheduling requests referred to in clause 3.6.1 are for the secondary cell group. The DRX cycle is the DRX cycle of the secondary cell group.  NOTE 3: For a UE supporting concurrent gaps, the MRGP above is the MRGP of the measurement gap associated with the target frequency layer to be measured if concurrent measurement gaps are configured. | |

Table 9.3.5-2: Measurement period for inter-frequency measurements with gaps (Frequency FR2)

|  |  |
| --- | --- |
| **Condition NOTE1,2** | **T SSB\_measurement\_period\_inter** |
| No DRX | Max(400ms, Ceil(Kgap × Mmeas\_period\_inter)× Max(MGRP, SMTC period)) × CSSFinter |
| DRX cycle ≤ 320ms | Max(400ms, Ceil(1.5 \* Kgap × Mmeas\_period\_inter) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter |
| DRX cycle > 320ms | Ceil(Kgap × Mmeas\_period\_inter) × DRX cycle × CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: In EN-DC operation, the parameters, timers and scheduling requests referred to in clause 3.6.1 are for the secondary cell group. The DRX cycle is the DRX cycle of the secondary cell group.  NOTE 3: For a UE supporting concurrent gaps, the MRGP above is the MRGP of the measurement gap associated with the target frequency layer to be measured if concurrent measurement gaps are configured. | |

Table 9.3.5-3: Measurement period for inter-frequency measurements with gaps when highSpeedMeasInterFreq-r17 is configured (Frequency range FR1)

|  |  |
| --- | --- |
| Condition NOTE1,2 | T SSB\_measurement\_period\_inter |
| No DRX | max(200ms, 7 × Max(MGRP, SMTC period)) × CSSFinter |
| DRX cycle ≤ 160ms | max(200ms, ceil(7 x M2 NOTE3) x max(MGRP, SMTC period, DRX cycle)) x CSSFinter |
| 160ms < DRX cycle ≤ 320ms | ceil(7 x M2 NOTE3) x DRX cycle x CSSFinter |
| DRX cycle>320ms | 4 x M2 NOTE3 x DRX cycle x CSSFinter |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified  NOTE 2: In EN-DC operation, the parameters, timers and scheduling requests referred to in clause 3.6.1 are for the secondary cell group. The DRX cycle is the DRX cycle of the secondary cell group.  NOTE 3: M2 = 1.5 if SMTC periodicity > 40 ms, otherwise M2=1 | |

#### 9.3.5.1 Void

#### 9.3.5.2 Void

#### 9.3.5.3 Void

### 9.3.6 Inter-frequency measurements reporting requirements

#### 9.3.6.1 Periodic Reporting

Reported SS-RSRP, SS-RSRQ, and SS-SINR measurements contained in periodically triggered measurement reports shall meet the requirements in clauses 10.1.4.1, 10.1.5.1, 10.1.9.1, 10.1.10.1, 10.1.14.1 and 10.1.15.1, respectively.

#### 9.3.6.2 Event-triggered Periodic Reporting

Reported SS-RSRP, SS-RSRQ, and SS-SINR measurements contained in event triggered periodic measurement reports shall meet the requirements in clauses 10.1.4.1, 10.1.5.1, 10.1.9.1, 10.1.10.1, 10.1.14.1 and 10.1.15.1, respectively.

The first report in event triggered periodic measurement reporting shall meet the requirements specified in clause 9.3.6.3.

#### 9.3.6.3 Event-triggered Reporting

Reported SS-RSRP, SS-RSRQ, and SS-SINR measurements contained in event triggered measurement reports shall meet the requirements in clauses 10.1.4.1, 10.1.5.1, 10.1.9.1, 10.1.10.1, 10.1.14.1 and 10.1.15.1, respectively.

The UE shall not send any event triggered measurement reports, as long as no reporting criteria are fulfilled.

The measurement reporting delay is defined as the time between an event that will trigger a measurement report and the point when the UE starts to transmit the measurement report over the air interface. This requirement assumes that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 × TTIDCCH. This measurement reporting delay excludes a delay which caused by no UL resources for UE to send the measurement report.

The event triggered measurement reporting delay, measured without L3 filtering shall be within Tidentify\_inter\_without\_index if UE is not indicated to report SSB based RRM measurement result with the associated SSB index. Otherwise UE shall be able to identify a new detectable inter frequency cell within Tidentify\_inter\_with\_index. Both Tidentify\_inter\_without\_index and Tidentify\_inter\_with\_index are defined in clause 9.3.4.When L3 filtering is used an additional delay can be expected. In EN-DC and NE-DC operation, when the UE is configured to perform E-UTRA SRS carrier-based switching an additional delay can be expected in FR1 if the UE is capable of per-FR gap, or in both FR1 and FR2 if the UE is not capable of per-FR gap.

A cell is detectable only if at least one SSBs measured from the Cell being configured remains detectable during the time period Tidentify\_intra\_without\_index or Tidentify\_intra\_with\_index as defined in clause 9.2.5.1 or clause 9.2.6.2. If a cell which has been detectable at least for the time period Tidentify intra without index or Tidentify intra with index defined in clause 9.2.5.1 or clause 9.2.6.2 becomes undetectable for a period ≤ 5 seconds and then the cell becomes detectable again with the same spatial reception parameter and triggers an event, the event triggered measurement reporting delay shall be less than TSSB\_measurement\_period\_intra provided the timing to that cell has not changed more than ± 3200/ Tc while the measurement gap has not been available and L3 filtering has not been used, where *µ* is the SCS configuration as defined in clause 4.2 of TS 38.211 [3]. When L3 filtering is used, an additional delay can be expected. In EN-DC and NE-DC operation, when the UE is configured to perform E-UTRA SRS carrier-based switching an additional delay can be expected in FR1 if the UE is capable of per-FR gap, or an additional delay can be expected in both FR1 and FR2 if the UE is not capable of per-FR gap.

### 9.3.7 Void

### 9.3.8 Inter-frequency SFTD measurement requirements

#### 9.3.8.1 Introduction

This clause contains requirements for a UE supporting NR inter-frequency SFTD measurement and is applicable in RRC\_CONNECTED state. The UE shall, depending on network request, perform inter-frequency SFTD measurement and report SFTD result with or without SS-RSRP. The overall delay includes RRC procedure delay defined in clause 12 in TS 38.331 [2] and SFTD measurement reporting delay in clause 9.3.8.3.

UE which fulfils the requirements in clause 9.3.8 is not supposed to fulfil the requirements defined in clause 9.2.5.4.

#### 9.3.8.2 SFTD Measurement delay

The requirements on SFTD measurement delay defined in this clause are applicable under the side condition SCH Ês/Iot ≥ -3 dB for the inter-frequency neighbour cell. Depending on configuration, the SFTD measurement may be carried out with or without the support of configured measurement gaps. In the current release, indication on whether to carry out the SFTD measurement with or without measurement gaps is implicit and depending on whether measurement gaps are configured.

The UE shall be able to detect, identify and measure SFTD of up to 3 of the strongest applicable inter-frequency neighbour cells on the carrier frequency provided in the SFTD measurement configuration. Further depending on the SFTD measurement configuration, the UE shall additionally report SS-RSRP for the one or more strongest cells. The UE may or may not be configured with *cellsForWhichToReportSFTD*. The UE does not expect *cellsForWhichToReportSFTD* to change during an ongoing SFTD measurement.

When no measurement gaps are provided, the UE shall be capable of finding the inter-frequency neighbour cell regardless of its SSB position in the SMTC period, provided that the carrier frequency where SFTD measurement is configured and the serving carrier(s) form a supported CA or NR-DC band combination of the UE. The SFTD measurement shall be conducted with sustained connection to the PCell and activated SCell(s) in MCG. Depending on capability, the UE may be allowed to cause a certain amount of interruptions for reconfiguration of the radio receiver, as specified in clause 8.2.2.2.6.

When measurement gaps are provided, the UE shall be capable of finding the inter-frequency neighbour cell under the additional condition that the SSB at least occasionally falls within the measurement gap.

When no DRX is used, the UE shall be capable of determining SFTD within a physical layer measurement period of Tmeasure\_SFTD1 as follows:

- For SFTD measurements without measurement gaps, and without additional SS-RSRP reporting:

- For carrier frequency in FR1: Tmeasure\_SFTD1 = 14 SMTC periods

- For carrier frequency in FR2: Tmeasure\_SFTD1 = 112 SMTC periods

- For SFTD measurements in measurement gaps, and without additional SS-RSRP reporting:

- For carrier frequency in FR1: Tmeasure\_SFTD1 = CSSFinter × 8 × Max(MGRP, SMTC period)

- For carrier frequency in FR2: Tmeasure\_SFTD1 = CSSFinter × 64 × Max(MGRP, SMTC period))

- For SFTD measurements without measurement gaps, and with additional SS-RSRP reporting:

- For carrier frequency in FR1: Tmeasure\_SFTD1 = 19 SMTC periods

- For carrier frequency in FR2: Tmeasure\_SFTD1 = 152 SMTC periods

- For SFTD measurements in measurement gaps, and with additional SS-RSRP reporting:

- For carrier frequency in FR1: Tmeasure\_SFTD1 = CSSFinter × 13 × Max(MGRP, SMTC period)

- For carrier frequency in FR2: Tmeasure\_SFTD1 = CSSFinter × 104 × Max(MGRP, SMTC period)

where CSSFinter is a carrier specific scaling factor and is determined according to CSSFwithin\_gap,i in clause 9.1.5.2 for measurement conducted within measurement gaps.

When DRX is used, the same Tmeasure\_SFTD1 as for non-DRX applies, but the reporting delay depends on the DRX cycle length in use.

In case PCell is changed due to handover, the UE shall terminate the inter-frequency SFTD measurement.

The measurement accuracy for the SFTD measurement shall fulfil the requirement in clause 10.1.21.3. The measurement accuracy for additionally reported SS-RSRP shall fulfil the requirement in clauses 10.1.4.1 and 10.1.5.1 for neighbour cell in FR1 and FR2, respectively.

#### 9.3.8.3 SFTD Measurement reporting delay

The SFTD measurement reporting delay is defined as the time between a command that will trigger an SFTD measurement report and the point when the UE starts to transmit the measurement report over the air interface. This requirement assumes that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty of 2 × TTIDCCH resulting when inserting the measurement report to the TTI of the uplink DCCH. This measurement reporting delay excludes any delay caused by lack of UL resources for UE to send the measurement report.

The SFTD measurement reporting delay shall be less than Tmeasure\_SFTD1 defined in clause 9.3.8.2 plus the RRC procedure delay defined in TS 38.331 [2].

### 9.3.9 Inter frequency measurements without measurement gaps

#### 9.3.9.1 Inter frequency Cell identification

If UE supports *interFrequencyMeas-NoGap-r16* and the flag *interFrequencyConfig-NoGap-r16* is configured by the Network, UE shall be able to identify a new detectable inter frequency cell within Tidentify\_inter\_without\_index if UE is not indicated to report SSB based RRM measurement result with the associated SSB index (*reportQuantityRsIndexes* or *maxNrofRSIndexesToReport* is not configured) or *deriveSSB-IndexFromCellInter-r17* is configured for the FR1 and FR2-1 target frequency layers and and UE supporting [recognition of *deriveSSB-IndexFromCellInter*]. Otherwise UE shall be able to identify a new detectable inter frequency cell within Tidentify\_inter\_with\_index. The UE shall be able to identify a new detectable inter frequency SS block of an already detected cell within Tidentify\_inter\_without\_index. It is assumed that when UE performs inter-frequency measurements without measurement gaps in a TDD bands on FR1 and FR2, the following condition is met:

- SFN and frame boundary across serving cell and inter-frequency neighbor cells is aligned

Tidentify\_inter\_without\_index = (TPSS/SSS\_sync\_inter + T SSB\_measurement\_period\_inter) ms

Tidentify\_inter\_without\_index = (TPSS/SSS\_sync\_inter + T SSB\_measurement\_period\_inter) ms

Tidentify\_inter\_with\_index = (TPSS/SSS\_sync\_inter + T SSB\_measurement\_period\_inter + TSSB\_time\_index\_inter) ms

Where:

TPSS/SSS\_sync\_inter: it is the time period used in PSS/SSS detection given in table 9.3.9.1-1 and table 9.3.9.1-2.

TSSB\_time\_index\_inter: it is the time period used to acquire the index of the SSB being measured given in table 9.3.9.1-3.

T SSB\_measurement\_period\_inter: equal to a measurement period of SSB based measurement given in table 9.3.9.2-1, table 9.3.9.2-2 and table 9.3.9.2-3 when *highSpeedMeasInterFreq-r17* is configured and UE supports measurementEnhancementInterFreq-r17.

CSSFinter: it is a carrier specific scaling factor and is determined according to CSSFoutside\_gap,i in clause 9.1.5.1 for measurement conducted outside measurement gaps or NCSG, i.e. when interfrequency SMTC is fully non overlapping or partially overlapping with measurement gaps or according to CSSFwithin\_gap,i in clause 9.1.5.2 for measurement conducted within measurement gaps, i.e. when interfrequency SMTC is fully overlapping with measurement gaps, or according to CSSFwithin\_ncsg,i in clause 9.1.5.x for measurement conducted within NCSG, i.e. when inter-frequency SMTC is fully overlapping with NCSG.

Mpss/sss\_sync\_inter: For a UE supporting FR2-1 power class 1 or 5, Mpss/sss\_sync\_inter = 40. For a UE supporting FR2-1 power class 2, Mpss/sss\_sync\_inter = 24. For a UE supporting FR2-1 power class 3, Mpss/sss\_sync\_inter = 24. For a UE supporting FR2-1 power class 4, Mpss/sss\_sync = 24. For a UE supporting FR2-2 power class 1, Mpss/sss\_sync\_inter = 60. For a UE supporting FR2-2 power class 2, Mpss/sss\_sync\_inter = 36. For a UE supporting FR2-2 power class 3, Mpss/sss\_sync\_inter = 36.

MSSB\_index\_inter: For a UE supporting FR2-2 power class 1, MSSB\_index\_inter = 72. For a UE supporting FR2-2 power class 2, MSSB\_index\_inter = 48. For a UE supporting FR2-2 power class 3, MSSB\_index\_inter = 48.

Mmeas\_period\_inter: For a UE supporting FR2-1 power class 1 or 5, Mmeas\_period\_inter = 40. For a vehicle mounted UE supporting FR2-1 power class 2, Mpss/sss\_sync\_inter=24. For a UE supporting FR2-1 power class 3, Mmeas\_period\_inter = 24. For a UE supporting FR2-1 power class 4, Mmeas\_period\_inter = 24. For a UE supporting FR2-2 power class 1, Mmeas\_period\_inter = 60. For a UE supporting FR2-2 power class 2, Mpss/sss\_sync\_inter = 36. For a UE supporting FR2-2 power class 3, Mmeas\_period\_inter = 36.

When UE supports *concurrentMeasGap-r17* and is configured with concurrent measurement gaps,

Kp is a scaling factor for an SSB frequency layer to be measured without measurement gaps. Kp = Ntotal / Navailable, where Navailable and Ntotal are calculated as follows:

For a window W of duration max(SMTC period, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE MG and per-FR MG within the same FR as the SSB frequency layer, and starting at the beginning of any SMTC occasion:

Ntotal is the total number of SMTC occasions within the window, including those overlapped with MG occasions within the window, and

Navailable is the number of SMTC occasions that are not overlapped with any MG occasion within the window W, after accounting for MG collisions by applying the selected gap collision rule provided that concurrent measurement gaps are configured.

Kp = 1 when Navailable = 0.

Otherwise, when UE is not configured with or UE does not support concurrent measurement gaps:

When interfrequency SMTC is fully non overlapping with measurement gaps or interfrequency SMTC is fully overlapping with MGs, Kp =1.

When interfrequency SMTC is partially overlapping with measurement gaps, Kp = 1/(1- (SMTC period /MGRP)), where SMTC period < MGRP. When inter-frequency SMTC is partially overlapping with the VIL of NCSG, Kp = 1/(1- (SMTC period /VIRP)), where SMTC period < VIRP.

For FR2,

Klayer1\_measurement=1,

if all of the reference signals configured for RLM, BFD, CBD or L1-RSRP for beam reporting on any FR2 serving frequency in the same band outside measurement gap are not fully overlapped by inter-frequency SMTC occasions, or

- if all of the reference signal configured for RLM, BFD, CBD or L1-RSRP for beam reporting on any FR2 serving frequency in the same band outside measurement gap and fully-overlapped by inter-frequency SMTC occasions are not overlapped with any of the SSB symbols and the RSSI symbols, and 1 symbol before each consecutive SSB symbols and the RSSI symbols, and 1 symbol after each consecutive SSB symbols and the RSSI symbols, given that *SSB-ToMeasure* and *SS-RSSI-Measurement* are configured, where SSB symbols are indicated by *SSB-ToMeasure* and RSSI symbols are indicated by *SS-RSSI-Measurement*;

Klayer1\_measurement=1.5, otherwise.

If the above-mentioned reference signal configured for L1-RSRP measurement is aperiodic CSI-RS resource, longer cell identification delay would be expected.

For calculation of Kp, if the high layer signalling (TS 38.331 [2]) of *smtc2* is configured, for cells indicated in the *pci-List* parameter in *smtc2*, the SMTC periodicity corresponds to the value of higher layer parameter *smtc2*; for the other cells, the SMTC periodicity corresponds to the value of higher layer parameter *smtc1.*

Table 9.3.9.1-1: Time period for PSS/SSS detection, (FR1)

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_inter |
| No DRX | max( 600ms, ceil( 5 x Kp) x SMTC period )Note 1 x CSSFinter |
| DRX cycle≤ 320ms | max( 600ms, ceil(M2x 5 x Kp) x max(SMTC period,DRX cycle)) x CSSFinter |
| DRX cycle>320ms | ceil(5 x Kp) x DRX cycle x CSSFinter |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified  NOTE 2: Void  NOTE 3: When *highSpeedMeasInterFreq-r17* is not configured, M2 = 1.5; When *highSpeedMeasInterFreq-r17* is configured, M2 = 1.5 if SMTC periodicity > 40 ms; otherwise M2 = 1 | |

Table 9.3.9.1-2: Time period for PSS/SSS detection, (FR2)

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_inter |
| No DRX | max(600ms, ceil(Mpss/sss\_sync\_inter x Kp x Klayer1\_measurement)x SMTC period)Note 1 x CSSFinter |
| DRX cycle≤ 320ms | max(600ms, ceil(1.5 x Mpss/sss\_sync\_inter x Kp x Klayer1\_measurement)x max(SMTC period,DRX cycle)) x CSSFinter |
| DRX cycle>320ms | ceil(Mpss/sss\_sync\_inter x Kp x Klayer1\_measurement) x DRX cycle x CSSFinter |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified  NOTE 2: Void | |

Table 9.3.9.1-3: Time period for time index detection (FR1)

|  |  |
| --- | --- |
| DRX cycle | TSSB\_time\_index\_inter |
| No DRX | max(120ms, ceil( 3 x Kp )x SMTC period)Note 1 x CSSFinter |
| DRX cycle≤ 320ms | max(120ms, ceil (M2 x 3 x Kp) x max(SMTC period,DRX cycle)) x CSSFinter |
| DRX cycle>320ms | Ceil(3 x Kp) x DRX cycle x CSSFinter |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified  NOTE 2: Void  NOTE 3: When *highSpeedMeasInterFreq-r17* is not configured, M2 = 1.5; When *highSpeedMeasInterFreq-r17* is configured, M2 = 1.5 if SMTC periodicity > 40 ms; otherwise M2 = 1 | |

Table 9.3.9.1-4: Time period for time index detection (FR2-2)

|  |  |
| --- | --- |
| **Condition NOTE1,2** | **TSSB\_time\_index\_inter** |
| No DRX | Max(200ms, Ceil(MSSB\_index\_inter x Kp)× SMTC period) × CSSFinter |
| DRX cycle ≤ 320ms | Max(200ms, Ceil(1.5 × MSSB\_index\_inter x Kp) × Max(SMTC period, DRX cycle)) × CSSFinter |
| DRX cycle > 320ms | Ceil(MSSB\_index\_inter x Kp) × DRX cycle × CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: Kp is applicable for UE supporting [concurrent gaps] | |

#### 9.3.9.2 Measurement period

The UE physical layer shall be capable of reporting SS-RSRP, SS-RSRQ and SS-SINR measurements to higher layers with measurement accuracy as specified in clauses 10.1.4, 10.1.5, 10.1.9, 10.1.10, 10.1.14 and 10.1.15, respectively, as shown in table 9.3.9.2-1 and 9.3.9.2-2, if UE supports inter-frequency measurement without measurement gaps. When highSpeedMeasInterFreq-r17 is configured and UE supports [measurementEnhancementInterFreq-r17], T SSB\_measurement\_period\_inter is specified in table 9.3.9.2-3.

Table 9.3.9.2-1: Measurement period for inter-frequency measurements without gaps ((FR1)

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_inter |
| No DRX | max(200ms, ceil( 5 x Kp) x SMTC period)Note 1 x CSSFinter |
| DRX cycle≤ 320ms | max(200ms, ceil(1.5x 5 x Kp) x max(SMTC period,DRX cycle)) x CSSFinter |
| DRX cycle>320ms | ceil( 5 x Kp ) x DRX cycle x CSSFinter |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified | |

Table 9.3.9.2-2: Measurement period for inter-frequency measurements without gaps (FR2)

|  |  |
| --- | --- |
| **DRX cycle** | **T SSB\_measurement\_period\_inter** |
| No DRX | max(400ms, ceil(Mmeas\_period\_inter x Kp x Klayer1\_measurement) x SMTC period)Note 1 x CSSFinter |
| DRX cycle≤ 320ms | max(400ms, ceil(1.5x Mmeas\_period\_inter x Kp x Klayer1\_measurement) x max(SMTC period,DRX cycle)) x CSSFinter |
| DRX cycle>320ms | ceil(Mmeas\_period\_inter xKp x Klayer1\_measurement) x DRX cycle x CSSFinter |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified | |

Table 9.3.9.2-3: Measurement period for inter-frequency measurements without gaps when highSpeedMeasInterFreq-r17 is configured (FR1)

|  |  |
| --- | --- |
| **DRX cycle** | **T SSB\_measurement\_period\_inter** |
| No DRX | max(200ms, ceil( 5 x Kp) x SMTC period)Note 1 x CSSFinter |
| DRX cycle≤ 160ms | max(200ms, ceil(5 x M2 Note 2 x Kp) x max(SMTC period, DRX cycle)) x CSSFinter |
| 160ms < DRX cycle≤ 320ms | ceil(4 x M2 Note 2 x Kp) x max(SMTC period,DRX cycle) x CSSFinter |
| DRX cycle>320ms | ceil( Y Note 3 x Kp ) x DRX cycle x CSSFinter |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified  NOTE 2: M2 = 1.5 if SMTC period > 40 ms, otherwise M2 = 1  NOTE 3: Y=3 when SMTC period <= 40ms, Y=5 when SMTC period > 40ms | |

#### 9.3.9.3 Scheduling availability of UE during inter-frequency measurements

If UE supports *interFrequencyMeas-NoGap-r16* and the flag *interFrequencyConfig-NoGap-r16* is configured by the Network, UE is required to be capable of measuring without measurement gaps when the SSB is completely contained in the active bandwidth part of the UE. When any of the conditions in the following clauses is met, there are restrictions on the scheduling availability; otherwise, there is no scheduling restriction. Note that the SSB symbols to be measured in the following clauses are the SSB symbols indicated by SSB-ToMeasure [2], if it is configured; otherwise, all L SSB symbols within the SMTC window duration defined in clause 4.1 of TS 38.213 [3] are included.

The scheduling availability requirements when UE performs inter-frequency measurements without measurement gaps in a TDD bands on FR1 and FR2 in clause 9.3.9.3.1~9.3.9.3.3 are valid under the following conditions:

- SFN and frame boundary across serving cell and inter-frequency neighbor cells is aligned

##### 9.3.9.3.1 Scheduling availability of UE performing measurements in TDD bands on FR1

When UE performs inter-frequency measurements without measurement gaps in a TDD band, the following restrictions apply due to SS-RSRP or SS-SINR measurement

- UE is not expected to transmit PUCCH/PUSCH/SRS on SSB symbols to be measured, and on 1 data symbol before each consecutive SSB symbols to be measured and 1 data symbol after each consecutive SSB symbols to be measured within SMTC window duration.

When UE performs inter-frequency measurements without measurement gaps in a TDD band, the following restrictions apply due to SS-RSRQ measurement

- UE is not expected to transmit PUCCH/PUSCH/SRS on SSB symbols to be measured, RSSI measurement symbols, and on 1 data symbol before each consecutive SSB to be measured/RSSI symbols and 1 data symbol after each consecutive SSB to be measured/RSSI symbols within SMTC window duration.

When TDD intra-band carrier aggregation is performed, the scheduling restrictions due to one serving cell should also apply to all other serving cells in the same band on the symbols that fully or partially overlap with aforementioned restricted symbols.

##### 9.3.9.3.2 Scheduling availability of UE performing measurements with a different subcarrier spacing than PDSCH/PDCCH on FR1

For UE which do not support *simultaneousRxDataSSB-DiffNumerology-Inter-r16* [14] the following restrictions apply due to SS-RSRP/RSRQ/SINR measurement

- If UE performs inter-frequency measurements without measurement gaps in a TDD band, UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on SSB symbols to be measured, and on 1 data symbol before each consecutive SSB symbols to be measured and 1 data symbol after each consecutive SSB symbols to be measured within SMTC window duration.

- If UE performs inter-frequency measurements without measurement gaps in a FDD band, UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on all symbols within SMTC window duration.

When intra-band carrier aggregation is performed, the scheduling restrictions due to a given serving cell should also apply to all other serving cells in the same band on the symbols that fully or partially overlap with aforementioned restricted symbols.

##### 9.3.9.3.3 Scheduling availability of UE performing measurements on FR2

The following scheduling restriction applies due to SS-RSRP or SS-SINR measurement on an FR2 inter-frequency cell

The UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on SSB symbols to be measured, and on 1 data symbol before each consecutive SSB symbols to be measured and 1 data symbol after each consecutive SSB symbols to be measured within SMTC window duration.

The following scheduling restriction applies to SS-RSRQ measurement on an FR2 inter-frequency cell

- The UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on SSB symbols to be measured, RSSI measurement symbols, and on 1 data symbol before each consecutive SSB to be measured/RSSI symbols and 1 data symbol after each consecutive SSB to be measured/RSSI symbols within SMTC window duration*.*

When intra-band carrier aggregation is performed, the scheduling restrictions due to a given serving cell should also apply to all other serving cells in the same band on the symbols that fully or partially overlap with aforementioned restricted symbols.

If following conditions are met:

- The UE has been notified about system information update through paging,

- The gap between the UE’s reception of PDCCH that UE monitors in the Type 2-PDCCH CSS set that notifies system information update, and the PDCCH that UE monitors in the Type0-PDCCH CSS set, is greater than 2 slots.

For the SSB and CORESET for RMSI scheduling multiplexing patterns 3, the UE is expected to receive the PDCCH that the UE monitors in the Type0-PDCCH CSS set, and the corresponding PDSCH, on SSB symbols to be measured; and

For the SSB and CORESET for RMSI scheduling multiplexing patterns 2, the UE is expected to receive PDSCH that corresponds to the PDCCH that the UE monitors in the Type0-PDCCH CSS set, on SSB symbols to be measured.

##### 9.3.9.3.4 Scheduling availability of UE performing measurements on FR1 or FR2 in case of FR1-FR2 inter-band CA

There are no scheduling restrictions on FR1 serving cell(s) due to measurements performed on FR2 serving cell frequency layer.

There are no scheduling restrictions on FR2 serving cell(s) due to measurements performed on FR1 serving cell frequency layer.

### 9.3.10 Inter-frequency measurement with NCSG

#### 9.3.10.1 Inter-frequency cell identification

For the UE supporting NCSG, if NCSG is provided, the UE shall be able to identify a new detectable inter frequency cell within Tidentify\_inter\_without\_index if UE is not indicated to report SSB based RRM measurement result with the associated SSB index (*reportQuantityRsIndexes* or *maxNrofRSIndexesToReport* is not configured) or *deriveSSB-IndexFromCellInter-r17* is configured. Otherwise UE shall be able to identify a new detectable inter frequency cell within Tidentify\_inter\_with\_index. The UE shall be able to identify a new detectable inter frequency SS block of an already detected cell within Tidentify\_inter\_without\_index.

Tidentify\_inter\_without\_index = (TPSS/SSS\_sync\_inter + T SSB\_measurement\_period\_inter) ms

Tidentify\_inter\_with\_index = (TPSS/SSS\_sync\_inter + T SSB\_measurement\_period\_inter + TSSB\_time\_index\_inter) ms

Where:

TPSS/SSS\_sync\_inter: it is the time period used in PSS/SSS detection given in table 9.3.10.1-1 and table 9.3.10.1-2.

TSSB\_time\_index\_inter: it is the time period used to acquire the index of the SSB being measured given in table 9.3.10.1-3 and table 9.3.10.1-4.

TSSB\_measurement\_period\_inter: equal to a measurement period of SSB based measurement given in table 9.3.10.2-1 and table 9.3.10.2-2.

Mpss/sss\_sync\_inter: For a UE supporting FR2 power class 1 or 5, Mpss/sss\_sync\_inter = 64 samples. For a UE supporting FR2 power class 2, Mpss/sss\_sync\_inter = 40 samples. For a UE supporting FR2 power class 3, Mpss/sss\_sync\_inter = 40 samples. For a UE supporting FR2 power class 4, Mpss/sss\_sync\_inter = 40 samples.

MSSB\_index\_inter: For a UE supporting FR2 power class 1 or 5, MSSB\_index\_inter = 40 samples. For a UE supporting FR2 power class 2, MSSB\_index\_inter = 24 samples. For a UE supporting FR2 power class 3, MSSB\_index\_inter = 24 samples. For a UE supporting FR2 power class 4, MSSB\_index\_inter = 24 samples.

Mmeas\_period\_inter: For a UE supporting FR2 power class 1 or 5, Mmeas\_period\_inter =64 samples. For a UE supporting FR2 power class 2, Mmeas\_period\_inter=40 samples. For a UE supporting FR2 power class 3, Mmeas\_period\_inter =40 samples. For a UE supporting FR2 power class 4, Mmeas\_period\_inter = 40 samples.

CSSFinter: it is a carrier specific scaling factor and is determined according to CSSFwithin\_ncsg,i in clause 9.1.5.x for measurement conducted within NCSG.

**Table 9.3.10.1-1: Time period for PSS/SSS detection with NCSG (FR1)**

|  |  |
| --- | --- |
| **Condition NOTE1,2** | **TPSS/SSS\_sync\_inter** |
| No DRX | Max(600ms, 8 × Max(VIRP, SMTC period)) × CSSFinter |
| DRX cycle ≤ 320ms | Max(600ms, Ceil(8\*1.5) × Max(VIRP, SMTC period, DRX cycle)) × CSSFinter |
| DRX cycle > 320ms | 8 × DRX cycle × CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: In EN-DC operation, the parameters, timers and scheduling requests referred to in clause 3.6.1 are for the secondary cell group. The DRX cycle is the DRX cycle of the secondary cell group. | |

**Table 9.3.10.1-2: Time period for PSS/SSS detection with NCSG (FR2)**

|  |  |
| --- | --- |
| **Condition NOTE1,2** | **TPSS/SSS\_sync\_inter** |
| No DRX | Max(600ms, Mpss/sss\_sync\_inter × Max(VIRP, SMTC period)) × CSSFinter |
| DRX cycle ≤ 320ms | Max(600ms, (1.5 × Mpss/sss\_sync\_inter) × Max(VIRP, SMTC period, DRX cycle)) × CSSFinter |
| DRX cycle > 320ms | Mpss/sss\_sync\_inter × DRX cycle × CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: In EN-DC operation, the parameters, timers and scheduling requests referred to in clause 3.6.1 are for the secondary cell group. The DRX cycle is the DRX cycle of the secondary cell group. | |

**Table 9.3.10.1-3: Time period for time index detection with NCSG (FR1)**

|  |  |
| --- | --- |
| **Condition NOTE1,2** | **TSSB\_time\_index\_inter** |
| No DRX | Max(120ms, 3 × Max(VIRP, SMTC period)) × CSSFinter |
| DRX cycle ≤ 320ms | Max(120ms, Ceil(3 × 1.5) × Max(VIRP, SMTC period, DRX cycle)) × CSSFinter |
| DRX cycle > 320ms | 3 × DRX cycle × CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: In EN-DC operation, the parameters, timers and scheduling requests referred to in clause 3.6.1 are for the secondary cell group. The DRX cycle is the DRX cycle of the secondary cell group. | |

**Table 9.3.**10**.1-4: Time period for time index detection with NCSG (FR2)**

|  |  |
| --- | --- |
| **Condition NOTE1,2** | **TSSB\_time\_index\_inter** |
| No DRX | Max(200ms, MSSB\_index\_inter × Max(VIRP, SMTC period)) × CSSFinter |
| DRX cycle ≤ 320ms | Max(200ms, (1.5 × MSSB\_index\_inter) × Max(VIRP, SMTC period, DRX cycle)) × CSSFinter |
| DRX cycle > 320ms | MSSB\_index\_inter × DRX cycle × CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: In EN-DC operation, the parameters, timers and scheduling requests referred to in clause 3.6.1 are for the secondary cell group. The DRX cycle is the DRX cycle of the secondary cell group. | |

#### 9.3.10.2 Measurement period

When NCSG are provided for inter frequency measurements, the UE physical layer shall be capable of reporting SS-RSRP, SS-RSRQ and SS-SINR measurements to higher layers with measurement accuracy as specified in clauses 10.1.4, 10.1.5, 10.1.9, 10.1.10, 10.1.14 and 10.1.15, respectively, as shown in table 9.3.10.2-1 and 9.3.10.2-2:

**Table 9.3.10.2-1: Measurement period for inter-frequency measurements with NCSG (FR1)**

|  |  |
| --- | --- |
| **Condition NOTE1,2** | **T SSB\_measurement\_period\_inter** |
| No DRX | Max(200ms, 8 × Max(VIRP, SMTC period)) × CSSFinter |
| DRX cycle ≤ 320ms | Max(200ms, Ceil(8 × 1.5) × Max(VIRP, SMTC period, DRX cycle)) × CSSFinter |
| DRX cycle > 320ms | 8 × DRX cycle × CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: In EN-DC operation, the parameters, timers and scheduling requests referred to in clause 3.6.1 are for the secondary cell group. The DRX cycle is the DRX cycle of the secondary cell group. | |

**Table 9.3.10.2-2: Measurement period for inter-frequency measurements with NCSG (FR2)**

|  |  |
| --- | --- |
| **Condition NOTE1,2** | **T SSB\_measurement\_period\_inter** |
| No DRX | Max(400ms, Mmeas\_period\_inter × Max(VIRP, SMTC period)) × CSSFinter |
| DRX cycle ≤ 320ms | Max(400ms, (1.5 × Mmeas\_period\_inter) × Max(VIRP, SMTC period, DRX cycle)) × CSSFinter |
| DRX cycle > 320ms | Mmeas\_period\_inter × DRX cycle × CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: In EN-DC operation, the parameters, timers and scheduling requests referred to in clause 3.6.1 are for the secondary cell group. The DRX cycle is the DRX cycle of the secondary cell group. | |

#### 9.3.10.3 Scheduling availability during inter-frequency measurement with NCSG

When any of the conditions in the following clauses is met, there are restrictions on the scheduling availability; otherwise, there is no scheduling restriction. Note that the SSB symbols indicated by the union set of *SSB-ToMeasure* from all the configured measurement objects on the same serving carrier which can be merged[2], if it is configured; otherwise, all *L* SSB symbols within the SMTC window duration defined in clause 4.1 of TS 38.213 [3] are included.

The requirements in clause 9.3.10.3.3 based on *deriveSSB-IndexFromCell-inter* apply provided that UE supports [capability for *deriveSSB-IndexFromCellInter-r17*]. If UE does not supports [capability for *deriveSSB-IndexFromCellInter-r17*], the requirements in clause 9.3.10.3.3 apply assuming *deriveSSB-IndexFromCell-inter* is not enabled.

[An MO is considered as without frame boundary alignment when deriving scheduling restriction if any of the following alignment enablement conditions applicable to the MO are not satisfied:

*Editor note: conditions are under discussion*]

##### 9.3.10.3.1 Scheduling availability of UE performing measurements in TDD bands on FR1

When the UE performs inter-frequency measurements with NCSG in a TDD band, the following restrictions apply due to SS-RSRP or SS-SINR measurement when (1) *simultaneousRxTxInterBandCA* is not supported for the target measurement band and the serving cell’s band, or (2) target measurement and the serving cell are on the same band

The UE is not expected to transmit PUCCH/PUSCH/SRS on the union of restricted serving cell symbols due to measurement of all MOs, where the restricted serving cell symbols due to measurement of MO *i* include

- serving cell symbols fully or partially overlap with SSB symbols to be measured on MO *i*, and △t serving cell symbol before each consecutive SSB symbols to be measured and △t serving cell symbol after each consecutive SSB symbols to be measured within SMTC window duration, if *deriveSSB-IndexFromCellInter-r17* is enabled for MO *i*, [and the alignment enabling conditions are satisfied.] △t is defined as the minimum integer number of symbols with total duration no smaller than the tolerance specified in clause 7.9.

- serving cell symbols fully or partially overlap with SMTC window for MO *i* and on 1 serving cell symbol before and after the SMTC window, if *deriveSSB-IndexFromCellInter-r17* is not enabled for MO *i,* [or the alignment enabling conditions are not satisfied],

When the UE performs inter-frequency measurements with NCSG in a TDD band, the following restrictions apply due to SS-RSRQ measurement when *simultaneousRxTxInterBandCA* is not supported for the target measurement band and the serving cell band

The UE is not expected to transmit PUCCH/PUSCH/SRS on the union of restricted serving cell symbols due to measurement of all MOs, where the restricted serving cell symbols due to measurement of MO *i* include

- serving cell symbols fully or partially overlap with SSB symbols to be measured on MO *i*, and △t serving cell symbol before each consecutive SSB symbols to be measured and RSSI measurement symbols, and △t serving cell symbol after each consecutive SSB symbols to be measured and RSSI measurement symbols within SMTC window duration, if *deriveSSB-IndexFromCellInter-r17* is enabled for MO *i*, [and the alignment enabling conditions are satisfied.] △t is defined as the minimum integer number of symbols with total duration no smaller than the tolerance specified in clause 7.9.

- serving cell symbols fully or partially overlap with SMTC window for MO *i* and on 1 serving cell symbol before and after the SMTC window, if *deriveSSB-IndexFromCellInter-r17* is not enabled for MO *i,* [or the alignment enabling conditions are not satisfied].

If the high layer in TS 38.331 [2] signalling of *smtc2*is configured, the SMTC periodicityfollows *smtc2*; Otherwise SMTC periodicity follows *smtc1.*

When TDD intra-band carrier aggregation or TDD inter-band carrier aggregation without *simultaneousRxTxInterBandCA* support is performed, the scheduling restrictions due to a given serving cell should also apply to all other serving cells on the symbols that fully or partially overlap with the aforementioned restricted symbols.

When the UE performs inter-frequency measurements with NCSG in a TDD band and *simultaneousRxTxInterBandCA* is supported for the target measurement band and a serving cell’ band, no scheduling restriction applies to the serving cell.

##### 9.3.10.3.2 Scheduling availability of UE performing measurements with a different subcarrier spacing than PDSCH/PDCCH on FR1

For UE which do not support *simultaneousRxDataSSB-DiffNumerology* [14] the following restrictions apply due to SS-RSRP/RSRQ/SINR measurement when the target inter-frequency layer to be measured is on the same band with UE’s serving cell(s).

Editor’s note: FFS when target frequency layer to be measured is on the different band but with overlapped spectrum with UE’s serving cell(s)

- The UE is not expected to receive PDCCH/PDSCH/TRS/CSI-RS for CQI on the union of restricted serving cell symbols due to measurement of all MOs, where the restricted serving cell symbols due to measurement of MO *i* include

- serving cell symbols fully or partially overlap with SSB symbols to be measured on MO *i*, and △t serving cell symbol before each consecutive SSB symbols to be measured and △t serving cell symbol after each consecutive SSB symbols to be measured within SMTC window duration, if *deriveSSB-IndexFromCellInter-r17* is enabled for MO *i*, [and the alignment enabling conditions are satisfied.] △t is defined as the minimum integer number of symbols with total duration no smaller than the tolerance specified in clause 7.9.

- serving cell symbols fully or partially overlap with SMTC window for MO *i* and on 1 serving cell symbol before and after the SMTC window, if *deriveSSB-IndexFromCellInter-r17* is not enabled for MO *i,* [or the alignment enabling conditions are not satisfied],

If the high layer signalling of *smtc2*is configured in TS 38.331 [2], the SMTC periodicityfollows *smtc2*; Otherwise the SMTC periodicity follows *smtc1.*

When intra-band carrier aggregation is performed, the scheduling restrictions due to a given serving cell should also apply to all other serving cells in the same band on the symbols that fully or partially overlap with the aforementioned restricted symbols.

##### 9.3.10.3.3 Scheduling availability of UE performing measurements on FR2

When (1) UE does not support IBM between target measurement band and serving cell’s band(s) nor *simultaneousRxTxInterBandCA*, or (2) target measurement and a serving cell are on the same band, the following scheduling restriction applies to the serving cell due to SS-RSRP or SS-SINR measurement on an FR2 inter-frequency cell with NCSG:

The UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on the union of restricted serving cell symbols due to measurement of all MOs, where the restricted serving cell symbols due to measurement of MO *i* include

- serving cell symbols fully or partially overlap with SSB symbols to be measured on MO *i*, and △t serving cell symbol before each consecutive SSB symbols to be measured and △t serving cell symbol after each consecutive SSB symbols to be measured within SMTC window duration, if *deriveSSB‑IndexFromCellInter‑r17* is enabled for MO *i*, [and the alignment enabling conditions are satisfied.] △t is defined as the minimum integer number of symbols with total duration no smaller than the tolerance specified in clause 7.8.

- serving cell symbols fully or partially overlap with SMTC window for MO *i* and on 1 serving cell symbol before and after the SMTC window, if *deriveSSB-IndexFromCellInter-r17* is not enabled for MO *i,* [or the alignment enabling conditions are not satisfied],

and due to SS-RSRQ measurement on an FR2 inter-frequency cell with NCSG

The UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on the union of restricted serving cell symbols due to measurement of all MOs, where the restricted serving cell symbols due to measurement of MO *i* include

- serving cell symbols fully or partially overlap with SSB symbols to be measured on MO *i*, and △t serving cell symbol before each consecutive SSB symbols to be measured and RSSI measurement symbols, and △t serving cell symbol after each consecutive SSB symbols to be measured and RSSI measurement symbols within SMTC window duration, if *deriveSSB-IndexFromCellInter-r17* is enabled for MO *i*, [and the alignment enabling conditions are satisfied.] △t is defined as the minimum integer number of symbols with total duration no smaller than the tolerance specified in clause 7.8.

- serving cell symbols fully or partially overlap with SMTC window for MO *i* and on 1 serving cell symbol before and after the SMTC window, if *deriveSSB-IndexFromCellInter-r17* is not enabled for MO *i,* [or the alignment enabling conditions are not satisfied].

When UE does not support IBM between target measurement band and serving cell’s band(s) but supports *simultaneousRxTxInterBandCA*, the following scheduling restriction applies to the serving cell due to SS-RSRP or SS-SINR measurement on an FR2 inter-frequency cell with NCSG

The UE is not expected to receive PDCCH/PDSCH/TRS/CSI-RS for CQI on the union of restricted serving cell symbols due to measurement of all MOs, where the restricted serving cell symbols due to measurement of MO *i* include

- serving cell symbols fully or partially overlap with SSB symbols to be measured on MO *i*, and △t serving cell symbol before each consecutive SSB symbols to be measured and △t serving cell symbol after each consecutive SSB symbols to be measured within SMTC window duration, if *deriveSSB‑IndexFromCellInter‑r17* is enabled for MO *i*, [and the alignment enabling conditions are satisfied.] △t is defined as the minimum integer number of symbols with total duration no smaller than the tolerance specified in clause 7.9.

- serving cell symbols fully or partially overlap with SMTC window for MO *i* and on 1 serving cell symbol before and after the SMTC window, if *deriveSSB-IndexFromCellInter-r17* is not enabled for MO *i,* [or the alignment enabling conditions are not satisfied],

and due to SS-RSRQ measurement on an FR2 inter-frequency cell with NCSG

The UE is not expected to receive PDCCH/PDSCH/TRS/CSI-RS for CQI on the union of restricted serving cell symbols due to measurement of all MOs, where the restricted serving cell symbols due to measurement of MO *i* include

- serving cell symbols fully or partially overlap with SSB symbols to be measured on MO *i*, and △t serving cell symbol before each consecutive SSB symbols to be measured and RSSI measurement symbols, and △t serving cell symbol after each consecutive SSB symbols to be measured and RSSI measurement symbols within SMTC window duration, if *deriveSSB-IndexFromCellInter-r17* is enabled for MO *i*, [and the alignment enabling conditions are satisfied.] △t is defined as the minimum integer number of symbols with total duration no smaller than the tolerance specified in clause 7.8.

- serving cell symbols fully or partially overlap with SMTC window for MO *i* and on 1 serving cell symbol before and after the SMTC window, if *deriveSSB-IndexFromCellInter-r17* is not enabled for MO *i,* [or the alignment enabling conditions are not satisfied].

When UE supports IBM between target measurement band and serving cell’s band(s) but not *simultaneousRxTxInterBandCA*, the following scheduling restriction applies to the serving cell due to SS-RSRP or SS-SINR measurement on an FR2 inter-frequency cell with NCSG

The UE is not expected to transmit PUCCH/PUSCH/SRS on the union of restricted serving cell symbols due to measurement of all MOs, where the restricted serving cell symbols due to measurement of MO *i* include

- serving cell symbols fully or partially overlap with SSB symbols to be measured on MO *i*, and △t serving cell symbol before each consecutive SSB symbols to be measured and △t serving cell symbol after each consecutive SSB symbols to be measured within SMTC window duration, if *deriveSSB‑IndexFromCellInter‑r17* is enabled for MO *i*, [and the alignment enabling conditions are satisfied.] △t is defined as the minimum integer number of symbols with total duration no smaller than the tolerance specified in clause 7.9..

- serving cell symbols fully or partially overlap with SMTC window for MO *i* and on 1 serving cell symbol before and after the SMTC window, if *deriveSSB-IndexFromCellInter-r17* is not enabled for MO *i,* [or the alignment enabling conditions are not satisfied],

and due to SS-RSRQ measurement on an FR2 inter-frequency cell with NCSG

The UE is not expected to transmit PUCCH/PUSCH/SRS on the union of restricted serving cell symbols due to measurement of all MOs, where the restricted serving cell symbols due to measurement of MO *i* include

- serving cell symbols fully or partially overlap with SSB symbols to be measured on MO *i*, and △t serving cell symbol before each consecutive SSB symbols to be measured and RSSI measurement symbols, and △t serving cell symbol after each consecutive SSB symbols to be measured and RSSI measurement symbols within SMTC window duration, if *deriveSSB-IndexFromCellInter-r17* is enabled for MO *i*, [and the alignment enabling conditions are satisfied.] △t is defined as the minimum integer number of symbols with total duration no smaller than the tolerance specified in clause 7.9.

- serving cell symbols fully or partially overlap with SMTC window for MO *i* and on 1 serving cell symbol before and after the SMTC window, if *deriveSSB-IndexFromCellInter-r17* is not enabled for MO *i,* [or the alignment enabling conditions are not satisfied].

If the high layer signalling of *smtc2*is configured in TS 38.331 [2], the SMTC periodicityfollows *smtc2*; Otherwise the SMTC periodicity follows *smtc1.*

When UE supports IBM between target measurement band and serving cell’s band(s) and *simultaneousRxTxInterBandCA*, no scheduling restriction applies to the serving cell.

If following conditions are met:

- The UE has been notified about system information update through paging,

- The gap between the UE’s reception of PDCCH that UE monitors in the Type 2-PDCCH CSS set that notifies system information update, and the PDCCH that UE monitors in the Type0-PDCCH CSS set, is greater than 2

For the SSB and CORESET for RMSI scheduling multiplexing patterns 3, the UE is expected to receive the PDCCH that the UE monitors in the Type0-PDCCH CSS set, and the corresponding PDSCH, on SSB symbols to be measured; and

For the SSB and CORESET for RMSI scheduling multiplexing patterns 2, the UE is expected to receive PDSCH that corresponds to the PDCCH that the UE monitors in the Type0-PDCCH CSS set, on SSB symbols to be measured.

##### 9.3.10.3.4 Scheduling availability of UE performing measurements on FR1 or FR2 in case of FR1-FR2 inter-band CA

There are no scheduling restrictions on FR1 serving cell(s) due to measurements performed on FR2 serving cell frequency layer.

There are no scheduling restrictions on FR2 serving cell(s) due to measurements performed on FR1 serving cell frequency layer.

## 9.3A NR inter-frequency measurements in carrier frequencies with CCA

### 9.3A.1 Introduction

The requirements in clause 9.3A apply for inter-frequency measurements on a carrier frequency with CCA. A measurement is defined as an SSB based inter-frequency measurement provided it is not defined as an intra-frequency measurement according to clause 9.2A.The UE shall be able to identify new inter-frequency cells in carrier frequencies with CCA and perform SS-RSRP, SS-RSRQ, and SS-SINR measurements of identified inter-frequency cells if carrier frequency information is provided by PCell or PSCell, even if no explicit neighbour list with physical layer cell identities is provided.

When the inter-frequency measurement is performed on a neighbour cell in FR2-2 with shared spectrum channel access, UE shall determine the CCA mode of the neighbour cell according to *channelAccessMode2-r17*of the cell configured in *MeasObjectNR*. If *channelAccessMode2-r17* of the cell is enabled, UE shall assume that CCA applies to the cell and perform measurement accordingly, and the requirements in clause 9.3A shall apply; otherwise, UE shall assume that CCA does not apply to the cell and perform measurement accordingly, and requirements in 9.3 shall apply.

SSB based measurements are configured along with a measurement timing configuration (SMTC) per carrier, which provides periodicity, duration and offset information on a window of up to 5ms where the measurements on the configured inter-frequency carrier are to be performed. For inter-frequency connected mode measurements, one measurement window periodicity may be configured per inter-frequency measurement object.

When measurement gaps are needed, the UE is not expected to detect SSB on an inter-frequency measurement object which start earlier than the gap starting time + switching time, nor detect SSB which end later than the gap end – switching time.

In the requirements of clause 9.3A, the term SMTC occasion not available at the UE refers to when the SMTC contains SSBs configured by gNB in a cell on a carrier frequency subject to CCA, but N candidate SSB positions for the same SS/PBCH block index within the discovery burst transmission window are not available at the UE due to DL CCA failures at gNB during the corresponding evaluation or measurement period, where:

- For the cell detection procedure: N is at least one candidate SSB position (NOTE: the one candidate SSB position for the cell detection shall not be impacted by the set of candidate SSB positions which are already being measured by the UE within the current measurement period of the on-going measurements), and

- For other procedures in clause 9.3A: N are the first two successive candidate SSB positions when two or more candidate SSB positions are configured for this SSB index in one discovery burst transmission window, otherwise N is one candidate SSB position;

otherwise the SMTC occasion is considered as available at the UE.

For the FR2-2 requirements of clause 9.3A, an SMTC occasion group consists of N consecutive SMTC occasions. An SMTC occasion group is not available, when at least one SMTC occasion in the group is not transmitted by the gNB.

### 9.3A.2 Requirements applicability

The requirements in clause 9.3A apply, provided:

- The cell being identified or measured is detectable.

An inter-frequency CCA cell shall be considered detectable when for each relevant SSB:

- SS-RSRP related side conditions given in clause 10.1.28,

- SS-RSRQ related side conditions given in clause 10.1.30 and TBD for FR1 and FR2-2, respectively,

- SS-SINR related side conditions given in clause 10.1.32 and TBD for FR1 and FR2-2, respectively,

- SSB\_RP and SSB Ês/Iot according to Annex B.2.9.

### 9.3A.3 Number of cells and number of SSB

#### 9.3A.3.1 Requirements for FR1

For each inter-frequency layer, during each layer 1 measurement period, the UE shall be capable of performing SS-RSRP, SS-RSRQ, and SS-SINR measurements for at least:

- 4 identified cells, and

- 7 SSBs with different SSB indexes and/or PCI on the inter-frequency layer.

#### 9.3A.3.2 Requirements for FR2-2

For each inter-frequency layer, during each layer 1 measurement period, the UE shall be capable of performing SS-RSRP, SS-RSRQ, and SS-SINR measurements for at least:

- 4 identified cells, and

- 10 SSBs with different SSB index and/or PCI on the inter-frequency layer, and

- 1 SSB per identified cell.

### 9.3A.4 Inter-frequency cell identification

When measurement gaps are provided, or the UE supports capability of conducting such measurements without gaps, the UE shall be able to identify a new detectable inter-frequency cell within Tidentify\_inter\_cca\_without\_index if UE is not indicated to report SSB based RRM measurement result with the associated SSB index (*reportQuantityRsIndexes* or *maxNrofRSIndexesToReport* is not configured). Otherwise UE shall be able to identify a new detectable inter-frequency cell, in carrier frequencies with CCA, within Tidentify\_inter\_cca\_with\_index. The UE shall be able to identify a new detectable inter-frequency SS block, in carrier frequencies with CCA, of an already detected cell within Tidentify\_inter\_cca\_without\_index.

Tidentify\_inter\_cca\_without\_index = (TPSS/SSS\_sync\_inter\_cca + T SSB\_measurement\_period\_inter\_cca) ms

Tidentify\_inter\_cca\_with\_index = (TPSS/SSS\_sync\_inter\_cca + T SSB\_measurement\_period\_inter\_cca + TSSB\_time\_index\_inter\_cca) ms

Where:

TPSS/SSS\_sync\_inter\_cca: it is the time period used in PSS/SSS detection given in table 9.3A.4-1 and table 9.3A.4-3.

TSSB\_time\_index\_inter\_cca: it is the time period used to acquire the index of the SSB being measured given in table 9.3A.4-2 and Table 9.3A.4-4.

T SSB\_measurement\_period\_inter\_cca: equal to a measurement period of SSB based measurement given in table 9.3A.5-1.

CSSFinter : it is a carrier specific scaling factor and is determined according to CSSFwithin\_gap,i in clause 9.1.5.2 for measurement conducted within measurement gaps.

Mpss/sss\_sync\_inter\_CCA: For a UE supporting FR2-2 power class 1, Mpss/sss\_sync\_inter CCA = 96. For a UE supporting FR2-2 power class 2, Mpss/sss\_sync\_inter CCA = 60. For a UE supporting FR2-2 power class 3, Mpss/sss\_sync\_inter CCA = 60.

MSSB\_index\_inter\_CCA: For a UE supporting FR2-2 power class 2 or 3, MSSB\_index\_inter CCA = 48 samples. For a UE supporting FR2 power class 1, MSSB\_index\_inter CCA = 72 samples

Mmeas\_period\_inter\_CCA: For a UE supporting FR2-2 power class 1, Mmeas\_period\_inter CCA = 96. For a UE supporting FR2-2 power class 2, Mmeas\_period\_inter CCA = 60. For a UE supporting FR2-2 power class 3, Mmeas\_period\_inter CCA = 60

Table 9.3A.4-1: Time period for PSS/SSS detection (FR1)

|  |  |
| --- | --- |
| Condition NOTE1,2,3,4 | TPSS/SSS\_sync\_inter\_cca |
| No DRX | max(600ms, (8+LPSS/SSS,gaps) x max(MGRP, SMTC period)) x CSSFinter |
| DRX cycle ≤ 320ms | max(600ms, ceil((8+LPSS/SSS,gaps)x1.5) x max(MGRP, SMTC period, DRX cycle)) x CSSFinter |
| DRX cycle > 320ms | (8+LPSS/SSS,gaps) x DRX cycle x CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: In EN-DC operation, the parameters, timers and scheduling requests referred to in clause 3.6.1 are for the secondary cell group. The DRX cycle is the DRX cycle of the secondary cell group.  NOTE 3: When DRX is not configured, LPSS/SSS,gaps is the number of SMTC occasions not available at the UE during TPSS/SSS\_sync\_inter\_cca, for PSS/SSS detection, where LPSS/SSS,gaps ≤ LPSS/SSS,gaps,max. When DRX is configured, LPSS/SSS,gaps is the number of DRX cycles in which at least one SMTC occasion is not available at the UE during TPSS/SSS\_sync\_inter\_cca, for PSS/SSS detection, where LPSS/SSS,gaps ≤ LPSS/SSS,gaps,max. When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle. When configured with measurement gaps, the UE is not required to determine the availability of SMTC occasions more frequent than once during MGRP. FFS: The UE is not required to determine the availability of SMTC occasions more frequent than what is required by CSSFinter.  NOTE 4: LPSS/SSS,gaps,max = 12 for max(DRX cycle, SMTC period, MGRP) ≤ 40 ms LPSS/SSS,gaps,max = 8 for 40 ms < max(DRX cycle, SMTC period, MGRP) ≤ 320 ms, and LPSS/SSS,gaps,max = 5 for DRX cycle > 320 ms. | |

Upon exceeding LPSS/SSS,gaps,max, the UE is not required to meet the corresponding PSS/SSS detection requirement. The requirements apply provided that any two closest SMTC occasions available at the UE for the measurement shall be separated by no more than the maximum time requirement for the cell to remain known.

Table 9.3A.4-2: Time period for time index detection (FR1)

|  |  |
| --- | --- |
| Condition NOTE1,2,3,4 | TSSB\_time\_index\_inter\_cca |
| No DRX | max(120ms, (3+ Lind,gaps) x max(MGRP, SMTC period)) x CSSFinter |
| DRX cycle ≤ 320ms | max(120ms, ceil((3+ Lind,gaps) x 1.5) x max(MGRP, SMTC period, DRX cycle)) x CSSFinter |
| DRX cycle > 320ms | (3 + Lind,gaps) x DRX cycle x CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: In EN-DC operation, the parameters, timers and scheduling requests referred to in clause 3.6.1 are for the secondary cell group. The DRX cycle is the DRX cycle of the secondary cell group.  NOTE 3: When DRX is not configured, Lind,gaps is the number of SMTC occasions not available at the UE during TSSB\_time\_index\_inter\_cca for time index identification, where Lind,gaps ≤ Lind,gaps,max. When DRX is configured, Lind,gaps is the number of DRX cycles in which at least one SMTC occasion is not available at the UE during TSSB\_time\_index\_inter\_cca for time index identification, where Lind,gaps ≤ Lind,gaps,max. When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle. When configured with measurement gaps, the UE is not required to determine the availability of SMTC occasions more frequent than once during MGRP. FFS: The UE is not required to determine the availability of SMTC occasions more frequent than what is required by CSSFinter.  NOTE 4: Lind,gaps,max = 5 for max(DRX cycle, SMTC period, MGRP) ≤ 40 ms, Lind,gaps,max = 3 for 40 ms < max(DRX cycle, SMTC period, MGRP) ≤ 320 ms, and Lind,gaps,max = 2 for DRX cycle > 320 ms. | |

The UE shall restart the time index detection upon exceeding Lind,gaps,max. The requirements apply provided that any two closest SMTC occasions available at the UE for the measurement shall be separated by no more than the maximum time requirement for the cell to remain known.

Table 9.3A.4-3: Time period for PSS/SSS detection, (Frequency range FR2-2)

|  |  |
| --- | --- |
| **Condition NOTE** | **TPSS/SSS\_sync\_inter** |
| No DRX | Max(600ms, ceil(Mpss/sss\_sync\_inter\_CCA+ [NRxBeam] x LPSS/SSS,gaps))× Max(MGRP, SMTC period)) × CSSFinter |
| DRX cycle ≤ 320ms | Max(600ms, ceil(1.5 × Mpss/sss\_sync\_inter\_CCA+ [NRxBeam] x LPSS/SSS,gaps)) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter |
| DRX cycle > 320ms | Ceil(Mpss/sss\_sync\_inter\_CCA+ [NRxBeam] x LPSS/SSS,gaps)× DRX cycle × CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified  NOTE 3: When DRX is not configured, LPSS/SSS,gaps is the number of SMTC occasion groups not available at the UE during TPSS/SSS\_sync\_inter\_CCA for PSS/SSS detection, where LPSS/SSS,gaps < LPSS/SSS,gaps,max. A SMTC occasion group consists of NRxBeam consecutive SMTC occasions. An SMTC occasion group is not available, when at least one SMTC occasion in the group is not transmitted by the gNB. When DRX is configured, LPSS/SSS is the number of [DRX cycle groups] in which at least one SMTC occasion is not available at the UE during TPSS/SSS\_sync\_inter\_CCA for PSS/SSS detection, where LPSS/SSS,gaps < LPSS/SSS,gaps,max . [A DRX occasion group consists of NRxBeam consecutive DRX cycles. A DRX occasion group occasion group is not available, when at least one SMTC occasion in the group is not transmitted by the gNB.] When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle.  NOTE 4: LPSS/SSS,gaps = 12 for max(DRX cycle, SMTC period, MGRP) ≤ 40 ms LPSS/SSS,gaps = 8 for 40 ms < max(DRX cycle, SMTC period, MGRP) ≤ 320 ms, and LPSS/SSS,gaps = 5 for DRX cycle > 320 ms | |

Upon exceeding LPSS/SSS,gaps,max, the UE is not required to meet the corresponding PSS/SSS detection requirement. The requirements apply provided that any two closest SMTC occasions available at the UE for the measurement shall be separated by no more than the maximum time requirement for the cell to remain known.

Table 9.3A.4-4: Time period for time index detection (FR2-2)

|  |  |
| --- | --- |
| Condition NOTE1,2,3,4 | TSSB\_time\_index\_inter\_cca |
| No DRX | max(120ms, ceil(MSSB\_index\_inter\_CCA + [NRxBeam] x Lind,gaps) x max(MGRP, SMTC period)) x CSSFinter |
| DRX cycle ≤ 320ms | max(120ms, ceil(MSSB\_index\_inter\_CCA + [NRxBeam] x Lind,gaps) x 1.5) x max(MGRP, SMTC period, DRX cycle)) x CSSFinter |
| DRX cycle > 320ms | ceil(MSSB\_index\_inter\_CCA + [NRxBeam] x Lind,gaps) x DRX cycle x CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: When DRX is not configured, Lind,gaps is the number of SMTC occasions not available at the UE during **TSSB\_time\_index\_inter\_cca**, for for time index identification, where Lind,gaps ≤ Lind,gaps,max. When DRX is configured, Lind,gaps is the number of DRX cycles in which at least one SMTC occasion is not available at the UE during **TSSB\_time\_index\_inter\_cca**, for for time index identification, where Lind,gaps ≤ Lind,gaps,max. When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle. When configured with measurement gaps, the UE is not required to determine the availability of SMTC occasions more frequent than once during MGRP. FFS: The UE is not required to determine the availability of SMTC occasions more frequent than what is required by CSSFinter.  NOTE 3: Lind,gaps,max = [5] for max(DRX cycle, SMTC period, MGRP) ≤ 40 ms, Lind,gaps,max = [3] for 40 ms < max(DRX cycle, SMTC period, MGRP) ≤ 320 ms, and Lind,gaps,max = [2] for DRX cycle > 320 ms. | |

The UE shall restart the time index detection upon exceeding Lind,gaps,max. The requirements apply provided that any two closest SMTC occasions available at the UE for the measurement shall be separated by no more than the maximum time requirement for the cell to remain known.

### 9.3A.5 Inter-frequency measurements

When measurement gaps are provided for inter-frequency measurements in carrier frequencies with CCA, or the UE supports capability of conducting such measurements without gaps, the UE physical layer shall be capable of reporting SS-RSRP, SS-RSRQ and SS-SINR measurements to higher layers with measurement accuracy as specified in clauses 10.1.28, 10.1.30, 10.1.32, respectively, as shown in table 9.3A.5-1:

Table 9.3A.5-1: Measurement period for inter-frequency measurements with gaps

|  |  |
| --- | --- |
| Condition NOTE1,2,3,4 | T SSB\_measurement\_period\_inter\_cca |
| No DRX | max(200ms, (8+ Lmeas) x max(MGRP, SMTC period)) x CSSFinter |
| DRX cycle ≤ 320ms | max(200ms, ceil((8+ Lmeas) x 1.5) x max(MGRP, SMTC period, DRX cycle)) x CSSFinter |
| DRX cycle > 320ms | (8+ Lmeas) x DRX cycle x CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: In EN-DC operation, the parameters, timers and scheduling requests referred to in clause 3.6.1 are for the secondary cell group. The DRX cycle is the DRX cycle of the secondary cell group.  NOTE 3: When DRX is not configured, Lmeas is the number of SMTC occasions not available at the UE during T SSB\_measurement\_period\_NR\_cca, for inter-frequency measurements with gaps, where Lmeas ≤ Lmeas,max. When DRX is configured, Lmeas is the number of DRX cycles in which at least one SMTC occasion is not available at the UE during T SSB\_measurement\_period\_NR\_cca, for inter-frequency measurements with gaps, where Lmeas ≤ Lmeas,max. When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle. When configured with measurement gaps, the UE is not required to determine the availability of SMTC occasions more frequent than once during MGRP. FFS: The UE is not required to determine the availability of SMTC occasions more frequent than what is required by CSSFinter.  NOTE 4: Lmeas,max = 12 for max(DRX cycle, SMTC period, MGRP) ≤ 40 ms, Lmeas,max = 8 for 40 ms < max(DRX cycle, SMTC period, MGRP) ≤ 320 ms, and Lmeas,max = 5 for DRX cycle > 320 ms. | |

The UE shall restart the measurement upon exceeding Lmeas,max. The requirements apply provided that any two closest SMTC occasions available at the UE for the measurement shall be separated by no more than the maximum time requirement for the cell to remain known.

The UE shall stop the measurement attempts on the SSB of a cell and perform the detection procedure again, like for any other SSB, when the following conditions are met:

- Lmeas > Lmeas,max, and

- The time period of unsuccessful measurement attempts exceeds the maximum time required for the cell to remain known as defined in clause 9.3A.6.3.

Table 9.3A.5-2: Measurement period for inter-frequency measurements with gaps(FR2-2)

|  |  |
| --- | --- |
| Condition NOTE1,2,3,4 | T SSB\_measurement\_period\_inter\_cca |
| No DRX | max(200ms, ceil(Mmeas\_period\_inter\_CCA + [NRxBeam] x Lmeas,gaps) x max(MGRP, SMTC period)) x CSSFinter |
| DRX cycle ≤ 320ms | max(200ms, ceil(Mmeas\_period\_inter\_CCA + [NRxBeam] x Lmeas,gaps) x 1.5) x max(MGRP, SMTC period, DRX cycle)) x CSSFinter |
| DRX cycle > 320ms | ceil(Mmeas\_period\_inter\_CCA + [NRxBeam] x Lmeas,gaps) x DRX cycle x CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: In EN-DC operation, the parameters, timers and scheduling requests referred to in clause 3.6.1 are for the secondary cell group. The DRX cycle is the DRX cycle of the secondary cell group.  NOTE 3: When DRX is not configured, Lmeas,gaps is the number of SMTC occasions not available at the UE during T SSB\_measurement\_period\_inter\_cca, for inter-frequency measurements with gaps, where Lmeas,gaps ≤ Lmeas,gaps,max. When DRX is configured, Lmeas,gaps is the number of DRX cycles in which at least one SMTC occasion is not available at the UE during T SSB\_measurement\_period\_NR\_cca, for inter-frequency measurements with gaps, where Lmeas,gaps ≤ Lmeas,gaps,max. When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle. When configured with measurement gaps, the UE is not required to determine the availability of SMTC occasions more frequent than once during MGRP. FFS: The UE is not required to determine the availability of SMTC occasions more frequent than what is required by CSSFinter.  NOTE 4: Lmeas,gaps,max = [12] for max(DRX cycle, SMTC period, MGRP) ≤ 40 ms, Lmeas,gaps,max = [8] for 40 ms < max(DRX cycle, SMTC period, MGRP) ≤ 320 ms, and Lmeas,gaps,max = [5] for DRX cycle > 320 ms. | |

The UE shall restart the measurement upon exceeding Lmeas,gap,max. The requirements apply provided that any two closest SMTC occasions available at the UE for the measurement shall be separated by no more than the maximum time requirement for the cell to remain known.

### 9.3A.6 NR Inter-frequency measurements reporting requirements

#### 9.3A.6.1 Periodic Reporting

Reported SS-RSRP, SS-RSRQ, and SS-SINR measurements contained in periodically triggered measurement reports shall meet the requirements in clauses 10.1.28, 10.1.30, and 10.1.32, respectively.

#### 9.3A.6.2 Event-triggered Periodic Reporting

Reported SS-RSRP, SS-RSRQ, and SS-SINR measurements contained in event triggered periodic measurement reports shall meet the requirements in clauses 10.1.28, 10.1.30, and 10.1.32, respectively.

The first report in event triggered periodic measurement reporting shall meet the requirements specified in clause 9.3A.6.3.

#### 9.3A.6.3 Event-triggered Reporting

Reported SS-RSRP, SS-RSRQ, and SS-SINR measurements contained in event triggered measurement reports shall meet the requirements in clauses 10.1.28, 10.1.30, and 10.1.32, respectively.

The UE shall not send any event triggered measurement reports, as long as no reporting criteria are fulfilled.

The measurement reporting delay is defined as the time between an event that will trigger a measurement report and the point when the UE starts to transmit the measurement report over the air interface. This requirement assumes that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 x TTIDCCH. This measurement reporting delay excludes a delay which caused by no UL resources for UE to send the measurement report, and all delays due to UL CCA failures until the successful transmission of the report.

The event triggered measurement reporting delay, measured without L3 filtering shall be within Tidentify\_inter\_cca\_without\_index if UE is not indicated to report SSB based RRM measurement result with the associated SSB index. Otherwise UE shall be able to identify a new detectable inter-frequency cell within Tidentify\_inter\_cca \_with\_index. Both Tidentify\_inter\_cca \_without\_index and Tidentify\_inter\_cca \_with\_index are defined in clause 9.3A.4.When L3 filtering is used an additional delay can be expected.

A cell is detectable only if at least one SSB measured from the cell being configured remains detectable during the time period Tidentify\_inter\_cca \_without\_index or Tidentify\_inter\_cca \_with\_index defined in clause 9.3A.4. If a cell which has been detectable at least for the time period Tidentify\_inter\_cca \_without\_index or Tidentify\_inter\_cca \_with\_index defined in clause 9.3A.4 becomes undetectable for a period ≤ 8 seconds and then the cell becomes detectable again with the same spatial reception parameter and then triggers the measurement report as per TS 38.331 [2], the event triggered measurement reporting delay shall be less than TSSB\_measurement\_period\_inter\_cca defined in clause 9.3A.5 provided the timing to that cell has not changed more than ± 3200/ Tc while measurement gap has not been available and the L3 filtering has not been used, where *µ* is the SCS configuration as defined in clause 4.2 of TS 38.211 [3]. When L3 filtering is used an additional delay can be expected.

### 9.3A.8 Inter-frequency RSSI measurements

An RSSI measurement is defined as an inter-frequency measurement provided that the RSSI measurement bandwidth is not contained within the current carrier bandwidth of the UE.

The UE physical layer shall be capable of performing the RSSI measurements, defined in TS 38.215 [4] on one or more inter-frequency carriers operating with CCA, TS 37.213 [33], if the carrier(s) are indicated by higher layers [2], and report the RSSI measurements to higher layers. The UE physical layer shall provide to higher layers a single RSSI sample for each OFDM symbol within each configured RSSI measurement duration [2] occurring with a configured RSSI measurement timing configuration periodicity [2], *rmtc-Periodicity*. The requirements apply if *rmtc-SubframeOffset* [2] is configured.

For performing inter-frequency RSSI measurement in FR2-2,

- If a UE has serving cell in FR2-2,

- If the TCI state is provided in RMTC configuration of FR2-2, the UE shall assume the configured RSSI measurement resources are QCL-ed with TypeD to the DL RS associated with the TCI state provided in the RMTC configuration. If no TCI state is provided in the RMTC configuration, the UE shall assume the configured RSSI measurement resources are QCL-ed with TypeD to one of the latest received PDSCH and the latest monitored CORESET in the active BWP of a serving carrier in FR2-2.

- If a UE has no serving cell in FR2-2,

- The UE is not expected that a TCI state is provided in RMTC configuration. It is up to UE implementation how to determine the spatial domain filter for the inter-frequency RSSI measurement in FR2-2, and no requirements are defined.

For RSSI measurement in FR2-2 with SCS of 480 kHz or 960 kHz, the RSSI measurement results shall be derived based on symbols configured by RMTC except for the first symbol and the last symbol in RMTC, and there is no requirements when *measDurationSymbols* is configured as 1.

Table 9.3A.8-1: Measurement period for inter-frequency RSSI measurements with gaps

|  |  |
| --- | --- |
| Condition NOTE1,2,3,4 | T RSSI\_measurement\_period\_inter\_cca |
| No DRX | max(*reportInterval*, max(*rmtc-Periodicity, MGRP*) x CSSFinter) |
| DRX | max(*reportInterval*, max(*rmtc-Periodicity*, MGRP,DRX cycle) x CSSFinter) |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: CSSFinter is a carrier specific scaling factor and is determined according to CSSFwithin\_gap,i in clause 9.1.5.2 for measurement conducted within measurement gaps. | |

If the UE requires measurement gaps to perform inter-frequency measurements, a single measurement gap pattern is used for all concurrent inter-frequency measurements, including inter-frequency RSSI measurements. The RSSI measurement duration and the measurement gap should be aligned, and the following additional condition should be fulfilled:

- Entire RSSI measurement duration should be contained in the measurement gap.

The RSSI measurement performed and reported according to this clause shall meet the RSSI measurement accuracy requirement in Clause 10.1.34.2. The reported RSSI measurement values contained in measurement reports shall be based on the measurement report mapping requirements specified in Clause 10.1.34.3.

### 9.3A.9 Inter-frequency channel occupancy measurements

The UE shall be capable of estimating the channel occupancy on one or more carrier frequencies indicated by higher layers [2], based on RSSI samples provided by the physical layer. The requirements apply if *rmtc-SubframeOffset* [2] is configured.

Table 9.3A.9-1: Measurement period for inter-frequency Channel Occupancy measurements with gaps

|  |  |
| --- | --- |
| Condition NOTE1,2,3,4 | T CO\_measurement\_period\_inter\_cca |
| No DRX | max(*reportInterval*, max(*rmtc-Periodicity, MGRP*) x CSSFinter) |
| DRX | max(*reportInterval*, max(*rmtc-Periodicity*, MGRP,DRX cycle) x CSSFinter) |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: CSSFinter is a carrier specific scaling factor and is determined according to CSSFwithin\_gap,i in clause 9.1.5.2 for measurement conducted within measurement gaps. | |

If the UE requires measurement gaps to perform inter-frequency measurements, a single measurement gap pattern is used for all concurrent inter-frequency measurements, including inter-frequency channel occupancy measurements. The RSSI measurement duration used for channel occupancy measurement and the measurement gap should be aligned, and the following additional condition should be fulfilled:

- Entire RSSI measurement duration should be contained in the measurement gap.

The channel occupancy measurement performed and reported according to this clause shall meet the channel occupancy measurement accuracy requirements in Clause 10.1.35.2. The reported channel occupancy measurement values contained in measurement reports shall be based on the measurement reporting range specified in TS 38.331 [2].

## 9.3B NR inter-frequency measurements for RedCap

### 9.3B.1 Introduction

A measurement is defined as an SSB based inter-frequency measurement provided it is not defined as an intra-frequency measurement according to clause 9.2B.

The UE shall be able to identify new inter-frequency cells and perform SS-RSRP, SS-RSRQ, and SS-SINR measurements of identified inter-frequency cells if carrier frequency information is provided by PCell, even if no explicit neighbour list with physical layer cell identities is provided.

A measurement is defined as an inter-frequency SSB based measurements without measurement gaps for UE capable of *interFrequencyMeas-NoGap* provided

- the UE supports *interFrequencyMeas-Nogap-r16* [15], and

- the SSB is completely contained in the active BWP of the UE.

For inter-frequency SSB based measurements without measurement gaps, UE may cause scheduling restriction as specified in clause [9.3B.7.3].

SSB based measurements are configured along with a measurement timing configuration (SMTC) per carrier, which provides periodicity, duration and offset information on a window of up to 5ms where the measurements on the configured inter-frequency carrier are to be performed. For inter-frequency connected mode measurements, one measurement window periodicity may be configured per inter-frequency measurement object.

When measurement gaps are needed, the UE is not expected to detect SSB on an inter-frequency measurement object which start earlier than the gap starting time + switching time, nor detect SSB which ends later than the gap end – switching time. When the serving cells are in FR2, the inter-frequency cells are in FR2 and the per-UE gap or per-FR gap is configured to the UE in SA NR, the switching time is 0.25ms. Otherwise the switching time is 0.5ms.

Longer measurement period would be expected during the period Tidentify\_CGI\_RedCap when the UE is requested to decode an NR/E-UTRA CGI.

### 9.3B.2 Requirements applicability

The requirements in clause 9.3B apply, provided:

- The cell being identified or measured is detectable.

An inter-frequency cell shall be considered detectable when for each relevant SSB:

- For 2 Rx RedCap UE:

- SS-RSRP related side conditions given in clauses 10.1.4 and 10.1.5 for FR1 and FR2, respectively, for a corresponding Band,

- SS-RSRQ related side conditions given in clauses 10.1.9 and 10.1.10 for FR1 and FR2, respectively, for a corresponding Band,

- SS-SINR related side conditions given in clauses 10.1.14 and 10.1.15 for FR1 and FR2, respectively, for a corresponding Band,

- SSB\_RP and SSB Ês/Iot according to Annex B.2.3 for a corresponding Band.

- For 1 Rx RedCap UE:

- SS-RSRP related side conditions given in clauses [x.y.z] for FR1, respectively, for a corresponding Band,

- SS-RSRQ related side conditions given in clauses [x.y.z] for FR1, respectively, for a corresponding Band,

- SS-SINR related side conditions given in clauses [x.y.z] for FR1, respectively, for a corresponding Band,

- SSB\_RP and SSB Ês/Iot according to Annex [x.y.z] for a corresponding Band.

### 9.3B.3 Number of cells and number of SSB

#### 9.3B.3.1 Requirements for FR1

For each inter-frequency layer, during each layer 1 measurement period, the UE shall be capable of performing SS-RSRP, SS-RSRQ, and SS-SINR measurements for at least:

- 4 identified cells, and

- 7 SSBs with different SSB index and/or PCI on the inter-frequency layer.

#### 9.3B.3.2 Requirements for FR2

For each inter-frequency layer, during each layer 1 measurement period, the UE shall be capable of performing SS-RSRP, SS-RSRQ, and SS-SINR measurements for at least:

- 4 identified cells, and

- 10 SSBs with different SSB index and/or PCI on the inter-frequency layer, and

- 1 SSB per identified cell.

### 9.3B.4 Inter-frequency measurement with measurement gaps

When measurement gaps are provided, or the UE supports capability of conducting such measurements without gaps, the UE shall be able to identify a new detectable inter frequency cell within Tidentify\_inter\_without\_index\_RedCap if UE is not indicated to report SSB based RRM measurement result with the associated SSB index (*reportQuantityRsIndexes* or *maxNrofRSIndexesToReport* is not configured). Otherwise UE shall be able to identify a new detectable inter frequency cell within Tidentify\_inter\_with\_index\_RedCap. The UE shall be able to identify a new detectable inter frequency SS block of an already detected cell within Tidentify\_inter\_without\_index\_RedCap.

Tidentify\_inter\_without\_index\_RedCap = (TPSS/SSS\_sync\_inter\_RedCap + T SSB\_measurement\_period\_inter\_RedCap) ms

Tidentify\_inter\_with\_index\_RedCap = (TPSS/SSS\_sync\_inter\_RedCap + T SSB\_measurement\_period\_inter\_RedCap + TSSB\_time\_index\_inter\_RedCap) ms

Where:

TPSS/SSS\_sync\_inter\_RedCap: it is the time period used in PSS/SSS detection given in table 9.3B.4-1, table 9.3B.4-2, table 9.3B.4-3.

TSSB\_time\_index\_inter\_RedCap: it is the time period used to acquire the index of the SSB being measured given in table 9.3B.4-4, table 9.3B.4-5, table 9.3B.4-6.

TSSB\_measurement\_period\_inter\_RedCap: equal to a measurement period of SSB based measurement given in table 9.3B.5-1, table 9.3B.5-2, table 9.3B.5-3.

*Editor’s note: which power class to be used for RedCap depends on the RF session outcome.*

For 2 Rx RedCap UE:

Mpss/sss\_sync\_inter\_RedCap: For a UE supporting FR2 power class 1 or 5, Mpss/sss\_sync\_inter\_RedCap = 64 samples. For a UE supporting FR2 power class 2, Mpss/sss\_sync\_inter\_RedCap = 40 samples. For a UE supporting FR2 power class 3, Mpss/sss\_sync\_inter\_RedCap = 40 samples. For a UE supporting FR2 power class 4, Mpss/sss\_sync\_inter\_RedCap = 40 samples, For a UE supporting FR2 power class 7, Mpss/sss\_sync\_inter\_RedCap = 40 samples.

MSSB\_index\_inter\_RedCap: For a UE supporting FR2 power class 1 or 5, MSSB\_index\_inter\_RedCap = 40 samples. For a UE supporting FR2 power class 2, MSSB\_index\_inter\_RedCap = 24 samples. For a UE supporting FR2 power class 3, MSSB\_index\_inter\_RedCap = 24 samples. For a UE supporting FR2 power class 4, MSSB\_index\_inter\_RedCap = 24 samples, For a UE supporting FR2 power class 7 MSSB\_index\_inter\_RedCap =24 samples.

Mmeas\_period\_inter\_RedCap: For a UE supporting FR2 power class 1 or 5, Mmeas\_period\_inter\_RedCap =64 samples. For a UE supporting FR2 power class 2, Mmeas\_period\_inter\_RedCap =40 samples. For a UE supporting FR2 power class 3, Mmeas\_period\_inter\_RedCap =40 samples. For a UE supporting FR2 power class 4, Mmeas\_period\_inter\_RedCap = 40 samples, For a UE supporting FR2 power class 7 Mmeas\_period\_inter\_RedCap =40 samples.

CSSFinter\_RedCap: it is a carrier specific scaling factor and is determined according to CSSFwithin\_gap\_RedCap,i in clause 9.1A.5.2 for measurement conducted within measurement gaps.

Table 9.3B.4-1: Time period for PSS/SSS detection (Frequency range FR1) for 2Rx RedCap UE

|  |  |
| --- | --- |
| **Condition NOTE1** | **TPSS/SSS\_sync\_inter\_RedCap** |
| No DRX | Max(600ms, 8 × Max(MGRP, SMTC period)) × CSSFinter\_RedCap |
| DRX cycle ≤ 320ms | Max(600ms, Ceil(8\*1.5) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter\_RedCap |
| DRX cycle > 320ms | 8 × DRX cycle × CSSFinter\_RedCap |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1 | |

Table 9.3B.4-2: Time period for PSS/SSS detection, (Frequency range FR2) for 2Rx RedCap UE

|  |  |
| --- | --- |
| **Condition NOTE1** | **TPSS/SSS\_sync\_inter\_RedCap** |
| No DRX | Max(600ms, Mpss/sss\_sync\_inter\_RedCap × Max(MGRP, SMTC period)) × CSSFinter\_RedCap |
| DRX cycle ≤ 320ms | Max(600ms, (1.5 × Mpss/sss\_sync\_inter\_RedCap) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter\_RedCap |
| DRX cycle > 320ms | Mpss/sss\_sync\_inter\_RedCap × DRX cycle × CSSFinter\_RedCap |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1 | |

Table 9.3B.4-3: Time period for PSS/SSS detection (Frequency range FR1) for 1Rx RedCap UE

|  |  |
| --- | --- |
| **Condition NOTE1** | **TPSS/SSS\_sync\_inter\_RedCap** |
| No DRX | Max(600ms, 10 × Max(MGRP, SMTC period)) × CSSFinter\_RedCap |
| DRX cycle ≤ 320ms | Max(600ms, Ceil(10 \*1.5) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter\_RedCap |
| DRX cycle > 320ms | 10 × DRX cycle × CSSFinter\_RedCap |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1 | |

Table 9.3B.4-4: Time period for time index detection (Frequency range FR1) for 2Rx RedCap UE

|  |  |
| --- | --- |
| **Condition NOTE1** | **TSSB\_time\_index\_inter\_RedCap** |
| No DRX | Max(120ms, 3 × Max(MGRP, SMTC period)) × CSSFinter\_RedCap |
| DRX cycle ≤ 320ms | Max(120ms, Ceil(3 × 1.5) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter\_RedCap |
| DRX cycle > 320ms | 3 × DRX cycle × CSSFinter\_RedCap |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1 | |

Table 9.3B.4-5: Time period for time index detection (Frequency range FR2) for 2Rx RedCap UE

|  |  |
| --- | --- |
| **Condition NOTE1** | **TSSB\_time\_index\_inter\_RedCap** |
| No DRX | Max(200ms, MSSB\_index\_inter\_RedCap × Max(MGRP, SMTC period)) × CSSFinter\_RedCap |
| DRX cycle ≤ 320ms | Max(200ms, (1.5 × MSSB\_index\_inter\_RedCap) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter\_RedCap |
| DRX cycle > 320ms | MSSB\_index\_inter\_RedCap × DRX cycle × CSSFinter\_RedCap |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1 | |

Table 9.3B.4-6: Time period for time index detection (Frequency range FR1) for 1Rx RedCap UE

|  |  |
| --- | --- |
| **Condition NOTE1** | **TSSB\_time\_index\_inter\_RedCap** |
| No DRX | Max(160ms, [6] × Max(MGRP, SMTC period)) × CSSFinter\_RedCap |
| DRX cycle ≤ 320ms | Max(160ms, Ceil([6] × 1.5) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter\_RedCap |
| DRX cycle > 320ms | [6] × DRX cycle × CSSFinter\_RedCap |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1 | |

### 9.3B.5 Inter-frequency measurements

When measurement gaps are provided for inter frequency measurements, the 2Rx RedCap UE physical layer shall be capable of reporting SS-RSRP, SS-RSRQ and SS-SINR measurements to higher layers with measurement accuracy as specified in clauses 10.1.4, 10.1.5, 10.1.9, 10.1.10, 10.1.14 and 10.1.15, respectively, as shown in table 9.3B.5-1 and 9.3B.5-2.

**Table 9.3B.5-1: Measurement period for inter-frequency measurements with gaps (Frequency FR1) for 2Rx RedCap UE**

|  |  |
| --- | --- |
| **Condition NOTE1** | **T SSB\_measurement\_period\_inter\_RedCap** |
| No DRX | Max(200ms, 8 × Max(MGRP, SMTC period)) × CSSFinter\_RedCap |
| DRX cycle ≤ 320ms | Max(200ms, Ceil(8 × 1.5) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter\_RedCap |
| DRX cycle > 320ms | 8 × DRX cycle × CSSFinter\_RedCap |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1 | |

Table 9.3B.5-2: Measurement period for inter-frequency measurements with gaps (Frequency FR2) for 2Rx RedCap UE

|  |  |
| --- | --- |
| **Condition NOTE1** | **T SSB\_measurement\_period\_inter\_RedCap** |
| No DRX | Max(400ms, Mmeas\_period\_inter\_RedCap × Max(MGRP, SMTC period)) × CSSFinter\_RedCap |
| DRX cycle ≤ 320ms | Max(400ms, (1.5 × Mmeas\_period\_inter\_RedCap) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter\_RedCap |
| DRX cycle > 320ms | Mmeas\_period\_inter\_RedCap × DRX cycle × CSSFinter\_RedCap |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1 | |

When measurement gaps are provided for inter frequency measurements, the 1Rx RedCap UE physical layer shall be capable of reporting SS-RSRP, SS-RSRQ and SS-SINR measurements to higher layers with measurement accuracy as specified in clauses [x.y.z], [x.y.z], [x.y.z], [x.y.z], [x.y.z]and [x.y.z], respectively, as shown in table 9.3B.5-3.

Table 9.3B.5-3: Measurement period for inter-frequency measurements with gaps (Frequency FR1) for 1Rx RedCap UE

|  |  |
| --- | --- |
| **Condition NOTE1** | **T SSB\_measurement\_period\_inter\_RedCap** |
| No DRX | Max(400ms, 8× Max(MGRP, SMTC period)) × CSSFinter\_RedCap |
| DRX cycle ≤ 320ms | Max(400ms, ceil(1.5 × 8) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter\_RedCap |
| DRX cycle > 320ms | 8 × DRX cycle × CSSFinter\_RedCap |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1 | |

### 9.3B.6 Inter-frequency measurements reporting requirements

#### 9.3B.6.1 Periodic Reporting

For 2 Rx RedCap UE: The requirements in clause 9.3.6.1 shall apply.

For 1 Rx RedCap UE: Reported SS-RSRP, SS-RSRQ, and SS-SINR measurements contained in periodically triggered measurement reports shall meet the requirements in clauses [x.y.z], [x.y.z], [x.y.z], [x.y.z], [x.y.z]and [x.y.z], respectively.

#### 9.3B.6.2 Event-triggered Periodic Reporting

For 2 Rx RedCap UE: Reported SS-RSRP, SS-RSRQ, and SS-SINR measurements contained in event triggered periodic measurement reports shall meet the requirements in clauses 10.1.4.1, 10.1.5.1, 10.1.9.1, 10.1.10.1, 10.1.14.1 and 10.1.15.1, respectively.

For 1 Rx RedCap UE: Reported SS-RSRP, SS-RSRQ, and SS-SINR measurements contained in event triggered periodic measurement reports shall meet the requirements in clauses [x.y.z], [x.y.z], [x.y.z], [x.y.z], [x.y.z]and [x.y.z], respectively.

The first report in event triggered periodic measurement reporting shall meet the requirements specified in clause [9.3B.6.3].

#### 9.3B.6.3 Event-triggered Reporting

For 2 Rx RedCap UE: Reported SS-RSRP, SS-RSRQ, and SS-SINR measurements contained in event triggered measurement reports shall meet the requirements in clauses 10.1.4.1, 10.1.5.1, 10.1.9.1, 10.1.10.1, 10.1.14.1 and 10.1.15.1, respectively.

For 1 Rx RedCap UE: Reported SS-RSRP, SS-RSRQ, and SS-SINR measurements contained in event triggered measurement reports shall meet the requirements in clauses [x.y.z], [x.y.z], [x.y.z], [x.y.z], [x.y.z]and [x.y.z], respectively.

The UE shall not send any event triggered measurement reports, as long as no reporting criteria are fulfilled.

The measurement reporting delay is defined as the time between an event that will trigger a measurement report and the point when the UE starts to transmit the measurement report over the air interface. This requirement assumes that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 × TTIDCCH. This measurement reporting delay excludes a delay which caused by no UL resources for UE to send the measurement report.

The event triggered measurement reporting delay, measured without L3 filtering shall be within Tidentify\_inter\_without\_index\_ RedCap if UE is not indicated to report SSB based RRM measurement result with the associated SSB index. Otherwise UE shall be able to identify a new detectable inter frequency cell within Tidentify\_inter\_with\_index\_ RedCap. Both Tidentify\_inter\_without\_index\_ RedCap and Tidentify\_inter\_with\_index\_ RedCap are defined in clause 9.3B.4.When L3 filtering is used an additional delay can be expected.

A cell is detectable only if at least one SSBs measured from the Cell being configured remains detectable during the time period Tidentify\_intra\_without\_index\_ RedCap or Tidentify\_intra\_with\_index\_ RedCap as defined in clause 9.2B.5.1 or clause 9.2B.6.2. If a cell which has been detectable at least for the time period Tidentify intra without index\_ RedCap or Tidentify intra with index\_ RedCap defined in clause 9.2B.5.1 or clause 9.2B.6.2 becomes undetectable for a period ≤ 5 seconds and then the cell becomes detectable again with the same spatial reception parameter and triggers an event, the event triggered measurement reporting delay shall be less than TSSB\_measurement\_period\_intra\_ RedCap provided the timing to that cell has not changed more than ± 3200/ Tc while the measurement gap has not been available and L3 filtering has not been used, where *µ* is the SCS configuration as defined in clause 4.2 of TS 38.211 [3]. When L3 filtering is used, an additional delay can be expected.

### 9.3B.7 Inter frequency measurements without measurement gaps

#### 9.3B.7.1 Inter frequency Cell identification

If UE supports *interFrequencyMeas-NoGap-r16* and the flag *interFrequencyConfig-NoGap-r16* is configured by the Network, UE shall be able to identify a new detectable inter frequency cell within Tidentify\_inter\_without\_index\_RedCap if UE is not indicated to report SSB based RRM measurement result with the associated SSB index (*reportQuantityRsIndexes* or *maxNrofRSIndexesToReport* is not configured). Otherwise UE shall be able to identify a new detectable inter frequency cell within Tidentify\_inter\_with\_index\_RedCap. The UE shall be able to identify a new detectable inter frequency SS block of an already detected cell within Tidentify\_inter\_without\_index\_RedCap. It is assumed that when UE performs inter-frequency measurements without measurement gaps in a TDD bands on FR1 and FR2, the following conditions are met:

- SFN and frame boundary across serving cell and inter-frequency neighbor cells is aligned, and

- the timing of SSBs across serving cell and inter-frequency neighbor cells are aligned

Tidentify\_inter\_without\_index\_RedCap = (TPSS/SSS\_sync\_inter\_RedCap + T SSB\_measurement\_period\_inter\_RedCap) ms

Tidentify\_inter\_with\_index\_RedCap = (TPSS/SSS\_sync\_inter\_RedCap + T SSB\_measurement\_period\_inter\_RedCap + TSSB\_time\_index\_inter\_RedCap) ms

Where:

TPSS/SSS\_sync\_inter\_RedCap: it is the time period used in PSS/SSS detection given in table 9.3B.7.1-1, table 9.3B.7.1-2 and table 9.3B.7.1-3.

TSSB\_time\_index\_inter\_RedCap: it is the time period used to acquire the index of the SSB being measured given in table 9.3B.7.1-4 and table 9.3B.7.1-5.

T SSB\_measurement\_period\_inter\_RedCap: equal to a measurement period of SSB based measurement given in table 9.3B.7.2-1, table 9.3B.7.2-2 and table 9.3B.7.2-3.

CSSFinter\_RedCap: it is a carrier specific scaling factor and is determined according to CSSFoutside\_gap\_RedCap,i in clause 9.1A.5.1 for measurement conducted outside measurement gaps, i.e. when interfrequency SMTC is fully non overlapping or partially overlapping with measurement gaps or according to CSSFwithin\_gap\_RedCap,i in clause 9.1A.5.2 for measurement conducted within measurement gaps, i.e. when interfrequency SMTC is fully overlapping with measurement gaps.

Mpss/sss\_sync\_inter\_RedCap: For a UE supporting FR2 power class 1 or 5, Mpss/sss\_sync\_inter\_RedCap = 40 samples. For a UE supporting FR2 power class 2, Mpss/sss\_sync\_inter\_RedCap = 24 samples. For a UE supporting FR2 power class 3, Mpss/sss\_sync\_inter\_RedCap = 24 samples. For a UE supporting FR2 power class 4, Mpss/sss\_sync\_RedCap = 24 samples. For a UE supporting FR2 power class 7, Mpss/sss\_sync\_inter\_RedCap = 24 samples.

MSSB\_index\_inter\_RedCap: For a UE supporting power class 1 or 5, MSSB\_index\_inter\_RedCap = 40 samples. For a vehicle mounted UE supporting power class 2, Mpss/sss\_sync\_inter\_RedCap = 24 samples. For a UE supporting power class 3, MSSB\_index\_inter\_RedCap = 24 samples. For a UE supporting power class 4, Mmeas\_period\_inter\_RedCap = 24 samples. For a UE supporting power class 7, MSSB\_index\_inter\_RedCap = 24 samples.

Mmeas\_period\_inter\_RedCap: For a UE supporting FR2 power class 1 or 5, Mmeas\_period\_inter\_RedCap =40 samples. For a vehicle mounted UE supporting FR2 power class 2, Mpss/sss\_sync\_inter\_RedCap =24 samples. For a UE supporting FR2 power class 3, Mmeas\_period\_inter\_RedCap =24 samples. For a UE supporting FR2 power class 4, Mmeas\_period\_inter\_RedCap = 24 samples. For a UE supporting FR2 power class 7, Mmeas\_period\_inter\_RedCap =24 samples.

When interfrequency SMTC is fully non overlapping with measurement gaps or interfrequency SMTC is fully overlapping with MGs, Kp=1.

When interfrequency SMTC is partially overlapping with measurement gaps, Kp = 1/(1- (SMTC period /MGRP)), where SMTC period < MGRP.

For FR2,

Klayer1\_measurement =1,

- if all of the reference signals configured for RLM, BFD, CBD or L1-RSRP for beam reporting on any FR2 serving frequency in the same band outside measurement gap are not fully overlapped by inter-frequency SMTC occasions, or

- if all of the reference signal configured for RLM, BFD, CBD or L1-RSRP for beam reporting on any FR2 serving frequency in the same band outside measurement gap and fully-overlapped by inter-frequency SMTC occasions are not overlapped with any of the SSB symbols and the RSSI symbols, and 1 symbol before each consecutive SSB symbols and the RSSI symbols, and 1 symbol after each consecutive SSB symbols and the RSSI symbols, given that *SSB-ToMeasure* and *SS-RSSI-Measurement* are configured, where SSB symbols are indicated by *SSB-ToMeasure* and RSSI symbols are indicated by *SS-RSSI-Measurement*;

Klayer1\_measurement=1.5, otherwise.

If the above-mentioned reference signal configured for L1-RSRP measurement is aperiodic CSI-RS resource, longer cell identification delay would be expected.

Table 9.3B.7.1-1: Time period for PSS/SSS detection (FR1) for 2Rx RedCap UE

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_inter\_RedCap |
| No DRX | max( 600ms, ceil( 5 x Kp) x SMTC period )Note 1 x CSSFinter\_RedCap |
| DRX cycle≤ 320ms | max( 600ms, ceil(1.5x 5 x Kp) x max(SMTC period,DRX cycle)) x CSSFinter\_RedCap |
| DRX cycle>320ms | ceil(5 x Kp) x DRX cycle x CSSFinter\_RedCap |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified | |

Table 9.3B.7.1-2: Time period for PSS/SSS detection (FR2) for 2Rx RedCap UE

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_inter\_RedCap |
| No DRX | max(600ms, ceil(Mpss/sss\_sync\_inter\_RedCap x Kp x Klayer1\_measurement)x SMTC period)Note 1 x CSSFinter\_RedCap |
| DRX cycle≤ 320ms | max(600ms, ceil(1.5 x Mpss/sss\_sync\_inter\_RedCap x Kp x Klayer1\_measurement)x max(SMTC period,DRX cycle)) x CSSFinter\_RedCap |
| DRX cycle>320ms | ceil(Mpss/sss\_sync\_inter\_RedCap x Kp x Klayer1\_measurement) x DRX cycle x CSSFinter\_RedCap |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified | |

Table 9.3B.7.1-3: Time period for PSS/SSS detection (FR1) for 1Rx RedCap UE

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_inter\_RedCap |
| No DRX | max( 600ms, ceil( 7 x Kp) x SMTC period )Note 1 x CSSFinter\_RedCap |
| DRX cycle≤ 320ms | max( 600ms, ceil(1.5x 7 x Kp) x max(SMTC period,DRX cycle)) x CSSFinter\_RedCap |
| DRX cycle>320ms | ceil(7 x Kp) x DRX cycle x CSSFinter\_RedCap |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified | |

Table 9.3B.7.1-4: Time period for time index detection (FR1) for 2Rx RedCap UE

|  |  |
| --- | --- |
| DRX cycle | TSSB\_time\_index\_inter\_RedCap |
| No DRX | max(120ms, ceil( 3 x Kp )x SMTC period)Note 1 x CSSFinter\_RedCap |
| DRX cycle≤ 320ms | max(120ms, ceil (1.5 x 3 x Kp) x max(SMTC period,DRX cycle)) x CSSFinter\_RedCap |
| DRX cycle>320ms | Ceil(3 x Kp) x DRX cycle x CSSFinter\_RedCap |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified | |

Table 9.3B.7.1-5: Time period for time index detection (FR1) for 1Rx RedCap UE

|  |  |
| --- | --- |
| DRX cycle | TSSB\_time\_index\_inter\_RedCap |
| No DRX | max(160ms, ceil( [6] x Kp )x SMTC period)Note 1 x CSSFinter\_RedCap |
| DRX cycle≤ 320ms | max(160ms, ceil (1.5 x [6] x Kp) x max(SMTC period,DRX cycle)) x CSSFinter\_RedCap |
| DRX cycle>320ms | Ceil([6] x Kp) x DRX cycle x CSSFinter\_RedCap |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified | |

#### 9.3B.7.2 Measurement period

The 2Rx RedCap UE physical layer shall be capable of reporting SS-RSRP, SS-RSRQ and SS-SINR measurements to higher layers with measurement accuracy as specified in clauses 10.1.4, 10.1.5, 10.1.9, 10.1.10, 10.1.14 and 10.1.15, respectively, as shown in table 9.3B.7.2-1 and 9.3B.7.2-2, if UE supports inter-frequency measurement without measurement gaps:

Table 9.3B.7.2-1: Measurement period for inter-frequency measurements without gaps ((FR1) for 2Rx RedCap UE

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_inter |
| No DRX | max(200ms, ceil( 5 x Kp) x SMTC period)Note 1 x CSSFinter\_RedCap |
| DRX cycle≤ 320ms | max(200ms, ceil(1.5x 5 x Kp) x max(SMTC period,DRX cycle)) x CSSFinter\_RedCap |
| DRX cycle>320ms | ceil( 5 x Kp ) x DRX cycle x CSSFinter\_RedCap |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified | |

Table 9.3B.7.2-2: Measurement period for inter-frequency measurements without gaps (FR2) for 2Rx RedCap UE

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_inter\_RedCap |
| No DRX | max(400ms, ceil(Mmeas\_period\_inter\_RedCap x Kp x Klayer1\_measurement) x SMTC period)Note 1 x CSSFinter\_RedCap |
| DRX cycle≤ 320ms | max(400ms, ceil(1.5x Mmeas\_period\_inter\_RedCap x Kp x Klayer1\_measurement) x max(SMTC period,DRX cycle)) x CSSFinter\_RedCap |
| DRX cycle>320ms | ceil(Mmeas\_period\_inter\_RedCap xKp x Klayer1\_measurement) x DRX cycle x CSSFinter\_RedCap |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified | |

The 1Rx RedCap UE physical layer shall be capable of reporting SS-RSRP, SS-RSRQ and SS-SINR measurements to higher layers with measurement accuracy as specified in clauses [x.y.z], [x.y.z], [x.y.z], [x.y.z], [x.y.z] and [x.y.z], respectively, as shown in table 9.3B.7.2-3, if UE supports inter-frequency measurement without measurement gaps:

Table 9.3B.7.2-3: Measurement period for inter-frequency measurements without gaps ((FR1) for 1Rx RedCap UE

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_inter |
| No DRX | max([200]ms, ceil( [5] x Kp) x SMTC period)Note 1 x CSSFinter\_RedCap |
| DRX cycle≤ 320ms | max([200]ms, ceil(1.5x [5] x Kp) x max(SMTC period,DRX cycle)) x CSSFinter\_RedCap |
| DRX cycle>320ms | ceil( [5] x Kp ) x DRX cycle x CSSFinter\_RedCap |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified | |

#### 9.3B.7.3 Scheduling availability of UE during inter-frequency measurements

If UE supports *interFrequencyMeas-NoGap-r16* and the flag *interFrequencyConfig-NoGap-r16* is configured by the Network, UE is required to be capable of measuring without measurement gaps when the SSB is completely contained in the active bandwidth part of the UE. When any of the conditions in the following clauses is met, there are restrictions on the scheduling availability; otherwise, there is no scheduling restriction. Note that the SSB symbols to be measured in the following clauses are the SSB symbols indicated by SSB-ToMeasure [2], if it is configured; otherwise, all L SSB symbols within the SMTC window duration defined in clause 4.1 of TS 38.213 [3] are included.

The scheduling availability requirements when UE performs inter-frequency measurements without measurement gaps in a TDD bands on FR1 and FR2 and HD-FDD bands on FR1 in clause 9.3B.7.3.1~9.3B.7.3.4 are valid under the following conditions:

- SFN and frame boundary across serving cell and inter-frequency neighbor cells is aligned, and

- the timing of SSBs across serving cell and inter-frequency neighbor cells are aligned

##### 9.3B.7.3.1 Scheduling availability of UE performing measurements in TDD bands on FR1

When UE performs inter-frequency measurements without measurement gaps in a TDD band, the following restrictions apply due to SS-RSRP or SS-SINR measurement

- UE is not expected to transmit PUCCH/PUSCH/SRS on SSB symbols to be measured, and on 1 data symbol before each consecutive SSB symbols to be measured and 1 data symbol after each consecutive SSB symbols to be measured within SMTC window duration.

When UE performs inter-frequency measurements without measurement gaps in a TDD band, the following restrictions apply due to SS-RSRQ measurement

- UE is not expected to transmit PUCCH/PUSCH/SRS on SSB symbols to be measured, RSSI measurement symbols, and on 1 data symbol before each consecutive SSB to be measured/RSSI symbols and 1 data symbol after each consecutive SSB to be measured/RSSI symbols within SMTC window duration.

##### 9.3B.7.3.2 Scheduling availability of UE performing measurements with a different subcarrier spacing than PDSCH/PDCCH on FR1

For UE which do not support *simultaneousRxDataSSB-DiffNumerology-Inter-r16* [14] the following restrictions apply due to SS-RSRP/RSRQ/SINR measurement

- If UE performs inter-frequency measurements without measurement gaps in a TDD band, UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on SSB symbols to be measured, and on 1 data symbol before each consecutive SSB symbols to be measured and 1 data symbol after each consecutive SSB symbols to be measured within SMTC window duration.

- If UE performs inter-frequency measurements without measurement gaps in a FDD band, UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on all symbols within SMTC window duration.

##### 9.3B.7.3.3 Scheduling availability of UE performing measurements on FR2

The following scheduling restriction applies due to SS-RSRP or SS-SINR measurement on an FR2 inter-frequency cell

The UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on SSB symbols to be measured, and on 1 data symbol before each consecutive SSB symbols to be measured and 1 data symbol after each consecutive SSB symbols to be measured within SMTC window duration.

The following scheduling restriction applies to SS-RSRQ measurement on an FR2 inter-frequency cell

- The UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on SSB symbols to be measured, RSSI measurement symbols, and on 1 data symbol before each consecutive SSB to be measured/RSSI symbols and 1 data symbol after each consecutive SSB to be measured/RSSI symbols within SMTC window duration*.*

If following conditions are met:

- The UE has been notified about system information update through paging,

- The gap between the UE’s reception of PDCCH that UE monitors in the Type 2-PDCCH CSS set that notifies system information update, and the PDCCH that UE monitors in the Type0-PDCCH CSS set, is greater than 2

For the SSB and CORESET for RMSI scheduling multiplexing patterns 3, the UE is expected to receive the PDCCH that the UE monitors in the Type0-PDCCH CSS set, and the corresponding PDSCH, on SSB symbols to be measured; and

For the SSB and CORESET for RMSI scheduling multiplexing patterns 2, the UE is expected to receive PDSCH that corresponds to the PDCCH that the UE monitors in the Type0-PDCCH CSS set, on SSB symbols to be measured.

##### 9.3B.7.3.4 Scheduling availability of UE performing measurements in HD-FDD bands on FR1

When UE performs inter-frequency measurements without measurement gaps in a HD-FDD band, the following restrictions apply due to SS-RSRP or SS-SINR measurement

- UE is not expected to transmit PUCCH/PUSCH/SRS on SSB symbols to be measured, and on 1 data symbol before each consecutive SSB symbols to be measured and 1 data symbol after each consecutive SSB symbols to be measured within SMTC window duration.

When UE performs inter-frequency measurements without measurement gaps in a HD-FDD band, the following restrictions apply due to SS-RSRQ measurement

- UE is not expected to transmit PUCCH/PUSCH/SRS on SSB symbols to be measured, RSSI measurement symbols, and on 1 data symbol before each consecutive SSB to be measured/RSSI symbols and 1 data symbol after each consecutive SSB to be measured/RSSI symbols within SMTC window duration.

## 9.3C NR inter-frequency measurements for SAN

### 9.3C.1 Introduction

A measurement is defined as an SSB based inter-frequency measurement provided it is not defined as an intra-frequency measurement according to clause 9.2.

The UE shall be able to identify new inter-frequency cells and perform SS-RSRP, SS-RSRQ, and SS-SINR measurements of identified inter-frequency cells if carrier frequency information is provided by PCell, even if no explicit neighbour list with physical layer cell identities is provided.

A measurement is defined as an inter-frequency SSB based measurements without measurement gaps for UE capable of *interFrequencyMeas-NoGap* provided

- the UE supports *interFrequencyMeas-Nogap-r16* [15], and

- the SSB is completely contained in the active BWP of the UE.

For inter-frequency SSB based measurements without measurement gaps, UE may cause scheduling restriction as specified in clause 9.3C.5.3.

SSB based measurements are configured along with up to 2 measurement timing configurations (SMTC) in parallel per carrier, which provides periodicity, duration and offset information on a window of up to 5ms where the measurements on the configured inter-frequency carrier are to be performed. For inter-frequency connected mode measurements, the measurement window periodicity may be configured per inter-frequency measurement object.

When measurement gaps are needed, the UE is not expected to detect SSB on an inter-frequency measurement object which start earlier than the gap starting time + switching time, nor detect SSB which ends later than the gap end – switching time, and the switching time is 0.5ms.

The requirements in this clause shall also apply, when the UE is configured to perform SRS carrier based switching and using measurement gaps.

### 9.3C.2 Requirements applicability

The requirements in clause 9.3C apply, provided:

- The cell being identified or measured is detectable.

An inter-frequency cell shall be considered detectable when for each relevant SSB:

- SS-RSRP related side conditions given in clauses 10.1C.4 and 10.1C.5 for FR1, for a corresponding Band,

- SS-RSRQ related side conditions given in clauses 10.1C.9 and 10.1C.10 for FR1, for a corresponding Band,

- SS-SINR related side conditions given in clauses 10.1C.14 and 10.1C.15 for FR1, for a corresponding Band,

- SSB\_RP and SSB Ês/Iot according to Annex B.2.3 for a corresponding Band.

### 9.3C.3 Number of cells and number of SSB

#### 9.3C.3.1 Requirements for FR1

For each inter-frequency layer, during each layer 1 measurement period, the UE shall be capable of performing SS-RSRP, SS-RSRQ, and SS-SINR measurements for at least:

- [4] identified cells, and

- [7] SSBs with different SSB index and/or PCI on the inter-frequency layer.

- 4 SSBs with different SSB index and/or PCI from neighbour cells in GEO deployment.

### 9.3C.4 Inter-frequency measurement with measurement gaps

When measurement gaps are provided, or the UE supports capability of conducting such measurements without gaps, the UE shall be able to identify a new detectable inter frequency cell within Tidentify\_inter\_without\_index if UE is not indicated to report SSB based RRM measurement result with the associated SSB index (*reportQuantityRsIndexes* or *maxNrofRSIndexesToReport* is not configured). Otherwise UE shall be able to identify a new detectable inter frequency cell within Tidentify\_inter\_with\_index. The UE shall be able to identify a new detectable inter frequency SS block of an already detected cell within Tidentify\_inter\_without\_index.

Tidentify\_inter\_without\_index = (TPSS/SSS\_sync\_inter + T SSB\_measurement\_period\_inter) ms

Tidentify\_inter\_with\_index = (TPSS/SSS\_sync\_inter + T SSB\_measurement\_period\_inter + TSSB\_time\_index\_inter) ms

Where:

TPSS/SSS\_sync\_inter: it is the time period used in PSS/SSS detection given in table 9.3C.4-1.

TSSB\_time\_index\_inter: it is the time period used to acquire the index of the SSB being measured given in table 9.3C.4-2.

TSSB\_measurement\_period\_inter: equal to a measurement period of SSB based measurement given in table 9.3C.5-1.

CSSFinter: it is a carrier specific scaling factor and is determined according to CSSFwithin\_gap,i in clause 9.1C.5.2 for measurement conducted within measurement gaps.

K\_satellite: it is a statellite specific scaling factor.

* If SMTCs do not overlap with each other, and if LEO satellite(s) is/are required to be measured within SMTC
  + K\_satellite = 1, if GSO satellites are measured on the carrier
  + , if LEO satellites are measured on the carrier.
* If SMTCs partially overlap with each other, and if LEO and/or GEO satellite(s) is/are required to be measured within overlapped SMTCs
  + , if only GEO satellites are measured on the carrier
  + , if only LEO satellites are measured on the carrier.

Table 9.3C.4-1: Time period for PSS/SSS detection (Frequency range FR1)

|  |  |
| --- | --- |
| **Condition NOTE1** | **TPSS/SSS\_sync\_inter** |
| No DRX | Max(600ms, 8 × Max(MGRP, SMTC period **NOTE2**)) × CSSFinter × K\_satellite |
| DRX cycle ≤ 320ms | Max(600ms, Ceil(8\*1.5) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter × K\_satellite |
| DRX cycle > 320ms | 8 × DRX cycle × CSSFinter × K\_satellite |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: SMTC period is the SMTC period in SMTC configuration which is associated with the target cell to be measured configured in *SSB-MTC4List-r17*. | |

Table 9.3C.4-2: Time period for time index detection (Frequency range FR1)

|  |  |
| --- | --- |
| **Condition NOTE1** | **TSSB\_time\_index\_inter** |
| No DRX | Max(120ms, 3 × Max(MGRP, SMTC period **NOTE2**)) × CSSFinter × K\_satellite |
| DRX cycle ≤ 320ms | Max(120ms, Ceil(3 × 1.5) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter × K\_satellite |
| DRX cycle > 320ms | 3 × DRX cycle × CSSFinter × K\_satellite |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: SMTC period is the SMTC period in SMTC configuration which is associated with the target cell to be measured configured in *SSB-MTC4List-r17*. | |

### 9.3C.5 Inter-frequency measurements

When measurement gaps are provided for inter frequency measurements, or the UE supports capability of conducting such measurements without gaps, the UE physical layer shall be capable of reporting SS-RSRP, SS-RSRQ and SS-SINR measurements to higher layers with measurement accuracy as specified in clauses 10.1C.4, 10.1C.5, 10.1C.9, 10.1C.10, 10.1C.14 and 10.1C.15, respectively, as shown in table 9.3C.5-1.

Table 9.3C.5-1: Measurement period for inter-frequency measurements with gaps (Frequency FR1)

|  |  |
| --- | --- |
| **Condition NOTE1** | **T SSB\_measurement\_period\_inter** |
| No DRX | Max(200ms, 8 × Max(MGRP, SMTC period **NOTE2**)) × CSSFinter × K\_satellite |
| DRX cycle ≤ 320ms | Max(200ms, Ceil(8 × 1.5) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter × K\_satellite |
| DRX cycle > 320ms | 8 × DRX cycle × CSSFinter × K\_satellite |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: SMTC period is the SMTC period in SMTC configuration which is associated with the target cell to be measured configured in *SSB-MTC4List-r17*. | |

### 9.3C.6 Inter-frequency measurements reporting requirements

#### 9.3C.6.1 Periodic Reporting

Reported SS-RSRP, SS-RSRQ, and SS-SINR measurements contained in periodically triggered measurement reports shall meet the requirements in clauses 10.1C.4.1, 10.1C.5.1, 10.1C.9.1, 10.1C.10.1, 10.1C.14.1 and 10.1C.15.1, respectively.

#### 9.3C.6.2 Event-triggered Periodic Reporting

Reported SS-RSRP, SS-RSRQ, and SS-SINR measurements contained in event triggered periodic measurement reports shall meet the requirements in clauses 10.1C.4.1, 10.1C.5.1, 10.1C.9.1, 10.1C.10.1, 10.1C.14.1 and 10.1C.15.1, respectively.

The first report in event triggered periodic measurement reporting shall meet the requirements specified in clause 9.3C.6.3.

#### 9.3C.6.3 Event-triggered Reporting

Reported SS-RSRP, SS-RSRQ, and SS-SINR measurements contained in event triggered measurement reports shall meet the requirements in clauses 10.1C.4.1, 10.1C.5.1, 10.1C.9.1, 10.1C.10.1, 10.1C.14.1 and 10.1C.15.1, respectively.

The UE shall not send any event triggered measurement reports, as long as no reporting criteria are fulfilled.

The measurement reporting delay is defined as the time between an event that will trigger a measurement report and the point when the UE starts to transmit the measurement report over the air interface. This requirement assumes that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 × TTIDCCH. This measurement reporting delay excludes a delay which caused by no UL resources for UE to send the measurement report.

The event triggered measurement reporting delay, measured without L3 filtering shall be within Tidentify\_inter\_without\_index if UE is not indicated to report SSB based RRM measurement result with the associated SSB index. Otherwise UE shall be able to identify a new detectable inter frequency cell within Tidentify\_inter\_with\_index. Both Tidentify\_inter\_without\_index and Tidentify\_inter\_with\_index are defined in clause 9.3C.4.When L3 filtering is used an additional delay can be expected. I

A cell is detectable only if at least one SSBs measured from the Cell being configured remains detectable during the time period Tidentify\_intra\_without\_index or Tidentify\_intra\_with\_index as defined in clause 9.2C.5.1 or clause 9.2C.6.2. If a cell which has been detectable at least for the time period Tidentify intra without index or Tidentify intra with index defined in clause 9.2C.5.1 or clause 9.2C.6.2 becomes undetectable for a period ≤ 5 seconds and then the cell becomes detectable again with the same spatial reception parameter and triggers an event, the event triggered measurement reporting delay shall be less than TSSB\_measurement\_period\_intra provided the timing to that cell has not changed more than ± 3200/ Tc while the measurement gap has not been available and L3 filtering has not been used, where *µ* is the SCS configuration as defined in clause 4.2 of TS 38.211 [3]. When L3 filtering is used, an additional delay can be expected.

### 9.3C.7 Inter frequency measurements without measurement gaps

#### 9.3C.7.1 Inter frequency Cell identification

If UE supports *interFrequencyMeas-NoGap-r16* and the flag *interFrequencyConfig-NoGap-r16* is configured by the Network, UE shall be able to identify a new detectable inter frequency cell within Tidentify\_inter\_without\_index if UE is not indicated to report SSB based RRM measurement result with the associated SSB index (*reportQuantityRsIndexes* or *maxNrofRSIndexesToReport* is not configured). Otherwise UE shall be able to identify a new detectable inter frequency cell within Tidentify\_inter\_with\_index. The UE shall be able to identify a new detectable inter frequency SS block of an already detected cell within Tidentify\_inter\_without\_index. It is assumed that when UE performs inter-frequency measurements without measurement gaps in a TDD bands on FR1, the following conditions are met:

- SFN and frame boundary across serving cell and inter-frequency neighbor cells is aligned, and

- the timing of SSBs across serving cell and inter-frequency neighbor cells are aligned

Tidentify\_inter\_without\_index = (TPSS/SSS\_sync\_inter + T SSB\_measurement\_period\_inter) ms

Tidentify\_inter\_with\_index = (TPSS/SSS\_sync\_inter + T SSB\_measurement\_period\_inter + TSSB\_time\_index\_inter) ms

Where:

TPSS/SSS\_sync\_inter: it is the time period used in PSS/SSS detection given in table 9.3C.7.1-1.

TSSB\_time\_index\_inter: it is the time period used to acquire the index of the SSB being measured given in table 9.3C.7.1-2.

T SSB\_measurement\_period\_inter: equal to a measurement period of SSB based measurement given in table 9.3C.7.2-1.

CSSFinter: it is a carrier specific scaling factor and is determined according to CSSFoutside\_gap,i in clause 9.1C.5.1 for measurement conducted outside measurement gaps, i.e. when inter-frequency SMTC is fully non overlapping or partially overlapping with measurement gaps or according to CSSFwithin\_gap,i in clause 9.1C.5.2 for measurement conducted within measurement gaps, i.e. when inter-frequency SMTC is fully overlapping with measurement gaps.

Kp is the scaling factor for a SSB frequency layer to be measured without measurement gaps. Kp = Ntotal\_SAN / Navailable\_SAN, where Navailable\_SAN and Ntotal\_SAN are calculated as follows:

- For a window W of duration max(SMTC period, MGRP\_max), where

- If UE supports *parallelMeasurementGap-r17* and is configured with concurrent measurement gaps, MGRP max is the maximum MGRP across all configured per-UE measurement gap. Otherwise, MGRP max is the MGRP of configured measurement gap.

- Starting from the beginning of any SMTC occasion:

- Ntotal\_SAN is the total number of SMTC occasions within the window, including those overlapped and non-overlapped with measurement gap occasions within the window, and

- Navailable\_SAN is the number of SMTC occasions within the window W that don’t collide with any non-dropped MG occasion within or outside the window W, after accounting for measurement gap collisions by applying the measurement gap collision rule in section 9.1C.8.3. The collision rule between SMTC occasion and measurement gap occasion is defined in section 9.1C.9.1

Kp = [1] when Navailable\_SAN = 0 and measurement gap sharing in clause 9.1.2.1a shall apply.

Kp = 1 when inter-frequency SMTC is fully non overlapping with measurement gaps.

Ksatellite: it is a satellite specific scaling factor.

* If SMTCs do not overlap with each other, and if LEO and/or GEO satellite(s) is/are required to be measured within SMTC
  + Ksatellite = 1, if GSO satellite(s) is/are measured on the carrier
  + , if LEO satellite(s) is/are measured on the carrier.
* If SMTCs partially overlap with each other, and if LEO and/or GEO satellite(s) is/are required to be measured within overlapped SMTCs
  + , if only GEO satellite(s) is/are measured on the carrier
  + , if only LEO satellite(s) is/are measured on the carrier.

Table 9.3C.7.1-1: Time period for PSS/SSS detection, (FR1)

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_inter |
| No DRX | max( 600ms, ceil( 5 x Kp) x SMTC period )Note 1 x CSSFinter × Ksatellite |
| DRX cycle≤ 320ms | max( 600ms, ceil(1.5x 5 x Kp) x max(SMTC period,DRX cycle)) x CSSFinter × Ksatellite |
| DRX cycle>320ms | ceil(5 x Kp) x DRX cycle x CSSFinter × Ksatellite |
| NOTE 1: SMTC period is the SMTC period in SMTC configuration which is associated with the target cell to be measured configured in *SSB-MTC4List-r17*. | |

Table 9.3C.7.1-2: Time period for time index detection (FR1)

|  |  |
| --- | --- |
| DRX cycle | TSSB\_time\_index\_inter |
| No DRX | max(120ms, ceil( 3 x Kp )x SMTC period)Note 1 x CSSFinter × Ksatellite |
| DRX cycle≤ 320ms | max(120ms, ceil (1.5 x 3 x Kp) x max(SMTC period,DRX cycle)) x CSSFinter × Ksatellite |
| DRX cycle>320ms | Ceil(3 x Kp) x DRX cycle x CSSFinter × Ksatellite |
| NOTE 1: SMTC period is the SMTC period in SMTC configuration which is associated with the target cell to be measured configured in *SSB-MTC4List-r17*. | |

#### 9.3C.7.2 Measurement period

The UE physical layer shall be capable of reporting SS-RSRP, SS-RSRQ and SS-SINR measurements to higher layers with measurement accuracy as specified in clauses 10.1C.4, 10.1C.5, 10.1C.9, 10.1C.10, 10.1C.14 and 10.1C.15, respectively, as shown in table 9.3C.7.2-1, if UE supports inter-frequency measurement without measurement gaps:

Table 9.3C.7-1: Measurement period for inter-frequency measurements without gaps ((FR1)

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_inter |
| No DRX | max(200ms, ceil( 5 x Kp) x SMTC period)Note 1 x CSSFinter × K\_satellite |
| DRX cycle≤ 320ms | max(200ms, ceil(1.5x 5 x Kp) x max(SMTC period,DRX cycle)) x CSSFinter × K\_satellite |
| DRX cycle>320ms | ceil( 5 x Kp ) x DRX cycle x CSSFinter × K\_satellite |
| NOTE 1: SMTC period is the SMTC period in SMTC configuration which is associated with the target cell to be measured configured in *SSB-MTC4List-r17*. | |

#### 9.3C.7.3 Scheduling availability of UE during inter-frequency measurements

If UE supports *interFrequencyMeas-NoGap-r16* and the flag *interFrequencyConfig-NoGap-r16* is configured by the Network, UE is required to be capable of measuring without measurement gaps when the SSB is completely contained in the active bandwidth part of the UE. When any of the conditions in the following clauses is met, there are restrictions on the scheduling availability; otherwise, there is no scheduling restriction. Note that the SSB symbols to be measured in the following clauses are the SSB symbols indicated by SSB-ToMeasure [2], if it is configured; otherwise, all L SSB symbols within the SMTC window duration defined in clause 4.1 of TS 38.213 [3] are included.

The scheduling availability requirements when UE performs inter-frequency measurements without measurement gaps in a TDD bands on FR1 in clause 9.3C.7.3.1~9.3C.7.3.3 are valid under the following conditions:

- SFN and frame boundary across serving cell and inter-frequency neighbor cells is aligned, and

- the timing of SSBs across serving cell and inter-frequency neighbor cells are aligned

##### 9.3C.7.3.1 Scheduling availability of UE performing measurements in TDD bands on FR1

When UE performs inter-frequency measurements without measurement gaps in a TDD band, the following restrictions apply due to SS-RSRP or SS-SINR measurement

- UE is not expected to transmit PUCCH/PUSCH/SRS on SSB symbols to be measured, and on 1 data symbol before each consecutive SSB symbols to be measured and 1 data symbol after each consecutive SSB symbols to be measured within SMTC window duration.

When UE performs inter-frequency measurements without measurement gaps in a TDD band, the following restrictions apply due to SS-RSRQ measurement

- UE is not expected to transmit PUCCH/PUSCH/SRS on SSB symbols to be measured, RSSI measurement symbols, and on 1 data symbol before each consecutive SSB to be measured/RSSI symbols and 1 data symbol after each consecutive SSB to be measured/RSSI symbols within SMTC window duration.

When TDD intra-band carrier aggregation is performed, the scheduling restrictions due to one serving cell should also apply to all other serving cells in the same band on the symbols that fully or partially overlap with aforementioned restricted symbols.

##### 9.3C.7.3.2 Scheduling availability of UE performing measurements with a different subcarrier spacing than PDSCH/PDCCH on FR1

For UE which do not support *simultaneousRxDataSSB-DiffNumerology-Inter-r16* [14] the following restrictions apply due to SS-RSRP/RSRQ/SINR measurement

- If UE performs inter-frequency measurements without measurement gaps in a TDD band, UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on SSB symbols to be measured, and on 1 data symbol before each consecutive SSB symbols to be measured and 1 data symbol after each consecutive SSB symbols to be measured within SMTC window duration.

- If UE performs inter-frequency measurements without measurement gaps in a FDD band, UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on all symbols within SMTC window duration.

When intra-band carrier aggregation is performed, the scheduling restrictions due to a given serving cell should also apply to all other serving cells in the same band on the symbols that fully or partially overlap with aforementioned restricted symbols.

## 9.4 Inter-RAT measurements

### 9.4.1 Introduction

The requirements in this clause are specified for NR−E-UTRAN FDD and NR−E-UTRAN TDD measurements and are applicable without an explicit E-UTRAN neighbour cell list containing physical layer cell identities, for a UE:

- in RRC\_CONNECTED state, and

- configured

- with SA or NR-DC operation mode or configured in NE-DC operation mode by PCell with NR−E-UTRAN FDD or TDD measurement (RSRP, RSRQ, RS-SINR, RSTD, or E-CID RSRP and RSRQ) on E-UTRA non-serving frequency carrier, or

- with SA operation mode on NR carrier frequencies with CCA by PCell with NR−E-UTRAN FDD or TDD measurement (RSRP, RSRQ, RS-SINR) on E-UTRA non-serving frequency carrier, and

- configured with an appropriate measurement gap pattern according to Table 9.1.2-3.

The requirements in this clause for concurrent measurement gaps are only applied for UE in NR SA operation mode.

For UE supporting *eutra-NeedForGapNCSG-reporting-r17* and indicating *NeedForGapNCSG-InfoEUTRA* for inter-RAT measurement,

- An inter-RAT measurement is defined as measurement without gap if

- the UE indicates ‘nogap-noncsg’ via *NeedForGapNCSG-InfoEUTRA* for the inter-RAT measurement

- An inter-RAT measurement is defined as measurement with NCSG if

- the UE indicates ‘ncsg’ via *NeedForGapNCSG-InfoEUTRA* for the inter-RAT measurement

When network configures measurement gap or NCSG, the delay requirements are specified in clause 9.4.2 and 9.4.3.

- An inter-RAT SSB measurement is defined as measurement with gap if

- the UE indicates ‘gap’ via *NeedForGapNCSG-InfoEUTRA* for the inter-RAT measurement

When network configures measurement gap, the delay requirements are specified in clauses 9.4.2 and 9.4.3.

- For inter-RAT measurements with NCSG, UE may cause scheduling restriction as specified in clause 9.4.3.5.

When the UE is in NE-DC operation mode and an NR−E-UTRAN FDD or TDD measurement (RSRP, RSRQ, RS-SINR, or E-CID RSRP and RSRQ) configured by NR PCell is on a E-UTRA serving frequency carrier, then the corresponding E-UTRA intra-frequency measurements requirements specified in clause 8.19 of TS 36.133 [15] shall apply.

When *highSpeedMeasFlag-r16* is configured but UE does not support either *measurementEnhancement-r16 or* *interRAT-MeasurementEnhancement-r16*, the UE is not required to meet the requirements specified in Table 9.4.2.3-2 and Table 9.4.3.3-2.

*Editor’s note: the exact signalling names in the above brackets and in Table 9.4.2.3-2 and Table 9.4.3.3-2 are subject to RAN2 definitions and the brackets shall be replaced by the correct signalling names according to RAN2 specification.*

Parameter TInter1 used in inter-RAT requirements in clause 9.4 is specified in Table 9.4.1-1 when measurement gap is used, and in Table 9.4.1-2 when NCSG is used.

Table 9.4.1-1: Minimum available time for inter-RAT measurements measurements when measurement gap is configured

|  |  |  |  |
| --- | --- | --- | --- |
| Gap Pattern Id | MeasurementGap Length (MGL, ms) | Measurement Gap Repetition Period  (MGRP, ms) | Minimum available time for inter-frequency and inter-RAT measurements during 480 ms period  (Tinter1, ms) |
| 0 | 6 | 40 | 60 |
| 1 | 6 | 80 | 30 |
| 2 | 3 | 40 | 24Note 1 |
| 3 | 3 | 80 | 12Note 1 |
| 4 | 6 | 20 | 120 Note 1 |
| 6 | 4 | 20 | 72 Note 1,3,6 |
| 7 | 4 | 40 | 36 Note 1,4,6 |
| 8 | 4 | 80 | 18Note 1,5,6 |
| 10 | 3 | 20 | 48 Note 1 |
| NOTE 1: When determining UE requirements using Tinter1 for gap pattern IDs 2, 3, 4, 6, 7, 8, 10, Tinter1 = 60 for gap pattern IDs 2, 4, 6, 7, 10, and Tinter1 = 30 for gap pattern IDs 3 and 8 shall be used.  NOTE 2: Measurement gaps pattern configurations applicability is as specified in Table 9.1.2-1.  NOTE 3: When this gap pattern is used, the Tinter for E-UTRA inter-frequency measurements is 48 ms corresponding to the first 3 ms of the 4 ms gap.  NOTE 4: When this gap pattern is used, the Tinter for E-UTRA inter-frequency measurements is 24 ms corresponding to the first 3 ms of the 4 ms gap.  NOTE 5: When this gap pattern is used, the Tinter for E-UTRA inter-frequency measurements is 12 ms corresponding to the first 3 ms of the 4 ms gap.  NOTE 6: This gap pattern is applicable for E-UTRA inter-frequency measurements only if gap based NR measurements are also configured.  NOTE 7: If multiple concurrent gaps are configured, the MGRP is the periodicity of the MG pattern associated to the E-UTRA inter-RAT frequency layers. | | | |

Table 9.4.1-2: Minimum available time for inter-RAT measurements when NCSG is configured

|  |  |  |  |
| --- | --- | --- | --- |
| NCSG Pattern Id | Measurement Length (ML, ms) | Visible Interruption Repetition Period  (VIRP, ms) | Minimum available time for inter-frequency and inter-RAT measurements during 480 ms period  (Tinter1, ms) |
| 0 | 5 | 40 | 60 |
| 1 | 5 | 80 | 30 |
| 2 | 2 | 40 | 24Note 1 |
| 3 | 2 | 80 | 12Note 1 |
| 4 | 5 | 20 | 120 Note 1 |
| 6 | 3 | 20 | 72 Note 1,3 |
| 7 | 3 | 40 | 36 Note 1,3 |
| 8 | 3 | 80 | 18Note 1,3 |
| 10 | 2 | 20 | 48 Note 1 |
| NOTE 1: When determining UE requirements using Tinter1 for NCSG pattern IDs 2, 3, 4, 6, 7, 8, 10, Tinter1 = 60 for NCSG pattern IDs 2, 4, 6, 7, 10, and Tinter1 = 30 for NCSG pattern IDs 3 and 8 shall be used.  NOTE 2: NCSG pattern configurations applicability is as specified in Table 9.1.2C-1.  NOTE 3: This NCSG pattern is applicable for E-UTRA inter-frequency measurements only if NCSG based NR measurements are also configured. | | | |

A UE configured with gap/NCSG pattern ID 2, 3 or 10 shall be able to detect a target cell, provided that

- the E-UTRA subframe #0 or #5 of the target E-UTRAN cell begins not earlier than 500 μs from the start of the measurement gap, and

- the E-UTRA subframe #0 or #5 of the target E-UTRAN cell ends not later than 500 μs before the end of the measurement gap in case of FDD and not later than 750 μs before the end of measurement gap in case of TDD.

A UE configured with gap/NCSG pattern ID 6, 7 or 8 shall be able to detect a target cell, provided that

- the E-UTRA subframe #0 or #5 of the target E-UTRAN cell begins not earlier than 500 μs from the start of the measurement gap, and

- the E-UTRA subframe #0 or #5 of the target E-UTRAN cell ends no later than 1500 μs before the end of the measurement gap in case of FDD and no later than 1750 μs before the end of measurement gap in case of TDD.

### 9.4.2 NR − E-UTRAN FDD measurements

#### 9.4.2.1 Introduction

The requirements are applicable for NR−E-UTRAN FDD RSRP, RSRQ, and RS-SINR measurements.

In the requirements, an E-UTRAN FDD cell is considered to be detectable when:

- RSRP related conditions in the accuracy requirements in clause 10.2.2 are fulfilled for a corresponding Band, together with the corresponding side conditions in Annex B.2.3 and Annex B.3.3 of TS 36.133 [15],

- RSRQ related conditions in the accuracy requirements in clause 10.2.3 are fulfilled for a corresponding Band, together with the corresponding side conditions in Annex B.2.3 and Annex B.3.3 of TS 36.133 [15],

- RS-SINR related conditions in the accuracy requirements in clause 10.2.5 are fulfilled for a corresponding Band, together with the corresponding side conditions in Annex B.2.3 and Annex B.3.19 of TS 36.133 [15].

#### 9.4.2.2 Requirements when no DRX is used

When the UE requires measurement gaps or NCSG to identify and measure inter-RAT cells and an appropriate measurement gap pattern or NCSG is scheduled, or when the UE is capable of concurrent measurement gap patterns and concurrent measurement gap patterns are scheduled, or an appropriate pre-MG is scheduled and activated, or the UE supports capability of conducting such measurements without gaps, the UE shall be able to identify a new detectable FDD cell within TIdentify, E-UTRAN FDD according to the following expression:

,

where:

TBasicIdentify = 480 ms,

TInter1 is defined in clause 9.4.1,

CSSFinterRAT = CSSFwithin\_gap,i when measurement gaps are configured, or CSSFwithin\_ncsg,i when NCSGs are configured, is the scaling factor for the measured inter-RAT E-UTRA carrier *i* which is calculated as specified in clause 9.1.5.2.

For a UE supporting and configured with concurrent measurement gaps, Kgap\_EUTRA: it is the scaling factor for an E-UTRAN frequency layer to be measured within the associated measurement gap pattern. Kgap = 1 when the UE is not configured with concurrent measurement gaps. Otherwise, Kgap\_EUTRA = Ntotal / Navailable for UE configured with concurrent measurement gaps.

For a window W of duration MGRP\_max, where MGRP\_max is the maximum MGRP across all configured per-UE measurement gap(s) and per-FR measurement gap(s) for FR1, and starting from the beginning of any associated gap occasion:

Ntotal is the total number of associated gap occasions within the window, including those overlapped with other MG occasions within the window, and

Navailable is the number of non-dropped associated measurement gap occasions after accounting for collisions between the measurement gaps by applying the measurement gap collision rule in section 9.1.8.3.

Requirements do not apply for UE configured with concurrent measurement gaps, if Navailable =0

Identification of a cell shall include detection of the cell and additionally performing a single measurement with measurement period of TMeasure, E-UTRAN FDD defined in Table 9.4.2.2-1.

**Table 9.4.2.2-1:** M**easurement period and measurement bandwidth**

|  |  |  |
| --- | --- | --- |
| **Configuration** | **Physical Layer Measurement period: TMeasure, E-UTRAN FDD [ms]** | **Measurement bandwidth [RB]** |
| 0 | 480 x [CSSFinterRAT x Ceil(Kgap\_EUTRA)] | 6 |
| 1 (Note 1) | 240 x [CSSFinterRAT x Ceil(Kgap\_EUTRA)] | 50 |
| NOTE 1: This configuration is optional.  NOTE 2: Kgap\_EUTRA is only applicable for a UE supporting concurrent measurement gaps. Otherwise Kgap\_EUTRA =1 | | |

When measurement gaps are scheduled for E-UTRAN FDD inter-RAT measurements, or the UE supports capability of conducting such measurements without gaps, the UE physical layer shall be capable of reporting RSRP, RSRQ, and RS-SINR measurements to higher layers with measurement period TMeasure, E-UTRAN FDDgiven by table 9.4.2.2-1.

If higher layer filtering is used, an additional cell identification delay can be expected.

The NR – E-UTRAN FDD RSRP measurement accuracy for all measured cells shall be as specified in clause 10.2.2. The NR – E-UTRAN FDD RSRQ measurement accuracy for all measured cells shall be as specified in clause 10.2.3. The NR – E-UTRAN FDD RS-SINR measurement accuracy for all measured cells shall be as specified in clause 10.2.5.

#### 9.4.2.3 Requirements when DRX is used

When DRX is in use and an appropriate measurement gap pattern or NCSG is configured, or when the UE is capable of concurrent measurement gap patterns and concurrent measurement gap patterns are configured, or an appropriate pre-MG is scheduled and activated, the UE shall be able to identify a new detectable E-UTRAN FDD cell within TIdentify, E-UTRAN FDD specified in Table 9.4.2.3-1. When *highSpeedMeasFlag-r16* is configured and UE supports the enhanced inter-RAT E-UTRAN measurement requirements, the UE shall be able to identify a new detectable E-UTRAN FDD cell within TIdentify, E-UTRAN FDD specified in Table 9.4.2.3-2.

For a UE supporting and configured with concurrent measurement gaps, Kgap\_EUTRA: it is the scaling factor for an E-UTRAN frequency layer to be measured within the associated measurement gap pattern. Kgap = 1 when the UE is not configured with concurrent measurement gaps. Otherwise, Kgap\_EUTRA = Ntotal / Navailable for UE configured with concurrent measurement gaps.

For a window W of duration MGRP\_max, where MGRP\_max is the maximum MGRP across all configured per-UE measurement gap(s) and per-FR measurement gap(s) for FR1, and starting from the beginning of any associated gap occasion:

Ntotal is the total number of associated gap occasions within the window, including those overlapped with other MG occasions within the window, and

Navailable is the number of non-dropped associated measurement gap occasions after accounting for collisions between the measurement gaps by applying the measurement gap collision rule in section 9.1.8.3.

Requirements do not apply for UE configured with concurrent measurement gaps, if Navailable =0

Table 9.4.2.3-1: Requirement to identify a newly detectable E-UTRAN FDD cell

|  |  |  |
| --- | --- | --- |
| **DRX cycle length (s)** | **TIdentify, E-UTRAN FDD (s) (DRX cycles)** | |
|  | Gap/NCSG period = 40 ms, 20 ms | Gap/NCSG period = 80 ms |
| ≤0.16 | Non-DRX requirements in clause 9.4.2.2 apply | Non-DRX requirements in clause 9.4.2.2 apply |
| 0.256 | 5.12\* CSSFinterRAT x Ceil(Kgap\_EUTRA) (20\*CSSFinterRAT x Ceil(Kgap\_EUTRA)) | 7.68\* CSSFinterRAT x Ceil(Kgap\_EUTRA) (30\*CSSFinterRAT x Ceil(Kgap\_EUTRA)) |
| 0.32 | 6.4\* CSSFinterRAT x Ceil(Kgap\_EUTRA) (20\*CSSFinterRAT x Ceil(Kgap\_EUTRA)) | 7.68\* CSSFinterRAT x Ceil(Kgap\_EUTRA) (24\*CSSFinterRAT x Ceil(Kgap\_EUTRA)) |
| 0.32< DRX-cycle ≤10.24 | Note1 (20\*CSSFinterRAT x Ceil(Kgap\_EUTRA)) | Note1 (20\*CSSFinterRAT x Ceil(Kgap\_EUTRA)) |
| NOTE 1: The time depends on the DRX cycle length.  NOTE 2: CSSFinterRAT is as defined in clause 9.4.2.2.  NOTE 3: Kgap\_EUTRA is only applicable for a UE supporting concurrent measurement gaps. Otherwise Kgap\_EUTRA =1  NOTE 4: If multiple concurrent gaps are configured, the gap period is the periodicity of the MG pattern associated to the E-UTRA inter-RAT frequency layer. | | |

Table 9.4.2.3-2: Requirement to identify a newly detectable E-UTRAN FDD cell when *highSpeedMeasFlag-r16* is configured

|  |  |  |
| --- | --- | --- |
| DRX cycle length (s) | TIdentify, E-UTRAN FDD (s) (DRX cycles) | |
|  | Gap/NCSG period = 40 ms, 20 ms | Gap/NCSG period = 80 ms |
| ≤0.16 | Non-DRX requirements in clause 9.4.2.2 apply | Non-DRX requirements in clause 9.4.2.2 apply |
| 0.16<DRx cycle<=0.32 | Note 1(15\*CSSFinterRAT x Ceil((Kgap\_EUTRA)) |  |
| 0.32<DRx cycle <= 0.64 | Note 1(10\*CSSFinterRAT x Ceil(Kgap\_EUTRA)) |  |
| DRx cycle = 1.024 | Note 1(10\*CSSFinterRAT x Ceil( Kgap\_EUTRA)) | Note 1(10\*CSSFinterRAT x Ceil(Kgap\_EUTRA)) |
| DRx cycle = 1.28 | Note 1(8\*CSSFinterRAT x Ceil( Kgap\_EUTRA)) | Note 1(8\*CSSFinterRAT x Ceil(Kgap\_EUTRA)) |
| 1.28< DRX-cycle ≤10.24 | Note1 (20\*CSSFinterRAT x Ceil( Kgap\_EUTRA)) | Note1 (20\*CSSFinterRAT x Ceil(Kgap\_EUTRA)) |
| NOTE 1: The time depends on the DRX cycle length.  NOTE 2: CSSFinterRAT is as defined in clause 9.4.2.2.  NOTE 3: When *highSpeedMeasFlag-r16* is configured, the requirements apply only to UE supporting either *measurementEnhancement-r16* or *[interRAT-MeasurementEnhancement-r16].*  NOTE 4: Kgap\_EUTRA is only applicable for a UE supporting concurrent measurement gaps. Otherwise Kgap\_EUTRA =1  NOTE 5: If multiple concurrent gaps are configured, the gap period is the periodicity of the MG pattern associated to the E-UTRA inter-RAT frequency layer. | | |

When DRX is in use, the UE shall be capable of performing NR – E-UTRAN FDD RSRP, RSRQ, and RS-SINR measurements of at least 4 identified E-UTRAN FDD cells per E-UTRA FDD frequency layer during each layer 1 measurement period, for up to 7 E-UTRA FDD carrier frequency layers, and the UE physical layer shall be capable of reporting NR – E-UTRAN FDD RSRP, RSRQ, and RS-SINR measurements to higher layers with the measurement period Tmeasure, E-UTRAN FDD specified in Table 9.4.2.3-2.

**Table 9.4.2.3-2: Requirement to measure E-UTRAN FDD cells**

|  |  |
| --- | --- |
| **DRX cycle length (s)** | **Tmeasure, E-UTRAN FDD (s) (DRX cycles)** |
| ≤0.08 | Non-DRX requirements in clause 9.4.2.2 apply |
| 0.08< DRX-cycle ≤10.24 | Note1 (5\* CSSFinterRAT x Ceil(Kgap\_EUTRA)) |
| NOTE 1: The time depends on the DRX cycle length.  NOTE 2: CSSFinterRAT is as defined in clause 9.4.2.2.  NOTE 3: Kgap\_EUTRA is only applicable for a UE supporting concurrent measurement gaps. Otherwise Kgap\_EUTRA =1 | |

If higher layer filtering is used, an additional cell identification delay can be expected.

The NR – E-UTRAN FDD RSRP measurement accuracy for all measured cells shall be as specified in clause 10.2.2. The NR – E-UTRAN FDD RSRQ measurement accuracy for all measured cells shall be as specified in clause 10.2.3. The NR – E-UTRAN FDD RS-SINR measurement accuracy for all measured cells shall be as specified in clause 10.2.5.

#### 9.4.2.4 Measurement reporting requirements

##### 9.4.2.4.1 Periodic Reporting

The reported NR – E-UTRAN FDD RSRP, RSRQ, and RS-SINR measurements contained in periodically triggered measurement reports shall meet the requirements in clauses 10.2.2, 10.2.3, and 10.2.5, respectively.

##### 9.4.2.4.2 Event-Triggered Periodic Reporting

The reported NR – E-UTRAN FDD RSRP, RSRQ, and RS-SINR measurements contained in event-triggered periodic measurement reports shall meet the requirements in clauses 10.2.2, 10.2.3, and 10.2.5, respectively.

The first report in event-triggered periodic measurement reporting shall meet the requirements specified in clause 9.4.2.4.3.

##### 9.4.2.4.3 Event-Triggered Reporting

The reported NR – E-UTRAN FDD RSRP, RSRQ, and RS-SINR measurements contained in event-triggered measurement reports shall meet the requirements in clauses 10.2.2, 10.2.3, and 10.2.5, respectively.

The UE shall not send any event-triggered measurement reports as long as no reporting criteria are fulfilled.

The measurement reporting delay is defined as the time between an event that will trigger a measurement report and the point when the UE starts to transmit the measurement report over the air interface. This requirement assumes that that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 x TTIDCCH where TTIDCCH is the duration of subframe or slot or subslot when the measurement report is transmitted on the PUSCH with subframe or slot or subslot duration. This measurement reporting delay excludes a delay which caused by no UL resources for UE to send the measurement report.

The event triggered measurement reporting delay, measured without L3 filtering shall be less than T Identify, E-UTRAN FDD defined in clauses 9.4.2.2 and 9.4.2.3 without DRX and with DRX, respectively.When L3 filtering is used, an additional delay can be expected.

If a cell which has been detectable at least for the time period TIdentify, E-UTRAN FDD becomes undetectable for a period ≤ 5 seconds and then the cell becomes detectable again and triggers an event as per TS 38.331 [2], the event triggered measurement reporting delay shall be less than TMeasure, E-UTRAN FDD provided the timing to that cell has not changed more than ± 50 Ts while measurement gap or NCSG has not been available and the L3 filter has not been used.

### 9.4.3 NR − E-UTRAN TDD measurements

#### 9.4.3.1 Introduction

The requirements are applicable for NR−E-UTRAN TDD RSRP, RSRQ, and RS-SINR measurements.

In the requirements, an E-UTRAN TDD cell is considered to be detectable when:

- RSRP related conditions in the accuracy requirements in clause 10.2.2 are fulfilled for a corresponding Band, together with the corresponding side conditions in Annex B.2.3 and Annex B.3.3 of TS 36.133 [15],

- RSRQ related conditions in the accuracy requirements in clause 10.2.3 are fulfilled for a corresponding Band, together with the corresponding side conditions in Annex B.2.3 and Annex B.3.3 of TS 36.133 [15],

RS-SINR related conditions in the accuracy requirements in clause 10.2.5 are fulfilled for a corresponding Band, together with the corresponding side conditions in Annex B.2.3 and Annex B.3.19 of TS 36.133 [15].

#### 9.4.3.2 Requirements when no DRX is used

When the UE requires measurement gaps or NCSG to identify and measure inter-RAT cells and an appropriate measurement gap pattern or NCSG is scheduled, or when the UE is capable of concurrent measurement gap patterns and concurrent measurement gap patterns are scheduled, or an appropriate pre-MG is scheduled and activated or the UE supports capability of conducting such measurements without gaps, the UE shall be able to identify a new detectable TDD cell within TIdentify, E-UTRAN TDD according to the following expression:

- When configuration 0 or configuration 1 in Table 9.4.3.2-1 is applied,

,

- When configuration 2 or configuration 3 in Table 9.4.3.2-1 is applied,

,

where:

TBasicIdentify = 480 ms,

TInter1 is defined in clause 9.4.1,

CSSFinterRAT = CSSFwithin\_gap,i when measurement gaps are configured, or CSSFwithin\_ncsg,i when NCSGs are configured, is the scaling factor for the measured inter-RAT E-UTRA carrier *i* which is calculated as specified in clause 9.1.5.2.

For a UE supporting and configured with concurrent measurement gaps, Kgap\_EUTRA: it is the scaling factor for an E-UTRAN frequency layer to be measured within the associated measurement gap pattern. Kgap = 1 when the UE is not configured with concurrent measurement gaps. Otherwise, Kgap\_EUTRA = Ntotal / Navailable for UE configured with concurrent measurement gaps.

- For a window W of duration MGRP\_max, where MGRP\_max is the maximum MGRP across all configured per-UE measurement gap(s) and per-FR measurement gap(s) for FR1, and starting from the beginning of any associated gap occasion:

- Ntotal is the total number of associated gap occasions within the window, including those overlapped with other MG occasions within the window, and

- Navailable is the number of non-dropped associated measurement gap occasions after accounting for collisions between the measurement gaps by applying the measurement gap collision rule in section 9.1.8.3.

- Requirements do not apply for UE configured with concurrent measurement gaps, if Navailable =0

Identification of a cell shall include detection of the cell and additionally performing a single measurement with measurement period of TMeasure, E-UTRAN TDD defined in Table 9.4.3.2-1.

Table 9.4.3.2-1: TMeasure, E-UTRAN TDD for different configurations

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Configuration | Measurement bandwidth (RB) | Number of UL/DL sub-frames per half frame (5 ms) | | DwPTS | | TMeasure, E-UTRAN TDD (ms) |
|  |  | DL | UL | Normal CP | Extended CP |  |
| 0 | 6 | 2 | 2 |  |  | 480 x CSSFinterRAT x Ceil(Kgap\_EUTRA) |
| 1 (Note 1) | 50 | 2 | 2 |  |  | 240 x CSSFinterRAT x Ceil(Kgap\_EUTRA) |
| 2 | 6 | 1 | 3 |  |  | 720 x CSSFinterRAT x Ceil(Kgap\_EUTRA) |
| 3 (Note 1) | 50 | 1 | 3 |  |  | 480 x CSSFinterRAT x Ceil(Kgap\_EUTRA) |
| NOTE 1: This configuration is optional.  NOTE 2: Void  NOTE 3: Kgap\_EUTRA is only applicable for a UE supporting concurrent measurement gaps. Otherwise Kgap\_EUTRA =1 | | | | | | |

When measurement gaps are scheduled for E-UTRAN TDD inter-RAT measurements, or the UE supports capability of conducting such measurements without gaps, the UE physical layer shall be capable of reporting RSRP, RSRQ, and RS-SINR measurements to higher layers with measurement period Tmeasure, E-UTRAN TDD given by table 9.4.3.2-1.

If higher layer filtering is used, an additional cell identification delay can be expected.

The NR – E-UTRAN TDD RSRP measurement accuracy for all measured cells shall be as specified in clause 10.2.2. The NR – E-UTRAN TDD RSRQ measurement accuracy for all measured cells shall be as specified in clause 10.2.3. The NR – E-UTRAN TDD RS-SINR measurement accuracy for all measured cells shall be as specified in clause 10.2.5.

#### 9.4.3.3 Requirements when DRX is used

When DRX is in use and an appropriate measurement gap pattern or NCSG is configured, or when the UE is capable of concurrent measurement gap patterns and concurrent measurement gap patterns are configured, or an appropriate pre-MG is scheduled and activated, the UE shall be able to identify a new detectable E-UTRAN TDD cell within TIdentify, E-UTRAN TDD specified in Table 9.4.3.3-1. When *highSpeedMeasFlag-r16* is configured and UE supports the enhanced inter-RAT E-UTRAN measurement requirements, the UE shall be able to identify a new detectable E-UTRAN TDD cell within TIdentify, E-UTRAN TDD specified in Table 9.4.3.3-2.

For a UE supporting and configured with concurrent measurement gaps, Kgap\_EUTRA: it is the scaling factor for an E-UTRAN frequency layer to be measured within the associated measurement gap pattern. Kgap = 1 when the UE is not configured with concurrent measurement gaps. Otherwise, Kgap\_EUTRA = Ntotal / Navailable for UE configured with concurrent measurement gaps.

For a window W of duration MGRP\_max, where MGRP\_max is the maximum MGRP across all configured per-UE measurement gap(s) and per-FR measurement gap(s) for FR1, and starting from the beginning of any associated gap occasion:

Ntotal is the total number of associated gap occasions within the window, including those overlapped with other MG occasions within the window, and

Navailable is the number of non-dropped associated measurement gap occasions after accounting for collisions between the measurement gaps by applying the measurement gap collision rule in section 9.1.8.3.

Requirements do not apply for UE configured with concurrent measurement gaps, if Navailable =0

Table 9.4.3.3-1: Requirement to identify a newly detectable E-UTRAN TDD cell

|  |  |  |
| --- | --- | --- |
| DRX cycle length (s) | TIdentify, E-UTRAN TDD (s) (DRX cycles) | |
|  | Gap/NCSG period = 40 ms, 20 ms | Gap/NCSG period = 80 ms |
| ≤0.16 | Non-DRX requirements in clause 9.4.3.2 apply | Non-DRX requirements in clause 9.4.3.2 apply |
| 0.256 | 5.12\* CSSFinterRAT x Ceil(Kgap\_EUTRA) (20\*CSSFinterRAT x Ceil(Kgap\_EUTRA)) | 7.68\* CSSFinterRAT x Ceil(Kgap\_EUTRA) (30\*CSSFinterRAT x Ceil(Kgap\_EUTRA)) |
| 0.32 | 6.4\* CSSFinterRAT x Ceil(Kgap\_EUTRA) (20\*CSSFinterRAT x Ceil(Kgap\_EUTRA)) | 7.68\* CSSFinterRAT x Ceil(Kgap\_EUTRA) (24\*CSSFinterRAT x Ceil(Kgap\_EUTRA)) |
| 0.32< DRX-cycle ≤10.24 | Note1 (20\*CSSFinterRAT x Ceil(Kgap\_EUTRA)) | Note1 (20\*CSSFinterRAT x Ceil(Kgap\_EUTRA)) |
| NOTE 1: The time depends on the DRX cycle length.  NOTE 2: CSSFinterRAT is as defined in clause 9.4.3.2.  NOTE 3: Kgap\_EUTRA is only applicable for a UE supporting concurrent measurement gaps. Otherwise Kgap\_EUTRA =1  NOTE 4: If multiple concurrent gaps are configured, the gap period is the periodicity of the MG pattern associated to the E-UTRA inter-RAT frequency layer. | | |

Table 9.4.3.3-2: Requirement to identify a newly detectable E-UTRAN TDD cell when *highSpeedMeasFlag-r16* is configured

|  |  |  |
| --- | --- | --- |
| DRX cycle length (s) | TIdentify, E-UTRAN TDD (s) (DRX cycles) | |
|  | Gap/NCSG period = 40 ms, 20 ms | Gap/NCSG period = 80 ms |
| ≤0.16 | Non-DRX requirements in clause 9.4.3.2 apply | Non-DRX requirements in clause 9.4.3.2 apply |
| 0.16<DRx cycle<=0.32 | Note 1(15\*CSSFinterRAT x Ceil(Kgap\_EUTRA)) |  |
| 0.32<DRx cycle <= 0.64 | Note 1(10\*CSSFinterRAT x Ceil(Kgap\_EUTRA)) |  |
| DRx cycle = 1.024 | Note 1(10\*CSSFinterRAT x Ceil(Kgap\_EUTRA)) | Note 1(10\*CSSFinterRAT x Ceil(Kgap\_EUTRA)) |
| DRx cycle = 1.28 | Note 1(8\*CSSFinterRAT x Ceil(Kgap\_EUTRA)) | Note 1(8\*CSSFinterRAT x Ceil(Kgap\_EUTRA)) |
| 1.28< DRX-cycle ≤10.24 | Note1 (20\*CSSFinterRAT x Ceil(Kgap\_EUTRA)) | Note1 (20\*CSSFinterRAT x Ceil(Kgap\_EUTRA)) |
| NOTE 1: The time depends on the DRX cycle length.  NOTE 2: CSSFinterRAT is as defined in clause 9.4.3.2.  NOTE 3: When *highSpeedMeasFlag-r16* is configured, the requirements apply only to UE supporting either *measurementEnhancement-r16* or *[interRAT-MeasurementEnhancement-r16].*  NOTE 4: Kgap\_EUTRA is only applicable for a UE supporting concurrent measurement gaps. Otherwise Kgap\_EUTRA =1  NOTE 5: If multiple concurrent gaps are configured, the gap period is the periodicity of the MG pattern associated to the E-UTRA inter-RAT frequency layer. | | |

When DRX is in use, the UE shall be capable of performing NR – E-UTRAN TDD RSRP, RSRQ, and RS-SINR measurements of at least 4 identified E-UTRAN TDD cells per E-UTRA TDD frequency layer during each layer 1 measurement period, for up to 7 E-UTRA TDD carrier frequency layers, and the UE physical layer shall be capable of reporting NR – E-UTRAN TDD RSRP, RSRQ, and RS-SINR measurements to higher layers with the measurement period Tmeasure, E-UTRAN TDD specified in Table 9.4.3.3-3.

Table 9.4.3.3-3: Requirement to measure E-UTRAN TDD cells

|  |  |
| --- | --- |
| DRX cycle length (s) | Tmeasure, E-UTRAN TDD (s) (DRX cycles) |
| ≤0.08 | Non-DRX Requirements in clause 9.4.3.2 apply |
| 0.128 | For configuration 2 Note3, non-DRX requirements in clause 9.4.3.2 apply,  Otherwise: Note1 (5\*CSSFinterRAT x Ceil(Kgap\_EUTRA)) |
| 0.128<DRX-cycle≤10.24 | Note1 (5\*CSSFinterRAT x Ceil(Kgap\_EUTRA)) |
| NOTE 1: The time depends on the DRX cycle length.  NOTE 2: CSSFinterRAT is as defined in clause 9.4.3.2.  NOTE 3: See Table 9.4.3.2-1.  NOTE 4: Kgap\_EUTRA is only applicable for a UE supporting concurrent measurement gaps. Otherwise Kgap\_EUTRA =1 | |

If higher layer filtering is used, an additional cell identification delay can be expected.

The NR – E-UTRAN TDD RSRP measurement accuracy for all measured cells shall be as specified in clause 10.2.2. The NR – E-UTRAN TDD RSRQ measurement accuracy for all measured cells shall be as specified in clause 10.2.3. The NR – E-UTRAN TDD RS-SINR measurement accuracy for all measured cells shall be as specified in clause 10.2.5.

#### 9.4.3.4 Measurement reporting requirements

##### 9.4.3.4.1 Periodic Reporting

The reported NR – E-UTRAN TDD RSRP, RSRQ, and RS-SINR measurements contained in periodically triggered measurement reports shall meet the requirements in clauses 10.2.2, 10.2.3, and 10.2.5, respectively.

##### 9.4.3.4.2 Event-Triggered Periodic Reporting

The reported NR – E-UTRAN TDD RSRP, RSRQ, and RS-SINR measurements contained in event-triggered periodic measurement reports shall meet the requirements in clauses 10.2.2, 10.2.3, and 10.2.5, respectively.

The first report in event-triggered periodic measurement reporting shall meet the requirements specified in clause 9.4.3.4.3.

##### 9.4.3.4.3 Event-Triggered Reporting

The reported NR – E-UTRAN TDD RSRP, RSRQ, and RS-SINR measurements contained in event-triggered measurement reports shall meet the requirements in clauses 10.2.2, 10.2.3, and 10.2.5, respectively.

The UE shall not send any event-triggered measurement reports as long as no reporting criteria are fulfilled.

The measurement reporting delay is defined as the time between an event that will trigger a measurement report and the point when the UE starts to transmit the measurement report over the air interface. This requirement assumes that that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 x TTIDCCH where TTIDCCH is the duration of subframe or slot or subslot when the measurement report is transmitted on the PUSCH with subframe or slot or subslot duration. This measurement reporting delay excludes a delay which caused by no UL resources for UE to send the measurement report.

The event triggered measurement reporting delay, measured without L3 filtering shall be less than T Identify, E-UTRAN TDD defined in clauses 9.4.3.2 and 9.4.3.3 without DRX and with DRX, respectively.When L3 filtering is used, an additional delay can be expected.

If a cell which has been detectable at least for the time period TIdentify, E-UTRAN TDD becomes undetectable for a period ≤ 5 seconds and then the cell becomes detectable again and triggers an event as per TS 38.331 [2], the event triggered measurement reporting delay shall be less than TMeasure, E-UTRAN TDD provided the timing to that cell has not changed more than ± 50 Ts while measurement gap or NCSG has not been available and the L3 filter has not been used.

#### 9.4.3.5 Scheduling Availability During NR − E-UTRAN TDD measurements with NCSG

[When UE supports *simultaneousRxTxInterBandENDC* for a band combination, no scheduling restriction is applicable to NR − E-UTRAN TDD measurements with NCSG in this band combination; otherwise UE is not expected to transmit PUCCH/PUSCH/SRS on all symbols within NCSG ML.]

### 9.4.4 Inter-RAT RSTD measurements

#### 9.4.4.1 NR − E-UTRAN FDD RSTD measurements

##### 9.4.4.1.1 Introduction

The requirements are applicable for NR−E-UTRAN FDD RSTD measurements requested via LPP [22, 27].

When the UE is in NE-DC operation mode and an NR−E-UTRAN FDD RSTD measurement configured by NR PCell is on a E-UTRA serving frequency carrier, then the corresponding E-UTRA intra-frequency measurements requirements as follows shall apply.

- Measurements configured on E-UTRA PSCC shall meet E-UTRAN OTDOA intra-frequency measurements requirements in clause 8.1.2.5. The applicable measurement accuracy requirements are in clause 9.1.10.

- Measurements configured on E-UTRA SCC shall meet all applicable requirements in clause 8.4, except that the terms PCell and primary component carrier shall be deemed to be swapped with PSCell and PSCC. The applicable measurement accuracy requirements are in clause 9.1.12, except that the terms PCell and primary component carrier shall be deemed to be swapped with PSCell and PSCC.

The requirements in clause 9.4.4.1 apply when:

- the UE is provided with the LTE timing information via LPP [27], including both *nr-LTE-SFN-Offset* and *nr-LTE-fineTiming-Offset*, or

- the UE is not provided with *nr-LTE-SFN-Offset* or *nr-LTE-fineTiming-Offset*, or

- the UE is provided with *nr-LTE-SFN-Offset* but not with *nr-LTE-fineTiming-Offset*.

When the UE is not aware of the SFN of at least one LTE cell in the OTDOA assistance data, the UE may be using autonomous gaps to acquire SFN of the OTDOA assistance data reference cell prior to requesting measurement gaps for performing the requested E-UTRA RSTD measurements before the  time period starts while meeting all the requirements in clause 9.4.4.1.2, provided that the OTDOA assistance data is provided to allow sufficient time for the UE to acquire the SFN before the  starts.

When the UE is not aware of and cannot derive the subframe timing difference between the NR serving cell and the OTDOA assistance data reference cell, the UE may need to request measurement gaps to perform cell detection for the OTDOA assistance data reference cell prior to requesting measurement gaps for performing the requested E-UTRA RSTD measurements before the  time period starts while meeting all the requirements in clause 9.4.4.1.2, provided that the OTDOA assistance data is provided to allow sufficient time for the UE to detect the cell before the  starts.

##### 9.4.4.1.2 Requirements

When the physical layer cell identities of neighbour cells together with the OTDOA assistance data are provided, the UE shall be able to detect and measure inter-RAT E-UTRAN FDD RSTD, specified in TS 38.215 [4], for at least *n*=16 cells, including the reference cell, within  ms as given below:

,

where

 is the total time for detecting and measuring at least *n* cells,

 is the largest value of the cell-specific positioning subframe configuration period, defined in TS 36.211 [23], among the measured *n* cells including the reference cell,

 is the number of PRS positioning occasions as defined in Table 9.4.4.1.2-1, where each PRS positioning occasion comprises of  (1≤≤6) consecutive downlink positioning subframes defined in TS 36.211 [23],

CSSFinterRAT=CSSFwithin\_gap,i is the scaling factor determined by the gap sharing scheme for the RSTD measurements on the carrier frequency *i* as defined in clause 9.1.5.2,

 =  ms is the measurement time for a single PRS positioning occasion which includes the sampling time and the processing time, and

the *n* cells are distributed on up to two E-UTRAN FDD carrier frequencies.

**Table 9.4.4.1.2-1: Number of PRS positioning occasions within **

|  |  |  |
| --- | --- | --- |
| Positioning subframe configuration period, | Number of PRS positioning occasions, | |
|  | f2 Note1 | f1 and f2 Note2 |
| 160 ms | 16 × CSSFinterRAT | 32 × CSSFinterRAT |
| >160 ms | 8 × CSSFinterRAT | 16 × CSSFinterRAT |
| NOTE 1: When inter-RAT E-UTRAN FDD RSTD measurements are performed over the reference cell and neighbour cells, which belong to the E-UTRAN FDD carrier frequency f2.  NOTE 2: When inter-RAT E-UTRAN FDD RSTD measurements are performed over the reference cell and the neighbour cells, which belong to the E-UTRAN FDD carrier frequency f1 and the E-UTRAN FDD carrier frequency f2 respectively. | | |

The UE physical layer shall be capable of reporting RSTD for the reference cell and all the neighbor cells *i* out of at least (*n*-1) neighbor cells within  provided:

≥-6 dB for all Frequency Bands for the reference cell,

≥-13 dB for all Frequency Bands for neighbour cell *i*,

 and  conditions apply for all subframes of at least  PRS positioning occasions,

PRP 1,2|dBm according to TS 36.133 [15, Annex B.2.6] for a corresponding Band,

 is defined as the ratio of the average received energy per PRS resource element during the useful part of the symbol to the average received power spectral density of the total noise and interference for this resource element, where the ratio is measured over all resource elements which carry PRS.

The time  starts from the first subframe of the PRS positioning occasion closest in time after both the *OTDOA-RequestLocationInformation* message and the OTDOA assistance data in the *OTDOA-ProvideAssistanceData* message via LPP as specified in TS 38.305 [22], are delivered to the physical layer of the UE.

The RSTD measurement accuracy for all measured neighbor cells *i* shall be fulfilled according to the accuracy as specified in clause 10.2.4.

9.4.4.1.2.1 RSTD Measurement Reporting Delay

This requirement assumes that the measurement report is not delayed by other LPP signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 x TTIDCCH where TTIDCCH is the duration of subframe or slot or subslot when the measurement report is transmitted on the PUSCH with subframe or slot or subslot duration. This measurement reporting delay excludes any delay caused by no UL resources for UE to send the measurement report.

9.4.4.1.2.2 Requirements for acquiring the timing of the E-UTRA OTDOA reference cell

When the UE is not aware of the SFN of at least one LTE cell in the OTDOA assistance data, the UE supporting per-FR gaps may make autonomous gaps in downlink reception and uplink transmission of the PCell, PSCell, and each of the SCells in FR1 for acquiring SFN of the reference cell in the E-UTRA OTDOA assistance data, while no autonomous gaps in downlink reception or uplink transmission are allowed in any of the UE serving cells in FR2. The UE, which are only supporting per-UE gaps, may make autonomous gaps in downlink reception and uplink transmission of the PCell, PSCell, and each of the SCells for acquiring the SFN of the reference cell in the E-UTRA OTDOA assistance data.

When the UE is not aware of and cannot derive the subframe timing difference between the NR serving cell and the OTDOA assistance data reference cell, the UE may need to request measurement gaps while indicating *eutra-FineTimingDetection* according to TS 38.331 [2] for detecting the reference cell in the E-UTRA OTDOA assistance data.

When the UE is performing one or both of SFN acquisition or cell detection as specified above, the UE shall be able to determine the timing of the E-UTRA OTDOA assistance data reference cell during the time period

TRefCell,E-UTRAN = TDetect, E-UTRAN FDD + TMIB + TECGI ,

where

TDetect, E-UTRAN FDD = TIdentify, E-UTRAN FDD - Tmeasure, E-UTRAN FDD is according to clause 9.4.2 assuming CSSFinterRAT=1 and it is the time needed to detect the E-UTRA OTDOA assistance data reference cell when the UE needs to acquire the subframe and slot timing of the cell, provided the UE is configured with measurement gaps (TDetect, E-UTRAN FDD=0 when both *nr-LTE-SFN-Offset* and *nr-LTE-fineTiming-Offset* are provided in the E-UTRA OTDOA assistance data or the E-UTRA OTDOA assistance data reference cell is known to the UE), and

TMIB = 50 ms is the time required to acquire SFN and/or PHICH configuration of the E-UTRA OTDOA assistance data reference cell provided the OTDOA assistance data reference cell is decodable and at least all E-UTRA subframes #0 during TMIB are available at the UE receiver (TMIB=0 when *nr-LTE-SFN-Offset* is provided in the E-UTRA OTDOA assistance data and ECGI acquisition is not needed), and

TECGI = 100 ms is the time required to acquire ECGI of the E-UTRA OTDOA assistance data reference cell when *cellGlobalId* is included in *OTDOA-ReferenceCellInfo* and the UE is not aware of the ECGI of this cell (TECGI = 0 when *cellGlobalId* is not included in *OTDOA-ReferenceCellInfo* or the UE is aware of the ECGI of the E-UTRA OTDOA assistance data reference cell).

When detecting the E-UTRAN OTDOA reference cell, the requirements in this clause shall be met, provided the conditions for the detectable cell are fulfilled according to clause 9.4.2.1. In addition, the MIB of the E-UTRA OTDOA reference cell whose SFN is acquired shall be considered decodable by the UE provided the PBCH demodulation requirements are met according to TS 36.101 [25].

The requirement for acquiring the timing of the E-UTRA OTDOA reference cell within TRefCell,E-UTRAN is applicable when no DRX is used as well as when any of the DRX cycles specified in TS 38.331 [2] is used.

When TMIB>0 and UE is using autonomous gaps during TMIB, the UE shall transmit at least NACK/NACK, MIB, FDD ACK/NACKs on PCell, PSCell, and each of activated SCell(s) in the frequency range where the autonomous gaps are created, specified in Table 9.4.4.1.2.2-1. When both TMIB>0 and TECGI>0 and UE is using autonomous gaps during TMIB+TECGI, the UE shall transmit on PCell, PSCell, and each of activated SCell(s) in the frequency range where autonomous gaps are created at least NACK/NACK, MIB+ECGI, FDD ACK/NACKs specified in Table 9.4.4.1.2.2-3, provided the OTDOA reference cell bandwidth is configured in the OTDOA assistance data [22, 27]. The requirements in Tables 9.4.4.1.2.2-1, 9.4.4.1.2.2-2, and 9.4.4.1.2.2-3 apply, provided that:

- there is continuous DL data allocation,

- no DRX cycle is used,

- no measurement gaps are configured,

- only one code word is transmitted in each slot,

- 2 slot ACK/NACK feedback is configured,

- 20 ms SMTC period is configured,

- SSBs are transmitted in one slot within SMTC window.

Table 9.4.4.1.2.2-2: Void

Table 9.4.4.1.2.2-2: Number of ACK/NACKs transmitted by the UE during TECGI

|  |  |  |
| --- | --- | --- |
| NACK/NACK, ECGI, FDD | Configuration of the serving cell in which the transmitted ACK/NACKs are counted | |
|  | Duplex mode configuration | SCS |
| 66 | FDD | 15 kHz |
| 145 | FDD | 30 kHz |
| 298 | FDD | 60 kHz |
| 28 | TDD Note 1 | 15 kHz |
| 67 | TDD Note 1 | 30 kHz |
| 144 | TDD Note 1 | 60 kHz |
| 175 | TDD Note 2 | 60 kHz |
| 363 | TDD Note 2 | 120 kHz |
| NOTE 1: TDD UL-DL configuration is as specified in Table A.3.3.1-1 of TS 38.101-1 [18].  NOTE 2: TDD UL-DL configuration is as specified in Table A.3.3.1-1 of TS 38.101-2 [19]. | | |

Table 9.4.4.1.2.2-3: Number of ACK/NACKs transmitted by the UE during TMIB+TECGI

|  |  |  |
| --- | --- | --- |
| NACK/NACK, MIB+ECGI, FDD | Configuration of the serving cell in which the transmitted ACK/NACKs are counted | |
|  | Duplex mode configuration | SCS |
| 84 | FDD | 15 kHz |
| 193 | FDD | 30 kHz |
| 402 | FDD | 60 kHz |
| 28 | TDD Note 1 | 15 kHz |
| 81 | TDD Note 1 | 30 kHz |
| 159 | TDD Note 1 | 60 kHz |
| 233 | TDD Note 2 | 60 kHz |
| 491 | TDD Note 2 | 120 kHz |
| NOTE 1: TDD UL-DL configuration is as specified in Table A.3.3.1-1 of TS 38.101-1 [18].  NOTE 2: TDD UL-DL configuration is as specified in Table A.3.3.1-1 of TS 38.101-2 [19]. | | |

#### 9.4.4.2 NR − E-UTRAN TDD RSTD measurements

##### 9.4.4.2.1 Introduction

The requirements are applicable for NR−E-UTRAN TDD RSTD measurements requested via LPP [22, 27].

When the UE is in NE-DC operation mode and an NR−E-UTRAN TDD RSTD measurement configured by NR PCell is on a E-UTRA serving frequency carrier, then the corresponding E-UTRA intra-frequency measurements requirements as follows shall apply.

- Measurements configured on E-UTRA PSCC shall meet E-UTRAN OTDOA intra-frequency measurements requirements in clause 8.1.2.5. The applicable measurement accuracy requirements are in clause 9.1.10.

- Measurements configured on E-UTRA SCC shall meet all applicable requirements in clause 8.4, except that the terms PCell and primary component carrier shall be deemed to be swapped with PSCell and PSCC. The applicable measurement accuracy requirements are in clause 9.1.12, except that the terms PCell and primary component carrier shall be deemed to be swapped with PSCell and PSCC.

The requirements in clause 9.4.4.1 apply when:

- the UE is provided with the LTE timing information via LPP [27], including both *nr-LTE-SFN-Offset* and *nr-LTE-fineTiming-Offset*, or

- the UE is not provided with *nr-LTE-SFN-Offset* or *nr-LTE-fineTiming-Offset*, or

- the UE is provided with *nr-LTE-SFN-Offset* but not with *nr-LTE-fineTiming-Offset*.

When the UE is not aware of the SFN of at least one LTE cell in the OTDOA assistance data, the UE may be using autonomous gaps to acquire SFN of the OTDOA assistance data reference cell prior to requesting measurement gaps for performing the requested E-UTRA RSTD measurements before the  time period starts while meeting all the requirements in clause 9.4.4.2.2, provided that the OTDOA assistance data is provided to allow sufficient time for the UE to acquire the SFN before the  starts. When the UE is not aware of and cannot derive the subframe timing difference between the NR serving cell and the OTDOA assistance data reference cell, the UE may need to request measurement gaps to perform cell detection for the OTDOA assistance data reference cell prior to requesting measurement gaps for performing the requested E-UTRA RSTD measurements before the  time period starts while meeting all the requirements in clause 9.4.4.2.2, provided that the OTDOA assistance data is provided to allow sufficient time for the UE to detect the cell before the  starts.

##### 9.4.4.2.2 Requirements

When the physical layer cell identities of neighbour cells together with the OTDOA assistance data are provided, the UE shall be able to detect and measure inter-RAT -UTRAN TDD RSTD, specified in TS 38.215 [4], for at least *n*=16 cells, including the reference cell, within  ms as given below:

 ,

where

is the total time for detecting and measuring at least *n* cells,

 is the largest value of the cell-specific positioning subframe configuration period, defined in TS 36.211 [23], among the measured *n* cells including the reference cell,

 is the number of PRS positioning occasions as defined in Table 9.4.4.2.2-1, where a PRS positioning occasion is as defined in clause 9.4.4.1.2,

CSSFinterRAT=CSSFwithin\_gap,i is the scaling factor determined by the gap sharing scheme for the RSTD measurements on the carrier frequency *i* as defined in clause 9.1.5.2,

 =  ms is the measurement time for a single PRS positioning occasion which includes the sampling time and the processing time, and

the *n* cells are distributed on up to two E-UTRAN TDD carrier frequencies.

**Table 9.4.4.2.2-1: Number of PRS positioning occasions within **

|  |  |  |
| --- | --- | --- |
| Positioning subframe | Number of PRS positioning occasions, | |
| configuration period, | f2 Note1 | f1 and f2 Note2 |
| 160 ms | 16 × CSSFinterRAT | 32 × CSSFinterRAT |
| >160 ms | 8 × CSSFinterRAT | 16 × CSSFinterRAT |
| NOTE 1: When inter-RAT E-UTRAN TDD RSTD measurements are performed over the reference cell and neighbour cells, which belong to the E-UTRAN TDD carrier frequency f2.  NOTE 2: When inter-RAT E-UTRAN TDD RSTD measurements are performed over the reference cell and the neighbour cells, which belong to the E-UTRAN TDD carrier frequency f1 and the E-UTRAN TDD carrier frequency f2 respectively. | | |

The requirements in this clause shall apply for all TDD special subframe configurations specified in TS 36.211 [23] and for the TDD uplink-downlink configurations as specified in Table 9.4.4.2.2-2 for UE requiring measurement gaps for these measurements. For UEs capable of performing inter-RAT RSTD measurements without measurement gaps, TDD uplink-downlink subframe configurations as specified in Table 9.4.4.2.2-3 shall apply.

Table 9.4.4.2.2-2: TDD uplink-downlink subframe configurations applicable for inter-RAT RSTD requirements

|  |  |
| --- | --- |
| **PRS Transmission Bandwidth (RB)** | **Applicable TDD uplink-downlink configurations** |
| 6, 15 | 3, 4 and 5 |
| 25 | 1, 2, 3, 4, 5 and 6 |
| 50, 75, 100 | 0, 1, 2, 3, 4, 5 and 6 |
| NOTE 1: Uplink-downlink configurations are specified in Table 4.2-2 in TS 36.211 [23]. | |

**Table 9.4.4.2.2-3: TDD uplink-downlink subframe configurations applicable for inter-RAT RSTD requirements without gaps**

|  |  |
| --- | --- |
| **PRS Transmission Bandwidth (RB)** | **Applicable TDD uplink-downlink configurations** |
| 6, 15 | 1, 2, 3, 4 and 5 |
| 25, 50, 75, 100 | 0, 1, 2, 3, 4, 5 and 6 |
| NOTE 1: Uplink-downlink configurations are specified in Table 4.2-2 in TS 36.211 [23]. | |

The UE physical layer shall be capable of reporting RSTD for the reference cell and all the neighbor cells *i* out of at least (*n*-1) neighbor cells within  provided:

≥-6 dB for all Frequency Bands for the reference cell,

≥-13 dB for all Frequency Bands for neighbour cell *i*,

 and  conditions apply for all subframes of at least  PRS positioning occasions,

PRP 1,2|dBm according to TS 36.133 [15, Annex B.2.6] for a corresponding Band,

 is as defined in clause 9.4.4.1.2.

The time  starts from the first subframe of the PRS positioning occasion closest in time after both the OTDOA-RequestLocationInformation message and the OTDOA assistance data in the OTDOA-ProvideAssistanceData message via LPP as specified in TS 38.305 [22], are delivered to the physical layer of the UE.

The RSTD measurement accuracy for all measured neighbor cells *i* shall be fulfilled according to the accuracy as specified in clause 10.2.4.

9.4.4.2.2.1 RSTD Measurement Reporting Delay

This requirement assumes that that the measurement report is not delayed by other LPP signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 x TTIDCCH where TTIDCCH is the duration of subframe or slot or subslot when the measurement report is transmitted on the PUSCH with subframe or slot or subslot duration. This measurement reporting delay excludes any delay caused by no UL resources for UE to send the measurement report.

9.4.4.2.2.2 Requirements for acquiring the timing of the E-UTRA OTDOA reference cell

When the UE is not aware of the SFN of at least one LTE cell in the OTDOA assistance data, the UE supporting per-FR gaps may make autonomous gaps in downlink reception and uplink transmission of the PCell, PSCell, and each of the SCells in FR1 for acquiring SFN of the reference cell in the E-UTRA OTDOA assistance data, while no autonomous gaps in downlink reception or uplink transmission are allowed in any of the UE serving cells in FR2. The UE, which are only supporting per-UE gaps, may make autonomous gaps in downlink reception and uplink transmission of the PCell, PSCell, and each of the SCells for acquiring the SFN of the reference cell in the E-UTRA OTDOA assistance data.

When the UE is not aware of and cannot derive the subframe timing difference between the NR serving cell and the OTDOA assistance data reference cell, the UE may need to request measurement gaps while indicating *eutra-FineTimingDetection* according to TS 38.331 [2] for detecting the reference cell in the E-UTRA OTDOA assistance data.

When the UE is performing one or both of SFN acquisition or cell detection as specified above, the UE shall be able to determine the timing of the E-UTRA OTDOA assistance data reference cell during the time period

TRefCell,E-UTRAN = TDetect, E-UTRAN TDD + TMIB + TECGI ,

where

TDetect, E-UTRAN TDD = TIdentify, E-UTRAN TDD - Tmeasure, E-UTRAN TDD is according to clause 9.4.3 assuming CSSFinterRAT=1 and it is the time needed to detect the E-UTRA OTDOA assistance data reference cell when the UE needs to acquire the subframe and slot timing of the cell, provided the UE is configured with measurement gaps (TDetect, E-UTRAN TDD=0 when both *nr-LTE-SFN-Offset* and *nr-LTE-fineTiming-Offset* are provided in the E-UTRA OTDOA assistance data or the E-UTRA OTDOA assistance data reference cell is known to the UE), and

TMIB = 50 ms is the time required to acquire SFN and/or PHICH configuration of the E-UTRA OTDOA assistance data reference cell provided the OTDOA assistance data reference cell is decodable and at least all E-UTRA subframes #0 during TMIB are available at the UE receiver (TMIB=0 when *nr-LTE-SFN-Offset* is provided in the E-UTRA OTDOA assistance data and ECGI acquisition is not needed), and

TECGI = 100 ms is the time required to acquire ECGI of the E-UTRA OTDOA assistance data reference cell when *cellGlobalId* is included in *OTDOA-ReferenceCellInfo* and the UE is not aware of the ECGI of this cell (TECGI = 0 when *cellGlobalId* is not included in *OTDOA-ReferenceCellInfo* or the UE is aware of the ECGI of the E-UTRA OTDOA assistance data reference cell).

When detecting the E-UTRAN OTDOA reference cell, the requirements in this clause shall be met, provided the conditions for the detectable cell are fulfilled according to clause 9.4.3.1. In addition, the MIB of the E-UTRA OTDOA reference cell whose SFN is acquired shall be considered decodable by the UE provided the PBCH demodulation requirements are met according to TS 36.101 [25].

The requirement for acquiring the timing of the E-UTRA OTDOA reference cell within TRefCell,E-UTRAN is applicable when no DRX is used as well as when any of the DRX cycles specified in TS 38.331 [2] is used.

When TMIB>0 and UE is using autonomous gaps during TMIB, the UE shall transmit at least NACK/NACK, MIB, TDD ACK/NACKs on PCell, PSCell, and each of activated SCell(s) in the frequency range where the autonomous gaps are created, specified in Table 9.4.4.2.2.2-1. When both TMIB>0 and TECGI>0 and UE is using autonomous gaps during TMIB+TECGI, the UE shall transmit on PCell, PSCell, and each of activated SCell(s) in the frequency range where autonomous gaps are created at least NACK/NACK, MIB+ECGI, TDD ACK/NACKs specified in Table 9.4.4.2.2.2-3, provided the OTDOA reference cell bandwidth is configured in the OTDOA assistance data [22, 27]. The requirements in Tables 9.4.4.2.2.2-1, 9.4.4.2.2.2-2 and 9.4.4.2.2.2-3 apply, provided that:

- there is continuous DL data allocation,

- no DRX cycle is used,

- no measurement gaps are configured,

- only one code word is transmitted in each slot,

- 2 slot ACK/NACK feedback is configured,

- 20 ms SMTC period is configured,

- SSBs are transmitted in one slot within SMTC window.

Table 9.4.4.2.2.2-1: Minimum number of ACK/NACKs transmitted by the UE during TMIB

|  |  |  |
| --- | --- | --- |
| NACK/NACK, MIB, TDD | Configuration of the serving cell in which the transmitted ACK/NACKs are counted | |
|  | Duplex mode configuration | SCS |
| 15 | FDD | 15 kHz |
| 39 | FDD | 30 kHz |
| 85 | FDD | 60 kHz |
| 0 | TDD Note 1 | 15 kHz |
| 4 | TDD Note 1 | 30 kHz |
| 12 | TDD Note 1 | 60 kHz |
| 46 | TDD Note 2 | 60 kHz |
| 104 | TDD Note 2 | 120 kHz |
| NOTE 1: TDD UL-DL configuration is as specified in Table A.3.3.1-1 of TS 38.101-1 [18].  NOTE 2: TDD UL-DL configuration is as specified in Table A.3.3.1-1 of TS 38.101-2 [19]. | | |

Table 9.4.4.2.2.2-2: Void

Table 9.4.4.2.2.2-3: Minimum number of ACK/NACKs transmitted by the UE during TMIB+TECGI

|  |  |  |
| --- | --- | --- |
| NACK/NACK, MIB+ECGI, TDD | Configuration of the serving cell in which the transmitted ACK/NACKs are counted | |
|  | Duplex mode configuration | SCS |
| 84 | FDD | 15 kHz |
| 193 | FDD | 30 kHz |
| 402 | FDD | 60 kHz |
| 28 | TDD Note 1 | 15 kHz |
| 81 | TDD Note 1 | 30 kHz |
| 159 | TDD Note 1 | 60 kHz |
| 233 | TDD Note 2 | 60 kHz |
| 491 | TDD Note 2 | 120 kHz |
| NOTE 1: TDD UL-DL configuration is as specified in Table A.3.3.1-1 of TS 38.101-1 [18].  NOTE 2: TDD UL-DL configuration is as specified in Table A.3.3.1-1 of TS 38.101-2 [19]. | | |

### 9.4.5 Inter-RAT E-CID measurements

#### 9.4.5.1 NR−E-UTRAN FDD E-CID RSRP and RSRQ measurements

##### 9.4.5.1.1 Introduction

The requirements in clause 9.4.5.1. shall apply provided the UE has received *ECID-RequestLocationInformation* message from LMF via LPP requesting the UE to report inter-RAT E-UTRAN FDD E-CID RSRP and RSRQ measurements [22, 27].

##### 9.4.5.1.2 Requirements

The requirements in clause 9.4.2 also apply for this clause except the measurement reporting requirements. The measurement reporting requirements for E-CID RSRP and RSRQ are defined in clause 9.4.5.1.3.

##### 9.4.5.1.3 Measurement Reporting Delay

This requirement assumes that that the measurement report is not delayed by other LPP signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 x TTIDCCH where TTIDCCH is the duration of subframe or slot or subslot when the measurement report is transmitted on the PUSCH with subframe or slot or subslot duration. This measurement reporting delay excludes any delay caused by no UL resources for UE to send the measurement report.

Reported RSRP and RSRQ measurements contained in periodically triggered measurement reports shall meet the requirements in clauses 10.2.2 and 10.2.3, respectively.

#### 9.4.5.2 NR−E-UTRAN TDD E-CID RSRP and RSRQ measurements

##### 9.4.5.2.1 Introduction

The requirements in clause 9.4.5.2. shall apply provided the UE has received *ECID-RequestLocationInformation* message from LMF via LPP requesting the UE to report inter-RAT E-UTRAN TDD E-CID RSRP and RSRQ measurements [22, 27].

##### 9.4.5.2.2 Requirements

The requirements in clause 9.4.3 also apply for this clause except the measurement reporting requirements. The measurement reporting requirements for E-CID RSRP and RSRQ are defined in clause 9.4.5.2.3.

##### 9.4.5.2.3 Measurement Reporting Delay

This requirement assumes that the measurement report is not delayed by other LPP signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 x TTIDCCH where TTIDCCH is the duration of subframe or slot or subslot when the measurement report is transmitted on the PUSCH with subframe or slot or subslot duration. This measurement reporting delay excludes any delay caused by no UL resources for UE to send the measurement report.

Reported RSRP and RSRQ measurements contained in periodically triggered measurement reports shall meet the requirements in clauses 10.2.2 and 10.2.3, respectively.

### 9.4.6 NR − UTRAN FDD measurements

#### 9.4.6.1 Introduction

The requirements are applicable for NR− UTRAN FDD CPICH RSCP and CPICH Ec/No measurements for SRVCC.

#### 9.4.6.2 Requirements when no DRX is used

9.4.6.2.1 Identification of a new UTRA FDD cell

When explicit neighbour list is provided and no DRX is used, either measurement gaps are scheduled or the UE supports capability of conducting such measurements without gaps, the UE shall be able to identify a new detectable cell belonging to the monitored set within



A cell shall be considered detectable when

- CPICH Ec/Io > -20 dB,

- SCH\_Ec/Io > -17 dB for at least one channel tap and SCH\_Ec/Ior is equally divided between primary synchronisation code and secondary synchronisation code. When L3 filtering is used an additional delay can be expected.

9.4.6.2.2 UE UTRA FDD CPICH measurement capability

When measurement gaps are scheduled for UTRA FDD inter RAT measurements, or the UE supports capability of conducting such measurements without gaps, the UE physical layer shall be capable of reporting measurements to higher layers with measurement accuracy as specified in Clause 10 with measurement period given by



The UE shall be capable of performing UTRA FDD CPICH measurements for Xbasic measurementUTRA\_FDD inter-frequency cells per FDD frequency and the UE physical layer shall be capable of reporting measurements to higher layers with the measurement period of TMeasurement\_ UTRA\_FDD.

Xbasic measurement UTRA\_FDD = 6

TMeasurement\_Period UTRA\_FDD = 480 ms. The period used for calculating the measurement period Tmeasurement\_UTRA\_FDD for UTRA FDD CPICH measurements.

Tbasic\_identify\_UTRA\_FDD  = 300 ms. This is the time period used in the inter RAT equation in clause 9.4.6.2.1 where the maximum allowed time for the UE to identify a new UTRA FDD cell is defined.

Tbasic\_measurement\_UTRA\_FDD = 50 ms. This is the time period used in the equation for defining the measurement period for inter RAT CPICH measurements.

CSSFinterRAT = CSSFwithin\_gap,i is the scaling factor for the measured inter-RAT UTRA carrier *i* which is calculated as specified in clause 9.1.5.2.

Tinter1 is defined in clause 9.4.1.

9.4.6.2.3 Periodic Reporting

Reported measurements in periodically triggered measurement reports shall meet the requirements in clause 10.

9.4.6.2.4 Event Triggered Reporting

Reported measurements in event triggered measurement reports shall meet the requirements in clause 10.

The UE shall not send any event triggered measurement reports, as long as the reporting criteria is not fulfilled.

The measurement reporting delay is defined as the time between any event that will trigger a measurement report until the UE starts to transmit the measurement report over the Uu interface. This requirement assumes that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is twice the TTI of the uplink DCCH. This measurement reporting delay excludes a delay which caused by no UL resources for UE to send the measurement report.

The event triggered measurement reporting delay, measured without L3 filtering shall be less than Tidentify, UTRA\_FDD defined in Clause 9.4.6.2.1 for the minimum requirements. When L3 filtering is used an additional delay can be expected.

If a cell which has been detectable at least for the time period Tidentify, UTRA\_FDD defined in clause 9.4.6.2.1 for the minimum requirements and then triggers the measurement report as per TS 38.331 [2], the event triggered measurement reporting delay shall be less than Tmeasurement\_UTRA\_FDD defined in clause 9.4.6.2.2 provided the timing to that cell has not changed more than ± 32 chips while measurement gap has not been available and the L3 filter has not been used. When L3 filtering is used, an additional delay can be expected.

9.4.6.2.5 Event-triggered Periodic Reporting

Reported measurements contained in event triggered periodic measurement reports shall meet the requirements in clause 10.

The first report in event triggered periodic measurement reporting shall meet the requirements specified in clause 9.4.6.2.4 Event Triggered Reporting.

#### 9.4.6.3 Requirements when DRX is used

When explicit neighbour list is provided and DRX is used, either measurement gaps are scheduled or the UE supports capability of conducting such measurements without gaps, the UE shall be able to identify a new detectable cell belonging to the neighbour cell list within Tidentify,UTRA\_FDD as shown in table 9.4.6.3-1

Table 9.4.6.3-1: Requirement to identify a newly detectable UTRA FDD cell

|  |  |  |
| --- | --- | --- |
| DRX cycle length (s) | Tidentify\_UTRA\_FDD (s) (DRX cycles) | |
|  | Gap period = 40 ms | Gap period = 80 ms |
| ≤0.04 | Non DRX Requirements in clause 9.4.6.2 are applicable | Non DRX Requirements in clause 9.4.6.2 are applicable |
| 0.064 | 2.56 \*CSSFinterRAT (40\*CSSFinterRAT) | 4.8 \*CSSFinterRAT (75 \*CSSFinterRAT) |
| 0.08 | 3.2 \*CSSFinterRAT (40 \*CSSFinterRAT) | 4.8 \*CSSFinterRAT (60\* CSSFinterRAT) |
| 0.128 | 3.2 \*CSSFinterRAT (25\* CSSFinterRAT) | 4.8 \*CSSFinterRAT (37.5\* CSSFinterRAT) |
| 0.16 | 3.2 \*CSSFinterRAT (20 \*CSSFinterRAT) | 4.8 \*CSSFinterRAT (30 \*CSSFinterRAT) |
| 0.16<DRX-cycle≤2.56 | Note1 (20 \*CSSFinterRAT) | Note1  (20 \*CSSFinterRAT) |
| Note 1: Time depends upon the DRX cycle in use.  Note 2: CSSFinterRAT is as defined in clause 9.4.2.2. | | |

A cell shall be considered detectable provided following conditions are fulfilled: A cell shall be considered detectable when

- CPICH Ec/Io > -20 dB,

- SCH\_Ec/Io > -17 dB for at least one channel tap and SCH\_Ec/Ior is equally divided between primary synchronisation code and secondary synchronisation code. When L3 filtering is used an additional delay can be expected.

The UE shall be capable of performing RSCP and Ec/Io measurements of at least 6 UTRA cells per UTRA FDD carrier for up to 3 UTRA FDD carriers and the UE physical layer shall be capable of reporting RSCP and Ec/Io measurements to higher layers with the measurement period defined in table 9.4.6.3-2 when DRX is used, either measurement gaps are scheduled or the UE supports capability of conducting such measurements without gaps.

Table 9.4.6.3-2: Requirement to measure UTRA FDD cells

|  |  |  |
| --- | --- | --- |
| DRX cycle length (s) | Tmeasure\_ UTRA\_FDD (s) (DRX cycles) | |
|  | Gap period = 40 ms | Gap period = 80 ms |
| ≤0.04 | Non DRX Requirements in clause 9.4.6.2 are applicable | Non DRX Requirements in clause 9.4.6.2 are applicable |
| 0.064 | 0.48\* CSSFinterRAT (7.5\* Nfreq\*CSSFinterRAT) | 0.8 \*CSSFinterRAT  (12.5 \*CSSFinterRAT) |
| 0.08 | 0.48 \*CSSFinterRAT  (6 \*CSSFinterRAT) | 0. 8\*CSSFinterRAT (10 \*CSSFinterRAT) |
| 0.128 | 0.64 \*CSSFinterRAT  (5 \*CSSFinterRAT) | 0. 8 \*CSSFinterRAT (6.25 \*CSSFinterRAT) |
| 0.128<DRX-cycle≤2.56 | Note1 (5 \*CSSFinterRAT) | Note1 (5 \*CSSFinterRAT) |
| Note 1: Time depends upon the DRX cycle in use.  Note 2: CSSFinterRAT is as defined in clause 9.4.2.2. | | |

The measurement accuracy for all measured cells shall be as specified in the clause 10.3.

9.4.6.3.1 Periodic Reporting

Reported measurements in periodically triggered measurement reports shall meet the requirements in clause 10.

9.4.6.3.2 Event Triggered Reporting

Reported measurements in event triggered measurement reports shall meet the requirements in clause 10.

The UE shall not send any event triggered measurement reports, as long as the reporting criteria is not fulfilled.

The measurement reporting delay is defined as the time between any event that will trigger a measurement report until the UE starts to transmit the measurement report over the Uu interface. This requirement assumes that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is twice the TTI of the uplink DCCH. This measurement reporting delay excludes a delay which caused by no UL resources for UE to send the measurement report.

The event triggered measurement reporting delay, measured without L3 filtering shall be less than Tidentify,UTRA\_FDD defined in Clause 9.4.6.3.When L3 filtering is used an additional delay can be expected.

If a cell which has been detectable at least for the time period Tidentify, UTRA\_FDD defined in clause 9.4.6.3and then triggers the measurement report as per TS 38.331 [2], the event triggered measurement reporting delay shall be less than Tmeasurement\_UTRA\_FDD defined in clause 9.4.6.3 provided the timing to that cell has not changed more than ± 32 chips while measurement gap has not been available and the L3 filter has not been used. When L3 filtering is used, an additional delay can be expected.

9.4.6.3.3 Event-triggered Periodic Reporting

Reported measurements contained in event triggered periodic measurement reports shall meet the requirements in clause 10.

The first report in event triggered periodic measurement reporting shall meet the requirements specified in clause 9.4.6.3.2 Event Triggered Reporting.

### 9.4.7 NR – E-UTRAN measurements with autonomous gaps

#### 9.4.7.1 CGI identification of an E-UTRA cell with autonomous gaps

The requirements in this clause apply when the UE is configured with standalone NR, NE-DC or NR-DC. The UE shall identify and report the CGI when requested by an NR PCell for the purpose ‘reportCGI’. The UE may make autonomous gaps in downlink reception and uplink transmission for receiving MIB and SIB1 message according to clause 5.5.3.1 in TS 38.331 [2]. If autonomous gaps are used for measurement with the purpose of ‘reportCGI’, regardless of whether DRX is used or not, or regardless of whether SCell(s) are configured or not, the UE shall be able to identify a new CGI of E-UTRA cell within = 150 ms. This is the maximum allowed time for the UE to identify a new CGI of an E-UTRA cell, provided that the E-UTRA cell has been already identified by the UE.

A cell shall be considered identifiable following conditions are fulfilled:

- RSRP related side conditions given in Clause 9.1 in [15] are fulfilled for a corresponding Band,

- SCH\_RP and SCH Ês/Iot according to Annex B.2.2 in [15] for a corresponding Band

The MIB of an E-UTRA cell whose CGI is identified shall be considered decodable by the UE provided the PBCH demodulation requirements are met according to [25].

The requirement for identifying a new CGI of an E-UTRA cell within is applicable when no DRX is used as well as when any of the DRX cycles specified in TS 38.331 [2] is used.9.4.7.2 CGI reporting delay

The E-UTRA CGI reporting delay is defined as the time between a command that will trigger an E-UTRA CGI report and the point when the UE starts to transmit the measurement report over the air interface. This requirement assumes that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty of 2 x TTIDCCH resulting when inserting the measurement report to the TTI of the uplink DCCH. This measurement reporting delay excludes any delay caused by lack of UL resources for UE to send the measurement report.

The CGI reporting delay shall be less than plus RRC procedure delay defined in clause 12 in TS 38.331 [2], and an additional 30ms margin.

## 9.4A Inter-RAT measurements for RedCap

### 9.4A.1 Introduction

The requirements in this clause are specified for NR−E-UTRAN FDD and NR−E-UTRAN TDD measurements and are applicable without an explicit E-UTRAN neighbour cell list containing physical layer cell identities, for a UE:

- in RRC\_CONNECTED state, and

- configured

- with SA operation mode by PCell with NR−E-UTRAN FDD or TDD measurement (RSRP, RSRQ, RS-SINR) on E-UTRA non-serving frequency carrier, and

- configured with an appropriate measurement gap pattern according to Table 9.1A.2-3.

Parameter TInter1\_RedCap used in inter-RAT requirements in clause 9.4A is specified in Table 9.4A.1-1.

Table 9.4A.1-1: Minimum available time for inter-RAT measurements

|  |  |  |  |
| --- | --- | --- | --- |
| Gap Pattern Id | MeasurementGap Length (MGL, ms) | Measurement Gap Repetition Period  (MGRP, ms) | Minimum available time for inter-frequency and inter-RAT measurements during 480 ms period  (Tinter1\_RedCap, ms) |
| 0 | 6 | 40 | 60 |
| 1 | 6 | 80 | 30 |
| 2 | 3 | 40 | 24Note 1 |
| 3 | 3 | 80 | 12Note 1 |
| 4 | 6 | 20 | 120 Note 1 |
| 6 | 4 | 20 | 72 Note 1,3,6 |
| 7 | 4 | 40 | 36 Note 1,4,6 |
| 8 | 4 | 80 | 18Note 1,5,6 |
| 10 | 3 | 20 | 48 Note 1 |
| NOTE 1: When determining UE requirements using Tinter1\_RedCap for gap pattern IDs 2, 3, 4, 6, 7, 8, 10, Tinter1\_RedCap = 60 for gap pattern IDs 2, 4, 6, 7, 10, and Tinter1\_RedCap = 30 for gap pattern IDs 3 and 8 shall be used.  NOTE 2: Measurement gaps pattern configurations applicability is as specified in Table [9.1A.2-1].  NOTE 3: When this gap pattern is used, the Tinter\_RedCap for E-UTRA inter-frequency measurements is 48 ms corresponding to the first 3 ms of the 4 ms gap.  NOTE 4: When this gap pattern is used, the Tinter\_RedCap for E-UTRA inter-frequency measurements is 24 ms corresponding to the first 3 ms of the 4 ms gap.  NOTE 5: When this gap pattern is used, the Tinter\_RedCap for E-UTRA inter-frequency measurements is 12 ms corresponding to the first 3 ms of the 4 ms gap.  NOTE 6: This gap pattern is applicable for E-UTRA inter-frequency measurements only if gap based NR measurements are also configured. | | | |

A UE configured with gap pattern ID 2, 3 or 10 shall be able to detect a target cell, provided that

- the E-UTRA subframe #0 or #5 of the target E-UTRAN cell begins not earlier than 500 μs from the start of the measurement gap, and

- the E-UTRA subframe #0 or #5 of the target E-UTRAN cell ends not later than 500 μs before the end of the measurement gap in case of FDD and not later than 750 μs before the end of measurement gap in case of TDD.

A UE configured with gap pattern ID 6, 7 or 8 shall be able to detect a target cell, provided that

- the E-UTRA subframe #0 or #5 of the target E-UTRAN cell begins not earlier than 500 μs from the start of the measurement gap, and

- the E-UTRA subframe #0 or #5 of the target E-UTRAN cell ends no later than 1500 μs before the end of the measurement gap in case of FDD and no later than 1750 μs before the end of measurement gap in case of TDD.

In this clause, the SSB terminology applies for both CD-SSB and NCD-SSB.

### 9.4A.2 NR − E-UTRAN FDD measurements

#### 9.4A.2.1 Introduction

The requirements are applicable for NR−E-UTRAN FDD RSRP, RSRQ, and RS-SINR measurements.

In the requirements, an E-UTRAN FDD cell is considered to be detectable when:

*Editor’s note: New reference clauses shall be specified for 1Rx.*

- For 2 Rx RedCap UE:

- RSRP related conditions in the accuracy requirements in clause 10.2.2 are fulfilled for a corresponding Band, together with the corresponding side conditions in Annex B.2.3 and Annex B.3.3 of TS 36.133 [15],

- RSRQ related conditions in the accuracy requirements in clause 10.2.3 are fulfilled for a corresponding Band, together with the corresponding side conditions in Annex B.2.3 and Annex B.3.3 of TS 36.133 [15],

- RS-SINR related conditions in the accuracy requirements in clause 10.2.5 are fulfilled for a corresponding Band, together with the corresponding side conditions in Annex B.2.3 and Annex B.3.19 of TS 36.133 [15].

- For 1 Rx RedCap UE:

- RSRP related conditions in the accuracy requirements in clause [x.y.z] are fulfilled for a corresponding Band, together with the corresponding side conditions in Annex [B.2.3] and Annex [B.3.3] of TS 36.133 [15],

- RSRQ related conditions in the accuracy requirements in clause [x.y.z] are fulfilled for a corresponding Band, together with the corresponding side conditions in Annex [B.2.3] and Annex [B.3.3] of TS 36.133 [15],

#### 9.4A.2.2 Requirements when no DRX is used

When the UE requires measurement gaps to identify and measure inter-RAT cells and an appropriate measurement gap pattern is scheduled, the UE shall be able to identify a new detectable FDD cell within TIdentify\_RedCap, E-UTRAN FDD according to the following expression:

,

where:

TBasicIdentify = 480 ms,

TInter1\_RedCap is defined in clause 9.4A.1,

CSSFinterRAT\_RedCap = CSSFwithin\_gap\_RedCap,i is the scaling factor for the measured inter-RAT E-UTRA carrier *i* which is calculated as specified in clause 9.1A.5.2.

Identification of a cell shall include detection of the cell and additionally performing a single measurement with measurement period of TMeasure\_RedCap, E-UTRAN FDD defined in Table 9.4A.2.2-1 and Table 9.4A.2.2-2 for 2 Rx RedCap UE and 1 Rx RedCap UE, respectively.

Table 9.4A.2.2-1: Measurement period and measurement bandwidth for 2Rx RedCap UE

|  |  |  |
| --- | --- | --- |
| **Configuration** | **Physical Layer Measurement period: TMeasure\_RedCap, E-UTRAN FDD [ms]** | **Measurement bandwidth [RB]** |
| 0 | 480 x CSSFinterRAT\_RedCap | 6 |
| 1 (Note 1) | 240 x CSSFinterRAT\_RedCap | 50 |
| NOTE 1: This configuration is optional. | | |

Table 9.4A.2.2-2: Measurement period and measurement bandwidth for 1Rx RedCap UE

|  |  |  |
| --- | --- | --- |
| **Configuration** | **Physical Layer Measurement period: TMeasure\_RedCap, E-UTRAN FDD [ms]** | **Measurement bandwidth [RB]** |
| 0 | 960 x CSSFinterRAT\_RedCap | 6 |
| 1 (Note 1) | 480 x CSSFinterRAT\_RedCap | 50 |
| NOTE 1: This configuration is optional. | | |

The UE shall be capable of identifying and performing NR – E-UTRAN FDD RSRP, RSRQ, and RS-SINR measurements of at least 4 identified E-UTRAN FDD cells per E-UTRA FDD carrier frequency layer during each layer 1 measurement period, for up to 7 E-UTRA FDD carrier frequency layers.

If higher layer filtering is used, an additional cell identification delay can be expected.

For 2 Rx RedCap UE:

The NR – E-UTRAN FDD RSRP measurement accuracy for all measured cells shall be as specified in clause 10.2.2. The NR – E-UTRAN FDD RSRQ measurement accuracy for all measured cells shall be as specified in clause 10.2.3. The NR – E-UTRAN FDD RS-SINR measurement accuracy for all measured cells shall be as specified in clause 10.2.5.

For 1 Rx RedCap UE:

The NR – E-UTRAN FDD RSRP measurement accuracy for all measured cells shall be as specified in clause [x.y.z]. The NR – E-UTRAN FDD RSRQ measurement accuracy for all measured cells shall be as specified in clause [x.y.z]. The NR – E-UTRAN FDD RS-SINR measurement accuracy for all measured cells shall be as specified in clause [x.y.z].

#### 9.4A.2.3 Requirements when DRX is used

When DRX is in use and measurement gaps are configured, the UE shall be able to identify a new detectable E-UTRAN FDD cell within TIdentify\_RedCap, E-UTRAN FDD specified in Table 9.4A.2.3-1.

Table 9.4A.2.3-1: Requirement to identify a newly detectable E-UTRAN FDD cell

|  |  |  |
| --- | --- | --- |
| **DRX cycle length (s)** | **TIdentify\_RedCap, E-UTRAN FDD (s) (DRX cycles)** | |
|  | Gap period = 40 ms, 20 ms | Gap period = 80 ms |
| ≤0.16 | Non-DRX requirements in clause 9.4A.2.2 apply | Non-DRX requirements in clause 9.4A.2.2 apply |
| 0.256 | 5.12\* CSSFinterRAT\_RedCap (20\*CSSFinterRAT\_RedCap) | 7.68\* CSSFinterRAT\_RedCap (30\*CSSFinterRAT\_RedCap) |
| 0.32 | 6.4\* CSSFinterRAT\_RedCap (20\*CSSFinterRAT\_RedCap) | 7.68\* CSSFinterRAT\_RedCap (24\*CSSFinterRAT\_RedCap) |
| 0.32< DRX-cycle ≤10.24 | Note1 (20\*CSSFinterRAT\_RedCap) | Note1 (20\*CSSFinterRAT\_RedCap) |
| NOTE 1: The time depends on the DRX cycle length.  NOTE 2: CSSFinterRAT\_RedCap is as defined in clause 9.4A.2.2. | | |

When DRX is in use, the UE shall be capable of performing NR – E-UTRAN FDD RSRP, RSRQ, and RS-SINR measurements of at least 4 identified E-UTRAN FDD cells per E-UTRA FDD frequency layer during each layer 1 measurement period, for up to 7 E-UTRA FDD carrier frequency layers, and the UE physical layer shall be capable of reporting NR – E-UTRAN FDD RSRP, RSRQ, and RS-SINR measurements to higher layers with the measurement period Tmeasure\_RedCap, E-UTRAN FDD specified in Table 9.4A.2.3-2 and Table 9.4A.2.3-3.

Table 9.4A.2.3-2: Requirement to measure E-UTRAN FDD cells for 2Rx RedCap UE

|  |  |
| --- | --- |
| **DRX cycle length (s)** | **Tmeasure\_RedCap, E-UTRAN FDD (s) (DRX cycles)** |
| ≤0.08 | Non-DRX requirements in clause 9.4A.2.2 apply |
| 0.08< DRX-cycle ≤10.24 | Note1 (5\* CSSFinterRAT\_RedCap) |
| NOTE 1: The time depends on the DRX cycle length.  NOTE 2: CSSFinterRAT\_RedCap is as defined in clause 9.4A.2.2. | |

Table 9.4A.2.3-3: Requirement to measure E-UTRAN FDD cells for 1Rx RedCap UE

|  |  |
| --- | --- |
| **DRX cycle length (s)** | **Tmeasure\_RedCap, E-UTRAN FDD (s) (DRX cycles)** |
| ≤0.08 | Non-DRX requirements in clause 9.4A.2.2 apply |
| 0.08< DRX-cycle ≤10.24 | Note1 (10\* CSSFinterRAT\_RedCap) |
| NOTE 1: The time depends on the DRX cycle length.  NOTE 2: CSSFinterRAT\_RedCap is as defined in clause 9.4A.2.2. | |

If higher layer filtering is used, an additional cell identification delay can be expected.

For 2 Rx RedCap UE:

The NR – E-UTRAN FDD RSRP measurement accuracy for all measured cells shall be as specified in clause 10.2.2. The NR – E-UTRAN FDD RSRQ measurement accuracy for all measured cells shall be as specified in clause 10.2.3. The NR – E-UTRAN FDD RS-SINR measurement accuracy for all measured cells shall be as specified in clause 10.2.5.

For 1 Rx RedCap UE:

The NR – E-UTRAN FDD RSRP measurement accuracy for all measured cells shall be as specified in clause [x.y.z]. The NR – E-UTRAN FDD RSRQ measurement accuracy for all measured cells shall be as specified in clause [x.y.z]. The NR – E-UTRAN FDD RS-SINR measurement accuracy for all measured cells shall be as specified in clause [x.y.z].

#### 9.4A.2.4 Measurement reporting requirements

##### 9.4A.2.4.1 Periodic Reporting

For 2 Rx RedCap UE: The requirements in clause 9.4.2.4.1 shall apply.

For 1 Rx RedCap UE: The reported NR – E-UTRAN FDD RSRP, RSRQ, and RS-SINR measurements contained in periodically triggered measurement reports shall meet the requirements in clauses [x.y.z], [x.y.z], and [x.y.z], respectively.

##### 9.4A.2.4.2 Event-Triggered Periodic Reporting

For 2 Rx RedCap UE: The reported NR – E-UTRAN FDD RSRP, RSRQ, and RS-SINR measurements contained in event-triggered periodic measurement reports shall meet the requirements in clauses 10.2.2, 10.2.3, and 10.2.5, respectively.

For 1 Rx RedCap UE: The reported NR – E-UTRAN FDD RSRP, RSRQ, and RS-SINR measurements contained in event-triggered periodic measurement reports shall meet the requirements in clauses [x.y.z], [x.y.z], and [x.y.z], respectively.

The first report in event-triggered periodic measurement reporting shall meet the requirements specified in clause 9.4A.2.4.3.

##### 9.4A.2.4.3 Event-Triggered Reporting

For 2 Rx RedCap UE: The reported NR – E-UTRAN FDD RSRP, RSRQ, and RS-SINR measurements contained in event-triggered measurement reports shall meet the requirements in clauses 10.2.2, 10.2.3, and 10.2.5, respectively.

For 1 Rx RedCap UE: The reported NR – E-UTRAN FDD RSRP, RSRQ, and RS-SINR measurements contained in event-triggered measurement reports shall meet the requirements in clauses [x.y.z], [x.y.z], and [x.y.z], respectively.

The UE shall not send any event-triggered measurement reports as long as no reporting criteria are fulfilled.

The measurement reporting delay is defined as the time between an event that will trigger a measurement report and the point when the UE starts to transmit the measurement report over the air interface. This requirement assumes that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 x TTIDCCH where TTIDCCH is the duration of subframe or slot or subslot when the measurement report is transmitted on the PUSCH with subframe or slot or subslot duration. This measurement reporting delay excludes a delay which caused by no UL resources for UE to send the measurement report.

The event triggered measurement reporting delay, measured without L3 filtering shall be less than T Identify\_RedCap, E-UTRAN FDD defined in clauses 9.4A.2.2 and 9.4A.2.3 without DRX and with DRX, respectively.When L3 filtering is used, an additional delay can be expected.

If a cell which has been detectable at least for the time period TIdentify\_RedCap, E-UTRAN FDD becomes undetectable for a period ≤ 5 seconds and then the cell becomes detectable again and triggers an event as per TS 38.331 [2], the event triggered measurement reporting delay shall be less than TMeasure\_RedCap, E-UTRAN FDD provided the timing to that cell has not changed more than ± 50 Ts while measurement gap has not been available and the L3 filter has not been used.

### 9.4A.3 NR − E-UTRAN TDD measurements

#### 9.4A.3.1 Introduction

The requirements are applicable for NR−E-UTRAN TDD RSRP, RSRQ, and RS-SINR measurements.

In the requirements, an E-UTRAN TDD cell is considered to be detectable when:

*Editor’s note: New reference clauses shall be specified for 1Rx.*

- For 2 Rx RedCap UE:

- RSRP related conditions in the accuracy requirements in clause 10.2.2 are fulfilled for a corresponding Band, together with the corresponding side conditions in Annex B.2.3 and Annex B.3.3 of TS 36.133 [15],

- RSRQ related conditions in the accuracy requirements in clause 10.2.3 are fulfilled for a corresponding Band, together with the corresponding side conditions in Annex B.2.3 and Annex B.3.3 of TS 36.133 [15],

RS-SINR related conditions in the accuracy requirements in clause 10.2.5 are fulfilled for a corresponding Band, together with the corresponding side conditions in Annex B.2.3 and Annex B.3.19 of TS 36.133 [15].

- For 1 Rx RedCap UE:

- RSRP related conditions in the accuracy requirements in clause [x.y.z] are fulfilled for a corresponding Band, together with the corresponding side conditions in Annex B.2.3 and Annex B.3.3 of TS 36.133 [15],

- RSRQ related conditions in the accuracy requirements in clause [x.y.z] are fulfilled for a corresponding Band, together with the corresponding side conditions in Annex B.2.3 and Annex B.3.3 of TS 36.133 [15],

RS-SINR related conditions in the accuracy requirements in clause [x.y.z] are fulfilled for a corresponding Band, together with the corresponding side conditions in Annex B.2.3 and Annex B.3.19 of TS 36.133 [15].

#### 9.4A.3.2 Requirements when no DRX is used

When the UE requires measurement gaps to identify and measure inter-RAT cells and an appropriate measurement gap pattern is scheduled, the UE shall be able to identify a new detectable TDD cell within TIdentify\_RedCap, E-UTRAN TDD according to the following expression:

- When configuration 0 or configuration 1 in Table 9.4A.3.2-1 is applied,

,

- When configuration 2 or configuration 3 in Table 9.4A.3.2-1 is applied,

,

where:

TBasicIdentify = 480 ms,

TInter1\_RedCap is defined in clause 9.4A.1,

CSSFinterRAT\_RedCap = CSSFwithin\_gap\_RedCap,i is the scaling factor for the measured inter-RAT E-UTRA carrier *i* which is calculated as specified in clause 9.1A.5.2.

Identification of a cell shall include detection of the cell and additionally performing a single measurement with measurement period of TMeasure\_RedCap, E-UTRAN TDD defined in Table 9.4A.3.2-1 and Table 9.4A.3.2-1 for 2 Rx RedCap UE and 1 Rx RedCap UE, respectively.

Table 9.4A.3.2-1: TMeasure\_RedCap, E-UTRAN TDD for different configurations for 2Rx RedCap UE

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Configuration | Measurement bandwidth (RB) | Number of UL/DL sub-frames per half frame (5 ms) | | DwPTS | | TMeasure\_RedCap, E-UTRAN TDD (ms) |
|  |  | DL | UL | Normal CP | Extended CP |  |
| 0 | 6 | 2 | 2 |  |  | 480 x CSSFinterRAT\_RedCap |
| 1 (Note 1) | 50 | 2 | 2 |  |  | 240 x CSSFinterRAT\_RedCap |
| 2 | 6 | 1 | 3 |  |  | 720 x CSSFinterRAT\_RedCap |
| 3 (Note 1) | 50 | 1 | 3 |  |  | 480 x CSSFinterRAT\_RedCap |
| NOTE 1: This configuration is optional. | | | | | | |

Table 9.4A.3.2-2: TMeasure\_RedCap, E-UTRAN TDD for different configurations for 1Rx RedCap UE

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Configuration | Measurement bandwidth (RB) | Number of UL/DL sub-frames per half frame (5 ms) | | DwPTS | | TMeasure\_RedCap, E-UTRAN TDD (ms) |
|  |  | DL | UL | Normal CP | Extended CP |  |
| 0 | 6 | 2 | 2 |  |  | 960 x CSSFinterRAT\_RedCap |
| 1 (Note 1) | 50 | 2 | 2 |  |  | 480 x CSSFinterRAT\_RedCap |
| 2 | 6 | 1 | 3 |  |  | 1440 x CSSFinterRAT\_RedCap |
| 3 (Note 1) | 50 | 1 | 3 |  |  | 960 x CSSFinterRAT\_RedCap |
| NOTE 1: This configuration is optional. | | | | | | |

The UE shall be capable of identifying and performing NR – E-UTRAN TDD RSRP, RSRQ, and RS-SINR measurements of at least 4 identified E-UTRAN TDD cells per E-UTRA TDD carrier frequency layer during each layer 1 measurement period, for up to 7 E-UTRA TDD carrier frequency layers.

If higher layer filtering is used, an additional cell identification delay can be expected.

For 2 Rx RedCap UE:

The NR – E-UTRAN TDD RSRP measurement accuracy for all measured cells shall be as specified in clause 10.2.2. The NR – E-UTRAN TDD RSRQ measurement accuracy for all measured cells shall be as specified in clause 10.2.3. The NR – E-UTRAN TDD RS-SINR measurement accuracy for all measured cells shall be as specified in clause 10.2.5.

For 1 Rx RedCap UE:

The NR – E-UTRAN TDD RSRP measurement accuracy for all measured cells shall be as specified in clause [x.y.z]. The NR – E-UTRAN TDD RSRQ measurement accuracy for all measured cells shall be as specified in clause [x.y.z]. The NR – E-UTRAN TDD RS-SINR measurement accuracy for all measured cells shall be as specified in clause [x.y.z].

#### 9.4A.3.3 Requirements when DRX is used

When DRX is in use and measurement gaps are configured, the UE shall be able to identify a new detectable E-UTRAN TDD cell within TIdentify\_RedCap, E-UTRAN TDD specified in Table 9.4A.3.3-1.

Table 9.4A.3.3-1: Requirement to identify a newly detectable E-UTRAN TDD cell

|  |  |  |
| --- | --- | --- |
| DRX cycle length (s) | TIdentify\_RedCap, E-UTRAN TDD (s) (DRX cycles) | |
|  | Gap period = 40 ms, 20 ms | Gap period = 80 ms |
| ≤0.16 | Non-DRX requirements in clause [9.4A.3.2] apply | Non-DRX requirements in clause [9.4A.3.2] apply |
| 0.256 | 5.12\* CSSFinterRAT\_RedCap (20\*CSSFinterRAT\_RedCap) | 7.68\* CSSFinterRAT\_RedCap (30\*CSSFinterRAT\_RedCap) |
| 0.32 | 6.4\* CSSFinterRAT\_RedCap (20\*CSSFinterRAT\_RedCap) | 7.68\* CSSFinterRAT\_RedCap (24\*CSSFinterRAT\_RedCap) |
| 0.32< DRX-cycle ≤10.24 | Note1 (20\*CSSFinterRAT\_RedCap) | Note1 (20\*CSSFinterRAT\_RedCap) |
| NOTE 1: The time depends on the DRX cycle length.  NOTE 2: CSSFinterRAT\_RedCap is as defined in clause [9.4A.3.2]. | | |

For 1Rx RedCap UE, a cell shall be considered detectable provided following conditions are fulfilled:

- RSRP|dBm and RSRP Ês/Iot according to Annex B.2.3 in [15] for a corresponding Band,

- other RSRP related side conditions given in Clause 9.1.3.3 and 9.1.3.4 in [15] are fulfilled for a corresponding Band,

- RSRQ related side conditions given in Sections 9.1.6.5 and 9.1.6.6 in [15] are fulfilled for a corresponding Band,

- SCH\_RP|dBm SCH Ês/Iot according to Annex B.2.3 in [15] for a corresponding Band.

When DRX is in use, the UE shall be capable of performing NR – E-UTRAN TDD RSRP, RSRQ, and RS-SINR measurements of at least 4 identified E-UTRAN TDD cells per E-UTRA TDD frequency layer during each layer 1 measurement period, for up to 7 E-UTRA TDD carrier frequency layers, and the UE physical layer shall be capable of reporting NR – E-UTRAN TDD RSRP, RSRQ, and RS-SINR measurements to higher layers with the measurement period Tmeasure\_RedCap, E-UTRAN TDD specified in Table 9.4A.3.3-2 and Table 9.4A.3.3-3 for 2 Rx RedCap UE and 1 Rx RedCap UE, respectively.

Table 9.4A.3.3-2: Requirement to measure E-UTRAN TDD cells for 2Rx RedCap UE

|  |  |
| --- | --- |
| DRX cycle length (s) | Tmeasure\_RedCap, E-UTRAN TDD (s) (DRX cycles) |
| ≤0.08 | Non-DRX Requirements in clause [9.4A.3.2] apply |
| 0.128 | For configuration 2 Note3, non-DRX requirements in clause [9.4A.3.2] apply,  Otherwise: Note1 (5\*CSSFinterRAT\_RedCap) |
| 0.128<DRX-cycle≤10.24 | Note1 (5\*CSSFinterRAT\_RedCap) |
| NOTE 1: The time depends on the DRX cycle length.  NOTE 2: CSSFinterRAT\_RedCap is as defined in clause 9.4A.3.2.  NOTE 3: See Table [9.4A.3.2-1]. | |

Table 9.4A.3.3-3: Requirement to measure E-UTRAN TDD cells for 1Rx RedCap UE

|  |  |
| --- | --- |
| DRX cycle length (s) | Tmeasure\_RedCap, E-UTRAN TDD (s) (DRX cycles) |
| ≤0.08 | Non-DRX Requirements in clause [9.4A.3.2] apply |
| 0.128 | For configuration 2 Note3, non-DRX requirements in clause [9.4A.3.2] apply,  Otherwise: Note1 (5\*CSSFinterRAT\_RedCap) |
| 0.128<DRX-cycle≤10.24 | Note1 (10\*CSSFinterRAT\_RedCap) |
| NOTE 1: The time depends on the DRX cycle length.  NOTE 2: CSSFinterRAT\_RedCap is as defined in clause 9.4A.3.2.  NOTE 3: See Table [9.4A.3.2-1]. | |

If higher layer filtering is used, an additional cell identification delay can be expected.

For 2 Rx RedCap UE:

The NR – E-UTRAN TDD RSRP measurement accuracy for all measured cells shall be as specified in clause 10.2.2. The NR – E-UTRAN TDD RSRQ measurement accuracy for all measured cells shall be as specified in clause 10.2.3. The NR – E-UTRAN TDD RS-SINR measurement accuracy for all measured cells shall be as specified in clause 10.2.5.

For 1 Rx RedCap UE:

The NR – E-UTRAN TDD RSRP measurement accuracy for all measured cells shall be as specified in clause [x.y.z]. The NR – E-UTRAN TDD RSRQ measurement accuracy for all measured cells shall be as specified in clause [x.y.z]. The NR – E-UTRAN TDD RS-SINR measurement accuracy for all measured cells shall be as specified in clause [x.y.z].

#### 9.4A.3.4 Measurement reporting requirements

##### 9.4A.3.4.1 Periodic Reporting

For 2 Rx RedCap UE: The requirements in clause 9.4.3.4.1 shall apply.

For 1 Rx RedCap UE: The reported NR – E-UTRAN TDD RSRP, RSRQ, and RS-SINR measurements contained in periodically triggered measurement reports shall meet the requirements in clauses [x.y.z], [x.y.z], and [x.y.z], respectively.

##### 9.4A.3.4.2 Event-Triggered Periodic Reporting

For 2 Rx RedCap UE: The reported NR – E-UTRAN TDD RSRP, RSRQ, and RS-SINR measurements contained in event-triggered periodic measurement reports shall meet the requirements in clauses 10.2.2, 10.2.3, and 10.2.5, respectively.

For 1 Rx RedCap UE: The reported NR – E-UTRAN TDD RSRP, RSRQ, and RS-SINR measurements contained in event-triggered periodic measurement reports shall meet the requirements in clauses [x.y.z], [x.y.z], and [x.y.z], respectively.

The first report in event-triggered periodic measurement reporting shall meet the requirements specified in clause 9.4A.3.4.3.

##### 9.4A.3.4.3 Event-Triggered Reporting

For 2 Rx RedCap UE: The reported NR – E-UTRAN TDD RSRP, RSRQ, and RS-SINR measurements contained in event-triggered measurement reports shall meet the requirements in clauses 10.2.2, 10.2.3, and 10.2.5, respectively.

For 1 Rx RedCap UE: The reported NR – E-UTRAN TDD RSRP, RSRQ, and RS-SINR measurements contained in event-triggered measurement reports shall meet the requirements in clauses [x.y.z], [x.y.z], and [x.y.z], respectively.

The UE shall not send any event-triggered measurement reports as long as no reporting criteria are fulfilled.

The measurement reporting delay is defined as the time between an event that will trigger a measurement report and the point when the UE starts to transmit the measurement report over the air interface. This requirement assumes that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 x TTIDCCH where TTIDCCH is the duration of subframe or slot or subslot when the measurement report is transmitted on the PUSCH with subframe or slot or subslot duration. This measurement reporting delay excludes a delay which caused by no UL resources for UE to send the measurement report.

The event triggered measurement reporting delay, measured without L3 filtering shall be less than T Identify\_RedCap, E-UTRAN TDD defined in clauses 9.4A.3.2 and 9.4A.3.3 without DRX and with DRX, respectively.When L3 filtering is used, an additional delay can be expected.

If a cell which has been detectable at least for the time period TIdentify\_RedCap, E-UTRAN TDD becomes undetectable for a period ≤ 5 seconds and then the cell becomes detectable again and triggers an event as per TS 38.331 [2], the event triggered measurement reporting delay shall be less than TMeasure\_RedCap, E-UTRAN TDD provided the timing to that cell has not changed more than ± 50 Ts while measurement gap has not been available and the L3 filter has not been used.

### 9.4A.4 NR – E-UTRAN measurements with autonomous gaps

#### 9.4A.4.1 CGI identification of an E-UTRA cell with autonomous gaps

The requirements in this clause apply when the UE is configured with standalone NR with 2Rx UE. The UE shall identify and report the CGI when requested by an NR PCell for the purpose ‘reportCGI’. The UE may make autonomous gaps in downlink reception and uplink transmission for receiving MIB and SIB1 message according to clause 5.5.3.1 in TS 38.331 [2].

For 2Rx RedCap UE: If autonomous gaps are used for measurement with the purpose of ‘reportCGI’, the UE shall be able to identify a new CGI of E-UTRA cell within = 150 ms.

For 1Rx RedCap UE: If autonomous gaps are used for measurement with the purpose of ‘reportCGI’, the UE shall be able to identify a new CGI of E-UTRA cell within = 190 ms.

This is the maximum allowed time for the UE to identify a new CGI of an E-UTRA cell, provided that the E-UTRA cell has been already identified by the UE.

A cell shall be considered identifiable following conditions are fulfilled:

- RSRP related side conditions given in Clause 9.1 in [15] are fulfilled for a corresponding Band,

- SCH\_RP and SCH Ês/Iot according to Annex B.2.2 in [15] for a corresponding Band

The MIB of an E-UTRA cell whose CGI is identified shall be considered decodable by the UE provided the PBCH demodulation requirements are met according to [25].

The requirement for identifying a new CGI of an E-UTRA cell within is applicable when no DRX is used as well as when any of the DRX cycles specified in TS 38.331 [2] is used.

#### 9.4A.4.2 CGI reporting delay

The E-UTRA CGI reporting delay is defined as the time between a command that will trigger an E-UTRA CGI report and the point when the UE starts to transmit the measurement report over the air interface. This requirement assumes that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty of 2 x TTIDCCH resulting when inserting the measurement report to the TTI of the uplink DCCH. This measurement reporting delay excludes any delay caused by lack of UL resources for UE to send the measurement report.

The CGI reporting delay shall be less than plus RRC procedure delay defined in clause 12 in TS 38.331 [2], and an additional 30ms margin.

#### 9.4A.4.3 CGI reporting scheduling restriction

When a UE is identifying CGI of an E-UTRA FDD cell or E-UTRA TDD cell with autonomous gaps, within time period Tidentify\_CGI\_RedCap, E-UTRA specified in clause 9.4A.4.1, the UE shall be able to transmit at least the number of ACK/NACKs specified in Table 9.4A.4.3-1 on PCell in the frequency range where autonomous gaps are used, provided that:

- there is continuous DL data allocation,

- no DRX cycle is used,

- no measurement gaps are configured,

- only one code word is transmitted in each slot,

- 2 slot ACK/NACK feedback is configured,

- 20 ms SMTC period is configured.

Table 9.4A.4.3-1: Minimum number of ACK/NACKs transmitted by the UE during Tidentify\_CGI\_RedCap, E-UTRA

|  |  |  |
| --- | --- | --- |
| Minimum number of transmitted ACK/NACKs | SCS | |
|  | Duplex mode configuration | SCS |
|  | Duplex mode configuration | SCS |
| 84 | FDD | 15 kHz |
| 193 | FDD | 30 kHz |
| 402 | FDD | 60 kHz |
| 28 | TDD Note 1 | 15 kHz |
| 81 | TDD Note 1 | 30 kHz |
| 159 | TDD Note 1 | 60 kHz |
| 233 | TDD Note 2 | 60 kHz |
| 491 | TDD Note 2 | 120 kHz |
| NOTE 1: TDD UL-DL configuration is as specified in Table A.3.3.1-1 of TS 38.101-1 [18].  NOTE 2: TDD UL-DL configuration is as specified in Table A.3.3.1-1 of TS 38.101-2 [19]. | | |

## 9.5 L1-RSRP measurements for Reporting

### 9.5.1 Introduction

When configured by the network, the UE shall be able to perform L1-RSRP measurements of configured CSI-RS, SSB or CSI-RS and SSB resources for L1-RSRP. The measurements shall be performed for a serving cell, including PCell, PSCell, or SCell, on the resources configured for L1-RSRP measurements within the active BWP.

The UE shall be able to measure all CSI-RS resources and/or SSB resources of the *nzp-CSI-RS-ResourceSet* and/or *csi-SSB-ResourceSet* within the CSI-Resource*Config* settings configured for L1-RSRP for the active BWP, provided that the number of resources, including the number of SSB resources of the cell with PCI different from serving cell configured for L1-RSRP measurements in 9.13, does not exceed the UE capability indicated by *beamManagementSSB-CSI-RS*.

The UE shall report the measurement quantity (*reportQuantity*) and send periodic, semi-persistent or aperiodic reports, according to the *reportConfigType* according to the CSI reporting configuration(s) (*CSI-ReportConfig*) for the active BWP.

### 9.5.2 Requirements applicability

The requirements in clause 9.5 apply, provided:

- The CSI-RS or SSB or CSI-RS and SSB resources configured for L1-RSRP measurements are measurable.

An SSB resource configured for L1-RSRP shall be considered measurable when for each relevant SSB the following conditions are met:

- L1-RSRP related side conditions given in clauses 10.1.19.1 and 10.1.20.1 for FR1 and FR2, respectively, for a corresponding band,

- SSB\_RP and SSB Ês/Iot according to Annex B.2.4.1 for a corresponding band.

A CSI-RS resource configured for L1-RSRP shall be considered measurable when for each relevant CSI-RS the following conditions are met:

- L1-RSRP related side conditions given in clauses 10.1.19.2 and 10.1.20.2 for FR1 and FR2, respectively, for a corresponding band,

- CSI-RS\_RP and CSI-RS Ês/Iot according to Annex B.2.4.2 for a corresponding band.

A CSI-RS and SSB resource configured for L1-RSRP shall be considered measurable when the measurable resource conditions are met for both CSI-RS resource and SSB resource.

Requirements are defined for periodic, semi-persistent and aperiodic resources.

### 9.5.3 Measurement Reporting Requirements

The UE shall send L1-RSRP reports only for report configurations configured for the active BWP.

The UE shall report the L1-RSRP value as a 7-bit value in the range [-140, -44] dBm with 1dB step size according to clause 10.1.19 for FR1 and 10.1.20 for FR2 if *nrofReportedRS* is configured to one. If *nrofReportedRS* is configured to be larger than one, or if *groupBasedBeamReporting* is enabled, the UE shall use differential L1-RSRP based reporting as defined in clause 10.1.19 for FR1 and 10.1.20 for FR2. The differential L1-RSRP is quantized to a 4-bit value with 2dB step size. The mapping between the reported L1-RSRP value and the measured quantity is described in 10.1.6.

In EN-DC and NE-DC operation, when the UE is configured to perform E-UTRA SRS carrier-based switching an additional delay can be expected in FR1 if the UE is capable of per-FR gap, or an additional delay can be expected in both FR1 and FR2 if the UE is not capable of per-FR gap.

#### 9.5.3.1 Periodic Reporting

Reported L1-RSRP measurements contained in periodic L1-RSRP measurement reports shall meet the requirements in clauses 10.1.19 for FR1 and 10.1.20 for FR2, respectively.

The UE shall only send periodic L1-RSRP measurement reports for an active BWP.

The UE shall transmit the periodic L1-RSRP reporting on PUCCH over the air interface according to the periodicity defined in clause 5.2.1.4 in TS 38.214 [26].

#### 9.5.3.2 Semi-Persistent Reporting

Reported L1-RSRP measurements contained in a Semi-Persistent L1-RSRP measurement report shall meet the requirements in clauses 10.1.19 for FR1 and 10.1.20 for FR2, respectively. This requirement applies for semi-persistent L1-RSRP reports send on PUSCH or PUCCH.

The UE shall only send semi-persistent L1-RSRP measurement reports on PUSCH, if a DCI request has been received.

The UE shall only send semi-persistent L1-RSRP measurement reports on PUCCH, if an activation command [7] has been received.

The UE shall transmit the semi-persistent L1-RSRP reporting on PUSCH or PUCCH over the air interface according to the periodicity defined in clause 5.2.1.4 in TS 38.214 [26].

#### 9.5.3.3 Aperiodic Reporting

Reported L1-RSRP measurements contained in aperiodic triggered, aperiodic triggered periodic and aperiodic triggered semi-persistent L1-RSRP reports shall meet the requirements in clauses 10.1.19 for FR1 and 10.1.20 for FR2, respectively.

The UE shall only send aperiodic L1-RSRP measurement reports, if a DCI trigger has been received.

After the UE receives CSI request in DCI, the UE shall transmit the aperiodic L1-RSRP reporting on PUSCH over the air interface at the time specified according to clause 6.1.2.1 in TS 38.214 [26].

### 9.5.4 L1-RSRP measurement requirements

#### 9.5.4.1 SSB based L1-RSRP Reporting

The UE shall be capable of performing L1-RSRP measurements based on the configured SSB resource for L1-RSRP computation, and the UE physical layer shall be capable of reporting L1-RSRP measured over the measurement period of TL1-RSRP\_Measurement\_Period\_SSB.

The value of TL1-RSRP\_Measurement\_Period\_SSB is defined in Table 9.5.4.1-1 for FR1. The value of TL1-RSRP\_Measurement\_Period\_SSB is defined in Table 9.5.4.1-2 for FR2 when *highSpeedMeasFlagFR2-r17* is not configured, and defined in Table 9.5.4.1-3 for FR2 power class 6 UE when *highSpeedMeasFlagFR2-r17* is configured, where

- M=1 if higher layer parameter *timeRestrictionForChannelMeasurement* is configured, and M=3 otherwise

- N= 8 in Table 9.5.4.1-2.

When UE supports concurrent measurement gap and concurrent gaps are configured,

- P value for SSB resource to be measured is defined as

- Ntotal / Noutside\_MG in FR1

- Psharing factor \* Ntotal / Noutside\_MG in FR2 with Navailable = 0

- Ntotal / Navailable in FR2 with Navailable > 0

- For a window W of duration max(TL1, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE measurement gaps and per-FR measurement gaps within the same FR as serving cell, and starting at the beginning of any SSB resource occasion:

- Ntotal is the total number of SSB resource occasions within the window, including those overlapped with measurement gap occasions or SMTC occasions within the window, and

- Noutside\_MG is the number of SSB resource occasions that are not overlapped with any measurement gap occasion within the window W

- Navailable is the number of SSB resource occasions that are not overlapped with any measurement gap occasion nor any SMTC occasion within the window W

- TL1 is periodicity of the target SSB.

Otherwise, for a UE not supporting *concurrentMeasGap-r17* or when concurrent gaps are not configured,

For FR1,

- P=, when in the monitored cell there are GAPs configured for intra-frequency, inter-frequency or inter-RAT measurements, which are overlapping with some but not all occasions of the SSB; and

- P=1 when in the monitored cell there are no GAPs overlapping with any occasion of the SSB.

For FR2,

P1=, when SSB is not overlapped with measurement gap and SSB is partially overlapped with SMTC occasion (TSSB < TSMTCperiod).

- P is Psharing factor, when SSB is not overlapped with measurement gap and SSB is fully overlapped with SMTC period (TSSB = TSMTCperiod).

- P1=, when SSB is partially overlapped with GAP and SSB is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with GAP and

- TSMTCperiod ≠ xRP or

- TSMTCperiod = xRP and TSSB < 0.5\*TSMTCperiod

- P is , when SSB is partially overlapped with GAP and SSB is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with GAP and TSMTCperiod = xRP and TSSB = 0.5\*TSMTCperiod

- P1=, when SSB is partially overlapped with GAP (TSSB < xRP) and SSB is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is partially or fully overlapped with GAP.

- P is , when SSB is partially overlapped with measurement gap and SSB is fully overlapped with SMTC occasion (TSSB = TSMTCperiod) and SMTC occasion is partially overlapped with GAP (TSMTCperiod < xRP)

- Psharing factor = 1, if the SSB configured for L1-RSRP measurement outside measurement gap is

- not overlapped with the SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol before each consecutive SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol after each consecutive SSB symbols indicated by *SSB-ToMeasure*, given that *SSB-ToMeasure* is configured, where the *SSB-ToMeasure* is the union set of *SSB-ToMeasure* from all the configured measurement objects merged on the same serving carrier, and,

- not overlapped with the RSSI symbols indicated by *ss-RSSI-Measurement* and 1data symbol before each RSSI symbol indicated by *ss-RSSI-Measurement* and 1 data symbol after each RSSI symbol indicated by *ss-RSSI-Measurement*, given that *ss-RSSI-Measurement* is configured,

- Psharing factor = 3, otherwise.

- If SSB resource from the cell with different PCI is configured for L1-RSRP measurement, and P2 is valid accoding to 9.13.4.1, and any symbol of the SSBs from serving cell and cell with different PCI are overlapping or adjacent (in time domain)

- P = , if P1\*TSSB < P2\*TSSB\_CDP.

- P = P1, if P1\*TSSB > P2\*TSSB\_CDP.

- P = 2\*P1, if P1\*TSSB = P2\*TSSB\_CDP.

- Otherwise, P = P1

Where:

- TSSB = ssb-periodicityServingCell of the serving cell

- TSMTCperiod = the configured SMTC period

- TSSB\_CDP = SSB periodicity of the cell with PCI different from serving cell

- Psharing factor = 1, if the SSB configured for L1-RSRP measurement outside gap is

- not overlapped with the SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol before each consecutive SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol after each consecutive SSB symbols indicated by *SSB-ToMeasure*, given that *SSB-ToMeasure* is configured, where the *SSB-ToMeasure* is the union set of *SSB-ToMeasure* from all the configured measurement objects merged on the same serving carrier, and,

- not overlapped by the RSSI symbols indicated by *ss-RSSI-Measurement* and 1 data symbol before each RSSI symbol indicated by *ss-RSSI-Measurement* and 1 data symbol after each RSSI symbol indicated by *ss-RSSI-Measurement*, given that *ss-RSSI-Measurement* is configured.

- Psharing factor = 3, otherwise.

- TSSB = ssb-periodicityServingCell

- TSMTCperiod = the configured SMTC period

- If the UE is configured with Pre-MG, an SSB or an SMTC occasion is only considered to be overlapped by the Pre-MG if the Pre-MG is activated.

- When a measurement gap is configured and the measurement gap is not NCSG,

- an SSB or an SMTC occasion is considered to be overlapped with the GAP if it overlaps a measurement gap occasion, and

- xRP = MGRP

- Otherwise, when NCSG measurement gap is configured,

- an SSB or an SMTC occasion is considered to be overlapped with the GAP if

- it overlaps the VIL1 or VIL2 of NCSG, or

- it overlaps the ML of NCSG in FR2, and there exists a target carrier to be measured within NCSG that is intra-frequency carrier or inter-frequency carrier in the same band as the serving cell, or inter-frequency carrier in different band as the serving cell and UE does not support IBM between the target carrier and the serving cell,

- and

- xRP = VIRP

- When concurrent gaps are configured, an SSB or an SMTC occasion is not considered to be overlapped by a gap occasion if the gap occasion is dropped according to 9.1.8.

If the high layer in TS 38.331 [2] signaling of *smtc2* is configured, TSMTCperiod corresponds to the value of higher layer parameter *smtc2*; Otherwise TSMTCperiod corresponds to the value of higher layer parameter *smtc1*. TSMTCperiod is the shortest SMTC period among all CCs in the same FR2 band, provided the SMTC offset of all CCs in FR2 have the same offset.

Longer evaluation period would be expected if the combination of SSB, SMTC occasion and GAP configurations does not meet pervious conditions.

For either an FR1 or FR2 serving cell, longer evaluation period would be expected during the period Tidentify\_CGI when the UE is requested to decode an NR CGI.

For either an FR1 or FR2 serving cell, longer L1 RSRP measurement period would be expected during the period Tidentify\_CGI,E-UTRAN when the UE is requested to decode an LTE CGI.

Table 9.5.4.1-1: Measurement period TL1-RSRP\_Measurement\_Period\_SSB for FR1

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_SSB (ms) |
| non-DRX | max(TReport, ceil(M\*P)\*TSSB) |
| DRX cycle ≤ 320ms | max(TReport, ceil(K \*M\*P)\*max(TDRX,TSSB)) |
| DRX cycle > 320ms | ceil(M\*P)\*TDRX |
| Note 1: TSSB = ssb-periodicityServingCell is the periodicity of the SSB-Index configured for L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting.  Note 2: K = 1 when TSSB ≤ 40 ms and *highSpeedMeasFlag-r16 or highSpeedMeasCA-Scell-r17* are configured; otherwise K = 1.5.  Note 3: When *highSpeedMeasFlag-r16* is configured, the requirements apply only to UE supporting either *measurementEnhancement-r16* or *intraNR-MeasurementEnhancement-r16. or measurementEnhancementCA-r17* | |

Table 9.5.4.1-2: Measurement period TL1-RSRP\_Measurement\_Period\_SSB for FR2

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_SSB (ms) |
| non-DRX | max(TReport, ceil(M\*P\*N)\*TSSB) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P\*N)\*max(TDRX,TSSB)) |
| DRX cycle > 320ms | ceil(1.5\*M\*P\*N)\*TDRX |
| Note: TSSB = ssb-periodicityServingCell is the periodicity of the SSB-Index configured for L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting. | |

Table 9.5.4.1-3: Measurement period TL1-RSRP\_Measurement\_Period\_SSB configured with *highSpeedMeasFlagFR2-r17* for FR2

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_SSB (ms) |
| non-DRX | max(TReport, ceil(M\*P\*N1Note2)\*TSSB) |
| DRX cycle ≤ 80ms | max(TReport, ceil(M\*P\*N1Note2\*M2)\*max(TDRX,TSSB)) |
| 80ms< DRX ≤ 320ms | max(TReport, ceil(1.5\*M\*P\*N)\*max(TDRX,TSSB)) |
| DRX cycle > 320ms | ceil(1.5\*M\*P\*N)\*TDRX |
| Note1: TSSB = ssb-periodicityServingCell is the periodicity of the SSB-Index configured for L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting.  Note 2: N1 = 2 when *highSpeedMeasFlagFR2-r17* = set1; N1 = 6 when *highSpeedMeasFlagFR2-r17* = [set2].  Note 3: M2 = 1.5 if SMTC periodicity > 40 ms; otherwise M2 = 1 | |

#### 9.5.4.2 CSI-RS based L1-RSRP Reporting

The UE shall be capable of performing L1-RSRP measurements based on the configured CSI-RS resource for L1-RSRP computation, and the UE physical layer shall be capable of reporting L1-RSRP measured over the measurement period of TL1-RSRP\_Measurement\_Period\_CSI-RS.

The value of TL1-RSRP\_Measurement\_Period\_CSI-RS is defined in Table 9.5.4.2-1 for FR1 and in Table 9.5.4.2-2 for FR2, where

- For periodic and semi-persistent CSI-RS resources, M=1 if higher layer parameter *timeRestrictionForChannelMeasurement* is configured, and M=3 otherwise

- For aperiodic CSI-RS resources M=1

- For periodic CSI-RS resources in a resource set configured with higher layer parameter *repetition* set to OFF, N=1. The requirements apply if *qcl-InfoPeriodicCSI-RS* is configured for all the resources in the resource set and for each resource one RS has QCL-TypeD with

- SSB for L1-RSRP measurement, or

- another CSI-RS in resource set configured with repetition ON.

- For periodic CSI-RS resources in a resource set configured with higher layer parameter *repetition* set to ON, N=ceil(*maxNumberRxBeam* / Nres\_per\_set), where Nres\_per\_set is number of resources in the resource set. The requirements apply provided *qcl-InfoPeriodicCSI-RS* is configured with QCL-TypeD for all resources in the resource set.

- For semi-persistent CSI-RS resources in a resource set configured with higher layer parameter *repetition* set to OFF, N=1. The requirements apply provided TCI state is provided for all resources in the resource set in the MAC CE activating the resource set and for each resource one RS has QCL-TypeD with

- SSB for L1-RSRP measurement, or

- another CSI-RS in resource set configured with repetition ON.

- For semi-persistent CSI-RS resources in a resource set configured with higher layer parameter *repetition* set to ON, N=ceil(*maxNumberRxBeam* / Nres\_per\_set), where Nres\_per\_set is number of resources in the resource set. The requirements apply provided TCI state is provided with QCL-TypeD for all resources in the resource set in the MAC CE activating the resource set.

- For aperiodic CSI-RS resources in a resource set configured with higher layer parameter *repetition* set to OFF, N=1. The requirements apply provided *qcl-info* is configured for all resources in the resource set and for each resource one RS has QCL-TypeD with

- SSB for L1-RSRP measurement, or

- another CSI-RS in resource set configured with repetition ON.

- For aperiodic CSI-RS resources in a resource set configured with higher layer parameter *repetition* set to ON, N=1. UE is not required to meet the accuracy requirements in clause 10.1.19.2 and 10.1.20.2 if number of resources in the resource set is smaller than *maxNumberRxBeam*. The requirements apply provided *qcl-info* is configured with QCL-TypeD for all resources in the resource set.

When UE supports [concurrent measurement gap] and concurrent gaps are configured,

- P value for a CSI-RS resource to be measured is defined as

- Ntotal / Noutside\_MG in FR1

- Psharing factor \* Ntotal / Noutside\_MG in FR2 with Navailable = 0

- Ntotal / Navailable in FR2 with Navailable > 0

- For a window W of duration max(TL1, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE measurement gaps and per-FR measurement gaps within the same FR as serving cell, and starting at the beginning of any CSI-RS resource occasion:

- Ntotal is the total number of CSI-RS resource occasions within the window, including those overlapped with measurement gap occasions or SMTC occasions within the window, and

- Noutside\_MG is the number of CSI-RS resource occasions that are not overlapped with any measurement gap occasion within the window W

- Navailable is the number of CSI-RS resource occasions that are not overlapped with any measurement gap occasion nor any SMTC occasion within the window W

TL1 is periodicity of the target CSI-RS.

Otherwise, for a UE not supporting *concurrentMeasGap-r17* or when concurrent gaps are not configured,

For FR1,

- P=, when in the monitored cell there are GAPs configured for intra-frequency, inter-frequency or inter-RAT measurements, which are overlapping with some but not all occasions of the CSI-RS; and

- P=1 when in the monitored cell there are no GAPs overlapping with any occasion of the CSI-RS.

For FR2,

- P=1, when CSI-RS is not overlapped with a GAP and also not overlapped with SMTC occasion.

- P=, when CSI-RS is partially overlapped with GAP and CSI-RS is not overlapped with SMTC occasion (TCSI-RS < xRP)

- P=, when CSI-RS is not overlapped with GAP and CSI-RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod).

- P=Psharing factor, when CSI-RS is not overlapped with GAP and CSI-RS is fully overlapped with SMTC occasion (TCSI-RS = TSMTCperiod).

- P=1, when aperiodic CSI-RS resource is not overlapped with GAP

- P=, when CSI-RS is partially overlapped with GAP and CSI-RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is not overlapped with GAP and

- TSMTCperiod ≠ xRP or

- TSMTCperiod = xRP and TCSI-RS < 0.5\*TSMTCperiod

- P=, when CSI-RS is partially overlapped with [measurement gap] and CSI-RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is not overlapped with GAP and TSMTCperiod = xRP and TCSI-RS = 0.5\*TSMTCperiod

- P=, when CSI-RS is partially overlapped with GAP (TCSI-RS < xRP) and CSI-RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is partially or fully overlapped with GAP.

- P=, when CSI-RS is partially overlapped with GAP and CSI-RS is fully overlapped with SMTC occasion (TCSI-RS = TSMTCperiod) and SMTC occasion is partially overlapped with GAP (TSMTCperiod < xRP)

Where:

- Psharing factor = 1, if the CSI-RS configured for L1-RSRP measurement outside gap is

- not overlapped with the SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol before each consecutive SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol after each consecutive SSB symbols indicated by *SSB-ToMeasure*, given that *SSB-ToMeasure* is configured, where the *SSB-ToMeasure* is the union set of *SSB-ToMeasure* from all the configured measurement objects merged on the same serving carrier, and,

- not overlapped by the RSSI symbols indicated by *ss-RSSI-Measurement* and 1 data symbol before each RSSI symbol indicated by *ss-RSSI-Measurement* and 1 data symbol after each RSSI symbol indicated by *ss-RSSI-Measurement*, given that *ss-RSSI-Measurement* is configured.

- Psharing factor = 3, otherwise.

TSMTCperiod = the configured SMTC period.

TCSI-RS = the periodicity of CSI-RS configured for L1-RSRP measurement

If the UE is configured with Pre-MG, a CSI-RS or an SMTC occasion is only considered to be overlapped by the Pre-MG if the Pre-MG is activated.

- When a measurement gap is configured and the measurement gap is not NCSG,

- a CSI-RS or an SMTC occasion is considered to be as overlapped with the GAP if it overlapps a measurement gap occasion, and

- xRP = MGRP

- Otherwise, when NCSG measurement gap is configured,

- a CSI-RS or an SMTC occasion is considered to be as overlapped with the GAP if

- it overlaps the VIL1 or VIL2 of NCSG, or

- it overlaps the ML of NCSG in FR2, and there exists a target carrier to be measured within NCSG that is intra-frequency carrier or inter-frequency carrier in the same band as the serving cell, or inter-frequency carrier in different band as the serving cell and UE does not support IBM between the target carrier and the serving cell,

- and

- xRP = VIRP

When concurrent gaps are configured, a CSI-RS or an SMTC occasion is not considered to be overlapped by a gap occasion if the gap occasion is dropped according to 9.1.8.

Table 9.5.4.2-1: Measurement period TL1-RSRP\_Measurement\_Period\_CSI-RS for FR1

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_CSI-RS (ms) |
| non-DRX | max(TReport, ceil(M\*P)\*TCSI-RS) |
| DRX cycle ≤ 320ms | max(TReport, ceil(K \*M\*P)\*max(TDRX,TCSI-RS)) |
| DRX cycle > 320ms | ceil(M\*P)\*TDRX |
| Note 1: TCSI-RS is the periodicity of CSI-RS configured for L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting.  Note 2: the requirements are applicable provided that the CSI-RS resource configured for L1-RSRP measurement is transmitted with Density = 3.  Note 3: K = 1 when TCSI-RS ≤ 40 ms and *highSpeedMeasFlag-r16 or highSpeedMeasCA-Scell-r17* are configured; otherwise K = 1.5.  Note 4: When *highSpeedMeasFlag-r16* is configured, the requirements apply only to UE supporting either *measurementEnhancement-r16* or *intraNR-MeasurementEnhancement-r16 or measurementEnhancementCA-r17.* | |

Table 9.5.4.2-2: Measurement period TL1-RSRP\_Measurement\_Period\_CSI-RS for FR2

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_CSI-RS (ms) |
| non-DRX | max(TReport, ceil(M\*P\*N)\*TCSI-RS) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P\*N)\*max(TDRX,TCSI-RS)) |
| DRX cycle > 320ms | ceil(M\*P\*N)\*TDRX |
| Note 1: TCSI-RS is the periodicity of CSI-RS configured for L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting.  Note 2: the requirements are applicable provided that the CSI-RS resource configured for L1-RSRP measurement is transmitted with Density = 3. | |

### 9.5.4A Void

#### 9.5.4A.1 Void

Table 9.5.4A.1-1: Void

### 9.5.5 Measurement restriction for CSI-RS and SSB for L1-RSRP measurement

The UE is required to be capable of measuring SSB and CSI-RS for L1-RSRP without measurement gaps. The UE is required to perform the SSB and CSI-RS measurements with measurement restrictions as described in the following clauses.

#### 9.5.5.1 Measurement restriction for SSB based L1-RSRP

For FR1, when the SSB for L1-RSRP measurement is in the same OFDM symbol as CSI-RS for RLM, BFD, CBD or L1-RSRP measurement,

- If SSB and CSI-RS have same SCS, UE shall be able to measure the SSB for L1-RSRP measurement without any restriction;

- If SSB and CSI-RS have different SCS,

- If UE supports simultaneousRxDataSSB-DiffNumerology, UE shall be able to measure the SSB for L1-RSRP measurement without any restriction;

- If UE does not support simultaneousRxDataSSB-DiffNumerology, UE is required to measure one of but not both SSB for L1-RSRP measurement and CSI-RS. Longer measurement period for SSB based L1-RSRP measurement is expected, and no requirements are defined.

For FR2, when the SSB for L1-RSRP measurement on one CC is in the same OFDM symbol as CSI-RS for RLM, BFD, CBD or L1-RSRP measurement on the same CC or different CCs in the same band, UE is required to measure one of but not both SSB for L1-RSRP measurement and CSI-RS. Longer measurement period for SSB based L1-RSRP measurement is expected, and no requirements are defined.

For FR2, if the network configures same or mixed numerology between SSB for L1-RSRP measurement on one FR2 band and CSI-RS for RLM, BFD, CBD, L1-RSRP or L1-SINR measurement on the other FR2 band, UE shall be able to perform the related SSB based measurements in one band without any measurement restrictions in the other band, provided that UE is capable of independent beam management on this FR2 band pair.

#### 9.5.5.2 Measurement restriction for CSI-RS based L1-RSRP

For both FR1 and FR2, when the CSI-RS for L1-RSRP measurement is in the same OFDM symbol as SSB for RLM, BFD, CBD or L1-RSRP measurement, UE is not required to receive CSI-RS for L1-RSRP measurement in the PRBs that overlap with an SSB.

For FR1, when the SSB for RLM, BFD, CBD or L1-RSRP measurement is within the active BWP and has same SCS than CSI-RS for L1-RSRP measurement, the UE shall be able to perform CSI-RS measurement without restrictions.

For FR1, when the SSB for RLM, BFD, CBD or L1-RSRP measurement is within the active BWP and has different SCS than CSI-RS for L1-RSRP measurement, the UE shall be able to perform CSI-RS measurement with restrictions according to its capabilities:

- If the UE supports *simultaneousRxDataSSB-DiffNumerology* the UE shall be able to perform CSI-RS measurement without restrictions.

- If the UE does not support *simultaneousRxDataSSB-DiffNumerology*, UE is required to measure one of but not both CSI-RS for L1-RSRP measurement and SSB. Longer measurement period for CSI-RS based L1-RSRP measurement is expected, and no requirements are defined.

For FR1, when the CSI-RS for L1-RSRP measurement is in the same OFDM symbol as another CSI-RS for RLM, BFD, CBD or L1-RSRP measurement, UE shall be able to measure the CSI-RS for L1-RSRP measurement without any restriction.

For FR2, when the CSI-RS for L1-RSRP measurement on one CC is in the same OFDM symbol as SSB for RLM, BFD or L1-RSRP measurement on the same CC or different CCs in the same band, or in the same symbol as SSB for CBD measurement on the same CC or different CCs in the same band when beam failure is detected, UE is required to measure one of but not both CSI-RS for L1-RSRP measurement and SSB. Longer measurement period for CSI-RS based L1-RSRP measurement is expected, and no requirements are defined.

For FR2, when the CSI-RS for L1-RSRP measurement on one CC is in the same OFDM symbol as another CSI-RS for RLM, BFD, CBD or L1-RSRP measurement on the same CC or different CCs in the same band,

- In the following cases, UE is required to measure one of but not both CSI-RS for L1-RSRP measurement and the other CSI-RS. Longer measurement period for CSI-RS based L1-RSRP measurement is expected, and no requirements are defined.

- The CSI-RS for L1-RSRP measurement or the other CSI-RS in a resource set configured with repetition ON, or

- The other CSI-RS is configured in q1 and beam failure is detected, or

- The two CSI-RS-es are not QCL-ed w.r.t. QCL-TypeD, or the QCL information is not known to UE,

- Otherwise, UE shall be able to measure the CSI-RS for L1-RSRP measurement without any restriction.

### 9.5.6 Scheduling availability of UE during L1-RSRP measurement

Scheduling availability restrictions when the UE is performing L1-RSRP measurement are described in the following clauses.

#### 9.5.6.1 Scheduling availability of UE performing L1-RSRP measurement with a same subcarrier spacing as PDSCH/PDCCH on FR1

There are no scheduling restrictions due to L1-RSRP measurement performed on SSB and CSI-RS configured as RS for L1-RSRP measurement with the same SCS as PDSCH/PDCCH in FR1.

#### 9.5.6.2 Scheduling availability of UE performing L1-RSRP measurement with a different subcarrier spacing than PDSCH/PDCCH on FR1

For UEs which support *simultaneousRxDataSSB-DiffNumerology* [14] there are no restrictions on scheduling availability due to L1-RSRP measurement based on SSB as RS for L1-RSRP measurement. For UEs which do not support *simultaneousRxDataSSB-DiffNumerology* [14] the following restrictions apply due to L1-RSRP measurement based on SSB configured for L1-RSRP measurement.

- The UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/CSI-RS for tracking/CSI-RS for CQI on symbols corresponding to the SSB indexes configured for L1-RSRP measurement.

When intra-band carrier aggregation in FR1 is configured, the scheduling restrictions on serving cell where L1-RSRP measurement is performed apply to all serving cells in the same band on the symbols that fully or partially overlap with restricted symbols. When inter-band carrier aggregation within FR1 is configured, there are no scheduling restrictions on FR1 serving cell(s) configured in other bands than the bands in which the serving cell where L1-RSRP measurement is performed is configured.

#### 9.5.6.3 Scheduling availability of UE performing L1-RSRP measurement on FR2

The following scheduling restriction applies due to L1-RSRP measurement.

- For the case where RS for L1-RSRP measurement is CSI-RS which is QCLed with active TCI state for PDCCH/PDSCH and not in a CSI-RS resource set with repetition ON, and N=1 applies as specified in clause 9.5.4.2

- There are no scheduling restrictions due to L1-RSRP measurement performed based on the CSI-RS.

- Otherwise

- In non-HST scenario, for FR2-1 or the reference symbols to be measured for L1-RSRP is not using 480 kHz SCS or 960 kHz SCS on FR2-2, the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/CSI-RS for tracking/CSI-RS for CQI on

- symbols corresponding to the SSB indexes configured for L1-RSRP measurement, and/or

- symbols corresponding to the periodic CSI-RS resource configured for L1-RSRP measurement, and/or

- symbols corresponding to the semi-perssitent CSI-RS resource configured for L1-RSRP measurement when the resource is activated, and/or

- symbols corresponding to the aperiodic CSI-RS resource configured for L1-RSRP measurement when the reporting is triggered.

- For FR2-2 and the reference symbols to be measured for L1-RSRP is using 480 kHz SCS or 960 kHz SCS, the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/CSI-RS for tracking/CSI-RS for CQI on

- symbols corresponding to the SSB indexes configured for L1-RSRP measurement, and on one data symbol before and one data symbol after the symbols corresponding to the SSB indexes configured for L1-RSRP measurement, and/or

- symbols corresponding to the periodic CSI-RS resource configured for L1-RSRP measurement, and on one data symbol before and one data symbol after the symbols corresponding to the periodic CSI-RS resource configured for L1-RSRP measurement, and/or

- symbols corresponding to the semi-perssitent CSI-RS resource configured for L1-RSRP measurement when the resource is activated, and on one data symbol before and one data symbol after the symbols corresponding to the semi-perssitent CSI-RS resource configured for L1-RSRP measurement when the resource is activated, and/or

- symbols corresponding to the aperiodic CSI-RS resource configured for L1-RSRP measurement when the reporting is triggered, and on one data symbol before and one data symbol after the symbols corresponding to the aperiodic CSI-RS resource configured for L1-RSRP measurement when the reporting is triggered.

- In HST scenario, the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/CSI-RS for tracking/CSI-RS for CQI on

- symbols corresponding to the SSB indexes configured for L1-RSRP measurement and 1 data symbol before each consecutive SSB symbols to be measured for L1-RSRP and 1 data symbol after each consecutive SSB symbols to be measured for L1-RSRP, and/or

- symbols corresponding to the periodic CSI-RS resource configured for L1-RSRP measurement and 1 data symbol before each periodic CSI-RS resource to be measured for L1-RSRP and 1 data symbol after each periodic CSI-RS for L1-RSRP measurement symbols to be measured for L1-RSRP, and/or

- symbols corresponding to the semi-persistent CSI-RS resource configured for L1-RSRP measurement and 1 data symbol before each semi-persistent CSI-RS resource to be measured for L1-RSRP and 1 data symbol after each semi-persistent CSI-RS resource to be measured for L1-RSRP when the resource is activated, and/or

- symbols corresponding to the aperiodic CSI-RS resource configured for L1-RSRP measurement and 1 data symbol before each aperiodic CSI-RS resource to be measured for L1-RSRP measurement and 1 data symbol after each aperiodic CSI-RS resource to be measured for L1-RSRP measurement when the reporting is triggered.

When intra-band carrier aggregation in FR2 is performed, the scheduling restrictions on serving cell where L1-RSRP measurement is performed apply to all serving cells in the band on the symbols that fully or partially overlap with restricted symbols.

When inter-band carrier aggregation in FR2 is performed, there are no scheduling restrictions on FR2 serving cells in the bands due to L1-RSRP measurement performed on FR2 serving cell(s) in different band(s), provided that UE is capable of independent beam management on this FR2 band pair. Additionally, there is no scheduling restriction if the UE is configured with different numerology between SSB on one FR2 band and data on the other FR2 band provided the UE is configured for IBM operation for the band pair.

If following conditions are met,

- UE has been notified about system information update through paging,

- The gap between UE’s reception of PDCCH that UE monitors in the Type 2-PDCCH CSS set and that notifies system information update, and the PDCCH that UE monitors in the Type0-PDCCH CSS set, is greater than 2 slots,

For the SSB and CORESET for RMSI scheduling multiplexing patterns 3, UE is expected to receive the PDCCH that UE monitors in the Type0-PDCCH CSS set, and the corresponding PDSCH, on SSB symbols to be measured for L1-RSRP measurement; and

For the SSB and CORESET for RMSI scheduling multiplexing patterns 2, UE is expected to receive PDSCH that corresponds to the PDCCH that UE monitors in the Type0-PDCCH CSS set, on SSB symbols to be measured for L1-RSRP measurement.

#### 9.5.6.4 Scheduling availability of UE performing L1-RSRP measurement on FR1 or FR2 in case of FR1-FR2 inter-band CA

There are no scheduling restrictions on FR1 serving cell(s) due to L1-RSRP measurement performed on FR2 serving cell(s).

There are no scheduling restrictions on FR2 serving cell(s) due to L1-RSRP measurement performed on FR1 serving cell(s).

## 9.5A L1-RSRP measurements for Reporting under CCA

### 9.5A.1 Introduction

When configured by the network, the UE shall be able to perform L1-RSRP measurements of configured SSB resources for L1-RSRP. The measurements shall be performed for a serving cell under CCA operating mode, including PCell, PSCell, or SCell, on the resources configured for L1-RSRP measurements within the active BWP.

The UE shall be able to measure all SSB resources of the *csi-SSB-ResourceSet* within the *CSI-ResourceConfig* settings configured for L1-RSRP for the active BWP, provided that the number of resources does not exceed the UE capability indicated by *beamManagementSSB-CSI-RS*.

The UE shall report the measurement quantity (*reportQuantity*) and send periodic, semi-persistent or aperiodic reports, according to the *reportConfigType* according to the CSI reporting configuration(s) (*CSI-ReportConfig*) for the active BWP.

During EN-DC operation in FR-1, when the UE is configured to perform E-UTRA SRS carrier-based switching, an additional delay can be expected.

The requirements in clause 9.5A apply for any *channelAccessMode* configuration [TS 38.331, 2].

In the requirements of clause 9.5A, the term SSB occasion not available at the UE refers to when the SSB is configured by gNB in a cell on a carrier frequency subject to CCA, but the first two successive candidate SSB positions for the same SS/PBCH block index within the set of configured SSB are not available at the UE due to DL CCA failures at gNB during the corresponding evaluation or measurement period; otherwise the SSB occasion is considered as available at the UE.

### 9.5A.2 Requirements applicability

The requirements in clause 9.5A apply, provided:

- The SSB resources configured for L1-RSRP measurements are measurable.

An SSB resource configured for L1-RSRP shall be considered measurable when for each relevant SSB the following conditions are met:

- L1-RSRP related side conditions given in clause 10.1.19.1 for FR1 for a corresponding band,

- SSB\_RP and SSB Ês/Iot according to Annex B.2.4.1 for a corresponding band.

An SSB resource configured for L1-RSRP shall be considered measurable when the measurable resource conditions are met for SSB resource.

Requirements are defined for periodic, semi-persistent and aperiodic resources.

### 9.5A.3 Measurement Reporting Requirements

The UE shall send L1-RSRP reports only for report configurations configured for the active BWP.

The UE shall report the L1-RSRP value as a 7-bit value in the range [-140, -44] dBm with 1dB step size according to clause 10.1.19 for FR1 and 10.1.20 for FR2-2 if *nrofReportedRS* is configured to one. If *nrofReportedRS* is configured to be larger than one, or if *groupBasedBeamReporting* is enabled, the UE shall use differential L1-RSRP based reporting as defined in clause 10.1.19 for FR1 and 10.1.20 for FR2-2. The differential L1-RSRP is quantized to a 4-bit value with 2dB step size. The mapping between the reported L1-RSRP value and the measured quantity is described in 10.1.6.

During EN-DC operation, for FR1, when the UE is configured to perform E-UTRA SRS carrier-based switching an additional delay can be expected if the UE is capable of per-FR gap, or an additional delay can be expected.

#### 9.5A.3.1 Periodic Reporting

Reported L1-RSRP measurements contained in periodic L1-RSRP measurement reports shall meet the requirements in clauses 10.1.19 for FR1 and 10.1.20 for FR2-2, respectively.

The UE shall only send periodic L1-RSRP measurement reports for an active BWP.

The UE shall transmit the periodic L1-RSRP reporting on PUCCH over the air interface according to the periodicity defined in clause 5.2.1.4 in TS 38.214 [26].

#### 9.5A.3.2 Semi-Persistent Reporting

Reported L1-RSRP measurements contained in a Semi-Persistent L1-RSRP measurement report shall meet the requirements in clauses 10.1.19 for FR1 and 10.1.20 for FR2-2, respectively. This requirement applies for semi-persistent L1-RSRP reports send on PUSCH or PUCCH.

The UE shall only send semi-persistent L1-RSRP measurement reports on PUSCH, if a DCI request has been received.

The UE shall only send semi-persistent L1-RSRP measurement reports on PUCCH, if an activation command [7] has been received.

The UE shall transmit the semi-persistent L1-RSRP reporting on PUSCH or PUCCH over the air interface according to the periodicity defined in clause 5.2.1.4 in TS 38.214 [26].

When CCA is used on target frequency, if UE cannot transmit HARQ-ACK for the MAC CE activation command due to UL CCA failure, the UE shall not perform MAC CE activation at the MAC action time based on the originally scheduled HARQ-ACK transmission time specified in clause 5.2.1.5.2 in TS 38.214 [26].

When CCA is used on target frequency, if UE cannot transmit HARQ-ACK for the MAC CE deactivation command due to UL CCA failure, the UE shall perform MAC CE deactivation at the MAC action time based on the originally scheduled HARQ-ACK transmission time specified in clause 5.2.1.5.2 in TS 38.214 [26].

#### 9.5A.3.3 Aperiodic Reporting

Reported L1-RSRP measurements contained in aperiodic triggered, aperiodic triggered periodic and aperiodic triggered semi-persistent L1-RSRP reports shall meet the requirements in clauses 10.1.19 for FR1 and 10.1.20 for FR2-2, respectively.

The UE shall only send aperiodic L1-RSRP measurement reports if a DCI trigger has been received.

After the UE receives CSI request in DCI, the UE shall transmit the aperiodic L1-RSRP reporting on PUSCH over the air interface at the time specified according to clause 6.1.2.1 in TS 38.214 [26].

### 9.5A.4 L1-RSRP measurement requirements

#### 9.5A.4.1 SSB based L1-RSRP Reporting

The value of TL1-RSRP\_Measurement\_Period\_SSB\_CCA is defined in Table 9.5A.4.1-1 for FR1, and in Table 9.5A.4.1-2 for FR2-2, where,

- M=1 if higher layer parameter *timeRestrictionForChannelMeasurement* is configured, and M=3 otherwise

- N = TBD

For FR1 when UE supports concurrent measurement gap and concurrent gaps configured,

- P value for an SSB resource to be measured is defined as Ntotal / Noutside\_MG

- For a window W of duration max(TL1, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE measurement gaps and per-FR measurement gaps within the same FR as serving cell, and starting at the beginning of any SSB resource occasion:

- Ntotal is the total number of SSB resource occasions within the window, including those overlapped with measurement gap occasions within the window, and

- Noutside\_MG is the number of SSB resource occasions that are not overlapped with any measurement gap occasion within the window W

Otherwise, for a UE not supporting *concurrentMeasGap-r17* or when concurrent gaps are not configured,

For FR1,

- P=, when in the monitored cell there are GAPs configured for intra-frequency, inter-frequency or inter-RAT measurements, which are overlapping with some but not all occasions of the SSB; and

- P=1 when in the monitored cell there are no GAPs overlapping with any occasion of the SSB.

For FR2-2,

- P=, when SSB is not overlapped with measurement gap and SSB is partially overlapped with SMTC occasion (TSSB < TSMTCperiod).

- P is Psharing factor, when SSB is not overlapped with measurement gap and SSB is fully overlapped with SMTC period (TSSB = TSMTCperiod).

- P=, when SSB is partially overlapped with measurement gap and SSB is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and

- TSMTCperiod ≠ MGRP or

- TSMTCperiod = MGRP and TSSB < 0.5\*TSMTCperiod

- P is , when SSB is partially overlapped with measurement gap and SSB is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and TSMTCperiod = MGRP and TSSB = 0.5\*TSMTCperiod

- P=, when S SSB is partially overlapped with measurement gap (TSSB <MGRP) and SSB is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is partially or fully overlapped with measurement gap.

- P is , when SSB is partially overlapped with measurement gap and SSB is fully overlapped with SMTC occasion (TSSB = TSMTCperiod) and SMTC occasion is partially overlapped with measurement gap (TSMTCperiod < MGRP)

- Psharing factor = 1, if the SSB configured for L1-RSRP measurement outside measurement gap is

- not overlapped with the SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol before each consecutive SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol after each consecutive SSB symbols indicated by *SSB-ToMeasure*, given that *SSB-ToMeasure* is configured, where the *SSB-ToMeasure* is the union set of *SSB-ToMeasure* from all the configured measurement objects merged on the same serving carrier, and,

- not overlapped with the RSSI symbols indicated by *ss-RSSI-Measurement* and 1data symbol before each RSSI symbol indicated by *ss-RSSI-Measurement* and 1 data symbol after each RSSI symbol indicated by *ss-RSSI-Measurement*, given that *ss-RSSI-Measurement* is configured,

- Psharing factor = 3, otherwise.

Where:

Psharing factor = 1, if the SSB resource outside gap is

not overlapped with the SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol before each consecutive SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol after each consecutive SSB symbols indicated by *SSB-ToMeasure*, given that *SSB-ToMeasure* is configured, where the *SSB-ToMeasure* is the union set of *SSB-ToMeasure* from all the configured measurement objects merged on the same serving carrier, and,

not overlapped by the RSSI symbols indicated by *ss-RSSI-Measurement* and 1 data symbol before each RSSI symbol indicated by *ss-RSSI-Measurement* and 1 data symbol after each RSSI symbol indicated by *ss-RSSI-Measurement*, given that *ss-RSSI-Measurement* is configured.

Psharing factor = 3, otherwise.

TSSB = ssb-periodicityServingCell

TSMTCperiod = the configured SMTC1 period or SMTC2 period if configured

If the UE is configured with Pre-MG, an SSB is only considered to be overlapped by the Pre-MG if the Pre-MG is activated.

- When a measurement gap is configured,

- an SSB is considered to be overlapped with the GAP if it overlaps a measurement gap occasion, and

- xRP = MGRP

- When NCSG is configured,

- an SSB is considered to be overlapped with the GAP if it overlaps the VIL1 or VIL2 of NCSG, and

- xRP = VIRP

- When concurrent gaps are configured, an SSB or an SMTC occasion is not considered to be overlapped by a gap occasion if the gap occasion is dropped according to 9.1.8.

If the high layer in TS 38.331 [2] signaling of *smtc2* is configured, TSMTCperiod corresponds to the value of higher layer parameter *smtc2*; Otherwise TSMTCperiod corresponds to the value of higher layer parameter *smtc1*.

Longer evaluation period would be expected if the combination of SSB, SMTC occasion and measurement gap configurations does not meet pervious conditions.

UE shall report RSRP\_0 (Not valid) if L1>L1max, where L1 and L1max are defined in Table 9.5A.4.1-1.

Table 9.5A.4.1-1: Measurement period TL1-RSRP\_Measurement\_Period\_SSB\_CCA for FR1

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_SSB\_CCA (ms) |
| non-DRX | max(TReport, ceil((M+L1)\*P)\*TSSB) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*(M+L1)\*P)\*max(TDRX,TSSB)) |
| DRX cycle > 320ms | ceil((M+L1)\*P)\*TDRX |
| Note 1: TSSB = ssb-periodicityServingCell is the periodicity of the SSB-Index configured for L1-RSRP measurement. TDRX is the DRX cycle length.  TReport is configured periodicity for reporting.  Note 2: L1=0 if higher layer parameter timeRestrictionForChannelMeasurement is configured. Otherwise, when DRX is not configured L1 is the number of SSBs not available at the UE during TL1-RSRP\_Measurement\_Period\_SSB\_CCA, and when DRX is configured L1 is the number of DRX cycles in which at least one SSB is not available at the UE during TL1-RSRP\_Measurement\_Period\_SSB\_CCA, where L1 ≤ L1max. The UE is not required to determine the availability of SSB occasions more frequent than Once per Max(TReport, P \* TSSB) if no DRX is used,  Once per Max(TReport, Ceil(1.5 \* P) \* Max(TDRX, TSSB)) if DRX cycle ≤ 320ms,  Once per P \* TDRX if DRX cycle > 320ms.  Note 3: L1max =7 for Max(TDRX,TSSB) ≤ 40ms assuming TDRX=0 for non-DRX, L1max =5 for 40ms < Max(TDRX, TSSB) ≤ 320ms,  L1max =3 for TDRX > 320ms. | |

Table 9.5A.4.1-2: Measurement period TL1-RSRP\_Measurement\_Period\_SSB\_CCA for FR2-2

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_SSB\_CCA (ms) |
| non-DRX | max(TReport, ceil((M+L1)\*P\*N)\*TSSB) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*(M+L1)\*P\*N)\*max(TDRX,TSSB)) |
| DRX cycle > 320ms | ceil(1.5\*(M+L1)\*P\*N)\*TDRX |
| Note 1: TSSB = ssb-periodicityServingCell is the periodicity of the SSB-Index configured for L1-RSRP measurement. TDRX is the DRX cycle length.  TReport is configured periodicity for reporting.  Note 2: L1=0 if higher layer parameter timeRestrictionForChannelMeasurement is configured. Otherwise, when DRX is not configured L1 is the number of SSB occasion groups not available at the UE during TL1-RSRP\_Measurement\_Period\_SSB\_CCA, where L1 ≤ L1max. An SSB occasions group consists of N consecutive SSB occasions, and the SSB occasions group is not available at the UE when at least one SSB occasion in the group is not transmitted by the gNB. When DRX is configured, L1 is the number of DRX cycle groups in which at least one SSB occasion is not available at the UE during TL1-RSRP\_Measurement\_Period\_SSB\_CCA, where L1 ≤ L1max. A DRX group consists of N DRX cycles, and the DRX cycle group is not available when there is at least one DRX in which at least one SSB occasion is not available. The UE is not required to determine the availability of SSB occasions more frequent than once per DRX cycle length, when configured with DRX.  Note 3: L1max =7 for Max(TDRX,TSSB) ≤ 40ms assuming TDRX=0 for non-DRX, L1max =5 for 40ms < Max(TDRX, TSSB) ≤ 320ms,  L1max =3 for TDRX > 320ms. | |

### 9.5A.5 Measurement restriction for L1-RSRP measurement

The UE is required to be capable of measuring SSB for L1-RSRP without measurement gaps. The UE is required to perform the SSB measurements with measurement restrictions as described in the following clauses.

#### 9.5A.5.1 Measurement restriction for SSB based L1-RSRP

When the SSB for L1-RSRP measurement is in the same OFDM symbol as CSI-RS for RLM, BFD, CBD or L1-RSRP measurement,

- If SSB and CSI-RS have same SCS, UE shall be able to measure the SSB for L1-RSRP measurement without any restriction;

- If SSB and CSI-RS have different SCS,

- If UE supports simultaneousRxDataSSB-DiffNumerology, UE shall be able to measure the SSB for L1-RSRP measurement without any restriction;

- If UE does not support simultaneousRxDataSSB-DiffNumerology, UE is required to measure SSB for L1-RSRP measurement.

### 9.5A.6 Scheduling availability of UE during L1-RSRP measurement

Scheduling availability restrictions when the UE is performing L1-RSRP measurement are described in the following clauses.

#### 9.5A.6.1 Scheduling availability of UE performing L1-RSRP measurement with a same subcarrier spacing as PDSCH/PDCCH on FR1

There are no scheduling restrictions due to L1-RSRP measurement performed on SSB configured as RS for L1-RSRP measurement with the same SCS as PDSCH/PDCCH in FR1.

#### 9.5A.6.2 Scheduling availability of UE performing L1-RSRP measurement with a different subcarrier spacing than PDSCH/PDCCH on FR1

For UEs which support *simultaneousRxDataSSB-DiffNumerology* [14] there are no restrictions on scheduling availability due to L1-RSRP measurement based on SSB as RS for L1-RSRP measurement. For UEs which do not support *simultaneousRxDataSSB-DiffNumerology* [14] the following restrictions apply due to L1-RSRP measurement based on SSB configured for L1-RSRP measurement.

- The UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/CSI-RS for tracking/CSI-RS for CQI on symbols corresponding to the SSB indexes configured for L1-RSRP measurement.

When intra-band carrier aggregation in FR1 is configured, the scheduling restrictions on serving cell where L1-RSRP measurement is performed apply to all serving cells in the same band on the symbols that fully or partially overlap with restricted symbols. When inter-band carrier aggregation within FR1 is configured, there are no scheduling restrictions on FR1 serving cell(s) configured in other bands than the bands in which the serving cell where L1-RSRP measurement is performed is configured.

#### 9.5A.6.3 Scheduling availability of UE performing L1-RSRP measurement in case of FR1-FR2 inter-band CA

There are no scheduling restrictions on FR2 serving cell(s) due to L1-RSRP measurement performed on serving cell(s) under CCA.

#### 9.5A.6.3 Scheduling availability of UE performing L1-RSRP measurement on FR2-2

The following scheduling restriction applies due to L1-RSRP measurement on an FR2-2 serving PCell and/or PSCell.

- The UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/CSI-RS for tracking/CSI-RS for CQI on

- symbols corresponding to the SSB indexes configured for L1-RSRP measurement, and/or

- symbols corresponding to the periodic CSI-RS resource configured for L1-RSRP measurement, and/or

- symbols corresponding to the semi-perssitent CSI-RS resource configured for L1-RSRP measurement when the resource is activated, and/or

- symbols corresponding to the aperiodic CSI-RS resource configured for L1-RSRP measurement when the reporting is triggered.

When intra-band carrier aggregation in FR2-2 is performed, the scheduling restrictions on serving cell where L1-RSRP measurement is performed apply to all serving cells in the band on the symbols that fully or partially overlap with restricted symbols.

For FR2-2, if following conditions are met,

- UE has been notified about system information update through paging,

- The gap between UE’s reception of PDCCH that UE monitors in the Type 2-PDCCH CSS set and that notifies system information update, and the PDCCH that UE monitors in the Type0-PDCCH CSS set, is greater than 2 slots,

For the SSB and CORESET for RMSI scheduling multiplexing patterns 3, UE is expected to receive the PDCCH that UE monitors in the Type0-PDCCH CSS set, and the corresponding PDSCH, on SSB symbols to be measured for L1-RSRP measurement; and

For the SSB and CORESET for RMSI scheduling multiplexing patterns 2, UE is expected to receive PDSCH that corresponds to the PDCCH that UE monitors in the Type0-PDCCH CSS set, on SSB symbols to be measured for L1-RSRP measurement.

#### 9.5A.6.4 Scheduling availability of UE performing L1-RSRP measurement on FR1 or FR2 in case of FR1-FR2 inter-band CA

There are no scheduling restrictions on FR1 serving cell(s) due to L1-RSRP measurement performed on FR2-2 serving cell(s) under CCA.

There are no scheduling restrictions on FR2 serving cell(s) due to L1-RSRP measurement performed on FR1 serving cell(s) under CCA.

## 9.5B L1-RSRP measurements for Reporting for RedCap

### 9.5B.1 Introduction

The applicability of the requirements for performing L1-RSRP measurements for reporting in subclause 9.5B is defined in Section 3.6.

When configured by the network, the UE shall be able to perform L1-RSRP measurements of configured CSI-RS, SSB or CSI-RS and SSB resources for L1-RSRP. The measurements shall be performed for PCell, on the resources configured for L1-RSRP measurements within the active BWP.

The UE shall be able to measure all CSI-RS resources and/or SSB resources of the *nzp-CSI-RS-ResourceSet* and/or *csi-SSB-ResourceSet* within the CSI-Resource*Config* settings configured for L1-RSRP for the active BWP, provided that the number of resources does not exceed the UE capability indicated by *beamManagementSSB-CSI-RS*.

The UE shall report the measurement quantity (*reportQuantity*) and send periodic, semi-persistent or aperiodic reports, according to the *reportConfigType* according to the CSI reporting configuration(s) (*CSI-ReportConfig*) for the active BWP.

### 9.5B.2 Requirements applicability

The requirements in clause 9.5B apply, provided:

- The CSI-RS or SSB or CSI-RS and SSB resources configured for L1-RSRP measurements are measurable.

An SSB resource configured for L1-RSRP shall be considered measurable when for each relevant SSB the following conditions are met:

For 1 Rx RedCap:

- L1-RSRP related side conditions given in clauses TBD for FR1, respectively, for a corresponding band,

- SSB\_RP and SSB Ês/Iot according to Annex TBD for a corresponding band.

For 2 Rx RedCap:

- L1-RSRP related side conditions given in clauses 10.1.19.1 and 10.1.20.1 for FR1 and FR2, respectively, for a corresponding band,

- SSB\_RP and SSB Ês/Iot according to Annex B.2.4.1 for a corresponding band.

A CSI-RS resource configured for L1-RSRP shall be considered measurable when for each relevant CSI-RS the following conditions are met:

For 1 Rx RedCap:

- L1-RSRP related side conditions given in clauses TBD for FR1, respectively, for a corresponding band,

- CSI-RS\_RP and CSI-RS Ês/Iot according to Annex TBD for a corresponding band.

For 2 Rx RedCap:

- L1-RSRP related side conditions given in clauses 10.1.19.2 and 10.1.20.2 for FR1 and FR2, respectively, for a corresponding band,

- CSI-RS\_RP and CSI-RS Ês/Iot according to Annex B.2.4.2 for a corresponding band.

A CSI-RS and SSB resource configured for L1-RSRP shall be considered measurable when the measurable resource conditions are met for both CSI-RS resource and SSB resource.

Requirements are defined for periodic, semi-persistent and aperiodic resources.

### 9.5B.3 Measurement Reporting Requirements

The UE shall send L1-RSRP reports only for report configurations configured for the active BWP.

The UE shall report the L1-RSRP value as a 7-bit value in the range [-140, -44] dBm with 1dB step size according to clause TBD for FR1, for 1 Rx RedCap, and 10.1.19 for FR1 and 10.1.20 for FR2 for 2 Rx RedCap, if *nrofReportedRS* is configured to one. If *nrofReportedRS* is configured to be larger than one, or if *groupBasedBeamReporting* is enabled, the UE shall use differential L1-RSRP based reporting as defined in clause TBD for FR1, for 1 Rx RedCap, and 10.1.19 for FR1 and 10.1.20 for FR2 for 2 Rx RedCap. The differential L1-RSRP is quantized to a 4-bit value with 2dB step size. The mapping between the reported L1-RSRP value and the measured quantity is described in TBD for 1 Rx RedCap, and 10.1.6 for 2 Rx RedCap.

#### 9.5B.3.1 Periodic Reporting

For 1 Rx RedCap, reported L1-RSRP measurements contained in periodic L1-RSRP measurement reports shall meet the requirements in clause TBD for FR1.

For 2 Rx RedCap, reported L1-RSRP measurements contained in periodic L1-RSRP measurement reports shall meet the requirements in clauses 10.1.19 for FR1 and 10.1.20 for FR2, respectively.

The UE shall only send periodic L1-RSRP measurement reports for an active BWP.

The UE shall transmit the periodic L1-RSRP reporting on PUCCH over the air interface according to the periodicity defined in clause 5.2.1.4 in TS 38.214 [26].

#### 9.5B.3.2 Semi-Persistent Reporting

For 1 Rx RedCap, reported L1-RSRP measurements contained in a Semi-Persistent L1-RSRP measurement report shall meet the requirements in clauses TBD for FR1. This requirement applies for semi-persistent L1-RSRP reports send on PUSCH or PUCCH.

For 2 Rx RedCap, reported L1-RSRP measurements contained in a Semi-Persistent L1-RSRP measurement report shall meet the requirements in clauses 10.1.19 for FR1 and 10.1.20 for FR2, respectively. This requirement applies for semi-persistent L1-RSRP reports send on PUSCH or PUCCH.

The UE shall only send semi-persistent L1-RSRP measurement reports on PUSCH, if a DCI request has been received.

The UE shall only send semi-persistent L1-RSRP measurement reports on PUCCH, if an activation command [7] has been received.

The UE shall transmit the semi-persistent L1-RSRP reporting on PUSCH or PUCCH over the air interface according to the periodicity defined in clause 5.2.1.4 in TS 38.214 [26].

#### 9.5B.3.3 Aperiodic Reporting

For 1 Rx RedCap, reported L1-RSRP measurements contained in aperiodic triggered, aperiodic triggered periodic and aperiodic triggered semi-persistent L1-RSRP reports shall meet the requirements in clause TBD.

For 2 Rx Redcap, reported L1-RSRP measurements contained in aperiodic triggered, aperiodic triggered periodic and aperiodic triggered semi-persistent L1-RSRP reports shall meet the requirements in clauses 10.1.19 for FR1 and 10.1.20 for FR2, respectively.

The UE shall only send aperiodic L1-RSRP measurement reports, if a DCI trigger has been received.

After the UE receives CSI request in DCI, the UE shall transmit the aperiodic L1-RSRP reporting on PUSCH over the air interface at the time specified according to clause 6.1.2.1 in TS 38.214 [26].

### 9.5B.4 L1-RSRP measurement requirements

#### 9.5B.4.1 SSB based L1-RSRP Reporting

The UE shall be capable of performing L1-RSRP measurements based on the configured SSB resource for L1-RSRP computation, and the UE physical layer shall be capable of reporting L1-RSRP measured over the measurement period of TL1-RSRP\_Measurement\_Period\_SSB\_RedCap.

The value of TL1-RSRP\_Measurement\_Period\_SSB is defined in Table 9.5B.4.1-1 for FR1 and Table 9.5B.4.1-2 for FR2, for 2 Rx RedCap, and Table 9.5B.4.1-3 for FR1 for 1 Rx RedCap, where

- M=1 if higher layer parameter *timeRestrictionForChannelMeasurement* is configured, and M=3 otherwise.

- N= 8.

For FR1,

- P=, when in the monitored cell there are measurement gaps configured for intra-frequency, inter-frequency or inter-RAT measurements, which are overlapping with some but not all occasions of the SSB; and

- P=1 when in the monitored cell there are no measurement gaps overlapping with any occasion of the SSB.

For FR2,

- P=, when SSB is not overlapped with measurement gap and SSB is partially overlapped with SMTC occasion (TSSB < TSMTCperiod).

- P is Psharing factor, when SSB is not overlapped with measurement gap and SSB is fully overlapped with SMTC period (TSSB = TSMTCperiod).

- P=, when SSB is partially overlapped with measurement gap and SSB is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and

- TSMTCperiod ≠ MGRP or

- TSMTCperiod = MGRP and TSSB < 0.5\*TSMTCperiod

- P is , when SSB is partially overlapped with measurement gap and SSB is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and TSMTCperiod = MGRP and TSSB = 0.5\*TSMTCperiod

- P=, when S SSB is partially overlapped with measurement gap (TSSB <MGRP) and SSB is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is partially or fully overlapped with measurement gap.

- P is , when SSB is partially overlapped with measurement gap and SSB is fully overlapped with SMTC occasion (TSSB = TSMTCperiod) and SMTC occasion is partially overlapped with measurement gap (TSMTCperiod < MGRP)

- Psharing factor = 1, if the SSB configured for L1-RSRP measurement outside measurement gap is

- not overlapped with the SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol before each consecutive SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol after each consecutive SSB symbols indicated by *SSB-ToMeasure*, given that *SSB-ToMeasure* is configured, where the *SSB-ToMeasure* is the union set of *SSB-ToMeasure* from all the configured measurement objects merged on the same serving carrier, and,

- not overlapped with the RSSI symbols indicated by *ss-RSSI-Measurement* and 1data symbol before each RSSI symbol indicated by *ss-RSSI-Measurement* and 1 data symbol after each RSSI symbol indicated by *ss-RSSI-Measurement*, given that *ss-RSSI-Measurement* is configured,

- Psharing factor = 3, otherwise.

Where:

- TSSB = ssb-periodicityServingCell

- TSMTCperiod = the configured SMTC period

If the high layer in TS 38.331 [2] signaling of *smtc2* is configured, TSMTCperiod corresponds to the value of higher layer parameter *smtc2*; Otherwise TSMTCperiod corresponds to the value of higher layer parameter *smtc1*.

Longer evaluation period would be expected if the combination of SSB, SMTC occasion and measurement gap configurations does not meet pervious conditions.

For either an FR1 or FR2 serving cell, longer evaluation period would be expected during the period Tidentify\_CGI when the UE is requested to decode an NR CGI.

For either an FR1 or FR2 serving cell, longer L1 RSRP measurement period would be expected during the period Tidentify\_CGI,E-UTRAN when the UE is requested to decode an LTE CGI.

Table 9.5B.4.1-1: Measurement period TL1-RSRP\_Measurement\_Period\_SSB\_RedCap (FR1) for 2 Rx RedCap

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_SSB\_RedCap (ms) |
| non-DRX | max(TReport, ceil(M\*P)\*TSSB) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P)\*max(TDRX,TSSB)) |
| DRX cycle > 320ms | ceil(M\*P)\*TDRX |
| Note: TSSB = ssb-periodicityServingCell is the periodicity of the SSB-Index configured for L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting. | |

Table 9.5B.4.1-2: Measurement period TL1-RSRP\_Measurement\_Period\_SSB\_RedCap (FR2) for 2 Rx RedCap

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_SSB\_RedCap (ms) |
| non-DRX | max(TReport, ceil(M\*P\*N)\*TSSB) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P\*N)\*max(TDRX,TSSB)) |
| DRX cycle > 320ms | ceil(1.5\*M\*P\*N)\*TDRX |
| Note: TSSB = ssb-periodicityServingCell is the periodicity of the SSB-Index configured for L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting. | |

Table 9.5B.4.1-3: Measurement period TL1-RSRP\_Measurement\_Period\_SSB\_RedCap (FR1) for 1 Rx RedCap

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_SSB\_RedCap (ms) |
| non-DRX | max(TReport, ceil(M\*P)\*TSSB) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P)\*max(TDRX,TSSB)) |
| DRX cycle > 320ms | ceil(M\*P)\*TDRX |
| Note: TSSB = ssb-periodicityServingCell is the periodicity of the SSB-Index configured for L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting. | |

#### 9.5B.4.2 CSI-RS based L1-RSRP Reporting

The UE shall be capable of performing L1-RSRP measurements based on the configured CSI-RS resource for L1-RSRP computation, and the UE physical layer shall be capable of reporting L1-RSRP measured over the measurement period of TL1-RSRP\_Measurement\_Period\_CSI-RS\_RedCap.

The value of TL1-RSRP\_Measurement\_Period\_CSI-RS\_RedCap is defined in Table 9.5B.4.2-1 for FR1 and in Table 9.5B.4.2-2 for FR2, for 2 Rx RedCap, and in Table 9.5B.4.2-3 for 1 Rx RedCap, where

- For periodic and semi-persistent CSI-RS resources, M=1 if higher layer parameter *timeRestrictionForChannelMeasurement* is configured, and M=3 otherwise

- For aperiodic CSI-RS resources M=1

- For periodic CSI-RS resources in a resource set configured with higher layer parameter *repetition* set to OFF, N=1. The requirements apply if *qcl-InfoPeriodicCSI-RS* is configured for all the resources in the resource set and for each resource one RS has QCL-TypeD with

- SSB for L1-RSRP measurement, or

- another CSI-RS in resource set configured with repetition ON.

- For periodic CSI-RS resources in a resource set configured with higher layer parameter *repetition* set to ON, N=ceil(*maxNumberRxBeam* / Nres\_per\_set), where Nres\_per\_set is number of resources in the resource set. The requirements apply provided *qcl-InfoPeriodicCSI-RS* is configured with QCL-TypeD for all resources in the resource set.

- For semi-persistent CSI-RS resources in a resource set configured with higher layer parameter *repetition* set to OFF, N=1. The requirements apply provided TCI state is provided for all resources in the resource set in the MAC CE activating the resource set and for each resource one RS has QCL-TypeD with

- SSB for L1-RSRP measurement, or

- another CSI-RS in resource set configured with repetition ON.

- For semi-persistent CSI-RS resources in a resource set configured with higher layer parameter *repetition* set to ON, N=ceil(*maxNumberRxBeam* / Nres\_per\_set), where Nres\_per\_set is number of resources in the resource set. The requirements apply provided TCI state is provided with QCL-TypeD for all resources in the resource set in the MAC CE activating the resource set.

- For aperiodic CSI-RS resources in a resource set configured with higher layer parameter *repetition* set to OFF, N=1. The requirements apply provided *qcl-info* is configured for all resources in the resource set and for each resource one RS has QCL-TypeD with

- SSB for L1-RSRP measurement, or

- another CSI-RS in resource set configured with repetition ON.

- For aperiodic CSI-RS resources in a resource set configured with higher layer parameter *repetition* set to ON, N=1. UE is not required to meet the accuracy requirements in clause 10.1.19.2 and 10.1.20.2 if number of resources in the resource set is smaller than *maxNumberRxBeam*. The requirements apply provided *qcl-info* is configured with QCL-TypeD for all resources in the resource set.

For FR1,

- P=, when in the monitored cell there are measurement gaps configured for intra-frequency, inter-frequency or inter-RAT measurements, which are overlapping with some but not all occasions of the CSI-RS; and

- P=1 when in the monitored cell there are no measurement gaps overlapping with any occasion of the CSI-RS.

For FR2,

- P=1, when CSI-RS is not overlapped with measurement gap and also not overlapped with SMTC occasion.

- P=, when CSI-RS is partially overlapped with measurement gap and CSI-RS is not overlapped with SMTC occasion (TCSI-RS < MGRP)

- P=, when CSI-RS is not overlapped with measurement gap and CSI-RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod).

- P=Psharing factor, when CSI-RS is not overlapped with measurement gap and CSI-RS is fully overlapped with SMTC occasion (TCSI-RS = TSMTCperiod).

- P=1, when aperiodic CSI-RS resource is not overlapped with measurement gap

- P=, when CSI-RS is partially overlapped with measurement gap and CSI-RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and

- TSMTCperiod ≠ MGRP or

- TSMTCperiod = MGRP and TCSI-RS < 0.5\*TSMTCperiod

- P=, when CSI-RS is partially overlapped with measurement gap and CSI-RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and TSMTCperiod = MGRP and TCSI-RS = 0.5\*TSMTCperiod

- P=, when CSI-RS is partially overlapped with measurement gap (TCSI-RS < MGRP) and CSI-RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is partially or fully overlapped with measurement gap.

- P=, when CSI-RS is partially overlapped with measurement gap and CSI-RS is fully overlapped with SMTC occasion (TCSI-RS = TSMTCperiod) and SMTC occasion is partially overlapped with measurement gap (TSMTCperiod < MGRP)

- Psharing factor = 1, if the CSI-RS configured for L1-RSRP measurement outside measurement gap is

- not overlapped with the SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol before each consecutive SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol after each consecutive SSB symbols indicated by *SSB-ToMeasure*, given that *SSB-ToMeasure* is configured, where the *SSB-ToMeasure* is the union set of *SSB-ToMeasure* from all the configured measurement objects merged on the same serving carrier, and,

- not overlapped with the RSSI symbols indicated by *ss-RSSI-Measurement* and 1data symbol before each RSSI symbol indicated by *ss-RSSI-Measurement* and 1 data symbol after each RSSI symbol indicated by *ss-RSSI-Measurement*, given that *ss-RSSI-Measurement* is configured

- Psharing factor = 3, otherwise.

Where:

TSMTCperiod = the configured SMTC period.

TCSI-RS = the periodicity of CSI-RS configured for L1-RSRP measurement

If the high layer in TS 38.331 [2] signaling of *smtc2* is configured, TSMTCperiod corresponds to the value of higher layer parameter *smtc2*; Otherwise TSMTCperiod corresponds to the value of higher layer parameter *smtc1*. TSMTCperiod is the shortest SMTC period among all CCs in the same FR2 band, provided the SMTC offset of all CCs in FR2 have the same offset.

Note: The overlap between CSI-RS for L1-RSRP measurement and SMTC means that CSI-RS for L1-RSRP measurement is within the SMTC window duration.

Longer evaluation period would be expected if the combination of CSI-RS, SMTC occasion and measurement gap configurations does not meet pervious conditions.

For either an FR1 or FR2 serving cell, longer evaluation period would be expected during the period Tidentify\_CGI when the UE is requested to decode an NR CGI.

For either an FR1 or FR2 serving cell, longer L1 RSRP measurement period would be expected during the period Tidentify\_CGI,E-UTRAN when the UE is requested to decode an LTE CGI.

Table 9.5B.4.2-1: Measurement period TL1-RSRP\_Measurement\_Period\_CSI-RS\_RedCap (FR1) for 2 Rx RedCap

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_CSI-RS\_RedCap (ms) |
| non-DRX | max(TReport, ceil(M\*P)\*TCSI-RS) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P)\*max(TDRX,TCSI-RS)) |
| DRX cycle > 320ms | ceil(M\*P)\*TDRX |
| Note 1: TCSI-RS is the periodicity of CSI-RS configured for L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting.  Note 2: the requirements are applicable provided that the CSI-RS resource configured for L1-RSRP measurement is transmitted with Density = 3. | |

Table 9.5B.4.2-2: Measurement period TL1-RSRP\_Measurement\_Period\_CSI-RS\_RedCap (FR2) for 2 Rx RedCap

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_CSI-RS\_RedCap (ms) |
| non-DRX | max(TReport, ceil(M\*P\*N)\*TCSI-RS) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P\*N)\*max(TDRX,TCSI-RS)) |
| DRX cycle > 320ms | ceil(M\*P\*N)\*TDRX |
| Note 1: TCSI-RS is the periodicity of CSI-RS configured for L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting.  Note 2: the requirements are applicable provided that the CSI-RS resource configured for L1-RSRP measurement is transmitted with Density = 3. | |

Table 9.5B.4.2-3: Measurement period TL1-RSRP\_Measurement\_Period\_CSI-RS\_RedCap (FR1) for 1 Rx RedCap

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_CSI-RS\_RedCap (ms) |
| non-DRX | max(TReport, ceil(M\*P)\*TCSI-RS) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P)\*max(TDRX,TCSI-RS)) |
| DRX cycle > 320ms | ceil(M\*P)\*TDRX |
| Note 1: TCSI-RS is the periodicity of CSI-RS configured for L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting.  Note 2: the requirements are applicable provided that the CSI-RS resource configured for L1-RSRP measurement is transmitted with Density = 3. | |

### 9.5B.5 Measurement restriction for CSI-RS and SSB for L1-RSRP measurement

The UE is required to be capable of measuring SSB and CSI-RS for L1-RSRP without measurement gaps. The UE is required to perform the SSB and CSI-RS measurements with measurement restrictions as described in the following clauses.

#### 9.5B.5.1 Measurement restriction for SSB based L1-RSRP

For FR1, when the SSB for L1-RSRP measurement is in the same OFDM symbol as CSI-RS for RLM, BFD, CBD or L1-RSRP measurement,

- If SSB and CSI-RS have same SCS, UE shall be able to measure the SSB for L1-RSRP measurement without any restriction;

- If SSB and CSI-RS have different SCS,

- If UE supports simultaneousRxDataSSB-DiffNumerology, UE shall be able to measure the SSB for L1-RSRP measurement without any restriction;

- If UE does not support simultaneousRxDataSSB-DiffNumerology, UE is required to measure one of but not both SSB for L1-RSRP measurement and CSI-RS. Longer measurement period for SSB based L1-RSRP measurement is expected, and no requirements are defined.

For FR2, when the SSB for L1-RSRP measurement on one CC is in the same OFDM symbol as CSI-RS for RLM, BFD, CBD or L1-RSRP measurement on the same CC, UE is required to measure one of but not both SSB for L1-RSRP measurement and CSI-RS. Longer measurement period for SSB based L1-RSRP measurement is expected, and no requirements are defined.

#### 9.5B.5.2 Measurement restriction for CSI-RS based L1-RSRP

For both FR1 and FR2, when the CSI-RS for L1-RSRP measurement is in the same OFDM symbol as SSB for RLM, BFD, CBD or L1-RSRP measurement, UE is not required to receive CSI-RS for L1-RSRP measurement in the PRBs that overlap with an SSB.

For FR1, when the SSB for RLM, BFD, CBD or L1-RSRP measurement is within the active BWP and has same SCS than CSI-RS for L1-RSRP measurement, the UE shall be able to perform CSI-RS measurement without restrictions.

For FR1, when the SSB for RLM, BFD, CBD or L1-RSRP measurement is within the active BWP and has different SCS than CSI-RS for L1-RSRP measurement, the UE shall be able to perform CSI-RS measurement with restrictions according to its capabilities:

- If the UE supports *simultaneousRxDataSSB-DiffNumerology* the UE shall be able to perform CSI-RS measurement without restrictions.

- If the UE does not support *simultaneousRxDataSSB-DiffNumerology*, UE is required to measure one of but not both CSI-RS for L1-RSRP measurement and SSB. Longer measurement period for CSI-RS based L1-RSRP measurement is expected, and no requirements are defined.

For FR1, when the CSI-RS for L1-RSRP measurement is in the same OFDM symbol as another CSI-RS for RLM, BFD, CBD or L1-RSRP measurement, UE shall be able to measure the CSI-RS for L1-RSRP measurement without any restriction.

### 9.5B.6 Scheduling availability of UE during L1-RSRP measurement

Scheduling availability restrictions when the UE is performing L1-RSRP measurement are described in the following clauses.

#### 9.5B.6.1 Scheduling availability of UE performing L1-RSRP measurement with a same subcarrier spacing as PDSCH/PDCCH on FR1

For FD-FDD and TDD RedCap UEs, there are no scheduling restrictions due to L1-RSRP measurement performed on SSB and CSI-RS configured as RS for L1-RSRP measurement with the same SCS as PDSCH/PDCCH in FR1.

For HD-FDD RedCap UE, scheduling restrictions apply for transmission on PUCCH/PUSCH/SRS during the CBD evaluation period, as CBD evaluation is prioritized over UL transmission. The CBD evaluation period equals the measurement period of TL1-RSRP\_Measurement\_Period\_SSB\_RedCap in case L1-RSRP measurement is performed on SSB as defined in clause 9.5B.4.1, or TL1‑RSRP\_Measurement\_Period\_CSI‑RS\_RedCap in case L1-RSRP measurement is performed on CSI-RS and/or SSB as defined in clause 9.5B.4.1.

#### 9.5B.6.2 Scheduling availability of UE performing L1-RSRP measurement with a different subcarrier spacing than PDSCH/PDCCH on FR1

For UEs which support *simultaneousRxDataSSB-DiffNumerology* [14] there are no restrictions on scheduling availability due to L1-RSRP measurement based on SSB as RS for L1-RSRP measurement. For UEs which do not support *simultaneousRxDataSSB-DiffNumerology* [14] the following restrictions apply due to L1-RSRP measurement based on SSB configured for L1-RSRP measurement.

- For FD-FDD and TDD RedCap UEs, the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/CSI-RS for tracking/CSI-RS for CQI on symbols corresponding to the SSB indexes configured for L1-RSRP measurement.

- For HD-FDD RedCap UE, scheduling restrictions apply for transmission on PUCCH/PUSCH/SRS during the CBD evaluation period, as CBD evaluation is prioritized over UL transmission. The CBD evaluation period equals the measurement period of TL1-RSRP\_Measurement\_Period\_SSB\_RedCap in case L1-RSRP measurement is performed on SSB as defined in clause 9.5B.4.1, or TL1‑RSRP\_Measurement\_Period\_CSI‑RS\_RedCap in case L1-RSRP measurement is performed on CSI-RS and/or SSB as defined in clause 9.5B.4.1.

#### 9.5B.6.3 Scheduling availability of UE performing L1-RSRP measurement on FR2

The following scheduling restriction applies due to L1-RSRP measurement.

- For the case where RS for L1-RSRP measurement is CSI-RS which is QCLed with active TCI state for PDCCH/PDSCH and not in a CSI-RS resource set with repetition ON, and N=1 applies as specified in clause 9.5B.4.2

- There are no scheduling restrictions due to L1-RSRP measurement performed based on the CSI-RS.

- Otherwise

- The UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/CSI-RS for tracking/CSI-RS for CQI on

- symbols corresponding to the SSB indexes configured for L1-RSRP measurement, and/or

- symbols corresponding to the periodic CSI-RS resource configured for L1-RSRP measurement, and/or

- symbols corresponding to the semi-perssitent CSI-RS resource configured for L1-RSRP measurement when the resource is activated, and/or

- symbols corresponding to the aperiodic CSI-RS resource configured for L1-RSRP measurement when the reporting is triggered.

If following conditions are met,

- UE has been notified about system information update through paging,

- The gap between UE’s reception of PDCCH that UE monitors in the Type 2-PDCCH CSS set and that notifies system information update, and the PDCCH that UE monitors in the Type0-PDCCH CSS set, is greater than 2 slots,

For the SSB and CORESET for RMSI scheduling multiplexing patterns 3, UE is expected to receive the PDCCH that UE monitors in the Type0-PDCCH CSS set, and the corresponding PDSCH, on SSB symbols to be measured for L1-RSRP measurement; and

For the SSB and CORESET for RMSI scheduling multiplexing patterns 2, UE is expected to receive PDSCH that corresponds to the PDCCH that UE monitors in the Type0-PDCCH CSS set, on SSB symbols to be measured for L1-RSRP measurement.

## 9.5C L1-RSRP measurements for Reporting for satellite access

### 9.5C.1 Introduction

When configured by the network, the UE shall be able to perform L1-RSRP measurements of configured CSI-RS, SSB or CSI-RS and SSB resources for L1-RSRP. The measurements shall be performed for PCell on the resources configured for L1-RSRP measurements within the active BWP.

The UE shall be able to measure all CSI-RS resources and/or SSB resources of the *nzp-CSI-RS-ResourceSet* and/or *csi-SSB-ResourceSet* within the CSI-Resource*Config* settings configured for L1-RSRP for the active BWP, provided that the number of resources does not exceed the UE capability indicated by *beamManagementSSB-CSI-RS*.

The UE shall report the measurement quantity (*reportQuantity*) and send periodic, semi-persistent or aperiodic reports, according to the *reportConfigType* according to the CSI reporting configuration(s) (*CSI-ReportConfig*) for the active BWP.

9.5C.2 Requirements applicability

The requirements in clause 9.5C apply, provided:

- The CSI-RS or SSB or CSI-RS and SSB resources configured for L1-RSRP measurements are measurable.

An SSB resource configured for L1-RSRP shall be considered measurable when for each relevant SSB the following conditions are met:

- L1-RSRP related side conditions given in clauses 10.1.19.1 for FR1, for a corresponding band,

- SSB\_RP and SSB Ês/Iot according to Annex B.2.4.1 for a corresponding band.

A CSI-RS resource configured for L1-RSRP shall be considered measurable when for each relevant CSI-RS the following conditions are met:

- L1-RSRP related side conditions given in clauses 10.1.19.2 for FR1, respectively, for a corresponding band,

- CSI-RS\_RP and CSI-RS Ês/Iot according to Annex B.2.4.2 for a corresponding band.

A CSI-RS and SSB resource configured for L1-RSRP shall be considered measurable when the measurable resource conditions are met for both CSI-RS resource and SSB resource.

Requirements are defined for periodic, semi-persistent and aperiodic resources.

### 9.5C.3 Measurement Reporting Requirements

The UE shall send L1-RSRP reports only for report configurations configured for the active BWP.

The UE shall report the L1-RSRP value as a 7-bit value in the range [-140, -44] dBm with 1dB step size according to clause 10.1.19 for FR1 if *nrofReportedRS* is configured to one. If *nrofReportedRS* is configured to be larger than one, or if *groupBasedBeamReporting* is enabled, the UE shall use differential L1-RSRP based reporting as defined in clause 10.1.19 for FR1. The differential L1-RSRP is quantized to a 4-bit value with 2dB step size. The mapping between the reported L1-RSRP value and the measured quantity is described in 10.1.6.

#### 9.5C.3.1 Periodic Reporting

Reported L1-RSRP measurements contained in periodic L1-RSRP measurement reports shall meet the requirements in clauses [FFS].

The UE shall only send periodic L1-RSRP measurement reports for an active BWP.

The UE shall transmit the periodic L1-RSRP reporting on PUCCH over the air interface according to the periodicity defined in clause 5.2.1.4 in TS 38.214 [26].

#### 9.5C.3.2 Semi-Persistent Reporting

Reported L1-RSRP measurements contained in a Semi-Persistent L1-RSRP measurement report shall meet the requirements in clauses [FFS]. This requirement applies for semi-persistent L1-RSRP reports send on PUSCH or PUCCH.

The UE shall only send semi-persistent L1-RSRP measurement reports on PUSCH, if a DCI request has been received.

The UE shall only send semi-persistent L1-RSRP measurement reports on PUCCH, if an activation command [7] has been received.

The UE shall transmit the semi-persistent L1-RSRP reporting on PUSCH or PUCCH over the air interface according to the periodicity defined in clause 5.2.1.4 in TS 38.214 [26].

#### 9.5C.3.3 Aperiodic Reporting

Reported L1-RSRP measurements contained in aperiodic triggered, aperiodic triggered periodic and aperiodic triggered semi-persistent L1-RSRP reports shall meet the requirements in clauses [FFS].

The UE shall only send aperiodic L1-RSRP measurement reports, if a DCI trigger has been received.

After the UE receives CSI request in DCI, the UE shall transmit the aperiodic L1-RSRP reporting on PUSCH over the air interface at the time specified according to clause 6.1.2.1 in TS 38.214 [26].

### 9.5C.4 L1-RSRP measurement requirements

#### 9.5C.4.1 SSB based L1-RSRP Reporting

The UE shall be capable of performing L1-RSRP measurements based on the configured SSB resource for L1-RSRP computation, and the UE physical layer shall be capable of reporting L1-RSRP measured over the measurement period of TL1-RSRP\_Measurement\_Period\_SSB\_SAN.

The value of TL1-RSRP\_Measurement\_Period\_SSB\_SAN is defined in Table 9.5C.4.1-1 for FR1, where

- M=1 if higher layer parameter *timeRestrictionForChannelMeasurement* is configured, and M=3 otherwise

- P value for SSB resource to be measured is defined as

- Psharing factor \* Ntotal / Noutside\_MG with Navailable = 0

- Ntotal / Navailable with Navailable > 0

- For a window W of duration max(TL1, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE measurement gaps, and starting at the beginning of any SSB resource occasion:

- Ntotal is the total number of SSB resource occasions within the window, including those overlapped with measurement gap occasions or SMTC occasions within the window, and

- Noutside\_MG is the number of SSB resource occasions that are not overlapped with any measurement gap occasion within the window W

- Navailable is

- the number of SSB resource occasions that are not overlapped with any measurement gap occasion nor any SMTC occasion within the window W, if UE does not support *parallelMeasurementWithoutRestriction* and LEO satellites are measured for intra-frequency measurement, and

- same as Noutside\_MG, otherwise

- TL1 is periodicity of the target SSB.

- Psharing factor = 3.

Longer evaluation period would be expected if the combination of SSB, SMTC occasion and measurement gap configurations does not meet pervious conditions.

Table 9.5C.4.1-1: Measurement period TL1-RSRP\_Measurement\_Period\_SSB\_SAN for FR1

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_SSB\_SAN (ms) |
| non-DRX | max(TReport, ceil(M\*P)\*TSSB) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P)\*max(TDRX,TSSB)) |
| DRX cycle > 320ms | ceil(M\*P)\*TDRX |
| Note: TSSB = ssb-periodicityServingCell is the periodicity of the SSB-Index configured for L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting. | |

9.5C.4.2 CSI-RS based L1-RSRP Reporting

The UE shall be capable of performing L1-RSRP measurements based on the configured CSI-RS resource for L1-RSRP computation, and the UE physical layer shall be capable of reporting L1-RSRP measured over the measurement period of TL1-RSRP\_Measurement\_Period\_CSI-RS\_SAN.

The value of TL1-RSRP\_Measurement\_Period\_CSI-RS is defined in Table 9.5C.4.2-1 for FR1, where

- For periodic and semi-persistent CSI-RS resources, M=1 if higher layer parameter *timeRestrictionForChannelMeasurement* is configured, and M=3 otherwise

- For aperiodic CSI-RS resources M=1

- P value for a CSI-RS resource to be measured is defined as

- Psharing factor \* Ntotal / Noutside\_MG with Navailable = 0

- Ntotal / Navailable with Navailable > 0

- For a window W of duration max(TL1, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE measurement gaps, and starting at the beginning of any CSI-RS resource occasion:

- Ntotal is the total number of CSI-RS resource occasions within the window, including those overlapped with measurement gap occasions or SMTC occasions within the window, and

- Noutside\_MG is the number of CSI-RS resource occasions that are not overlapped with any measurement gap occasion within the window W

- Navailable is

- the number of SSB resource occasions that are not overlapped with any measurement gap occasion nor any SMTC occasion within the window W, if UE does not support *parallelMeasurementWithoutRestriction* and LEO satellites are measured for intra-frequency measurement, and

- same as Noutside\_MG, otherwise

- TL1 is periodicity of the target CSI-RS.

- Psharing factor = 3.

Note: The overlap between CSI-RS for L1-RSRP measurement and SMTC means that CSI-RS for L1-RSRP measurement is within the SMTC window duration.

Longer evaluation period would be expected if the combination of CSI-RS, SMTC occasion and measurement gap configurations does not meet pervious conditions.

Table 9.5C.4.2-1: Measurement period TL1-RSRP\_Measurement\_Period\_CSI-RS\_SAN for FR1

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_CSI-RS\_SAN (ms) |
| non-DRX | max(TReport, ceil(M\*P)\*TCSI-RS) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P)\*max(TDRX,TCSI-RS)) |
| DRX cycle > 320ms | ceil(M\*P)\*TDRX |
| Note 1: TCSI-RS is the periodicity of CSI-RS configured for L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting.  Note 2: the requirements are applicable provided that the CSI-RS resource configured for L1-RSRP measurement is transmitted with Density = 3. | |

### 9.5C.5 Measurement restriction for L1-RSRP measurement

The UE is required to be capable of measuring SSB and CSI-RS for L1-RSRP without measurement gaps. The UE is required to perform the SSB and CSI-RS measurements with measurement restrictions as described in the following clauses.

#### 9.5C.5.1 Measurement restriction for SSB based L1-RSRP

L1-RSRP measurement,

- If SSB and CSI-RS have same SCS, UE shall be able to measure the SSB for L1-RSRP measurement without any restriction;

- If SSB and CSI-RS have different SCS,

- If UE supports simultaneousRxDataSSB-DiffNumerology, UE shall be able to measure the SSB for L1-RSRP measurement without any restriction;

- If UE does not support simultaneousRxDataSSB-DiffNumerology, UE is required to measure one of but not both SSB for L1-RSRP measurement and CSI-RS. Longer measurement period for SSB based L1-RSRP measurement is expected, and no requirements are defined.

#### 9.5C.5.2 Measurement restriction for CSI-RS based L1-RSRP

For FR1, when the CSI-RS for L1-RSRP measurement is in the same OFDM symbol as SSB for RLM, BFD, CBD or L1-RSRP measurement, UE is not required to receive CSI-RS for L1-RSRP measurement in the PRBs that overlap with an SSB.

For FR1, when the SSB for RLM, BFD, CBD or L1-RSRP measurement is within the active BWP and has same SCS than CSI-RS for L1-RSRP measurement, the UE shall be able to perform CSI-RS measurement without restrictions.

For FR1, when the SSB for RLM, BFD, CBD or L1-RSRP measurement is within the active BWP and has different SCS than CSI-RS for L1-RSRP measurement, the UE shall be able to perform CSI-RS measurement with restrictions according to its capabilities:

- If the UE supports *simultaneousRxDataSSB-DiffNumerology* the UE shall be able to perform CSI-RS measurement without restrictions.

- If the UE does not support *simultaneousRxDataSSB-DiffNumerology*, UE is required to measure one of but not both CSI-RS for L1-RSRP measurement and SSB. Longer measurement period for CSI-RS based L1-RSRP measurement is expected, and no requirements are defined.

For FR1, when the CSI-RS for L1-RSRP measurement is in the same OFDM symbol as another CSI-RS for RLM, BFD, CBD or L1-RSRP measurement, UE shall be able to measure the CSI-RS for L1-RSRP measurement without any restriction.

### 9.5C.6 Scheduling availability of UE during L1-RSRP measurement

Scheduling availability restrictions when the UE is performing L1-RSRP measurement are described in the following clauses.

#### 9.5C.6.1 Scheduling availability of UE performing L1-RSRP measurement with a same subcarrier spacing as PDSCH/PDCCH on FR1

There are no scheduling restrictions due to L1-RSRP measurement performed on SSB and CSI-RS configured as RS for L1-RSRP measurement with the same SCS as PDSCH/PDCCH in FR1.

#### 9.5C.6.2 Scheduling availability of UE performing L1-RSRP measurement with a different subcarrier spacing than PDSCH/PDCCH on FR1

For UEs which support *simultaneousRxDataSSB-DiffNumerology* [14] there are no restrictions on scheduling availability due to L1-RSRP measurement based on SSB as RS for L1-RSRP measurement. For UEs which do not support *simultaneousRxDataSSB-DiffNumerology* [14] the following restrictions apply due to L1-RSRP measurement based on SSB configured for L1-RSRP measurement.

- The UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/CSI-RS for tracking/CSI-RS for CQI on symbols corresponding to the SSB indexes configured for L1-RSRP measurement.

## 9.6 NE-DC: Measurements

### 9.6.1 Introduction

This clause contains requirements for UE supporting dual connectivity with NR PCell and E-UTRA FDD or TDD PSCell. The requirements apply to UEs that have been configured with NE-DC.

### 9.6.2 SFTD Measurements

#### 9.6.2.1 Introduction

This clause contains requirements on UE capabilities for reporting of SFN and frame time difference between NR PCell and E-UTRA PSCell in RRC\_CONNECTED state. The requirements comprise measurement reporting delay and measurement accuracy. The overall measurement reporting delay includes a RRC procedure delay specified in TS 38.331 [2], and the SFTD measurement reporting delay specified below.

#### 9.6.2.2 SFTD Measurement requirements

When no DRX is used in either of the NR PCell and E-UTRA PSCell, the physical layer measurement period of the SFTD measurement shall be Tmeasure\_SFTD1 = max(0.2, 5 \* SMTC period) s.

When DRX is used in either of the NR PCell or the E-UTRA PSCell, or in both PCell and PSCell, the physical layer measurement period (Tmeasure\_SFTD1) of the SFTD measurement shall be as specified in Table 9.6.2.2-1.

Table 9.6.2.2-1: SFTD measurement requirement when DRX is used

|  |  |
| --- | --- |
| DRX cycle length (s)Note2 | Tmeasure\_SFTD1 (s) |
| DRX cycle≤0.04 | max(0.2,5 x SMTC period) (Note1) |
| 0.04<DRX cycle≤0.32 | 8 x max(DRX cycle, SMTC period) |
| 0.32<DRX cycle≤10.24 | 5 x DRX cycle |
| Note1: Number of DRX cycles depends upon the DRX cycle in use  Note2: DRX cycle length in this table refers to the DRX cycle length configured for PCell or PSCell. When DRX is used in both PCell and PSCell, DRX cycle length in this table refers to the longer of the DRX cycle lengths for PCell and PSCell. | |

If PSCell is changed without changing carrier frequency of PSCell while the UE is performing SFTD measurements, the UE shall still meet SFTD measurement and accuracy requirements for the new PSCell. In this case the UE shall restart the SFTD measurement, and the total physical layer measurement period shall not exceed Tmeasure\_SFTD2 as defined by the following expression:

Tmeasure\_SFTD2 = (M+1)\*(Tmeasure\_SFTD1) + M\*TPSCell\_change\_NEDC

where:

M is the number of times the E-UTRA PSCell is changed over the measurement period (Tmeasure\_SFTD2), and

TPSCell\_change\_NEDC is the time necessary to change the PSCell; it can be up to 25 ms.

If PCell is changed, or if PSCell is changed to a different carrier frequency, the UE shall terminate the SFTD measurement.

The measurement accuracy for the SFTD measurement when DRX is used as well as when no DRX is used shall be as specified in clause 10.1.21.1.

## 9.7 Cross Link Interference measurements

### 9.7.1 Introduction

The UE capable of performing CLI measurements shall be able to measure SRS-RSRP and CLI-RSSI which are defined in TS38.215 [4] within active DL BWP. The measurements requirements in this clause apply for TDD mode only.

CLI measurements are only applicable for RRC\_CONNECTED intra-frequency:

- when SRS-RSRP measurement resource is fully confined within BW of DL active BWP

- when CLI-RSSI measurement resouce is configured within active BWP

When the UE measures SRS-RSRP and CLI-RSSI, a constant offset relative to the downlink reference timing in the serving cell shall be applied. The constant offset value is derived by UE implementation and shall be at least Tc\*NTA\_offset.

For performing CLI measurement in FR2, UE can assume the configured CLI measurement resources are QCL-ed with TypeD to one of the latest received PDSCH and the latest monitored CORESET.

CLI measurement requirements defined in clause 9.7 are applicable if

- CLI measurement is not performed on an NR carrier in the same band as E-UTRA serving carrier; and

- UE supports simultaneous Rx/Tx for inter-band CA, inter-band EN-DC, inter-band NE-DC, and NR-DC.

### 9.7.2 SRS-RSRP measurements

#### 9.7.2.1 Introduction

When configured by the network, the UE shall be able to perform SRS-RSRP measurements of configured *srs-ResourceConfigCLI*. The requirements apply when the subcarrier spacing for SRS-RSRP measurement resource configuration is the same as the subcarrier spacing of the active DL BWP of serving cell. The UE is not required to measure SRS using different SCS compared to the downlink active BWP SCS of the same carrier.

#### 9.7.2.2 Requirements applicability

The requirements in clause 9.7.2 apply, provided:

- SRS resources configured for SRS-RSRP measurements are measurable.

An SRS resource configured for SRS-RSRP shall be considered measurable when for each relevant SRS the following conditions are met:

- SRS-RSRP related side conditions given in clauses 10.1.22.1 for FR1 and FR2 for a corresponding band,

- SRS\_RP and SRS Ês/Iot according to Annex B.2.7 for a corresponding band.

#### 9.7.2.3 Measurement Reporting Requirements

The UE shall send SRS-RSRP reports only for report configurations according to *reportType* which is *cliPeriodical* or *cliEventTriggered* when SRS-RSRP report is configured.

The UE shall report the SRS-RSRP value as a 7-bit value in the range [-140, -44] dBm with 1dB step size according to clause 10.1.22.1 for FR1 and FR2.

##### 9.7.2.3.1 Periodic Reporting

Reported SRS-RSRP measurements contained in periodically triggered measurement reports shall meet the requirements in clause 10.1.22.1.

##### 9.7.2.3.2 Event-triggered Periodic Reporting

Reported SRS-RSRP measurements contained in periodically triggered measurement reports shall meet the requirements in clauses 10.1.22.1.

The first report in event triggered periodic measurement reporting shall meet the requirements specified in clause 9.7.2.3.3.

##### 9.7.2.3.3 Event Triggered Reporting

Reported SRS-RSRP measurements contained in periodically triggered measurement reports shall meet the requirements in clause 10.1.22.1.

The UE shall not send any event triggered measurement reports as long as no reporting criteria is fulfilled.

The measurement reporting delay is defined as the time between an event that will trigger a measurement report and the point when the UE starts to transmit the measurement report over the air interface. This requirement assumes that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 x TTIDCCH. This measurement reporting delay excludes a delay which caused by no UL resources for UE to send the measurement report on.

#### 9.7.2.4 Measurement capability

The UE shall be capable of performing SRS-RSRP measurements on the SRS resources configured for measurement, provided that the number of SRS to be monitored by UE does not exceed 8 within a slot, and the total number of SRSs to be monitored by the UE does not exceed 32.

#### 9.7.2.5 SRS-RSRP measurement period

The UE shall be capable of performing SRS-RSRP measurement based on the configured SRS resource, and the UE shall be capable of reporting SRS-RSRP measured over measurement period of TSRS\_RSRP\_measurement\_period for FR1 and FR2.

Table 9.7.2.5‑1 Measurement period TSRS\_RSRP\_measurement\_period

|  |  |
| --- | --- |
| Configuration | TSRS\_measurement\_period (ms) |
| No DRX | Max(60, 3 X TSRS) |
| DRX cycle ≤ 320ms | Max(60, Ceil(1.5 X 3) X max(TSRS, TDRX)) |
| DRX cycle > 320ms | 3 X TDRX |
| Note: TSRS is SRS measurement periodicity configured *SRS-PeriodicityAndOffset*, and TDRX is the DRX cycle length. | |

If the SRS resources configured for measurement are partially or fully overlapping with SMTC window, SSB or CSI-RS configured for RLM, BFD, CBD or L1-RSRP measurement or measurement gaps, requirements are not specified for TSRS\_RSRP\_measurement\_period.

### 9.7.3 CLI-RSSI measurements

#### 9.7.3.1 Introduction

When configured by the network, the UE shall be able to perform CLI-RSSI measurement of configured *rssi-ResourceConfigCLI*. The subcarrier spacing for CLI-RSSI measurement resource configuration can be same or different from the subcarrier spacing of active BWP. UE shall perform CLI-RSSI measurement with the SCS of the active BWP.

#### 9.7.3.2 Requirements applicability

The requirements in clause 9.7.3 apply, provided:

- The measurement resources configured for CLI-RSSI measurements are measurable.

A measurement resource configured for CLI-RSSI shall be considered measurable when for each relevant CLI-RSSI resource the following conditions are met:

- CLI-RSSI related side conditions given in clauses 10.1.22.2 for FR1 and FR2 for a corresponding band.

#### 9.7.3.3 Measurement Reporting Requirements

The UE shall send CLI-RSSI reports only for report configurations according to *reportType* which is *cliPeriodical* or *cliEventTriggered* when CLI-RSSI report is configured.

The UE shall report the CLI-RSSI value as a 7-bit value in the range [-100, -25] dBm with 1dB step size according to clause 10.1.22.2 for FR1 and FR2.

##### 9.7.3.3.1 Periodic Reporting

Reported CLI-RSSI measurements contained in periodically triggered measurement reports shall meet the requirements in clause 10.1.22.2.

##### 9.7.3.3.2 Event-triggered Periodic Reporting

Reported CLI-RSSI measurements contained in periodically triggered measurement reports shall meet the requirements in clauses 10.1.22.2.

The first report in event triggered periodic measurement reporting shall meet the requirements specified in clause 9.7.3.3.3.

##### 9.7.3.3.3 Event Triggered Reporting

Reported CLI-RSSI measurements contained in periodically triggered measurement reports shall meet the requirements in clause 10.1.22.2.

The UE shall not send any event triggered measurement reports as long as no reporting criteria is fulfilled.

The measurement reporting delay is defined as the time between an event that will trigger a measurement report and the point when the UE starts to transmit the measurement report over the air interface. This requirement assumes that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 x TTIDCCH. This measurement reporting delay excludes a delay which caused by no UL resources for UE to send the measurement report on.

#### 9.7.3.4 Measurement capability

The UE should be capable of performing CLI-RSSI measurement based on the configured resource, provided that the maximum number of CLI-RSSI measurement resources for the UE does not exceed 64.

#### 9.7.3.5 CLI-RSSI measurement period

The UE shall be capable of performing CLI-RSSI measurement based on the configured measurement resource within TCLI\_RSSI\_measurement\_period. The UE shall be able to provide a single RSSI sample for each measurement resource configured for CLI-RSSI measurement occurring with a configured periodicity. The CLI-RSSI measurement period TCLI\_RSSI\_measurement\_period corresponds to the CLI-RSSI measurement resource periodicity, which is configured for by higher layers via *RSSI-PeriodicityAndOffset*.

If the CLI-RSSI measurement resources configured for measurement are partially or fully overlapping with SMTC window, SSB or CSI-RS configured for RLM, BFD, CBD or L1-RSRP measurement or measurement gaps, requirements are not specified for TCLI\_RSSI\_measurement\_period.

### 9.7.4 Scheduling availability of UE during CLI measurements

Scheduling availability restrictions when the UE is performing CLI measurements which are SRS-RSRP and CLI-RSSI are described in the following clause.

#### 9.7.4.1 Scheduling availability of UE performing measurement on FR1

The following scheduling restriction applies due to CLI measurements.

- The UE is not expected to transmit PUCCH/PUSCH/SRS on OFDM symbols on which the UE performs CLI measurements, and on 1 data symbol before an OFDM symbol used for CLI measurements for 15 kHz and 30 kHz subcarrier spacing.

- For the UE which does not support *cli-SRS-RSRP-FDM\_DL*, the UE is not expected to receive PDCCH/PDSCH/CSI-RS for tracking/CSI-RS for CQI on OFDM symbols on which the UE performs SRS-RSRP measurements, and on 1 data symbol before an OFDM symbol used for SRS-RSRP measurements for 15 kHz and 30 kHz subcarrier spacing.

- For the UE which does not support *cli-RSSI-FDM-DL*, the UE is not expected to receive PDCCH/PDSCH/CSI-RS for tracking/CSI-RS for CQI on OFDM symbols on which the UE performs CLI-RSSI measurements, and on 1 data symbol before an OFDM symbol used for CLI-RSSI measurements for 15 kHz and 30 kHz subcarrier spacing.

- The UE is not expected to transmit PUCCH/PUSCH/SRS on OFDM symbols on which the UE performs CLI measurement, and on 2 data symbols before an OFDM symbol used for CLI measurements for 60 kHz subcarrier spacing.

- For the UE which does not support *cli-SRS-RSRP-FDM\_DL*, the UE is not expected to receive PDCCH/PDSCH/CSI-RS for tracking/CSI-RS for CQI on OFDM symbols on which the UE performs SRS-RSRP measurement, and on 2 data symbols before an OFDM symbol used for SRS-RSRP measurements for 60 kHz subcarrier spacing.

- For the UE which does not support *cli-RSSI-FDM-DL*, the UE is not expected to receive PDCCH/PDSCH/CSI-RS for tracking/CSI-RS for CQI on OFDM symbols on which the UE performs CLI-RSSI measurement, and on 2 data symbols before an OFDM symbol used for CLI-RSSI measurements for 60 kHz subcarrier spacing.

When TDD intra-band carrier aggregation is configured, the scheduling restrictions on serving cell where CLI measurements are performed apply on all serving cells in the same band on the symbols that fully or partially overlap with restricted symbols.

#### 9.7.4.2 Scheduling availability of UE performing measurement on FR2

The following scheduling restriction applies due to CLI measurements.

- The UE is not expected to transmit PUCCH/PUSCH/SRS on OFDM symbols on which the UE performs CLI measurements, and on 1 data symbol before an OFDM symbol used for CLI measurements for 60 kHz subcarrier spacing.

- For the UE which does not support *cli-SRS-RSRP-FDM\_DL*, the UE is not expected to receive PDCCH/PDSCH/CSI-RS for tracking/CSI-RS for CQI on OFDM symbols on which the UE performs SRS-RSRP measurements, and on 1 data symbol before an OFDM symbol used for SRS-RSRP measurements for 60 kHz subcarrier spacing.

- For the UE which does not support *cli-RSSI-FDM-DL*, the UE is not expected to receive PDCCH/PDSCH/CSI-RS for tracking/CSI-RS for CQI on OFDM symbols on which the UE performs CLI-RSSI measurements, and on 1 data symbol before an OFDM symbol used for CLI-RSSI measurements for 60 kHz subcarrier spacing.

- The UE is not expected to transmit PUCCH/PUSCH/SRS on OFDM symbols on which the UE performs CLI measurements, and on 2 data symbols before an OFDM symbol used for CLI measurements for 120 kHz subcarrier spacing.

- For the UE which does not support *cli-SRS-RSRP-FDM\_DL*, the UE is not expected to receive PDCCH/PDSCH/CSI-RS for tracking/CSI-RS for CQI on OFDM symbols on which the UE performs SRS-RSRP measurements, and on 2 data symbols before an OFDM symbol used for SRS-RSRP measurements for 120 kHz subcarrier spacing.

- For the UE which does not support *cli-RSSI-FDM-DL*, the UE is not expected to receive PDCCH/PDSCH/CSI-RS for tracking/CSI-RS for CQI on OFDM symbols on which the UE performs CLI-RSSI measurements, and on 2 data symbols before an OFDM symbol used for CLI-RSSI measurements for 120 kHz subcarrier spacing.

When TDD intra-band carrier aggregation is configured, the scheduling restrictions on serving cell where CLI measurements are performed apply on all serving cells in the same band on the symbols that fully or partially overlap with restricted symbols.

## 9.8 L1-SINR measurements for Reporting

### 9.8.1 Introduction

When configured by the network, the UE shall be able to perform L1-SINR measurements with the measurement resources configured as the selection of:

- CSI-RS based CMR and no dedicated IMR configured;

- SSB based CMR and dedicated IMR configured;

- CSI-RS based CMR and dedicated IMR configured.

The measurements shall be performed for a serving cell, including PCell, PSCell, or SCell, on the resources configured for L1-SINR measurements within the active BWP.

The UE shall be able to measure all CSI-RS resources and/or SSB resources and/or CSI-IM resources of the *nzp-CSI-RS-ResourceSet* and/or *csi-SSB-ResourceSet and/or CSI-IM-ResourceSet* within the *CSI-ResourceConfig* settings for L1-SINR for the active BWP and measure interference on corresponding NZP CSI-RS or CSI-IM resources if configured, provided that the number of resources does not exceed the UE capability indicated by *beamManagementSSB-CSI-RS*.

The UE shall report the measurement quantity (*reportQuantity*) and send periodic, semi-persistent or aperiodic reports, according to the *reportConfigType* according to the CSI reporting configuration(s) (*CSI-ReportConfig*) for the active BWP.

### 9.8.2 Requirements applicability

The requirements in clause 9.8 apply, provided:

- CMR resources configured for L1-SINR measurements are measurable, and

- NZP-IMR resources configured for L1-SINR measurements if applicable are measurable.

Requirements are defined for periodic, semi-persistent and aperiodic resources.

For CSI-RS based CMR and no dedicated IMR configured, a CSI-RS resource configured for L1-SINR shall be considered measurable when for each relevant CSI-RS the following conditions are met:

- L1-SINR related side conditions given in clauses 10.1.27 and 10.1.28 for FR1 and FR2, respectively, for a corresponding band,

- CSI-RS\_RP and CSI-RS Ês/Iot according to Annex B.2.8.1 for a corresponding band.

For SSB based CMR and dedicated IMR configured, a SSB and a dedicated IMR configured for L1-SINR shall be considered measurable when for each relevant SSB and IMR the following conditions are met:

- L1-SINR related side conditions given in clauses 10.1.27 and 10.1.28 for FR1 and FR2, respectively, for a corresponding band,

- SSB\_RP and SSB Ês/Iot according to Annex B.2.8.2 for a corresponding band.

- NZP-IMR Ês/Iot according to Annex B.2.8.2 for a corresponding band, if NZP-IMR is configured as dedicated IMR.

For CSI-RS based CMR and dedicated IMR configured, a CSI-RS and a dedicated IMR configured for L1-SINR shall be considered measurable when for each relevant CSI-RS and IMR the following conditions are met:

- L1-SINR related side conditions given in clauses 10.1.27 and 10.1.28 for FR1 and FR2, respectively, for a corresponding band,

- CSI-RS\_RP and CSI-RS Ês/Iot according to Annex B.2.8.3 for a corresponding band

- NZP-IMR Ês/Iot according to Annex B.2.8.3 for a corresponding band, if NZP-IMR is configured as dedicated IMR.

### 9.8.3 Measurement Reporting Requirements

The UE shall send L1-SINR reports only for report configurations configured for the active BWP.

The UE shall report the L1-SINR value as a 7-bit value in the range [-23, 40] dB with 0.5dB step size if *nrofReportedRS* is configured to one. If *nrofReportedRS* is configured to be larger than one, or if *groupBasedBeamReporting* is enabled, the UE shall use differential L1-SINR based reporting. The differential L1-SINR is quantized to a 4-bit value with 1dB step size. The mapping between the reported L1-SINR value and the measured quantity is described in 10.1.16.

#### 9.8.3.1 Periodic Reporting

Reported L1-SINR measurements contained in periodic L1-SINR measurement reports shall meet the requirements in clauses 10.1.27 for FR1 and 10.1.28 for FR2, respectively.

The UE shall transmit the periodic L1-SINR reporting on PUCCH over the air interface according to the periodicity defined in clause 5.2.1.4 in TS 38.214 [26].

#### 9.8.3.2 Semi-Persistent Reporting

Reported L1-SINR measurements contained in a Semi-Persistent L1-SINR measurement report shall meet the requirements in clauses 10.1.27 for FR1 and 10.1.28 for FR2, respectively. This requirement applies for semi-persistent L1-SINR reports send on PUSCH or PUCCH.

The UE shall only send semi-persistent L1-SINR measurement reports on PUSCH, if a DCI for triggering report has been received.

The UE shall only send semi-persistent L1-SINR measurement reports on PUCCH, if an activation command as described in clause 6.1.3.16 in TS38.321 [7] has been received.

The UE shall transmit the semi-persistent L1-SINR reporting on PUSCH or PUCCH over the air interface according to the periodicity defined in clause 5.2.1.4 in TS 38.214 [26].

9.8.3.3 Aperiodic Reporting

Reported L1-SINR measurements contained in aperiodic triggered, aperiodic triggered periodic and aperiodic triggered semi-persistent L1-SINR reports shall meet the requirements in clauses 10.1.x for FR1 and 10.1.x for FR2, respectively.

The UE shall only send aperiodic L1-SINR measurement reports, if a DCI for triggering report has been received.

After the UE receives CSI request in DCI, the UE shall transmit the aperiodic L1-SINR reporting on PUSCH over the air interface at the time specified according to clause 5.2.1.4 in TS 38.214 [26].

### 9.8.4 L1-SINR measurement requirements

#### 9.8.4.1 L1-SINR reporting with CSI-RS based CMR and no dedicated IMR configured

edicated resource configured as IMR for L1-SINR computation, and the UE physical layer shall be capable of reporting L1-SINR measured over the measurement period of TL1-SINR\_Measurement\_Period\_CSI-RS\_CMR\_Only.

The value of TL1-SINR\_Measurement\_Period\_CSI-RS\_CMR\_Only is defined in Table 9.8.4.1-1 for FR1 and in Table 9.8.4.1-2 for FR2, where

For the value of M,

- For periodic and semi-persistent CSI-RS resources as CMR, M=1 if higher layer parameter *timeRestrictionForChannelMeasurement* is configured, and M=3 otherwise;

- For aperiodic CSI-RS resources as CMR, M=1.

For the value of N in FR2

- For periodic CSI-RS resources as CMR in a resource set configured with higher layer parameter *repetition* set to OFF, N=1. The requirements apply if *qcl-InfoPeriodicCSI-RS* is configured for all the resources in the resource set and for each resource one RS has QCL-TypeD with

- SSB for L1-RSRP or L1-SINR measurement, or

- another CSI-RS in resource set configured with repetition ON.

- For periodic CSI-RS resources as CMR in a resource set configured with higher layer parameter *repetition* set to ON, N=ceil(*maxNumberRxBeam* / Nres\_per\_set), where Nres\_per\_set is number of resources in the resource set. The requirements apply provided *qcl-InfoPeriodicCSI-RS* is configured for all resources in the resource set.

- For semi-persistent CSI-RS resources as CMR in a resource set configured with higher layer parameter *repetition* set to OFF, N=1. The requirements apply provided TCI state is provided for all resources in the resource set in the MAC CE activating the resource set and for each resource has QCL-TypeD with

- SSB for L1-RSRP or L1-SINR measurement, or

- another CSI-RS in resource set configured with repetition ON.

- For semi-persistent CSI-RS resources as CMR in a resource set configured with higher layer parameter *repetition* set to ON, N=ceil(*maxNumberRxBeam* / Nres\_per\_set), where Nres\_per\_set is number of resources in the resource set. The requirements apply provided TCI state is provided for all resources in the resource set in the MAC CE activating the resource set.

- For aperiodic CSI-RS resources as CMR in a resource set configured with higher layer parameter *repetition* set to OFF, N=1. The requriements apply provided *qcl-info* is configured for all resources in the resource set and for each resource has QCL-TypeD with

- SSB for L1-RSRP or L1-SINR measurement, or

- another CSI-RS in resource set configured with repetition ON.

- For aperiodic CSI-RS resources as CMR in a resource set configured with higher layer parameter *repetition* set to ON, N=1. UE is not required to meet the accuracy requirements in clause 10.1.28.1 and 10.1.28.3 if number of resources in the resource set is smaller than *maxNumberRxBeam*. The requriements apply provided *qcl-info* is configured for all resources in the resource set.

When UE supports concurrent measurement gap and concurrent gaps are configured,

- P value for a CSI-RS resource to be measured is defined as

- Ntotal / Noutside\_MG in FR1

- Psharing factor \* Ntotal / Noutside\_MG in FR2 with Navailable = 0

- Ntotal / Navailable in FR2 with Navailable > 0

- For a window W of duration max(TL1, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE measurement gaps and per-FR measurement gaps within the same FR as serving cell, and starting at the beginning of any CSI-RS resource occasion:

- Ntotal is the total number of CSI-RS resource occasions within the window, including those overlapped with measurement gap occasions or SMTC occasions within the window, and

- Noutside\_MG is the number of CSI-RS resource occasions that are not overlapped with any measurement gap occasion within the window W

- Navailable is the number of CSI-RS resource occasions that are not overlapped with any measurement gap occasion nor any SMTC occasion within the window W

- TL1 is periodicity of the target CSI-RS.

Otherwise, for a UE not supporting *concurrentMeasGap-r17* or when concurrent gaps are not configured,

For the value of P in FR1,

- P=, when in the monitored cell there are [measurement gaps] configured for intra-frequency, inter-frequency or inter-RAT measurements, which are overlapping with some but not all occasions of the CSI-RS; and

- P=1 when in the monitored cell there are no GAPs overlapping with any occasion of the CSI-RS.

For the value of P in FR2,

- P=1, when CSI-RS is not overlapped with GAP and also not overlapped with SMTC occasion.

- P=, when CSI-RS is partially overlapped with GAP and CSI-RS is not overlapped with SMTC occasion (TCSI-RS < xRP)

- P=, when CSI-RS is not overlapped with GAP and CSI-RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod).

- P is Psharing factor,, when CSI-RS is not overlapped with [measurement gap] and CSI-RS is fully overlapped with SMTC occasion (TCSI-RS = TSMTCperiod).

- P=, when CSI-RS is partially overlapped with [measurement gap] and CSI-RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is not overlapped with GAP and

- TSMTCperiod ≠ xRP or

- TSMTCperiod = xRP and TCSI-RS < 0.5\*TSMTCperiod

- P=, when CSI-RS is partially overlapped with [measurement gap] and CSI-RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is not overlapped with GAP and TSMTCperiod = xRP and TCSI-RS = 0.5\*TSMTCperiod

- P=, when CSI-RS is partially overlapped with [measurement gap] (TCSI-RS < xRP) and CSI-RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is partially or fully overlapped with GAP .

- P=, when CSI-RS is partially overlapped with [measurement gap] and CSI-RS is fully overlapped with SMTC occasion (TCSI-RS = TSMTCperiod) and SMTC occasion is partially overlapped with GAP (TSMTCperiod < xRP)

Where:

Psharing factor = 1, if the CSI-RS configured for L1-SINR measurement outside gap is

not overlapped with the SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol before each consecutive SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol after each consecutive SSB symbols indicated by *SSB-ToMeasure*, given that *SSB-ToMeasure* is configured, where the *SSB-ToMeasure* is the union set of *SSB-ToMeasure* from all the configured measurement objects merged on the same serving carrier, and,

not overlapped by the RSSI symbols indicated by *ss-RSSI-Measurement* and 1 data symbol before each RSSI symbol indicated by *ss-RSSI-Measurement* and 1 data symbol after each RSSI symbol indicated by *ss-RSSI-Measurement*, given that *ss-RSSI-Measurement* is configured.

- Psharing factor = 3, otherwise.

- TSMTCperiod = the configured SMTC1 period or SMTC2 period if configured.

- TCSI-RS = the periodicity of CSI-RS configured for L1-SINR measurement

- If the UE is configured with Pre-MG, a CSI-RS reourse or an SMTC occasion is only considered to be overlapped by the Pre-MG if the Pre-MG is activated.

- When a measurement gap is configured and the measurement gap is not NCSG,

- a CSI-RS is considered to be overlapped with the GAP if it overlaps a measurement gap occasion, and

- xRP = MGRP

- Otherwise, when NCSG measurement gap is configured,

- a CSI-RS is considered to be overlapped with the GAP if

- it overlaps the VIL1 or VIL2 of NCSG, or

- it overlaps the ML of NCSG in FR2, and there exists a target carrier to be measured within NCSG that is intra-frequency carrier or inter-frequency carrier in the same band as the serving cell, or inter-frequency carrier in different band as the serving cell and UE does not support IBM between the target carrier and the serving cell,

- and

- xRP = VIRP

- When concurrent gaps are configured, a CSI-RS or an SMTC occasion is not considered to be overlapped by a gap occasion if the gap occasion is dropped according to 9.1.8.

If the high layer in TS 38.331 [2] signaling of *smtc2* is configured, TSMTCperiod corresponds to the value of higher layer parameter *smtc2*; Otherwise TSMTCperiod corresponds to the value of higher layer parameter *smtc1*.

Note: The overlap between CSI-RS for L1-SINR measurement and SMTC means that CSI-RS for L1-SINR measurement is within the SMTC window duration.

Longer evaluation period would be expected if the combination of CSI-RS, SMTC occasion and GAP configurations does not meet pervious conditions.

Table 9.8.4.1-1: Measurement period TL1-SINR\_Measurement\_Period\_CSI-RS\_CMR\_Only for FR1

|  |  |
| --- | --- |
| Configuration | TL1-SINR\_Measurement\_Period\_CSI-RS\_CMR\_Only (ms) |
| non-DRX | max(TReport, ceil(M\*P)\*TCSI-RS) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P)\*max(TDRX,TCSI-RS)) |
| DRX cycle > 320ms | ceil(M\*P)\*TDRX |
| Note 1: TCSI-RS is the periodicity of CSI-RS configured for L1-SINR measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting.  Note 2: the requirements are applicable provided that the CSI-RS resource configured for L1-SINR measurement is transmitted with Density = 3. | |

Table 9.8.4.1-2: Measurement period TL1-SINR\_Measurement\_Period\_CSI-RS\_CMR\_Only for FR2

|  |  |
| --- | --- |
| Configuration | TL1-SINR\_Measurement\_Period\_CSI-RS\_CMR\_Only (ms) |
| non-DRX | max(TReport, ceil(M\*P\*N)\*TCSI-RS) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P\*N)\*max(TDRX,TCSI-RS)) |
| DRX cycle > 320ms | ceil(M\*P\*N)\*TDRX |
| Note 1: TCSI-RS is the periodicity of CSI-RS configured for L1-SINR measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting.  Note 2: the requirements are applicable provided that the CSI-RS resource configured for L1-SINR measurement is transmitted with Density = 3. | |

9.8.4.2 L1-SINR reporting with SSB based CMR and dedicated IMR configured

The UE shall be capable of performing L1-SINR measurements with the SSB configured as CMR and dedicated resource configured as IMR for L1-SINR computation, in which the NZP-CSI-RS or CSI-IM resource configured as dedicated IMR shall be 1-to-1 mapped to SSB configured as CMR, with the same periodicity. The UE physical layer shall be capable of reporting L1-SINR measured over the measurement period of TL1-SINR\_Measurement\_Period\_SSB\_CMR\_IMR.

The requirements in this clause are not applicable if NZP-CSI-RS or CSI-IM resource configured as dedicated IMR is scheduled with different periodicity as SSB configured as CMR.

The value of TL1-SINR\_Measurement\_Period\_SSB\_CMR\_IMR is defined in Table 9.8.4.2-1 for FR1 and in Table 9.8.4.2-2 for FR2 when *highSpeedMeasFlagFR2-r17* is not configured, and defined in Table 9.8.4.2-3 for FR2 power class 6 UE when *highSpeedMeasFlagFR2-r17* is configured, where

For the value of M

- For periodic or semi-persistent NZP CSI-RS or CSI-IM resource as dedicated IMR, M=1 if the higher layer parameters *timeRestrictionForChannelMeasurements* and/or *timeRestrictionForInterferenceMeasurements* are configured, and M=3 otherwise;

For the value of N in FR2

- N = 8.

P is defined as the maximum value between PCMR and PIMR, i.e., P = max(PCMR, PIMR), where

- the value of PCMR shall be derived in the same way as the value of P used for SSB based L1-RSRP measurement in clause 9.5.4.1, in which the occasions and period of the SSB for CMR shall be used instead.

- the value of PIMR shall be derived in the same way as the value of P used for CSI-RS based L1-RSRP measurement in clause 9.5.4.2, in which the occasions and period of the NZP CSI-RS for NZP-IMR or CSI-IM for ZP-IMR shall be used instead.

Longer evaluation period would be expected if the combination of SSB, SMTC occasion and measurement gap configurations does not meet pervious conditions.

For L1-SINR measurement with SSB as CMR and CSI-RS or CSI-IM as IMR, the requirement shall apply if the CSI-RS is configured as IMR with repetition field as “repetition = OFF” or CSI-IM is configured as IMR.

For L1-SINR measurement with SSB as CMR and CSI-RS/CSI-IM as IMR, no requirement shall apply if SSB occasions for CMR or CSI-RS/CSI-IM occasions for IMR are fully overlapped with the configured measurement gap

Table 9.8.4.2-1: Measurement period TL1-SINR\_Measurement\_Period\_SSB\_CMR\_IMR for FR1

|  |  |
| --- | --- |
| Configuration | TL1-SINR\_Measurement\_Period\_SSB\_CMR\_IMR (ms) |
| non-DRX | max(TReport, ceil(M\*P)\*TSSB) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P)\*max(TDRX,TSSB)) |
| DRX cycle > 320ms | ceil(M\*P)\*TDRX |
| Note 1: TSSB = ssb-periodicityServingCell is the periodicity of the SSB-Index configured for L1-SINR channel measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting.  Note 2: The requirements are applicable provided that the CSI-RS resource configured for interference measurement shall be 1-to-1 mapped to SSB configured for channel measurement, with the same periodicity. | |

Table 9.8.4.2-2: Measurement period TL1-SINR\_Measurement\_Period\_SSB\_CMR\_IMR for FR2

|  |  |
| --- | --- |
| Configuration | TL1-SINR\_Measurement\_Period\_SSB\_CMR\_IMR (ms) |
| non-DRX | max(TReport, ceil(M\*P\*N)\*TSSB) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P\*N)\*max(TDRX,TSSB)) |
| DRX cycle > 320ms | ceil(1.5\*M\*P\*N)\*TDRX |
| Note 1: TSSB = ssb-periodicityServingCell is the periodicity of the SSB-Index configured for L1-SINR measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting.  Note 2: The requirements are applicable provided that the CSI-RS resource configured for interference measurement shall be 1-to-1 mapped to SSB configured for channel measurement, with the same periodicity. | |

Table 9.8.4.2-3: Measurement period TL1-SINR\_Measurement\_Period\_SSB\_CMR\_IMR configured with *highSpeedMeasFlagFR2-r17* for FR2

|  |  |
| --- | --- |
| Configuration | TL1-SINR\_Measurement\_Period\_SSB\_CMR\_IMR (ms) |
| non-DRX | max(TReport, ceil(M\*P\*N1Note 3)\*TSSB) |
| DRX cycle ≤ 80ms | max(TReport, ceil(M\*P\*N1Note 3\*M2)\*max(TDRX,TSSB)) |
| 80ms< DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P\*N)\*max(TDRX,TSSB)) |
| DRX cycle > 320ms | ceil(1.5\*M\*P\*N)\*TDRX |
| Note 1: TSSB = ssb-periodicityServingCell is the periodicity of the SSB-Index configured for L1-SINR measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting.  Note 2: The requirements are applicable provided that the CSI-RS resource configured for interference measurement shall be 1-to-1 mapped to SSB configured for channel measurement, with the same periodicity.  Note 3: N1 = 2 when *highSpeedMeasFlagFR2-r17* = set1; N1 = 6 when *highSpeedMeasFlagFR2-r17* = set2.  Note 4: M2 = 1.5 if SMTC periodicity > 40 ms; otherwise M2 = 1 | |

#### 9.8.4.3 L1-SINR reporting with CSI-RS based CMR and dedicated IMR configured

The UE shall be capable of performing L1-SINR measurements with the CSI-RS resource configured as CMR and dedicated resource configured as IMR for L1-SINR computation, in which the NZP-CSI-RS or CSI-IM resource configured as dedicated IMR shall be 1-to-1 mapped to CSI-RS resource configured as CMR, with the same periodicity. The UE physical layer shall be capable of reporting L1-SINR measured over the measurement period of TL1-SINR\_Measurement\_Period\_CSI-RS\_CMR\_IMR.

The requirements in this clause are not applicable if NZP-CSI-RS or CSI-IM resource configured as dedicated IMR is scheduled with different periodicity as CSI-RS resource configured as CMR.

The value of TL1-SINR\_Measurement\_Period\_CSI-RS\_CMR\_IMR is defined in Table 9.8.4.3-1 for FR1 and in Table 9.8.4.3-2 for FR2, where

For the value of M,

- M=1 shall be applied if

- aperiodic NZP-CSI-RS as CMR or dedicated IMR, or

- aperiodic CSI-IMR as dedicated IMR, or

- periodic and semi-persistent NZP-CSI-RS as CMR or dedicated IMR and the higher layer parameters *timeRestrictionForChannelMeasurement* and/or *timeRestrictionForInterferenceMeasurements* are configured, or

- periodic and semi-persistent CSI-IM as dedicated IMR and the higher layer parameters *timeRestrictionForChannelMeasurement* and/or *timeRestrictionForInterferenceMeasurements* are configured;

- M=3 otherwise.

For the value of N in FR2

- For periodic CSI-RS resources as CMR in a resource set configured with higher layer parameter *repetition* set to OFF, N=1. The requirements apply if *qcl-InfoPeriodicCSI-RS* is configured for all the resources in the resource set and for each resource one RS has QCL-TypeD with

- SSB for L1-RSRP or L1-SINR measurement, or

- another CSI-RS in resource set configured with repetition ON.

- For periodic CSI-RS resources as CMR in a resource set configured with higher layer parameter *repetition* set to ON, N=ceil(*maxNumberRxBeam* / Nres\_per\_set), where Nres\_per\_set is number of resources in the resource set. The requirements apply provided *qcl-InfoPeriodicCSI-RS* is configured for all resources in the resource set.

- For semi-persistent CSI-RS resources as CMR in a resource set configured with higher layer parameter *repetition* set to OFF, N=1. The requirements apply provided TCI state is provided for all resources in the resource set in the MAC CE activating the resource set and for each resource has QCL-TypeD with

- SSB for L1-RSRP or L1-SINR measurement, or

- another CSI-RS in resource set configured with repetition ON.

- For semi-persistent CSI-RS resources as CMR in a resource set configured with higher layer parameter *repetition* set to ON, N=ceil(*maxNumberRxBeam* / Nres\_per\_set), where Nres\_per\_set is number of resources in the resource set. The requirements apply provided TCI state is provided for all resources in the resource set in the MAC CE activating the resource set.

- For aperiodic CSI-RS resources as CMR in a resource set configured with higher layer parameter *repetition* set to OFF, N=1. The requriements apply provided *qcl-info* is configured for all resources in the resource set and for each resource has QCL-TypeD with

- SSB for L1-RSRP or L1-SINR measurement, or

- another CSI-RS in resource set configured with repetition ON.

- For aperiodic CSI-RS resources as CMR in a resource set configured with higher layer parameter *repetition* set to ON, N=1. UE is not required to meet the accuracy requirements in clause 10.1.28.1 and 10.1.28.3 if number of resources in the resource set is smaller than *maxNumberRxBeam*. The requriements apply provided *qcl-info* is configured for all resources in the resource set.

P is defined as the maximum value between PCMR and PIMR, i.e., P = max(PCMR, PIMR), where

- The value of PCMR and PIMR shall be derived in the same way as the value of P used for CSI-RS based L1-RSRP measurement in clause 9.5.4.2, in which the occasions and period of the CSI-RS for CMR and NZP CSI-RS for NZP-IMR or CSI-IM for ZP-IMR shall be used instead respectively.

Longer evaluation period would be expected if the combination of CSI-RS, SMTC occasion and measurement gap configurations does not meet pervious conditions.

For L1-SINR measurement with CSI-RS as CMR and CSI-RS as IMR, the requirement shall apply only if CSI-RS resources as CMR and IMR are configured with the same repetition field and the number of CSI-RS resources in the resource sets for CMR and IMR are same.

For L1-SINR measurement with CSI-RS as CMR and CSI-IM as IMR, the requirement shall apply only if the number of CSI-RS resources in the resource set for CMR and the number of CSI-IM resources in the resource set for IMR are same.

For L1-SINR measurement with CSI-RS as CMR and CSI-RS/CSI-IM as IMR, no requirement shall apply if CSI-RS occasions for CMR or CSI-RS/CSI-IM occasions for IMR are fully overlapped with the configured measurement gap.

Table 9.8.4.3-1: Measurement period TL1-SINR\_Measurement\_Period\_CSI-RS\_CMR\_IMR for FR1

|  |  |
| --- | --- |
| Configuration | TL1-SINR\_Measurement\_Period\_CSI-RS\_CMR\_IMR (ms) |
| non-DRX | max(TReport, ceil(M\*P)\*TCSI-RS) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P)\*max(TDRX,TCSI-RS)) |
| DRX cycle > 320ms | ceil(M\*P)\*TDRX |
| Note 1: TCSI-RS is the periodicity of CSI-RS configured for L1-SINR measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting.  Note 2: the requirements are applicable provided that the CSI-RS resource configured for L1-SINR measurement is transmitted with Density = 3.  Note 3: The requirements are applicable provided that the CSI-RS resource configured for interference measurement shall be 1-to-1 mapped to CSI-RS configured for channel measurement, with the same periodicity. | |

Table 9.8.4.3-2: Measurement period TL1-SINR\_Measurement\_Period\_CSI-RS\_CMR\_IMR for FR2

|  |  |
| --- | --- |
| Configuration | TL1-SINR\_Measurement\_Period\_CSI-RS\_CMR\_IMR (ms) |
| non-DRX | max(TReport, ceil(M\*P\*N)\*TCSI-RS) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P\*N)\*max(TDRX,TCSI-RS)) |
| DRX cycle > 320ms | ceil(M\*P\*N)\*TDRX |
| Note 1: TCSI-RS is the periodicity of CSI-RS configured for L1-SINR measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting.  Note 2: the requirements are applicable provided that the CSI-RS resource configured for L1-SINR measurement is transmitted with Density = 3.  Note 3: The requirements are applicable provided that the CSI-RS resource configured for interference measurement shall be 1-to-1 mapped to CSI-RS configured for channel measurement, with the same periodicity. | |

### 9.8.5 Measurement restriction for L1-SINR measurement

The UE is required to be capable of measuring L1-SINR without measurement gaps. The UE is required to perform the SSB and CSI-RS/CSI-IM measurements with measurement restrictions as described in the following clauses.

#### 9.8.5.1 Measurement restriction if SSB configured for L1-SINR Measurement

For FR1, when the SSB configured as CMR for L1-SINR measurement is in the same OFDM symbol as CSI-RS for RLM, BFD, CBD, L1-RSRP or L1-SINR measurement,

- If SSB and CSI-RS have same SCS, UE shall be able to measure the SSB for L1-SINR measurement without any restriction;

- If SSB and CSI-RS have different SCS,

- If UE supports *simultaneousRxDataSSB-DiffNumerology*, UE shall be able to measure the SSB for L1-SINR measurement without any restriction;

- If UE does not support *simultaneousRxDataSSB-DiffNumerology*, UE is required to measure one of but not both SSB for L1-SINR measurement and CSI-RS. Longer measurement period for SSB based L1-SINR measurement is expected, and no requirements are defined.

For FR2, when the SSB configured as CMR for L1-SINR measurement on one CC is in the same OFDM symbol as CSI-RS for RLM, BFD, CBD, L1-RSRP or L1-SINR measurement on the same CC or different CCs in the same band, UE is required to measure one of but not both SSB for L1-SINR measurement and CSI-RS. Longer measurement period for SSB based L1-RSRP measurement is expected, and no requirements are defined.

For FR2, there is no measurement restriction allowed when the network configures mixed numerology between SSB configured as CMR for L1-SINR measurement on one FR2 band and CSI-RS for RLM, BFD, CBD, L1-RSRP or L1-SINR measurement on the other FR2 band, provided that UE is capable of independent beam management on this FR2 band pair.

#### 9.8.5.2 Measurement restriction if CSI-RS configured for L1-SINR measurement

For both FR1 and FR2, when the CSI-RS configured for L1-SINR measurement is in the same OFDM symbol as SSB for RLM, BFD, CBD, L1-RSRP or L1-SINR measurement, UE is not required to receive CSI-RS for L1-SINR measurement in the PRBs that overlap with an SSB.

For FR1, when the SSB for RLM, BFD, CBD, L1-RSRP or L1-SINR measurement is within the active BWP and has same SCS than CSI-RS configured for L1-SINR measurement, the UE shall be able to perform CSI-RS measurement without restrictions.

For FR1, when the SSB for RLM, BFD, CBD, L1-RSRP or L1-SINR measurement is within the active BWP and has different SCS than CSI-RS configured for L1-SINR measurement, the UE shall be able to perform CSI-RS measurement with restrictions according to its capabilities:

- If the UE supports *simultaneousRxDataSSB-DiffNumerology*, UE shall be able to perform CSI-RS measurement without restrictions.

- If the UE does not support *simultaneousRxDataSSB-DiffNumerology*, UE is required to measure one of but not both CSI-RS for L1-SINR measurement and SSB. Longer measurement period for CSI-RS based L1-SINR measurement is expected, and no requirements are defined.

For FR1, when the CSI-RS configured for L1-SINR measurement is in the same OFDM symbol as another CSI-RS for RLM, BFD, CBD, L1-RSRP or L1-SINR measurement, UE shall be able to measure the CSI-RS for L1-SINR measurement without any restriction.

For FR2, when the CSI-RS configured for L1-SINR measurement on one CC is in the same OFDM symbol as SSB for RLM, BFD, L1-RSRP or L1-SINR measurement on the same CC or different CCs in the same band, or in the same symbol as SSB for CBD measurement on the same CC or different CCs in the same band when beam failure is detected, UE is required to measure one of but not both CSI-RS for L1-SINR measurement and SSB. Longer measurement period for CSI-RS based L1-SINR measurement is expected, and no requirements are defined.

For FR2, when the CSI-RS configured for L1-SINR measurement on one CC is in the same OFDM symbol as another CSI-RS for RLM, BFD, CBD, L1-RSRP or L1-SINR measurement on the same CC or different CCs in the same band,

- In the following cases, UE is required to measure one of but not both CSI-RS for L1-SINR measurement and the other CSI-RS. Longer measurement period for CSI-RS based L1-SINR measurement is expected, and no requirements are defined.

- The CSI-RS for L1-SINR measurement or the other CSI-RS in a resource set configured with repetition ON, or

- The CSI-RS or the other CSI-RS is configured as dedicated IMR for L1-SINR computation with SSB as CMR, or

- The other CSI-RS is configured in q1 and beam failure is detected, or

- The two CSI-RS-es are not QCL-ed w.r.t. QCL-TypeD, or the QCL information is not known to UE,

- Otherwise, UE shall be able to measure the CSI-RS configured for L1-SINR measurement without any restriction.

#### 9.8.5.3 Measurement restriction if CSI-IM configured for L1-SINR measurement

For both FR1 and FR2, when the CSI-IM configured for L1-SINR measurement is in the same OFDM symbol as SSB for RLM, BFD, CBD, L1-RSRP or L1-SINR measurement, UE is not required to measure CSI-IM for L1-SINR measurement in the PRBs that overlap with an SSB.

For FR1, UE shall be able to measure the CSI-IM configured for L1-SINR measurement without any restriction.

For FR2, when the CSI-IM configured for L1-SINR measurement on one CC is in the same OFDM symbol as SSB for RLM, BFD, L1-RSRP or L1-SINR measurement on the same CC or different CCs in the same band, or in the same symbol as SSB for CBD measurement on the same CC or different CCs in the same band when beam failure is detected, UE is required to measure one of but not both CSI-IM for L1-SINR measurement and SSB. Longer measurement period for L1-SINR measurement is expected, and no requirements are defined.

For FR2, when the CSI-IM configured for L1-SINR measurement on one CC is in the same OFDM symbol as the CSI-RS for RLM, BFD, CBD, L1-RSRP or L1-SINR measurement on the same CC or different CCs in the same band,

- In the following cases, UE is required to measure one of but not both CSI-IM for L1-SINR measurement and CSI-RS. Longer measurement period for L1-SINR measurement is expected, and no requirements are defined.

- The CSI-RS in a resource set configured with repetition ON, or

- The CSI-IM or the CSI-RS is configured as dedicated IMR for L1-SINR computation with SSB as CMR, or

- The CSI-RS is configured in q1 and beam failure is detected, or

- The CMR for L1-SINR measurement and the CSI-RS are not QCL-ed w.r.t. QCL-TypeD, or the QCL information is not known to UE,

- Otherwise, UE shall be able to measure the CSI-IM configured for L1-SINR measurement without any restriction.

### 9.8.6 Scheduling availability of UE during L1-SINR measurement

Scheduling availability restrictions when the UE is performing L1-SINR measurement are described in the following clauses.

#### 9.8.6.1 Scheduling availability of UE performing L1-SINR measurement with a same subcarrier spacing as PDSCH/PDCCH on FR1

There are no scheduling restrictions due to L1-SINR measurement performed on SSB and CSI-RS configured for L1-SINR measurement with the same SCS as PDSCH/PDCCH in FR1.

#### 9.8.6.2 Scheduling availability of UE performing L1-SINR measurement with a different subcarrier spacing than PDSCH/PDCCH on FR1

For UEs which support *simultaneousRxDataSSB-DiffNumerology* [14] there are no restrictions on scheduling availability due to L1-SINR measurement based on SSB configured for L1-SINR measurement. For UEs which do not support *simultaneousRxDataSSB-DiffNumerology* [14] the following restrictions apply due to L1-SINR measurement based on SSB configured for L1-SINR measurement.

- The UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/CSI-RS for tracking /CSI-RS for CQI on SSB symbols to be measured for L1-SINR measurement.

When intra-band carrier aggregation in FR1 is configured, the scheduling restrictions on serving cell where L1-SINR measurement is performed apply to all serving cells in the same band on the symbols that fully or partially overlap with restricted symbols. When inter-band carrier aggregation within FR1 is configured, there are no scheduling restrictions on FR1 serving cell(s) configured in other bands than the bands in which the serving cell where L1-SINR measurement is performed is configured.

9.8.6.3 Scheduling availability of UE performing L1-SINR measurement on FR2

The following scheduling restriction applies due to L1-SINR measurement.

- For the cases of CSI-RS used for L1-SINR measurement of CSI-RS based CMR only case and CSI-RS based CMR plus CSI-RS based ZP-IMR/NZP-IMR case and CSI-RS based CMR plus ZP-IMR case, where CSI-RS is QCLed with active TCI state for PDCCH/PDSCH and not in a CSI-RS resource set with repetition ON, and N=1 applies as specified in clause 9.8.4

- There are no scheduling restrictions due to L1-SINR measurement performed based on the CSI-RS.

- Otherwise

- The UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/CSI-RS for tracking/CSI-RS for CQI on the CSI-RS for L1-RSRP measurement symbols to be measured for L1-SINR for FR2 power class 6 UE which is not configured with *highSpeedMeasFlagFR2-r17*, and for the UE not supporting FR2 power class 6;

- The UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/CSI-RS for tracking/CSI-RS for CQI on the symbols to be measured for L1-SINR, and on 1 data symbol before symbols to be measured for L1-SINR and 1 data symbol after symbols to be measured for L1-SINR for FR2 power class 6 UE configured with *highSpeedMeasFlagFR2-r17*.

When intra-band carrier aggregation is performed, the scheduling restrictions on serving cell where L1-SINR measurement is performed apply to all serving cells in the band on the symbols that fully or partially overlap with restricted symbols.

If following conditions are met,

- UE has been notified about system information update through paging,

- The gap between UE’s reception of PDCCH that UE monitors in the Type 2-PDCCH CSS set and that notifies system information update, and the PDCCH that UE monitors in the Type0-PDCCH CSS set, is greater than 2 slots,

for the SSB and CORESET for RMSI scheduling multiplexing patterns 3, UE is expected to receive the PDCCH that UE monitors in the Type0-PDCCH CSS set, and the corresponding PDSCH, on SSB symbols to be measured for L1-SINR measurement; and

for the SSB and CORESET for RMSI scheduling multiplexing patterns 2, UE is expected to receive PDSCH that corresponds to the PDCCH that UE monitors in the Type0-PDCCH CSS set, on SSB symbols to be measured for L1-SINR measurement.

#### 9.8.6.4 Scheduling availability of UE performing L1-SINR measurement on FR1 or FR2 in case of FR1-FR2 inter-band CA

There are no scheduling restrictions on FR1 serving cell(s) due to L1-SINR measurement performed on FR2 serving cell(s).

There are no scheduling restrictions on FR2 serving cell(s) due to L1-SINR measurement performed on FR1 serving cell(s).

## 9.9 NR measurements for positioning

### 9.9.1 Introduction

This clause contains requirements for UE capable of performing NR positioning measurements defined in TS 38.215 [4], including RSTD, PRS-RSRP, UE Rx-Tx time difference, NR E-CID, and PRS-RSRPP measurements.

#### 9.9.1.1 General Aspects of Gap-based Measurement

For gap-based RSTD, PRS-RSRP, UE Rx-Tx time difference, and PRS-RSRPP measurements, the requirements in clauses 9.9.2, 9.9.3, 9.9.4 and 9.9.6 apply provided:

- the UE is configured or pre-configured with measurement gaps

- if the measurement gap is pre-configured, the gap must be activated throughout the measurement period, and

- if concurrent measurement gaps are configured, all positioning frequency layers are associated with only one of the measurement gaps, and

- if the UE does not support PRS measurements with per-FR gaps, the configured or pre-configured gap used to perform the PRS measurements must be of per-UE type, and

- No active BWP switching occurs during the measurement gaps for PRS measurement, and

All measurement requirements specified in clause 9.9.2, 9.9.3, 9.9.4 and 9.9.6 shall apply without DRX as well as for any DRX configuration specified in TS 38.331 [2].

UE is only required to measure PRS resources that are fully or partially overlapped with measurement gaps, and the requirements in clause 9.9.2, 9.9.3, 9.9.4 and 9.9.6 are applicable to PRS resources that are fully or partially overlapped with measurement gaps.

A PRS resource is considered to be fully (partially) overlapped with measurement gaps if all (some) of its instances are overlapped with a measurement gap occasion. A PRS resource instance is considered to be overlapped with measurement gap occasion if the minimum number of unmuted repetitions of the instance taking into account *nr-DL- PRS-ExpectedRSTD-Uncertainty* and *nr-DL-PRS-ExpectedRSTD* is fully covered by the MGL excluding RF switching time, where the minimum number is given in the accuracy requirements in clause 10.1.23, 10.1.24, 10.1.25 and 10.1.X for RSTD, PRS-RSRP, UE Rx-Tx time difference and PRS-RSRPP, respectively.

When UE is configured with measurement for more than one positioning requests, the measurement period for each request may be longer than measurement period when UE is configured with measurement for single positioning request.

If a positioning measurement gap is configured via *PosGapConfig* and activated by MAC CE, the measurement requirements in clause 9.9.2, 9.9.3, 9.9.4 and 9.9.6 in apply provided that no other MGs are configured, and only one measurement gap configured via *PosGapConfig* is activated.

#### 9.9.1.2 General Aspects of Gapless Measurement

The requirements for RSTD, PRS-RSRP, UE Rx-Tx time difference, and PRS-RS5RPP measurement without measurement gaps specified in clauses 9.9.2.7, 9.9.3.6, 9.9.4.6 and 9.9.6.6 shall apply provided that:

UE is configured with PPW,

No active BWP switching occurs during PPW,

PRS is within PPW and does not overlap with other signals/channels of higher priority,

- for PPW type 1A/1B, the PPW does not overlap with any symbol for SSB-based RLM/BFD/CBD/L1-RSRP/L1-SINR measurement on any CC or for SSB based RRM measurement on any MOs that are measured outside measurement gaps,

- for PPW type 2, PRS does not overlap with any symbol for SSB-based RLM/BFD/CBD/L1-RSRP/L1-SINR measurement on any CC or for SSB based RRM measurement on any MOs that are measured outside measurement gaps,

max∣ΔT∣≤ THR, where

∆T is the time difference between the start of a slot containing PRS from the neighbor cell/TRP and the start of the closest slot from the serving cell;

the range of ∆T is determined by the expected RSTD and expected RSTD uncertainty in the assistance data;

THR is the threshold as reported in UE capability [TBD].

SCS of PRS within PPW and SCS of DL active BWP are the same.

All measurement requirements specified in clauses 9.9.2.7, 9.9.3.6, 9.9.4.6 and 9.9.6.6 shall apply without DRX as well as for any DRX configuration specified in TS 38.331 [2].

The UE is not required to perform additional SSB measurement for the SSB configured as QCL source of PRS resources.

The UE is only required to measure PRS resources that are unmuted and fully or partially overlapped with PPW, and the requirements in clauses 9.9.2.7, 9.9.3.6, 9.9.4.6 and 9.9.6.6 are applicable to PRS resources that are unmuted and fully or partially overlapped with PPW.

A PRS resource is considered to be fully (partially) overlapped with PPW if all (some) of its instances are overlapped with a PPW occasion. A PRS resource instance is considered to be overlapped with PPW occasion if the minimum number of unmuted repetitions of the instance taking into account Rx time difference between serving and non-serving cellis fully covered by the PPW excluding RF switching time, where the minimum number is given in the accuracy requirements in clause 10.1.23, 10.1.24, 10.1.25 and 10.1.X for RSTD, PRS-RSRP, UE Rx-Tx time difference and PRS-RSRPP, respectively.

When UE is configured with measurement for more than one positioning requests, the measurement period for each request may be longer than measurement period when UE is configured with measurement for single positioning request.

#### 9.9.1.3 Scheduling Availability of UE during PRS Measurement without Measurement Gaps

The requirements in this clause apply for UE performing RSTD, PRS-RSRP, UE Rx-Tx time difference and PRS-RSRPP measurement without measurement gaps.

If Cap. 1A UE capable of supporting priority options 1,2, and 3 is configured with priority state 1 for PRS RSTD measurement, then UE is not expected to receive PDCCH/PDSCH/CSI-RS on all symbols within PRS processing window.

If Cap.1A UE capable of supporting priority option 2 is configured with priority state 2 for PRS RSTD measurement, then UE is not expected to receive PDSCH/CSI-RS on all symbols within PRS processing window but is expected to receive PDCCH and URLLC PDSCH within PRS processing window.

If Cap. 1B UE capable of supporting priority options 1,2, and 3 is configured with priority state 1 for PRS RSTD measurement, then UE is not expected to receive PDCCH/PDSCH/CSI-RS from a certain [band or CC] on all symbols within PRS processing window.

If Cap. 1B UE capable of supporting priority option 2 is configured with priority state 2 for PRS RSTD measurement, then UE is not expected to receive PDSCH/CSI-RS from a certain [band or CC] but is expected to receive PDCCH and URLLC PDSCH from a certain [band or CC] on all symbols within PRS processing window.

If Cap. 2 UE capable of supporting priority options 1,2, and 3 is configured with priority state 1 for PRS RSTD measurement, then the UE is not expected to receive PDCCH/PDSCH/CSI-RS on the symbols overlapped with DL PRS within PRS processing window.

If Cap. 2 UE capable of supporting priority option 2 is configured with priority state 2 for PRS RSTD measurement, then UE is not expected to receive PDSCH/CSI-RS on the symbols overlapped with DL PRS within PRS processing window but is expected to receive PDCCH and URLLC PDSCH on the symbols overlapped with DL PRS within PRS processing window.

When PRS is lower priority than the DL signals/channels the following applies for cap1A and 1B UEs:

- If UE determines the presence of other DL signals/channels except SSB of higher priority than PRS in the PPW no later than [N symbol/T ms] before the start of the PPW, UE expects to receive the DL signals/channels and drop all DL PRS in the PPW.

- If UE determines the presence of other DL signals/channels except SSB of higher priority than PRS in the PPW later than [N symbol/T ms] before the start of the PPW, UE is not required to receive the other DL signals/channels except SSB of higher priority and may receive the DL PRS in the PPW.

When PRS is lower priority than the DL signals/channels the following applies for cap 2 UEs:

- If UE determines the presence of other DL signals/channels except SSB of higher priority than PRS on a PRS symbol no later than [N symbol/T ms] before the PRS symbol, UE expects to receive the DL signals/channels and drop the PRS symbol.

- If UE determines the presence of other DL signals/channels except SSB of higher priority than PRS on a PRS symbol later than [N symbol/T ms] before the PRS symbol, UE is not required to receive the other DL signals/channels except SSB of higher priority and may receive the PRS symbol.

For inter-band case for FR2 for the DL signals/channels from a different FR2 band than the FR2 band of the DL PRS, if the same Rx beam is used for both FR2 bands and the DL PRS is determined to be higher priority, capability 1B and 2 UEs are not expected to receive the DL signals/channels.

### 9.9.2 RSTD measurements

#### 9.9.2.1 Introduction

The requirements in clause 9.9.2 shall apply provided the UE has received *NR-DL-TDOA-RequestLocationInformation* message from LMF via LPP [34] requesting the UE to measure and report DL RSTD measurements defined in TS 38.215 [4].

#### 9.9.2.2 Requirements Applicability

The requirements in clause 9.9.2 apply for periodic and triggered RSTD measurements, provided:

- PRS-RSTD related side conditions given in clause 10.1.23 for FR1 and FR2 are fulfilled, for a corresponding Band.

#### 9.9.2.3 Measurement Capability

UE PRS RSTD measurement capability is as indicated by the UE in *NR-DL-TDOA-ProvideCapabilities*, according to TS 37.355[34].

#### 9.9.2.4 Measurement Reporting Requirements

The measurement reporting delay is defined as the time between the moment when the periodic measurement report is triggered and the moment when the UE starts to transmit the measurement report over the air interface. This requirement assumes that the measurement report is not delayed by other LPP signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 x TTIDCCH where TTIDCCH is the duration of subframe or slot or subslot when the measurement report is transmitted on the PUSCH with subframe or slot or subslot duration. This measurement reporting delay excludes any delay caused by no UL resources for UE to send the measurement report.

The reported RSTD measurement values contained in measurement reports shall be based on the measurement report mapping requirements specified in clauses 10.1.23.3.

The RSTD measurements performed and reported according to this section shall meet the RSTD measurement accuracy requirements in clause 10.1.23, for each measured DL PRS resource.

##### 9.9.2.4.1 Void

##### 9.9.2.4.2 Void

##### 9.9.2.4.3 Void

#### 9.9.2.5 Measurements Period Requirements

When physical layer receives last of *NR-TDOA-ProvideAssistanceData* message and *NR-TDOA-RequestLocationInformation* message from LMF via LPP [34]*,* the UE shall be able to measure multiple (up to the UE capability specified in Clause 9.9.2.3) DL RSTD measurements, defined in TS 38.215 [4], during the measurement period defined as:

Where ,

is the index of positioning frequency layer,

is total number of positioning frequency layers, and

is the periodicity of the PRS RSTD measurement in positioning frequency layer i

is the measurement period for PRS RSTD measurement in positioning frequency layer *i* as specified below:

,

where:

is the UE Rx beam sweeping factor. In FR1, = 1;

and in FR2, is equal to the value reported by the UE in *lowerRxBeamSweepingThan8-FR2* if the UE supports the capability for the band containing positioning frequency layer i, and the LMF indicates *lowerRxBeamSweepingThan8-FR2* in *NR-TDOA-RequestLocationInformation*. is equal to 8, otherwise.

is the carrier-specific scaling factor for NR PRS-based positioning measurements in positioning frequency layer *i* as defined in clause 9.1.5.2.

is the scaling factor for measurement of same PRS resource with multiple Rx TEGs.

=1 if UE is not requested by LMF to measure a PRS resource with multiple Rx TEGs via *measureSameDL-PRS-ResourceWithDifferentRxTEGs-r17* [34] in *NR-DL-TDOA-RequestLocationInformation*;

otherwise,

=, if UE is not capable of receiving same DL PRS resource simultaneously from multiple Rx TEGs, and

= if UE is capable of receiving the same DL PRS resource simultaneously from multiple Rx TEGs.

where

is the number of Rx TEGs with which UE is requested to measure a PRS resource indicated via *measureSameDL-PRS-ResourceWithDifferentRxTEGs-r17* [34] in *NR-DL-TDOA-RequestLocationInformation*, and in case ‘n0’ is indicated, is the maximum number of Rx TEGs with which UE can support to measure the same PRS resource as reported in *NR-UE-TEG-Capability*, and

is the number of Rx TEGs UE can measure simultaneously which is reported via *measureSameDL-PRS-ResourceWithDifferentRxTEGsSimul*.

is a scaling factor for a positioning frequency layer to be measured within the associated measurement gap pattern, which is defined as = Ntotal / Navailable for UE configured with concurrent measurement gap, and = 1 for UE not configured with concurrent measurement gap.

- For a window W of duration max(, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE MG and per-FR MG within the same FR as the positioining frequency layer, and starting at the beginning of any associated gap occasions covering the PRS occasion:

- Ntotal is the total number of associated gap occasions covering PRS occasions within the window, including those overlapped with other MG occasions within the window, and

- Navailable is the number of non-dropped associated gap occasions covering PRS occasions within the window W, after further accounting for MG collisions by applying the selected gap collision rule

- Requirements do not apply if Navailable =0.

is the maximum number of DL PRS resources in positioning frequency layer *i* configured in a slot.

is the time duration of available PRS in the positioning frequency layer i to be measured during , and is calculated in the same way as PRS duration K defined in clause 5.1.6.5 of TS 38.214 [26]. For calculation of , only the PRS resources unmuted and fully or partially overlapped with MG are considered.

is the number of PRS RSTD measurement samples, where

- = 1 if the UE supports *supportedDL-PRS-ProcessingSamples* [34], and the LMF requests the UE to perform positioning measurements with reduced number of samples, and meets the following conditions:

- PRS bandwidth is within the active BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within [6] dB.

- = [2] if the UE supports *supportedDL-PRS-ProcessingSamples* [34], and the LMF requests the UE to perform positioning measurements with reduced number of samples, and does not meet the following conditions:

- PRS bandwidth is within the active BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within [6] dB.

- = 4 otherwise.

is the measurement duration for the last PRS RSTD sample in positioning frequency layer *i*, including the

sampling time and processing time. If all of the PRS resources to be measured are available in the same MG occasion during Tavailabe, = +MGL. Otherwise, = + ,

is the periodicity of the PRS RSTD measurement in positioning frequency layer i defined as:

*=*

Where,

corresponds to *durationOfPRS-ProcessingSymbolsInEveryTms* in TS 37.355 [34],

*,* the least common multiple between and .

is the repetition periodicity of the measurement gap applicable for measurement in the PRS frequency layer i. is the periodicity of DL PRS resource with muting on positioning frequency layer *i*.

If more than one PRS periodicities are configured in positioning frequency layer *i*, the least common multiple of PRS periodicities among all DL PRS resource sets in the positioning frequency layer is used to derive , where,

, is the PRS periodicity with muting per PRS resource,

is the periodicity of PRS resource sets given by the higher-layer parameter *DL-PRS-Periodicity*.

is the scaling factor considering PRS resource muting. , where

is the muting repetition factor given by the higher-layer parameter *DL-PRS-MutingBitRepetitionFactor*, and is the size of the bitmap .

- Note: For the purpose of calculating TPRS,i, only the PRS resources fully or partially covered by the MG are considered.

is UE capability combination per band where N is a duration of DL PRS symbols in ms corresponding to *durationOfPRS-ProcessingSysmbols* in TS 37.355 [34] processed every T ms corresponding to *durationOfPRS-ProcessingSymbolsInEveryTms* in TS 37.355 [34] for a given maximum bandwidth supported by UE corresponding to *supportedBandwidthPRS* in TS 37.355 [34].

is UE capability for number of DL PRS resources that it can process in a slot as indicated by *maxNumOfDL-PRS-ResProcessedPerSlot* specified in TS 37.355 [34].

Except for deferred MT-LR as defined in clause 4.1a.5 [TS 23.273], the time *s*tarts from the first MG instance aligned with a DL PRS resource(s) in the assistance data after both the *NR-TDOA-ProvideAssistanceData* message and *NR-TDOA-RequestLocationInformation* message are delivered from LMF to the physical layer of UE via LPP [34].

For deferred MT-LR with other event than “Periodic Location” as defined in clause 4.1a.5.1 [TS 23.273], the timestarts from the first MG instance aligned with a DL PRS resource(s) in the assistance data after the associated event(s) occurs.

*Editor’s Note: FFS the start of measurement period for deferred MT-LR with “Periodic Location”.*

Note: No per-positioning frequency layer requirement is applied in scenarios when multiple positioning frequency layers are configured.

If during the measurement period of one or more positioning frequency layers, the MG pattern is reconfigured, the measurement period can be longer. When PRS-RSRP is configured for DL-TDOA, RSTD and RSRP are performed over the same measurement period.

The measurement requirements in this clause apply, provided no PRS symbols are dropped during the measurement period TRSTD,Total within measurement gaps due to collisions with other signals; otherwise, the measurement period can be longer.

If CSSF changes during the measurement period, the measurement period could be longer.

The measurement requirements do not apply for a PRS resource, if the PRS resource is across two sampling duration of N within duration .

The measurement requirements do not apply for a PRS resource, if time span of the PRS resource instance (including at least the minimum number of repetitions specified in the accuracy requirements) is greater than UE reported capability N.

The requirements in clause 9.9.2 do not apply if the PRS configuration given by higher layer paramters *NR-DL-PRS-AssistanceData* exceeds any of the UE measurement capabilities given by *NR-DL-PRS-ResourcesCapability* in *NR-DL-TDOA-ProvideCapabilities*, and it is up to UE implementation which PRS resources are measured, subject to UE measurement capabilities*.*

If handover occurs while RSTD measurements are being performed, then the UE shall continue and complete the on-going RSTD measurements. The RSTD measurement period can be longer. The UE shall meet the RSTD measurement accuracy requirements in clause 10.1.23.

#### 9.9.2.6 Void

#### 9.9.2.7 Measurements Period Requirements without Measurement Gaps

When physical layer receives last of *NR-TDOA-ProvideAssistanceData* message and *NR-TDOA-RequestLocationInformation* message from LMF via LPP [34]*,* the UE shall be able to measure multiple (up to the UE capability specified in Clause 9.9.2.3) DL RSTD measurements, defined in TS 38.215 [4], during the measurement period defined as:

, if any of the positioning frequency layers are in Case 1, or

, if all the positioning frequency layers are in Case 2,

Where,

is the index of positioning frequency layer, and

is total number of positioning frequency layers, and

is the periodicity of the PRS RSTD measurement in positioning frequency layer i, and

is the time from the start of the first PPW occasion for positioning frequency layer i to the start of measurement period .

A positioning frequency layer is in Case 1 if UE reports *ppw-durationOfPRS-Processing1-r17* for the band containing the positioning frequency layer, and a positioning frequency layer is in Case 2 if UE reports *ppw-durationOfPRS-Processing2-r17* for the band containing the positioning frequency layer.

is the measurement period for PRS RSTD measurement in positioning frequency layer *i* as specified below.

,

where:

is the UE Rx beam sweeping factor. In FR1, = 1; and in FR2, is equal to the value reported by the UE in *lowerRxBeamSweepingThan8-FR2* if the UE supports the capability for the band containing positioning frequency layer i, and the LMF indicates *lowerRxBeamSweepingThan8-FR2* in *NR-TDOA-RequestLocationInformation*. is equal to 8, otherwise.

is the scaling factor for measurement of same PRS resource with multiple Rx TEGs.

=1 if UE is not supported *measureSameDL-PRS-ResourceWithDifferentRxTEGs-r17* or not requested by LMF to measure a PRS resource with multiple Rx TEGs via *measureSameDL-PRS-ResourceWithDifferentRxTEGs-r17* [34] in *NR-DL-TDOA-RequestLocationInformation*;

otherwise,

=, if the UE is not capable of receiving same DL PRS resource simultaneously from multiple Rx TEGs, and

= if the UE is capable of receiving the same DL PRS resource simultaneously from multiple Rx TEGs.

where

is the number of Rx TEGs with which UE is requested to measure a PRS resource indicated via *measureSameDL-PRS-ResourceWithDifferentRxTEGs-r17* [34] in *NR-DL-TDOA-RequestLocationInformation*, and in case ‘n0’ is indicated, is the maximum number of Rx TEGs with which UE can support to measure the same PRS resource as reported in *NR-UE-TEG-Capability*, and

is the number of Rx TEGs UE can measure simultaneously which is reported via *measureSameDL-PRS-ResourceWithDifferentRxTEGsSimul*.

is the maximum number of DL PRS resources in positioning frequency layer *i* configured in a slot.

is the time duration of available PRS in the positioning frequency layer i to be measured during , and is calculated in the same way as PRS duration K defined in clause 5.1.6.5 of TS 38.214 [26]. For calculation of ,

only the PRS resources unmuted and fully or partially overlapped with PPW are considered, if positioning frequency layer i is in Case 1, or

only the PRS resources unmuted and fully or partially overlapped with the first (PPWL-T2) ms of PPW are considered, if positioning frequency layer i is in Case 2, where PPWL is the PPW length and T2 corresponds to *ppw-durationOfPRS-ProcessingSymbolsT2*.

is the number of PRS RSTD measurement samples, where

- = 1 if the UE supports *supportedDL-PRS-ProcessingSamples* [34], and the LMF requests the UE to perform positioning measurements with reduced number of samples, and meets the following conditions:

- PRS bandwidth is within the active BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within [6] dB.

- = [2] if the UE supports *supportedDL-PRS-ProcessingSamples* [34], and the LMF requests the UE to perform positioning measurements with reduced number of samples, and does not meet the following conditions:

- PRS bandwidth is within the active BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within [6] dB.

- = 4 otherwise.

is the measurement duration for the last PRS RSTD sample in positioning frequency layer *i*, including the sampling time and processing time.

If positioning frequency layer *i* is in Case 1 and all of the PRS resources to be measured are available in the same PPW occasion during Tavailable, then = +PPWL, else

if positioning frequency layer *i* is in Case 2 and all of the PRS resources to be measured are available in the same PPW occasion during Tavailable, then = PPWL;

otherwise, = + .

is the periodicity of the PRS RSTD measurement in positioning frequency layer i defined as:

*=*

Where,

corresponds to *ppw-durationOfPRS-ProcessingSymbolsT* in TS 37.355 [34] if positioning frequency layer *i* is in Case 1, or corresponds to the sum of *ppw-durationOfPRS-ProcessingSymbolsT2* and *ppw-*durationOfPRS*-ProcessingSymbolsN2* in TS 37.355 [34] if positioning frequency layer *i* is in Case 2,

, the least common multiple between and .

is the repetition periodicity of the PRS processing window applicable for measurements in the positioning frequency layer *i*.

is the periodicity of DL PRS resource with muting on positioning frequency layer *i*.

If more than one PRS periodicities are configured in positioning frequency layer *i*, the least common multiple of PRS periodicities among all DL PRS resource sets in the positioning frequency layer is used to derive , where,

, is the PRS periodicity with muting per PRS resource,

is the periodicity of PRS resource sets given by the higher-layer parameter *DL-PRS-Periodicity*,

is the scaling factor considering PRS resource muting. , where is the muting repetition factor given by the higher-layer parameter *DL-PRS-MutingBitRepetitionFactor*, and is the size of the bitmap .

Note: For the purpose of calculating , only the PRS resources that meet the conditions for PRS measurement outside measurement gaps as defined in clause 9.9.1.2 are considered.

is a duration of DL PRS symbols in ms corresponding to *ppw-durationOfPRS-ProcessingSymbolsN* in TS 37.355 [34] if positioning frequency layer i is in Case 1, or corresponding to *ppw-durationOfPRS-ProcessingSymbolsN2* in TS 37.355 [34] if positioning frequency layer i is in Case 2.

is UE capability for number of DL PRS resources that it can process in a slot as indicated by *ppw-maxNumOfDL-PRS-ResProcessedPerSlot* specified in TS 37.355 [34].

The time *s*tarts from the first instance of the activated PPW for measurement of positioning frequency layer *i* aligned with a DL PRS resource(s) in the assistance data after both the *NR-TDOA-ProvideAssistanceData* message and *NR-TDOA-RequestLocationInformation* message are delivered from LMF to the physical layer of UE via LPP [34].

If during the measurement period of one or more positioning frequency layers, the PPW is re-configured or reactivated, the measurement period can be longer. When PRS-RSRP is configured for DL-TDOA, RSTD and RSRP are performed over the same measurement period.

The measurement requirements in this clause apply, provided no PRS symbols are dropped during the measurement period within PPW due to collisions with other signals; otherwise, the measurement period can be longer.

The measurement requirements do not apply for a PRS resource, if the PRS resource is across two sampling duration of N within duration .

The measurement requirements do not apply for a PRS resource, if time span of the PRS resource instance (including at least the minimum number of repetitions specified in the accuracy requirements) is greater than UE reported capability N.

The requirements in clause 9.9.2 do not apply if the PRS configuration given by higher layer paramters *NR-DL-PRS-AssistanceData* exceeds any of the UE measurement capabilities given by *NR-DL-PRS-ResourcesCapability* in *NR-DL-TDOA-ProvideCapabilities*, and it is up to UE implementation which PRS resources are measured, subject to UE measurement capabilities*.*

If handover occurs while RSTD measurements are being performed, then the UE shall continue and complete the on-going RSTD measurements. The RSTD measurement period can be longer. The UE shall meet the RSTD measurement accuracy requirements in clause 10.1.23.

If any positioning frequency layer is in Case 2, the requirements in this clause apply provided that the PPWL corresponding to the positioning frequency layer is larger than (T2+X) ms.

The requirements in this clause apply provided that a single positioning frequency layer is configured for measurement in each PPW.

#### 9.9.2.8 Void

### 9.9.3 PRS-RSRP measurements

#### 9.9.3.1 Introduction

The requirements in clause 9.9.3.5 shall apply provided the UE has received a message from LMF via LPP [34] requesting the UE to measure and report PRS-RSRP measurements defined in TS 38.215 [4].

#### 9.9.3.2 Requirements applicability

The requirements in clause 9.9.3 apply for periodic and triggered PRS-RSRP measurements, provided:

- PRS-RSRP related side conditions given in clause 10.1.24 are met for a corresponding Band.

#### 9.9.3.3 Measurement Capability

UE PRS-RSRP measurement capability is as indicated by the UE in *NR-DL-AoD-ProvideCapabilities* according to TS 37.355 [34].

#### 9.9.3.4 Measurement Reporting Requirements

This requirement assumes that the measurement report is not delayed by other LPP signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 x TTIDCCH where TTIDCCH is the duration of subframe or slot or subslot when the measurement report is transmitted on the PUSCH with subframe or slot or subslot duration. This measurement reporting delay excludes any delay caused by no UL resources for UE to send the measurement report.

The reported PRS-RSRP measurement values contained in measurement reports shall be based on the measurement report mapping requirements specified in clauses 10.1.24.3.

The PRS-RSRP measurement accuracy for all measured PRS resources shall be fulfilled according to the accuracy requriements specified in the clauses 10.1.24.

#### 9.9.3.5 Measurement Period Requirements

When the physical layer receives *NR-DL-AoD-ProvideAssistanceData* message and *NR-DL-AoD-RequestLocationInformation* message from LMF via LPP [34], the UE shall be able to measure multiple (up to the UE capability specified in Clause 9.9.3.3) PRS-RSRP measurements, defined in TS 38.215 [4], from configured PRS resources for configured TRPs on configured positioning frequency layers, within ms.

where

*i* is the index of positioning frequency layer,

L is total number of positioning frequency layers,

is the periodicity of the PRS-RSRP measurement in positioning frequency layer *i*.

where

is the carrier specific scaling factor for PRS-RSRP measurements specified in clause 9.1.5.2,

is a scaling factor for a positioning frequency layer to be measured within the associated measurement gap pattern, which is defined as = Ntotal / Navailable for UE configured with concurrent measurement gap, and = 1 for UE not configured with concurrent measurement gap.

For a window W of duration max(, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE MG and per-FR MG within the same FR as the positioining frequency layer, and starting at the beginning of any associated gap occasions covering the PRS occasion:

Ntotal is the total number of associated gap occasions covering PRS occasions within the window, including those overlapped with other MG occasions within the window, and

Navailable is the number of non-dropped associated gap occasions covering PRS occasions within the window W, after further accounting for MG collisions by applying the selected gap collision rule

Requirements do not apply if Navailable =0.

is the scaling factor for Rx beam sweeping, and =1 if positioning frequency layer *i* is in FR1 and if positioning frequency layer *i* is in FR2, is equal to the value reported by the UE in *lowerRxBeamSweepingThan8-FR2* if the UE supports the capability for the band containing positioning frequency layer i, and the LMF indicates *lowerRxBeamSweepingThan8-FR2* in *NR-TDOA-RequestLocationInformation*. is equal to 8, otherwise.

is the time duration of available PRS to be measured in the positioning frequency layer i to be measured during , and is calculated in the same way as PRS duration K defined in clause 5.1.6.5 of TS 38.214 [26]. For calculation of , only the PRS resources unmuted and fully or partially overlapped with MG are considered.

is the maximum number of DL PRS resources of positioning frequency layer i configured in a slot,

is UE capability combination per band where N is a duration of DL PRS symbols in ms corresponding to *durationOfPRS-ProcessingSysmbols* in TS 37.355 [34] processed every T ms corresponding to *durationOfPRS-ProcessingSymbolsInEveryTms* in TS 37.355 [34] for a given maximum bandwidth supported by UE corresponding to *supportedBandwidthPRS* in TS 37.355 [34],

is UE capability for number of DL PRS resources that it can process in a slot as indicated by *maxNumOfDL-PRS-ResProcessedPerSlot* in clause 6.4.3 of TS 37.355 [34],

is the number of PRS RSRP measurement samples, where

- = 1 if the UE supports *supportedDL-PRS-ProcessingSamples* [34], and the LMF requests the UE to perform positioning measurements with reduced number of samples, and meets the following conditions:

- PRS bandwidth is within the active BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within [6] dB.

- = [2] if the UE supports *supportedDL-PRS-ProcessingSamples* [34], and the LMF requests the UE to perform positioning measurements with reduced number of samples, and does not meet the following conditions:

- PRS bandwidth is within the active BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within [6] dB.

- = 4 otherwise.

*= +* is the measurement duration for the last PRS-RSRP sample, including the sampling time and processing time, if not all PRS resources to be measured are available in the same measurement gap occasion during , otherwise = + ,

is the periodicity of PRS-RSRP measurement in positioning frequency layer *i*,

corresponds to durationOfPRS-ProcessingSymbolsInEveryTms in TS 37.355 [34],

the least common multiple between and ,

is the maximum PRS resource periodicity among all PRS resources in positioning frequency layer i,

is the measurement gap repetition period in positioning frequency layer i.

If positioning frequency layer *i* has more than one DL PRS resource set with different PRS periodicities with muting, , the least common multiple of among the DL PRS resource sets is used to derive , where:

is the periodicity of PRS resource sets given by the higher-layer parameter *DL-PRS-Periodicity*.

is the scaling factor considering PRS resource muting. , where is the muting repetition factor given by the higher-layer parameter *DL-PRS-MutingBitRepetitionFactor*, and is the size of the bitmap .

Note: For the purpose of calculating TPRS,i, only the PRS resources fully or partially covered by the MG are considered.

When PRS-RSRP measurements are configured for DL-AoD, except for deferred MT-LR as defined in clause 4.1a.5 [TS 23.273], the time starts from the first MG instance aligned with DL PRS resources in the assistance data after both the *NR-DL-AoD-RequestLocationInformation* message and *NR-DL-AoD-ProvideAssistanceData* message from LMF via LPP [34] are delivered to the physical layer of UE.

For deferred MT-LR with other event than “Periodic Location” as defined in clause 4.1a.5.1 [TS 23.273], the timestarts from the first MG instance aligned with a DL PRS resource(s) in the assistance data after the associated event(s) occurs.

*Editor’s Note: FFS the start of measurement period for deferred MT-LR with “Periodic Location”.*

Note: No per-positioning frequency layer requirement is applied in scenarios when multiple positioning frequency layers are configured.

When the PRS-RSRP measurement is configured together with RSTD measurement then the PRS-RSRP measurement shall meet the RSTD measurement requirements defined in clause 9.9.2.

When the PRS-RSRP measurement is configured together with UE Rx-Tx time difference measurement then the PRS-RSRP measurement shall meet the UE Rx-Tx time difference measurement requirements defined in clause 9.9.4.

If CSSF changes during the measurement period, the measurement period could be longer.

The measurement requirements do not apply for a PRS resource:

* if the PRS resource is across two sampling duration of N within duration or
* if time span of the PRS resource instance (including at least the minimum number of repetitions specified in the accuracy requirements) is greater than UE reported capability N.

If during the measurement period of one or more positioning frequency layers, the MG pattern is reconfigured either per UE request or not per UE request, the measurement period can be longer.

The requirements in this section apply, provided no PRS symbols are dropped during the measurement period within measurement gaps due to collisions with other signals; otherwise, a longer measurement period may be used.

The requirements in clause 9.9.3 do not apply if the PRS configuration given by higher layer paramters *NR-DL-PRS-AssistanceData* exceeds any of the UE measurement capabilities given by *NR-DL-PRS-ResourcesCapability* in *NR-DL-AoD-ProvideCapabilities*, and it is up to UE implementation which PRS resources are measured, subject to UE measurement capabilities*.*

If handover occurs while PRS-RSRP measurements are being performed then the UE shall complete the ongoing PRS-RSRP measurements session. The PRS-RSRP measurement period can be longer. The UE shall meet the PRS-RSRP measurement accuracy requirements in clause 10.1.24.

#### 9.9.3.6 Measurement Period Requirements without Measurement Gaps

When the physical layer receives *NR-DL-AoD-ProvideAssistanceData* message and *NR-DL-AoD-RequestLocationInformation* message from LMF via LPP [34], the UE shall be able to measure multiple (up to the UE capability specified in Clause 9.9.3.3) PRS-RSRP measurements as defined in TS 38.215 [4] without measurement gap, on configured positioning frequency layer *i*, within ms.

if any of the positioning frequency layers are in Case 1, or

, if all the positioning frequency layers are in Case 2,

Where,

is the index of positioning frequency layer, and

is total number of positioning frequency layers, and

is the periodicity of the PRS RSTD measurement in positioning frequency layer i, and

is the time from the start of the first PPW occasion for positioning frequency layer i to the start of measurement period .

A positioning frequency layer is in Case 1 if UE reports *ppw-durationOfPRS-Processing1-r17* for the band containing the positioning frequency layer, and a positioning frequency layer is in Case 2 if UE reports *ppw-durationOfPRS-Processing2-r17* for the band containing the positioning frequency layer.

is the measurement period for PRS-RSRP measurement in positioning frequency layer *i* as specified below.

where

is the periodicity of the PRS-RSRP measurement in positioning frequency layer *i*.

is the scaling factor for Rx beam sweeping, and =1 if positioning frequency layer *i* is in FR1. If positioning frequency layer *i* is in FR2, is equal to the value reported by the UE in *lowerRxBeamSweepingThan8-FR2* if the UE supports the capability for the band containing positioning frequency layer i, and the LMF indicates *lowerRxBeamSweepingThan8-FR2* in *NR-TDOA-RequestLocationInformation*. is equal to 8, otherwise.

is the time duration of available PRS to be measured in the positioning frequency layer i to be measured during , and is calculated in the same way as PRS duration K defined in clause 5.1.6.5 of TS 38.214 [26]. For calculation of ,

only unmuted PRS resource instances that meet the applicability conditions and fully or partially overlapped with PRS processing window are considered, if positioning frequency layer i is in Case 1, or

only the PRS resources unmuted and fully or partially overlapped with the first (PPWL-T2) ms of PPW are considered, if positioning frequency layer i is in Case 2, where PPWL is the PPW length and T2 corresponds to *ppw-durationOfPRS-ProcessingSymbolsT2*.

is the maximum number of DL PRS resources of positioning frequency layer i configured in a slot,

is UE capability combination per band where N is a duration of DL PRS symbols in ms corresponding to *ppw-durationOfPRS-ProcessingSymbolsN*  in TS 37.355 [34] if positioning frequency layer *i* is in Case 1, or corresponding to *ppw-durationOfPRS-ProcessingSymbolsN2* in TS 37.355 [34] if positioning frequency layer *i* is in Case 2,

is UE capability for number of DL PRS resources that it can process in a slot as indicated by *ppw-maxNumOfDL-PRS-ResProcessedPerSlot* in clause 6.4.3 of TS 37.355 [34],

is the number of PRS RSRP measurement samples, where

- = 1 if the UE supports *supportedDL-PRS-ProcessingSamples* [34], and the LMF requests the UE to perform positioning measurements with reduced number of samples, and meets the following conditions:

- PRS bandwidth is within the active BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within [6] dB.

- = [2] if the UE supports *supportedDL-PRS-ProcessingSamples* [34], and the LMF requests the UE to perform positioning measurements with reduced number of samples, and does not meet the following conditions:

- PRS bandwidth is within the active BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within [6] dB.

- = 4 otherwise.

is the measurement duration for the last PRS-RSRP sample, including the sampling time and processing time.

If positioning frequency layer *i* is in Case 1 and all of the PRS resources to be measured are available in the same PPW occasion during Tavailable, then = +PPWL, else

if positioning frequency layer *i* is in Case 2 andall of the PRS resources to be measured are available in the same PPW occasion during Tavailable, then = PPWL;

otherwise, = + .

is the periodicity of PRS-RSRP measurement in positioning frequency layer *i*,

corresponds to *ppw-durationOfPRS-ProcessingSymbolsT*  in TS 37.355 [34] if positioning frequency layer *i* is in Case 1, or corresponds to the sum of *ppw-durationOfPRS-ProcessingSymbolsT2* and *ppw-durationOfPRS-ProcessingSymbolsN2* in TS 37.355 [34] if positioning frequency layer *i* is in Case 2

is the least common multiple between and ,

is the maximum PRS resource periodicity among all PRS resources in positioning frequency layer i,

is the PRS processing window repetition period in positioning frequency layer i.

If positioning frequency layer *i* has more than one DL PRS resource set with different PRS periodicities with muting, , the least common multiple of among the DL PRS resource sets is used to derive , where:

is the periodicity of PRS resource sets given by the higher-layer parameter *DL-PRS-Periodicity*.

is the scaling factor considering PRS resource muting. If bitmap for higher-layer parameter *DL-* is the scaling factor considering PRS resource muting. , where is the muting repetition factor given by the higher-layer parameter *DL-PRS-MutingBitRepetitionFactor*, and is the size of the bitmap .

Note: For the purpose of calculating TPRS,i, only the PRS resources that meet the applicability conditions and fully or partially covered by the PRS processing window are considered.

When PRS-RSRP measurements are configured for DL-AoD, the time starts from the first PRS processing window instance aligned with DL PRS resources in the assistance data after both the *NR-DL-AoD-RequestLocationInformation* message and *NR-DL-AoD-ProvideAssistanceData* message from LMF via LPP [34] are delivered to the physical layer of UE.

Note: No per-positioning frequency layer requirement is applied in scenarios when multiple positioning frequency layers are configured.

When the PRS-RSRP measurement is configured together with RSTD measurement then the PRS-RSRP measurement shall meet the RSTD measurement requirements defined in clause 9.9.2.

When the PRS-RSRP measurement is configured together with UE Rx-Tx time difference measurement then the PRS-RSRP measurement shall meet the UE Rx-Tx time difference measurement requirements defined in clause 9.9.4.

If CSSF changes during the measurement period, the measurement period could be longer.

The measurement requirements do not apply for a PRS resource:

if the PRS resource is across two sampling duration of N within duration or

if time span of the PRS resource instance (including at least the minimum number of repetitions specified in the accuracy requirements) is greater than UE reported capability N.

The requirements in clause 9.9.3 do not apply if the PRS configuration given by higher layer paramters *NR-DL-PRS-AssistanceData* exceeds any of the UE measurement capabilities given by *NR-DL-PRS-ResourcesCapability* in *NR-DL-AoD-ProvideCapabilities*, and it is up to UE implementation which PRS resources are measured, subject to UE measurement capabilities*.*

If during the measurement period of one or more positioning frequency layers, the PPW is reconfigured or reactivated, the PRS-RSRP measurement period can be longer.

If any positioning frequency layer is in Case 2, the requirements in this clause apply provided that the PPWL corresponding to the positioning frequency layer is larger than (T2+X) ms.

The requirements in this clause apply provided that a single positioning frequency layer is configured for measurement in each PPW.

#### 9.9.3.7 Void

### 9.9.4 UE Rx-Tx time difference measurements

#### 9.9.4.1 Introduction

The requirements in this clause shall apply, provided the UE has received *nr-Multi-RTT-RequestLocationInformation* message from LMF via LPP [34] requesting the UE to measure and report one or more UE Rx-Tx time difference measurements defined in TS 38.215 [4].

#### 9.9.4.2 Requirements Applicability

The requirements in clause 9.9.4 apply for periodic and triggered UE Rx-Tx time difference measurements, provided:

- UE Rx-Tx time difference measurement related side conditions given in clause 10.1.25 are met for a corresponding band.

- SRS is configured on at least one of the PCell, PSCell and SCell.

- The UE transmits SRS within [-160, 160] msec of at least one DL PRS resource of each of the TRPs in the assistance data.

#### 9.9.4.3 Measurement Capability

UE Rx-Tx time difference measurement capability is as indicated by the UE in *NR-Multi-RTT-ProvideCapabilities,* according to TS 37.355 [34].

#### 9.9.4.4 Measurement Reporting Requirements

This requirement assumes that the measurement report is not delayed by other LPP signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 x TTIDCCH where TTIDCCH is the duration of subframe or slot or subslot when the measurement report is transmitted on the PUSCH with subframe or slot or subslot duration. This measurement reporting delay excludes any delay caused by no UL resources for UE to send the measurement report.

The UE Rx-Tx time difference measurement values contained in measurement reports shall be based on the measurement report mapping requirements specified in clause 10.1.25.

The UE Rx-Tx time difference measurement accuracy for all measured DL PRS resourcesshall be fulfilled according to the accuracy requirements specified in clause 10.1.25.

#### 9.9.4.5 Measurement Period Requirements

When physical layer receives last of *NR-Multi-RTT-ProvideAssistanceData* message and *NR-Multi-RTT-RequestLocationInformation* message from LMF via LPP [34]*,* UE shall be able to measure multiple (up to the UE capability specified in clause 9.9.4.3) UE Rx-Tx time difference measurements as defined in TS 38.215 [4] in configured positioning frequency layers within the measurement period ms.

*.*

where is the index of positioning frequency layer,

is the measurement period for UE Rx-Tx time difference measurements in positioning frequency layer *i* as further defined in this clause,

L is total number of positioning frequency layers, and

is the periodicity of the UE Rx-Tx time difference measurement in positioning frequency layer *i* as defined further in this clause.

Where

is the carrier-specific scaling factor for NR PRS-based measurement in the positioning frequency layer *i* as defined in clause 9.1.5.2,

is the scaling factor for measurement of same PRS resource with multiple Rx TEGs.

=1 if UE is not requested by LMF to measure a PRS resource with multiple Rx TEGs via *measureSameDL-PRS-ResourceWithDifferentRxTEGs-r17* [34] in *NR-Multi-RTT-RequestLocationInformation*;

otherwise,

=, if UE is not capable of receiving same DL PRS resource simultaneously from multiple Rx TEGs, and

= if UE is capable of receiving the same DL PRS resource simultaneously from multiple Rx TEGs.

where

is the number of Rx TEGs with which UE is requested to measure a PRS resource indicated via *measureSameDL-PRS-ResourceWithDifferentRxTEGs-r17* [34] in *NR-Multi-RTT-RequestLocationInformation*, and in case ‘n0’ is indicated, is the maximum number of Rx TEGs with which UE can support to measure the same PRS resource as reported in *NR-UE-TEG-Capability*, and

is the number of Rx TEGs UE can measure simultaneously which is reported via *measureSameDL-PRS-ResourceWithDifferentRxTEGsSimul*.

is a scaling factor for a positioning frequency layer to be measured within the associated measurement gap pattern, which is defined as = Ntotal / Navailable for UE configured with concurrent measurement gap, and = 1 for UE not configured with concurrent measurement gap.

For a window W of duration max(, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE MG and per-FR MG within the same FR as the positioining frequency layer, and starting at the beginning of any associated gap occasions covering the PRS occasion:

Ntotal is the total number of associated gap occasions covering PRS occasions within the window, including those overlapped with other MG occasions within the window, and

Navailable is the number of non-dropped associated gap occasions covering PRS occasions within the window W, after further accounting for MG collisions by applying the selected gap collision rule

Requirements do not apply if Navailable =0.

is the scaling factor for Rx beam sweeping, and =1 if positioning frequency layer *i* is in FR1 and if positioning frequency layer *i* is in FR2, is equal to the value reported by the UE in *lowerRxBeamSweepingThan8-FR2* if the UE supports the capability for the band containing positioning frequency layer i, and the LMF indicates *lowerRxBeamSweepingThan8-FR2* in *NR-TDOA-RequestLocationInformation*. is equal to 8, otherwise.

is the time duration of available PRS resources in the positioning frequency layer *i*, to be measured during , and is calculated in the same way as PRS duration K defined in clause 5.1.6.5 of TS 38.214 [26]. For calculation of , only the PRS resources unmuted and fully or partially overlapped with MG are considered.

is the maximum number of DL PRS resources of positioning frequency layer i configured in a slot,

is UE capability combination per band where N is a duration of DL PRS symbols in ms corresponding to *durationOfPRS-ProcessingSysmbols* in TS 37.355 [34] processed every T ms corresponding to *durationOfPRS-ProcessingSymbolsInEveryTms* in TS 37.355 [34] for a given maximum bandwidth supported by UE corresponding to *supportedBandwidthPRS* in clause 4.2.7.2 of TS 37.355 [34],

is UE capability for number of DL PRS resources that it can process in a slot corresponding to *maxNumOfDL-PRS-ResProcessedPerSlot* as specified in clause 6.4.3 of TS 37.355 [34],

is the number of UE Rx-Tx time difference measurement samples:

- = 4 if the UE is not capable of *supportedDL-PRS-ProcessingSamples* defined in [34].

- = 1 if the UE is capable of *supportedDL-PRS-ProcessingSamples* defined in [34] and LMF requests the UE to perform positioning measurements with reduced number of samples by *requestedDL-PRS-ProcessingSamples* [34] and the following conditions are met:

- PRS bandwidth is within the active BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within [6] dB.

- = [2] if the UE is capable of *supportedDL-PRS-ProcessingSamples* defined in [34] and the LMF requests the UE to perform positioning measurements with reduced number of samples by *requestedDL-PRS-ProcessingSamples* [34] but the following conditions are not met:

- PRS bandwidth is within the active BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within [6] dB.

- = 4 otherwise.

is the measurement duration for the last UE Rx-Tx time difference measurement sample in the positioning layer i, including the sampling time and processing time,  *= +*  ,

is periodicity of UE Rx-Tx time difference measurement in positioning frequency layer *i*:

where

corresponds to *durationOfPRS-ProcessingSymbolsInEveryTms* in TS 37.355 [34],

, the least common multiple between and

is the measurement gap repetition periodicity in positioning frequency layer *i*.

is the PRS resource periodicity in positioning frequency layer *i*. If the positioning frequency layer *i* has more than one DL PRS resource sets with different PRS periodicities with muting, , the least common multiple of among DL PRS resource sets is used to derive , where

is the periodicity of PRS resource sets given by the higher-layer parameter *DL-PRS-Periodicity*.

is the scaling factor considering PRS resource muting. , where is the muting repetition factor given by the higher-layer parameter *DL-PRS-MutingBitRepetitionFactor*, and is the size of the bitmap

Note: For the purpose of calculating TPRS,i, only the PRS resources fully or partially covered by the MG are considered.

Except for deferred MT-LR as defined in clause 4.1a.5 [TS 23.273], the time starts from the first MG instance aligned with DL PRS resources in the assistance data after both the *NR-Multi-RTT-RequestLocationInformation* message and *NR-Multi-RTT-ProvideAssistanceData* message from LMF via LPP [34] are delivered to the physical layer of UE.

For deferred MT-LR with other event than “Periodic Location” as defined in clause 4.1a.5.1 [TS 23.273], the timestarts from the first MG instance aligned with a DL PRS resource(s) in the assistance data after the associated event(s) occurs.

*Editor’s Note: FFS the start of measurement period for deferred MT-LR with “Periodic Location”.*

Note: No per-positioning frequency layer requirement is applied in scenarios when multiple positioning frequency layers are configured.

The UE Rx-Tx time difference measurement period is restarted if HO occurs during the measurement period and after SRS reconfiguration on the target cell is complete.

The measurement requirements do not apply for a PRS resource:

- if the PRS resource is across two sampling duration of N within duration or

- if time span of the PRS resource instance (including at least the minimum number of repetitions specified in the accuracy requirements) is greater than UE reported capability N.

If during the measurement period of one or more positioning frequency layers, the MG pattern is reconfigured either per UE request or not per UE request, the measurement period can be longer.

The requirements in this section apply, provided no PRS symbols are dropped during the measurement period TUERxTx,Total within measurement gaps due to collisions with other signals; otherwise, a longer measurement period may be used.

When PRS-RSRP is configured for multi-RTT, the UE Rx-Tx time difference measurements and PRS-RSRP measurements are performed over the same measurement period.

The requirements in clause 9.9.4 do not apply if the PRS configuration given by higher layer paramters *NR-DL-PRS-AssistanceData* exceeds any of the UE measurement capabilities given by *NR-DL-PRS-ResourcesCapability* in *NR-Multi-RTT-ProvideCapabilities*, and it is up to UE implementation which PRS resources are measured, subject to UE measurement capabilities*.*

When PSCell or SCell addition or release does not cause SRS reconfiguration during the measurement period, UE continues the UE Rx-Tx time difference measurement, and the measurement period requirements apply.

When PSCell or SCell addition or release causes SRS reconfiguration during the measurement period, UE shall restart the UE Rx-Tx time difference measurement after the SRS reconfiguration on the target cell is complete.

When SRS is reconfigured without serving cell change during the measurement period, UE shall restart the UE Rx-Tx time difference measurement after the SRS reconfiguration is complete.If UE uplink transmission timing changes due to the network-configured Timing Advance command during the UE Rx-Tx measurement period, then the UE Rx-Tx time difference measurement period is restarted after uplink transmission timing changes, and the UE Rx-Tx time difference measurement period requirements in this clause shall not apply.

When a serving cell change occurs during the measurement period, the UE shall continue and complete the UE Rx-Tx time difference measurement provided that the serving cell change does not impact SRS configuration for the UE Rx-Tx time difference measurement.

If UE uplink transmission timing changes due to the change in the NTA\_offset defined in Table 7.1.2-2 during the UE Rx-Tx measurement period, then the UE Rx-Tx time difference measurement period is restarted after uplink transmission timing changes, and the UE Rx-Tx time difference measurement period requirements in this clause shall not apply.

If UE uplink transmission timing changes due to the UE autonomous timing adjustment defined in clause 7.1.2 during the UE Rx-Tx measurement period, then:

- UE Rx-Tx measurement period requirements in this clause shall apply for a cell, which is also the downlink reference cell (defined in section 7.1.1) for SRS transmission.

- UE Rx-Tx measurement period requirements in this clause shall not apply for a cell, which is not the downlink reference cell (defined in section 7.1.1) for SRS transmission. The UE Rx-Tx time difference measurement period may be restarted in such case.

#### 9.9.4.6 Measurement Period Requirements without Measurement Gaps

When physical layer receives last of *NR-Multi-RTT-ProvideAssistanceData* message and *NR-Multi-RTT-RequestLocationInformation* message from LMF via LPP [34]*,* UE shall be able to measure multiple (up to the UE capability specified in clause x.x.x) UE Rx-Tx time difference measurements as defined in TS 38.215 [4] in configured positioning frequency layers within the measurement period ms.

, if any of the positioning frequency layers are in Case 1, or

, if all the positioning frequency layers are in Case 2*.*

Where,

is the index of positioning frequency layer, and

is total number of positioning frequency layers, and

is the periodicity of the PRS RSTD measurement in positioning frequency layer i, and

is the time from the start of the first PPW occasion for positioning frequency layer i to the start of measurement period .

A positioning frequency layer is in Case 1 if UE reports *ppw-durationOfPRS-Processing1-r17* for the band containing the positioning frequency layer, and a positioning frequency layer is in Case 2 if UE reports *ppw-durationOfPRS-Processing2-r17* for the band containing the positioning frequency layer.

is the measurement period for UE Rx-Tx time difference measurement in positioning frequency layer *i* as specified below.

Where

is the periodicity of the UE Rx-Tx time difference measurement in positioning frequency layer *i* as defined further in this clause.

is the scaling factor for measurement of same PRS resource with multiple Rx TEGs.

=1 if UE is not supported *measureSameDL-PRS-ResourceWithDifferentRxTEGs-r17* or not requested by LMF to measure a PRS resource with multiple Rx TEGs via *measureSameDL-PRS-ResourceWithDifferentRxTEGs-r17* [34] in *NR-DL-TDOA-RequestLocationInformation*;

otherwise,

=, if UE is not capable of receiving same DL PRS resource simultaneously from multiple Rx TEGs, and

= if UE is capable of receiving the same DL PRS resource simultaneously from multiple Rx TEGs.

where

is the number of Rx TEGs with which UE is requested to measure a PRS resource indicated via *measureSameDL-PRS-ResourceWithDifferentRxTEGs-r17* [34] in *NR-Multi-RTT-RequestLocationInformation*, and in case ‘n0’ is indicated, is the maximum number of Rx TEGs with which UE can support to measure the same PRS resource as reported in *NR-UE-TEG-Capability*, and

is the number of Rx TEGs UE can measure simultaneously which is reported via *measureSameDL-PRS-ResourceWithDifferentRxTEGsSimul*.

is the scaling factor for Rx beam sweeping, and =1 if positioning frequency layer *i* is in FR1. If positioning frequency layer *i* is in FR2, is equal to the value reported by the UE in *lowerRxBeamSweepingThan8-FR2* if the UE supports the capability for the band containing positioning frequency layer i, and the LMF indicates *lowerRxBeamSweepingThan8-FR2* in *NR-TDOA-RequestLocationInformation*. is equal to 8, otherwise.

is the time duration of available PRS resources in the positioning frequency layer *i*, to be measured during , and is calculated in the same way as PRS duration K defined in clause 5.1.6.5 of TS 38.214 [26]. For calculation of ,

only the unmuted PRS resources that meet the applicability conditions and fully or partially overlapped with PRS processing window are considered, if positioning frequency layer i is in Case 1, or

only the PRS resources unmuted and fully or partially overlapped with the first (PPWL-T2) ms of PPW are considered, if positioning frequency layer i is in Case 2, where PPWL is the PPW length and T2 corresponds to *ppw-durationOfPRS-ProcessingSymbolsT2*.

is the maximum number of DL PRS resources of positioning frequency layer i configured in a slot,

is UE capability combination per band where N is a duration of DL PRS symbols in ms corresponding to *ppw-durationOfPRS-ProcessingSymbolsN*  in TS 37.355 [34] if positioning frequency layer *i* is in Case 1, or corresponding to *ppw-durationOfPRS-ProcessingSymbolsN2* in TS 37.355 [34] if positioning frequency layer *i* is in Case 2,

- is UE capability for number of DL PRS resources that it can process in a slot corresponding to *ppw-maxNumOfDL-PRS-ResProcessedPerSlot* as specified in clause 6.4.3 of TS 37.355 [34],

- is the number of UE Rx-Tx time difference measurement samples:

- = 4 if the UE is not capable of *supportedDL-PRS-ProcessingSamples* defined in [34].

- = 1 if the UE is capable of *supportedDL-PRS-ProcessingSamples* defined in [34] and LMF requests the UE to perform positioning measurements with reduced number of samples by *requestedDL-PRS-ProcessingSamples* [34] and the following conditions are met:

- PRS bandwidth is within the active BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within [6] dB.

- = [2] if the UE is capable of *supportedDL-PRS-ProcessingSamples* defined in [34] and the LMF requests the UE to perform positioning measurements with reduced number of samples by *requestedDL-PRS-ProcessingSamples* [34] but the following conditions are not met:

- PRS bandwidth is within the active BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within [6] dB.

- = 4 otherwise.

- is the measurement duration for the last UE Rx-Tx time difference measurement sample in the positioning layer i, including the sampling time and processing time.

If positioning frequency layer *i* is in Case 1 and all of the PRS resources to be measured are available in the same PPW occasion during Tavailable, then = +PPWL, else

if positioning frequency layer *i* is in Case 2 and all of the PRS resources to be measured are available in the same PPW occasion during Tavailable, then = PPWL;

otherwise, = + .

- is periodicity of UE Rx-Tx time difference measurement in positioning frequency layer *i*:

where

corresponds to *ppw-durationOfPRS-ProcessingSymbolsT*  in TS 37.355 [34]if positioning frequency layer *i* is in Case 1, or corresponds to the sum of *ppw-durationOfPRS-ProcessingSymbolsT2* and *ppw-durationOfPRS-ProcessingSymbolsN2* in TS 37.355 [34] if positioning frequency layer *i* is in Case 2,

, the least common multiple between and

is the PRS processing window repetition periodicity in positioning frequency layer *i*.

is the PRS resource periodicity in positioning frequency layer *i*. If the positioning frequency layer *i* has more than one DL PRS resource sets with different PRS periodicities with muting, , the least common multiple of among DL PRS resource sets is used to derive , where

is the periodicity of PRS resource sets given by the higher-layer parameter *DL-PRS-Periodicity*.

is the scaling factor considering PRS resource muting. , where is the muting repetition factor given by the higher-layer parameter *DL-PRS-MutingBitRepetitionFactor*, and is the size of the bitmap

Note: For the purpose of calculating TPRS,i, only the PRS resources that meet the applicability conditions and fully or partially covered by the PRS processing window are considered.

The time starts from the first PRS processing window instance aligned with DL PRS resources in the assistance data after both the *NR-Multi-RTT-RequestLocationInformation* message and *NR-Multi-RTT-ProvideAssistanceData* message from LMF via LPP [34] are delivered to the physical layer of UE.

The UE Rx-Tx time difference measurement period is restarted if HO occurs during the measurement period and after SRS reconfiguration on the target cell is complete.

The measurement requirements do not apply for a PRS resource:

- if the PRS resource is across two sampling duration of N within duration or

- if time span of the PRS resource instance (including at least the minimum number of repetitions specified in the accuracy requirements) is greater than UE reported capability N.

If during the measurement period of one or more positioning frequency layers, the PRS processing window is reconfigured or reactivated either per UE request or not per UE request, the measurement period can be longer.

The requirements in this section apply, provided no PRS symbols are dropped during the measurement period within PRS processing window due to collisions with other signals; otherwise, a longer measurement period may be used.

When PRS-RSRP is configured for multi-RTT, the UE Rx-Tx time difference measurements and PRS-RSRP measurements are performed over the same measurement period.

The requirements in clause 9.9.4.6 do not apply if the PRS configuration given by higher layer paramters *NR-DL-PRS-AssistanceData* exceeds any of the UE measurement capabilities given by *NR-DL-PRS-ResourcesCapability* in *NR-Multi-RTT-ProvideCapabilities*, and it is up to UE implementation which PRS resources are measured, subject to UE measurement capabilities*.*

When PSCell or SCell addition or release does not cause SRS reconfiguration during the measurement period, UE continues the UE Rx-Tx time difference measurement, and the measurement period requirements apply.

When PSCell or SCell addition or release causes SRS reconfiguration during the measurement period, UE shall restart the UE Rx-Tx time difference measurement after the SRS reconfiguration on the target cell is complete.

When SRS is reconfigured without cell change during the measurement period, UE shall restart the UE Rx-Tx time difference measurement after the SRS reconfiguration on the target cell is complete.

If UE uplink transmission timing changes due to the network-configured Timing Advance command during the UE Rx-Tx measurement period, then the UE Rx-Tx time difference measurement period is restarted after uplink transmission timing changes, and the UE Rx-Tx time difference measurement period requirements in this clause shall not apply.

If UE uplink transmission timing changes due to the change in the NTA\_offset defined in Table 7.1.2-2 during the UE Rx-Tx measurement period, then the UE Rx-Tx time difference measurement period is restarted after uplink transmission timing changes, and the UE Rx-Tx time difference measurement period requirements in this clause shall not apply.

If UE uplink transmission timing changes due to the UE autonomous timing adjustment defined in clause 7.1.2 during the UE Rx-Tx measurement period, then:

- UE Rx-Tx measurement period requirements in this clause shall apply for a cell, which is also the downlink reference cell (defined in section 7.1.1) for SRS transmission.

- UE Rx-Tx measurement period requirements in this clause shall not apply for a cell, which is not the downlink reference cell (defined in section 7.1.1) for SRS transmission. The UE Rx-Tx time difference measurement period may be restarted in such case.

If any positioning frequency layer is in Case 2, the requirements in this clause apply provided that the PPWL corresponding to the positioning frequency layer is larger than (T2+X) ms.

The requirements in this clause apply provided that a single positioning frequency layer is configured for measurement in each PPW.

#### 9.9.4.7 Void

### 9.9.5 E-CID measurements

#### 9.9.5.1 Introduction

The requirements in clause 9.9.5 shall apply provided the UE has received *nr-ECID-RequestLocationInformation* message from LMF via LPP [34] requesting the UE to report one or more of the following measurements for NR E-CID positioning [22]: SS-RSRP, SS-RSRQ, CSI-RSRP, and CSI-RSRQ.

#### 9.9.5.2 Measurement Requirements

##### 9.9.5.2.1 Intra-frequency Measurement Requirements

The intra-frequency NR E-CID measurements shall meet the requirements in clause 9.2 and clause 9.10.2, except the measurement reporting requirements. The NR E-CID measurement reporting requirements are defined in clause 9.9.5.2.3.

The reported intra-frequency NR E-CID measurements shall also meet:

- for FR1 SS-RSRP, the accuracy requirements in clauses 10.1.2.1,

- for FR1 SS-RSRQ, the accuracy requirements in clauses 10.1.7.1,

- for FR1 CSI-RSRP, the accuracy requirements in clause 10.1.2.3,

- for FR1 CSI-RSRQ, the accuracy requirements in clause 10.1.7.2,

- for FR2 SS-RSRP, the accuracy requirements in clauses 10.1.3.1,

- for FR2 SS-RSRQ, the accuracy requirements in clauses 10.1.8.1,

- for FR2 CSI-RSRP, the accuracy requirements in clause 10.1.3.3,

- for FR2 CSI-RSRQ, the accuracy requirements in clause 10.1.8.2.

##### 9.9.5.2.2 Inter-frequency Measurement Requirements

The inter-frequency NR E-CID measurements shall meet the requirements in clause 9.3 and 9.10.4, except the measurement reporting requirements. The NR E-CID measurement reporting requirements are defined in clause 9.9.5.2.3.

The reported inter-frequency NR E-CID measurements shall also meet:

- for FR1 SS-RSRP, the accuracy requirements in clauses 10.1.4.1,

- for FR1 SS-RSRQ, the accuracy requirements in clauses 10.1.9.1,

- for FR1 CSI-RSRP, the accuracy requirements 10.1.4.3,

- for FR1 CSI-RSRQ, the accuracy requirements 10.1.9.2,

- for FR2 SS-RSRP, the accuracy requirements in clauses 10.1.5.1,

- for FR2 SS-RSRQ, the accuracy requirements in clauses 10.1.10.1,

- for FR2 CSI-RSRP, the accuracy requirements 10.1.5.3,

- for FR2 CSI-RSRQ, the accuracy requirements 10.1.10.2.

##### 9.9.5.2.3 Measurement Reporting Delay

The measurement reporting delay is defined as the time between the moment when the periodic measurement report is triggered and the moment when the UE starts to transmit the measurement report over the air interface. This requirement assumes that that the measurement report is not delayed by other LPP signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 x TTIDCCH where TTIDCCH is the duration of subframe or slot or subslot when the measurement report is transmitted on the PUSCH with subframe or slot or subslot duration. This measurement reporting delay excludes any delay caused by no UL resources for UE to send the measurement report.

The reported NR E-CID measurement values contained in periodically triggered measurement reports shall be based on the measurement report mapping requirements specified in clause 10.1.6 for SS-RSRP and CSI-RSRP, and clause 10.1.11 for SS-RSRQ and CSI-RSRQ.

The UE shall not send any measurement reports as long as no corresponding reporting criteria specified in clause 9.1.4 are fulfilled.

### 9.9.6 PRS-RSRPP measurements

#### 9.9.6.1 Introduction

The requirements in clause 9.9.6.5 shall apply when UE is performing PRS measurement in the configured MG and provided the UE has received a message from LMF via LPP requesting the UE to measure and report PRS-RSRPP measurements defined in TS 38.215 [4].

The requirements in clause 9.9.6.6 shall apply when UE is performing PRS measurement without gap and provided the UE has received a message from LMF via LPP requesting the UE to measure and report PRS-RSRPP measurements defined in TS 38.215 [4].

#### 9.9.6.2 Requirements applicability

The requirements in clause 9.9.6 apply for periodic and triggered PRS-RSRPP measurements, provided:

- PRS-RSRPP related side conditions given in clause 10.1.X are met for a corresponding Band.

#### 9.9.6.3 Measurement capability

UE PRS-RSRPP measurement capability is as indicated by the UE in *NR-DL-AoD-ProvideCapabilities* according to TS 37.355 [34].

#### 9.9.6.4 Measurement reporting requirements

This requirement assumes that the measurement report is not delayed by other LPP signalling on the DCCH. This measurement reporting delay excludes the delay uncertainty caused by inserting the measurement report into the TTI of the uplink DCCH. The delay uncertainty is: 2 x TTIDCCH where TTIDCCH is the duration of subframe or slot or subslot when the measurement report is transmitted on the PUSCH with subframe or slot or subslot duration. This measurement reporting delay excludes any delay caused by no UL resources for UE to send the measurement report.

The reported PRS-RSRPP measurement values contained in measurement reports shall be based on the measurement report mapping requirements specified in clauses 10.1.24.3.

The PRS-RSRPP measurement accuracy for all measured PRS resources shall be fulfilled according to the accuracy requriements specified in the clauses 10.1.24.X.

#### 9.9.6.5 Measurement period requirements

For PRS measurement within MG configured to UE, measurement period requirements for PRS-RSRP defined in 9.9.3.5 is re-used for PRS-RSRPP.

#### 9.9.6.6 Measurement Period Requirements without Measurement Gaps

For PRS measurement without MG configured to UE, measurement period requirements for PRS-RSRP defined in 9.9.3.6 is re-used for PRS-RSRPP.

The PRS-RSRPP measurement requirements in this section apply for the first path PRS-RSRP measurement.

#### 9.9.6.7 Void

## 9.10 CSI-RS based L3 measurements

### 9.10.1 Introduction

This clause contains general requirements on the UE regarding CSI-RS based measurement reporting in RRC\_CONNECTED state. The requirements are split in intra-frequency and inter-frequency measurements requirements.

The requirements in this clause apply, provided:

- Only one MO is configured per CSI-RS frequency layer, and

- all CSI-RS resources in the same MO are configured with the same csi-rs-MeasurementBW, and

- *associatedSSB* is configured in *CSI-RS-Resource-Mobility* and detectable, and

- all CSI-RS resources in the same MO are configured with the same periodicity, and- the associated SSB is QCLed with the corresponding CSI-RS resources in FR2, and

- the number of CSI-RS resources in any duration that equals to the length of a slot is no larger than UE capability *maxNumberCSI-RS-RRM-RS-SINR*.

- When there are mixed numerologies, the length of a slot is defined based on the smallest SCS

### 9.10.2 CSI-RS based intra-frequency measurements

#### 9.10.2.1 Introduction

A measurement is defined as a CSI-RS based intra-frequency measurement provided that:

- the SCS of the CSI-RS resource of the neighbour cell configured for measurement is the same as the SCS of the CSI-RS resource on the serving cell indicated for measurement, and

- the CP type of the CSI-RS resource of neighbour cell configured for measurement is the same as the CP type of the CSI-RS resource of the serving cell indicated for measurement, and

- It is applied for SCS = 60KHz

- the centre frequency of the CSI-RS resource of the neighbour cell configured for measurement is the same as the centre frequency of the CSI-RS resource of the serving cell indicated for measurement

The UE shall be able to identify new intra-frequency cells and perform CSI-RSRP, CSI-RSRQ and CSI-SINR measurements of identified intra-frequency cells if carrier frequency information is provided by PCell or the PSCell.

No measurement gap is needed for intra-frequency CSI-RS resources measurements.

For intra-frequency CSI-RS based measurements, UE may cause scheduling restriction as specified in clause 9.10.2.6.

Note: Extended CP for CSI-RS based measurement is not supported in this release.

#### 9.10.2.2 Requirements applicability

The measurement of the associated SSB follows the same requirements as SSB based measurements defined in 9.2.

The requirements in clause 9.10.2 apply, provided:

- Only one intra-frequency CSI-RS layer per serving cell is configured, and

- The BW of the CSI-RS on the intra-frequency neighbor cell is within the active BWP of the UE, and

- The associated SSB of the CSI-RS resources being identified or measured are detectable, and the CSI-RS resources configured for CSI-RS based L3 measurements are measurable, and

- The bandwidth of CSI-RS resources of intra-MO is the same as that of the CSI-RS resources configured for the serving cell, and

- All CSI-RS resources on one intra-frequency layer are configured within up to two separate windows where each window is up to 5ms, and

- for the case of single window further provided

- The periodicity of the configured CSI-RS resources is 10ms, 20ms or 40ms- for the case of two separate windows further provided

- The two windows are either both fully non-overlapped with MG or both partially overlapped with MG

- The periodicity of the configured CSI-RS resources is 20ms or 40ms

- The starting point of the first window is the slot boundary of the serving cell, where the corresponding slot contains the configured L3 CSI-RS resource of the serving cell in the servingCellMO with the smallest offset, and

- The starting point of the second window if configured is determined by an offset of half of the CSI-RS periodicity in slots with regards to the starting point of the first window, and

- Numerology for intra-frequency CSI-RS and data of serving cell are the same.

An intra-frequency cell shall be considered detectable when for each relevant associated SSB:

- SS-RSRP related side conditions given in clauses 10.1.2.1 and 10.1.3.1 for FR1 and FR2, respectively, for a corresponding Band,

- SS-RSRQ related side conditions given in clauses 10.1.7.1 and 10.1.8.1 for FR1 and FR2, respectively, for a corresponding Band,

- SS-SINR related side conditions given in clauses 10.1.12.1 and 10.1.13.1 for FR1 and FR2, respectively, for a corresponding Band,

- SSB\_RP and SSB Ês/Iot according to Annex B.2.2 for a corresponding Band.

A CSI-RS resource shall be considered measurable when for each relevant CSI-RS resource:

- CSI-RSRP related side conditions given in clauses 10.1.2.3 and 10.1.3.3 for FR1 and FR2, respectively, for a corresponding Band,

- CSI-RSRQ related side conditions given in clauses 10.1.7.2 and 10.1.8.2 for FR1 and FR2, respectively, for a corresponding Band,

- CSI-SINR related side conditions given in clauses 10.1.12.2 and 10.1.13.2 for FR1 and FR2, respectively, for a corresponding Band,

- CSI\_RP and CSI-RS Ês/Iot according to Annex B.2.12 for a corresponding Band.

#### 9.10.2.3 Number of cells and number of CSI-RS

##### 9.10.2.3.1 Requirements for FR1

For each intra-frequency CSI-RS layer, during each layer 1 measurement period, the UE shall be capable of performing CSI-RSRP, CSI-RSRQ, and CSI-SINR measurements for at least:

- 32 CSI-RSs with different CSI-RS index and/or PCI on the intra-frequency layer, and

- the cells to be monitored based on CSI-RS are the same set or a subset of the cells monitored based on the layer of the associated SSB

##### 9.10.2.3.2 Requirements for FR2

For one single intra-frequency CSI-RS layer in a band, during each layer 1 measurement period, the UE shall be capable of performing CSI-RSRP, CSI-RSRQ, and CSI-SINR measurements for at least:

- 32 CSI-RSs with different CSI-RS index and/or PCI, and

- the cells to be monitored based on CSI-RS are the same set or a subset of the cells monitored based on the layer of the associated SSB.

where this single intra-frequency layer shall be:

- PCC on which UE is configured to report CSI-RS measurement when UE is configured with SA NR operation mode with PCC in the band; or

- PSCC on which UE is configured to report CSI-RS measurement when UE is configured with EN-DC with PSCC in the band; or

- One of the SCCs on which UE is configured to report CSI-RS based measurements when neither PCC nor PSCC is in the same band, so that the selected SCC shall be an SCC where the UE is configured with CSI-RSRP measurement reporting if such SCC exists, otherwise the selected SCC is determined by UE implementation.

The UE shall also be capable of performing CSI-RSRP, CSI-RSRQ, and CSI-SINR measurements for at least 2 CSI-RSs on serving cell for each of the other intra-frequency layer(s) in the same band.

For each FR2 band, UE is only required to measure neighbour cell CSI-RS on the CSI-RS layer, whose associated SSB should be on the same SSB layer as the one where UE is required to measure neighbour cell SSB.

#### 9.10.2.4 Measurement Reporting Requirements

Note: The UE is not required to report CSI-RS based L3 measurements when the timing offset between the reference measurement timing and the target CSI-RS in one layer is larger than one CP. If the UE reports CSI-RS based L3 measurements when the timing offset exceeds one CP, the UE may not meet the CSI-RS based L3 measurement accuracy requirements for CSI-RSRP, CSI-RSRQ and CSI-SINR in TS 38.133 section 10.1, which apply only when the timing offset is no larger than one CP.

##### 9.10.2.4.1 Periodic Reporting

Reported CSI-RSRP, CSI-RSRQ, and CSI-SINR measurements contained in periodic measurement reports shall meet the requirements in clauses 10.1.2.3, 10.1.3.3, 10.1.7.2, 10.1.8.2, 10.1.12.2 and 10.1.13.2.

##### 9.10.2.4.2 Event-triggered Periodic Reporting

Reported CSI-RSRP, CSI-RSRQ, and CSI-SINR measurements contained in event-triggered periodic measurement reports shall meet the requirements in clauses 10.1.2.3, 10.1.3.3, 10.1.7.2, 10.1.8.2, 10.1.12.2 and 10.1.13.2.

The first report in event triggered periodic measurement reporting shall meet the requirements specified in clause 9.10.2.4.3.

##### 9.10.2.4.3 Event Triggered Reporting

Reported CSI-RSRP, CSI-RSRQ, and CSI- SINR measurements contained in event triggered measurement reports shall meet the requirements in clauses 10.1.2.3, 10.1.3.3, 10.1.7.2, 10.1.8.2, 10.1.12.2 and 10.1.13.2.

The UE shall not send any event triggered measurement reports as long as no reporting criterion is fulfilled.

The measurement reporting delay is defined as the time between an event that will trigger a measurement report and the point when the UE starts to transmit the measurement report over the air interface. This requirement assumes that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 x TTIDCCH. This measurement reporting delay excludes a delay which caused by no UL resources being available for UE to send the measurement report on.

The event triggered measurement reporting delay, measured without L3 filtering shall be less than the CSI-RS based measurement defined in clause 9.10.2.5. When L3 filtering is used an additional delay can be expected.

#### 9.10.2.5 Intra-frequency measurements without measurement gaps

If a UE is configured with the higher layer parameters *CSI-RS-Resource-Mobility* and *associatedSSB*, the CSI-RS based measurement shall include PSS/SSS detection time of associatedSSB, the time period used to acquire the SFN information and CSI-RS based measurement period without gap.

- PSS/SSS detection time of associatedSSB is the intra-frequency TPSS/SSS\_sync\_intra in Clause 9.2.5.1.

- The time period used to acquire the SFN information is equal to 0 if the UE is indicated that the neighbour cell is synchronous with the serving cell (*deriveSSB-IndexFromCell* is enabled). Otherwise, the time period used to acquire the SFN information is TCSI-RS\_SFN\_intra as shown in Table 9.10.2.5-3 for FR1. It is assumed that *deriveSSB-IndexFromCell* is always enabled for FR1 TDD and FR2.

- If the associatedSSB, which has been detectable at least for the time period Tidentify\_intra\_with\_index defined in clause 9.2.5.1, becomes undetectable for a period ≤ 5 seconds and then the associatedSSB becomes detectable again with the same spatial reception parameter provided the timing to that cell has not changed more than  3200/ Tc, where *µ* is the SCS configuration as defined in clause 4.2 of TS 38.211 [3], PSS/SSS detection time and time period used to acquire the SFN information are equal to 0.

The measurement period for CSI- RS based intra-frequency measurements without gaps is as shown in table 9.10.2.5-1and Table 9.10.2.5-2.

Additionally, for a given CSI-RS resource, if the associated SS/PBCH block is configured but not detected by the UE, or if CSI-RS is configured with associated SSB but not QCL-ed to the associated SSB, the UE is not required to monitor the corresponding CSI-RS resource.

Table 9.10.2.5-1: Measurement period for intrafrequency CSI-RS based measurements without gaps(FR1)

|  |  |
| --- | --- |
| DRX cycle | T CSI-RS\_measurement\_period\_intra |
| No DRX | max(200ms, ceil( 5 x Kp\_CSI-RS) x CSI-RS period) x CSSFintra |
| DRX cycle≤ 320ms | max(200ms, ceil(1.5x 5 x Kp\_CSI-RS) x max(CSI-RS period, DRX cycle)) x CSSFintra |
| DRX cycle>320ms | ceil( 5 x Kp\_CSI-RS) x DRX cycle x CSSFintra |
| NOTE 1: The requirements apply assuming CSI-RS configuration with {D=3 with PRBs ≥ 48}. D is frequency domain density for the 1-port CSI-RS for L3 mobility defined in clause 7.4.1 of TS38.211 [6]. | |

Table 9.10.2.5-2: Measurement period for intrafrequency CSI-RS based measurements without gaps(FR2)

|  |  |
| --- | --- |
| DRX cycle | T CSI-RS\_measurement\_period\_intra |
| No DRX | max(400ms, ceil(Mmeas\_period\_w/o\_gaps x Kp\_CSI-RS) x CSI-RS period) x CSSFintra |
| DRX cycle≤ 320ms | max(400ms, ceil(1.5x Mmeas\_period\_w/o\_gaps x Kp\_CSI-RS) x max(CSI-RS period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | Mmeas\_period\_w/o\_gaps x DRX cycle x CSSFintra |
| NOTE 1: The requirements apply assuming CSI-RS configuration with {D=3 with PRBs ≥ 48}. D is frequency domain density for the 1-port CSI-RS for L3 mobility defined in clause 7.4.1 of TS38.211 [6]. | |

Mmeas\_period\_w/o\_gaps : For a UE supporting power class 1, Mmeas\_period\_w/o\_gaps =40. For a UE supporting FR2 power class 2, Mmeas\_period\_w/o\_gaps =24. For a UE supporting power class 3, Mmeas\_period\_w/o\_gaps =24. For a UE supporting power class 4, Mmeas\_period\_w/o\_gaps =24.

CSSFintra: it is a carrier specific scaling factor and is determined according to CSSFoutside\_gap,i in clause 9.1.5.

[For a UE not supporting [concurrent gap] or for a UE is supporting [concurrent gap] but not configured with concurrent measurement gaps,

- if the intra-frequency CSI-RS resource does not overlap with any measurement gaps, Kp\_CSI-RS=1;

- if some occaions of the intra-frequency CSI-RS resource is overlap with ameasurement gaps, Kp\_CSI-RS = 1/(1- (CSI-RS resource period /MGRP)) , where CSI-RS resource period < MGRP, and the MGRP is the periodicity of the measurement gap.

- Otherwise, if a UE which support concurrent measurement gaps and has been configured with concurrent measurement gaps, Kp\_CSI-RS is the scaling factor for a CSI-RS frequency layer to be measured outside gap which is defined as Kp\_CSI-RS = Ntotal / Navailable

For a window W of duration max(CSI-RS period, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE MG and per-FR MG within the same FR as the CSI-RS frequency layer, and starting at the beginning of any gap occasions covering the CSI-RS resources:

Ntotal is the total number of CSI-RS resources within the window, including those overlapped with other MG occasions within the window, and

Navailable is the number of CSI-RS resources that are not overlapped with any other non-dropped MG occasion within the window W, after accounting for MG collisions by applying the selected gap collision rule.

Kp\_CSI-RS = 1 when Navailable = 0

Table 9.10.2.5-3: Time period for SFN acquisition for intra-frequency CSI-RS based measurements without gaps(FR1)

|  |  |
| --- | --- |
| DRX cycle | TCSI-RS\_SFN\_intra |
| No DRX | max(200ms, ceil(5 x Kp )x SMTC period)Note 1 x CSSFintra |
| DRX cycle≤ 320ms | max(2000ms, ceil (1.5 x 5 x Kp) x max(SMTC period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | Ceil(5 x Kp) x DRX cycle x CSSFintra |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified  NOTE 2: Kp\_CSI-RS is applicable for a UE supporting concurrent gaps | |

#### 9.10.2.6 Scheduling availability of UE during CSI-RS based intra-frequency measurements

UE is required to be capable of measuring without measurement gaps when CSI-RS resources are completely contained in the active BWP of the UE. Note the configured CSI-RS symbol is indicated in *firstOFDMSymbolInTimeDomain* included in *CSI-RS-ResourceConfigMobility* for RRM. When UE is required to perform CSI-RS based RRM measurements, and any of the conditions in the following clauses is met, there are restrictions on the scheduling availability; otherwise, there is no scheduling restriction. Note same numerology for intra-frequency CSI-RS and data of serving cell is considered in this release.

##### 9.10.2.6.1 Scheduling availability of UE performing CSI-RS based measurements in TDD bands

When UE performs CSI-RS intra-frequency measurements in a TDD band,

- UE is not expected to transmit PUCCH/PUSCH/SRS on configured CSI-RS resource symbols, and on 1 OFDM symbol before and after each consecutively configured CSI-RS symbols.

When TDD intra-band carrier aggregation is performed, the scheduling restrictions due to a given serving cell should also apply to all other serving cells in the same band on the symbols that fully or partially overlap with the aforementioned restricted symbols.

##### 9.10.2.6.2 Scheduling availability of UE performing CSI-RS based measurements in FR2

When the UE performs CSI-RS based intra-frequency measurements for L3 mobility management in FR2, the following restrictions apply.

- The UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on the configured CSI-RS symbol within the configured slot as indicated in *slotConfig* of the corresponding CSI-RS resource to be measured for mobility.

When intra-band carrier aggregation in FR2 is performed, the scheduling restrictions due to a given serving cell should also apply to all other serving cells in the same band on the symbols that fully or partially overlap with aforementioned restricted symbols.

When inter-band carrier aggregation in FR2 is performed, there are no scheduling restrictions on FR2 serving cells in the bands due to CSI-RSRP, CSI-RSRQ or CSI-SINR measurement on an FR2 intra-frequency cell in different bands, provided that UE is capable of independent beam management on this FR2 band pair.

### 9.10.3 CSI-RS based Inter-frequency measurements

#### 9.10.3.1 Introduction

A measurement is defined as a CSI-RS based inter-frequency measurement provided it is not defined as an intra-frequency measurement according to clause 9.10.2.

If a UE is configured with the higher layer parameter *CSI-RS-Resource-Mobility* and the higher layer parameter *associatedSSB* is configured, the UE shall be able to identify inter-frequency cells indicated for measurement and perform CSI-RSRP, CSI-RSRQ, and CSI-SINR measurements of identified inter-frequency cells.

When measurement gaps are needed, the UE is not expected to detect the associated SSB nor perform measurement of the CSI-RS resource configured in *CSI-RS-Resource-Mobility* on an inter-frequency measurement object which start earlier than the gap starting time + switching time, and ends later than the gap end – switching time. When the inter-frequency cells are in FR2 and the per-FR gap is configured to the UE in EN-DC, SA NR, NE-DC and NR-DC, or the serving cells are in FR2, the inter-frequency cells are in FR2 and the per-UE gap is configured to the UE in SA NR and NR-DC, the switching time is 0.25ms. Otherwise the switching time is 0.5ms.

If a UE is configured with multiple concurrent gaps, the requirements in this clause shall apply when the measurement gap pattern is configured to be associated to the CSI-RS resources of the inter-frequency layer.

#### 9.10.3.2 Requirements applicability

The associated SSB layer of the CSI-RS follows the same requirements as SSB based measurements defined in 9.3.

The requirements in clause 9.10.3 apply, provided:

- The associated SSB of the cell being identified or measured is detectable, and

- All CSI-RS resources on one inter-frequency layer are configured within a window of up to 5ms, and

- The periodicity of the configured CSI-RS resources is 10ms, 20ms or 40ms, and

- CSI-RS resources for measurements and the associated SSB for cell identification are configured within measurement gap.

An inter-frequency cell shall be considered detectable when for each relevant associated SSB:

- SS-RSRP related side conditions given in clauses 10.1.4.1 and 10.1.5.1 for FR1 and FR2, respectively, for a corresponding Band,

- SS-RSRQ related side conditions given in clauses 10.1.9.1 and 10.1.10.1 for FR1 and FR2, respectively, for a corresponding Band,

- SS-SINR related side conditions given in clauses 10.1.14.1 and 10.1.15.1 for FR1 and FR2, respectively, for a corresponding Band,

- SSB\_RP and SSB Ês/Iot according to Annex B.2.3 for a corresponding Band.

A CSI-RS resource shall be considered measurable when for each relevant CSI-RS resource:

- CSI-RSRP related side conditions given in clauses 10.1.4.3 and 10.1.5.3 for FR1 and FR2, respectively, for a corresponding Band,

- CSI-RSRQ related side conditions given in clauses 10.1.9.2 and 10.1.10.2 for FR1 and FR2, respectively, for a corresponding Band,

- CSI-SINR related side conditions given in clauses 10.1.14.2 and 10.1.15.2 for FR1 and FR2, respectively, for a corresponding Band,

- CSI \_RP and CSI-RS Ês/Iot according to Annex B.2.13 for a corresponding Band.

#### 9.10.3.3 Number of cells and number of CSI-RS resources

##### 9.10.3.3.1 Requirements for FR1

For each inter-frequency CSI-RS layer, during each layer 1 measurement period, the UE shall be capable of performing CSI-RSRP, CSI-RSRQ, and CSI-SINR measurements for at least:

- 14 CSI-RSs with different CSI-RS index and/or PCI , and

- The cells to be monitored based on CSI-RS are the same set or a subset of the cells monitored based on the layer of the associated SSB.

##### 9.10.3.3.2 Requirements for FR2

For each inter-frequency CSI-RS layer, during each layer 1 measurement period, the UE shall be capable of performing CSI-RSRP, CSI-RSRQ, and CSI-SINR measurements for at least:

- 24 CSI-RSs with different CSI-RS index and/or PCI, and

- The cells to be monitored based on CSI-RS are the same set or a subset of the cells monitored based on the layer the associated SSB.

#### 9.10.3.4 Measurements reporting requirements

Note: The UE is not required to report CSI-RS based L3 measurements when the timing offset between the reference measurement timing and the target CSI-RS in one layer is larger than one CP. If the UE reports CSI-RS based L3 measurements when the timing offset exceeds one CP, the UE may not meet the CSI-RS based L3 measurement accuracy requirements for CSI-RSRP, CSI-RSRQ and CSI-SINR in TS 38.133 section 10.1, which apply only when the timing offset is no larger than one CP.

##### 9.10.3.4.1 Periodic Reporting

Reported CSI-RSRP, CSI-RSRQ, and CSI-SINR measurements contained in periodically triggered measurement reports shall meet the requirements in clauses 10.1.4.2, 10.1.5.2, 10.1.9.2, 10.1.10.2, 10.1.14.2 and 10.1.15.2..

##### 9.10.3.4.2 Event-triggered Periodic Reporting

Reported CSI-RSRP, CSI-RSRQ, and CSI-SINR measurements contained in periodically triggered measurement reports shall meet the requirements in clauses 10.1.4.2, 10.1.5.2, 10.1.9.2, 10.1.10.2, 10.1.14.2 and 10.1.15.2..

The first report in event triggered periodic measurement reporting shall meet the requirements specified in clause 9.10.3.4.3.

##### 9.10.3.4.3 Event-triggered Reporting

Reported CSI-RSRP, CSI-RSRQ, and CSI-SINR measurements contained in periodically triggered measurement reports shall meet the requirements in clauses 10.1.4.2, 10.1.5.2, 10.1.9.2, 10.1.10.2, 10.1.14.2 and 10.1.15.2..

The UE shall not send any event triggered measurement reports, as long as no reporting criteria are fulfilled.

The measurement reporting delay is defined as the time between an event that will trigger a measurement report and the point when the UE starts to transmit the measurement report over the air interface. This requirement assumes that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 × TTIDCCH. This measurement reporting delay excludes a delay which caused by no UL resources for UE to send the measurement report.

The event triggered measurement reporting delay, measured without L3 filtering shall be within CSI-RS based measurement defined in clause .When L3 filtering is used an additional delay can be expected.

#### 9.10.3.5 Inter frequency measurements with measurement gaps

When measurement gaps are provided, if configured with the higher layer parameters *CSI-RS-Resource-Mobility* and *associatedSSB,* the UE shall be able to identify a new detectable CSI-RS based inter frequency cell within T CSI-RS\_identify\_inter,

T CSI-RS\_identify\_inter = (TPSS/SSS\_sync + T CSI-RS\_measurement\_period\_inter + TCSI-RS\_SFN\_inter) ms

Where:

TPSS/SSS\_sync is the time period used in PSS/SSS detection which is determined according to TPSS/SSS\_sync\_inter in clause9.3.4,

TCSI-RS\_SFN\_inter is the time period used to acquire the SFN information of the cell being measured, which is shown in Table 9.10.3.5-3 for FR1 and equals inter-frequency TSSB\_time\_index\_inter in Clause 9.3.4 for FR2,

TCSI-RS\_measurement\_period\_inter: equal to a measurement period of CSI-RS based measurement given in table 9.10.3.5-1 and table 9.10.3.5-2..

Mmeas\_period\_inter: For a UE supporting FR2 power class 1 or 5, Mmeas\_period\_inter =8×N samples. For a UE supporting FR2 power class 2, Mmeas\_period\_inter=5×N samples. For a UE supporting FR2 power class 3, Mmeas\_period\_inter =5×N samples. For a UE supporting FR2 power class 4, Mmeas\_period\_inter = 5×N samples. Note that scaling factor N = [8].

CSSFinter: it is a carrier specific scaling factor and is determined according to CSSFwithin\_gap,i in clause 9.1.5 for measurement conducted within measurement gaps.

If a UE which supports concurrent measurement gaps has been configured with concurrent measurement gaps, Kp\_CSI-RS is the scaling factor for a CSI-RS frequency layer to be measured within the associated measurement gap which is defined as Kp\_CSI-RS = Ntotal / Navailable. Kp\_CSI-RS = 1 for for UE not configured with concurrent measurement gaps.

- For a window W of duration max(CSI-RS period, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE MG and per-FR MG within the same FR as the CSI-RS frequency layer, and starting at the beginning of any gap occasions covering the CSI-RS resources.:

- Ntotal is the total number of associated gap occasions covering CSI-RS resources within the window, including those overlapped with other MG occasions within the window, and

- Navailable is the number of non-dropped associated gap occasions covering CSI-RS resources within the window W, after accounting for MG collisions by applying the selected gap collision rule.

- Requirements do not apply if Navailable = 0

Additionally, for a given CSI-RS resource, if the associated SSB is configured but not detected by the UE, or if CSI-RS configured with associated SSB but not QCL-ed to the associated SSB, the UE is not required to monitor the corresponding CSI-RS resource.

Table 9.10.3.5-1: Measurement period for CSI-RS based inter-frequency measurements with gaps (FR1)

|  |  |
| --- | --- |
| Condition NOTE1,2 | T CSI-RS\_measurement\_period\_inter |
| No DRX | Max(200ms, ceil(8 × Kp\_CSI-RS) × Max(MGRP, CSI-RS period)) × CSSFinter |
| DRX cycle ≤ 320ms | Max(200ms, Ceil(8 × 1.5 × Kp\_CSI-RS)) × Max(MGRP, CSI-RS period, DRX cycle)) × CSSFinter |
| DRX cycle > 320ms | Ceil(8 × Kp\_CSI-RS) × DRX cycle × CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: In EN-DC operation, the parameters, timers and scheduling requests referred to in clause 3.6.1 are for the secondary cell group. The DRX cycle is the DRX cycle of the secondary cell group.  NOTE 3: If UE support concurrent gaps and multiple concurrent gaps are configured, the MGRP is the periodicity of the MG pattern associated to the CSI-RS resources of the inter-frequency layer.  NOTE 4: Kp\_CSI-RS is applicable for a UE supporting concurrent gaps | |

Table 9.10.3.5-2: Measurement period for CSI-RS based inter-frequency measurements with gaps (FR2)

|  |  |
| --- | --- |
| Condition NOTE1,2 | T CSI-RS\_measurement\_period\_inter |
| No DRX | Max(400 ms, ceil( Mmeas\_period\_inter × Kp\_CSI-RS )× Max(MGRP, CSI-RS period)) × CSSFinter |
| DRX cycle ≤ 320ms | Max(400 ms, ceil(1.5 × Mmeas\_period\_inter× Kp\_CSI-RS) × Max(MGRP, CSI-RS period, DRX cycle)) × CSSFinter |
| DRX cycle > 320ms | Ceil(Mmeas\_period\_inter × Kp\_CSI-RS )× DRX cycle × CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: In EN-DC operation, the parameters, timers and scheduling requests referred to in clause 3.6.1 are for the secondary cell group. The DRX cycle is the DRX cycle of the secondary cell group.  NOTE 3: If UE support concurrent gaps and multiple concurrent gaps are configured, the MGRP is the periodicity of the MG pattern associated to the CSI-RS resources of the inter-frequency layer.  NOTE 4: Kp\_CSI-RS is applicable for a UE supporting concurrent gaps | |

Table 9.10.3.5-3: Time period for SFN acuisition for interfrequency CSI-RS based measurements with gaps(FR1)

|  |  |
| --- | --- |
| Condition NOTE1,2 | T CSI-RS\_SFN\_inter |
| No DRX | Max(200ms, ceil(5 × Kp\_CSI-RS )× Max(MGRP, SMTC period)) × CSSFinter |
| DRX cycle ≤ 320ms | Max(200ms, Ceil(5 × 1.5 × Kp\_CSI-RS) × Max(MGRP, SMTC period, DRX cycle)) × CSSFinter |
| DRX cycle > 320ms | Ceil(5 × Kp\_CSI-RS )× DRX cycle × CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1  NOTE 2: In EN-DC operation, the parameters, timers and scheduling requests referred to in clause 3.6.1 are for the secondary cell group. The DRX cycle is the DRX cycle of the secondary cell group.  NOTE 3: If UE support concurrent gaps and multiple concurrent gaps are configured, the MGRP is the periodicity of the MG pattern associated to *associatedSSB*.  NOTE 4: Kp\_CSI-RS is applicable for a UE supporting concurrent gaps | |

## 9.11 NR measurements with autonomous gaps

### 9.11.1 Introduction

The requirements in this clause are applicable for CGI identification of an intra frequency and inter frequency NR target cell.

The requirements in this clause are specified for CGI identification of an NR target cell and are applicable for a UE:

- in RRC\_CONNECTED state, and

- configured with SA or NR-DC or NE-DC operation mode, or with EN-DC operation mode for CGI identification requested by NR PSCell.

The overall CGI reporting delay is defined in clause 9.11.3.

### 9.11.2 CGI identification of an NR cell with autonomous gaps

The UE shall identify and report the CGI of a known NR target cell when requested by the network for the purpose of reportCGI. Only one cell is provided to the UE with *cellForWhichToReportCGI* for identifying the CGI.The UE may make autonomous gaps in both downlink reception and uplink transmission for receiving MIB and SIB1 message according to clause 5.5.3 of TS 38.331 [2]. Note that a UE is not required to use autonomous gap if *useAutonomousGaps* is set to false. If autonomous gaps are used for measurement with the purpose of reportCGI, regardless of whether DRX is used or not, or whether SCell(s) are configured or not, the UE shall be able to identify a new CGI of NR cell within:

Tidentify\_CGI = (TMIB + T SIB1) ms

Where:

TMIB is the time period used to acquire MIB message. TMIB = 6 \* TSMTC ms for target cell carrier frequency on FR1 and TMIB = 25 \* TSMTC ms for target cell carrier frequency on FR2.

TSIB1 is the time period used to acquire SIB1 message. TSIB1 = 6 \* TRMSI-scheduling ms.

Where TSMTC is the SMTC periodicity configured for the target cell measurement, and TRMSI-scheduling is

- the maximum between the periodicity with which the SIB1 is actually transmitted by the NR target cell and 20ms when SSB and RMSI CORESET multiplexing pattern is 1

- the maximum between the periodicity with which the SIB1 is actually transmitted by the NR target cell and TSMTC when SSB and RMSI CORESET multiplexing pattern is 2 or 3.

The requirement for identifying the CGI of an NR cell within Tidentify\_CGI is applicable when no DRX is used as well as when any of the DRX cycles specified in TS 38.331 [2] is used.

Within the time Tidentify\_CGI, over which the UE identifies the CGI of an NR cell, the UE shall fulfil interruption requirements specified in,

- Clause 8.2.1.2.16 for NR serving cells and Clause 7.32.2.15 in TS36.133 [15] for E-UTRA serving cells if the UE is configured with EN-DC operation mode,

- Clause 8.2.2.2.14 if the UE is configured with SA operation mode,

- Clause 8.2.3.2.14 for NR serving cells and Clause 7.36.2.14 in TS36.133 [15] for E-UTRA serving cells if the UE is configured with NE-DC operation mode,

- Clause 8.2.4.2.11 if the UE is configured with NR-DC operation mode.

In the requirement a cell is known if,

- During the last 5 seconds for FR1 or 3 seconds for FR2 before the reception of the report CGI command:

- The UE has sent a valid L3-RSRP measurement report with SSB index for the target cell and

- During MIB decoding at least reported SSBs remains detectable according to the cell identification conditions specified in clauses 9.2 or 9.3 of TS 38.133, and

- During SIB1 decoding the SSB used for MIB decoding remains detectable according to the cell identification conditions specified in clauses 9.2 or 9.3 of TS 38.133, and

- During MIB decoding, the SSB for MIB decoding remains detectable with SNR ≥-3dB

- During SIB1 decoding, the PDSCH for SIB1 decoding remains detectable with SNR ≥-3dB

### 9.11.3 CGI reporting delay

The CGI reporting delay is defined as the time between a command that will trigger a CGI report and the point when the UE starts to transmit the measurement report over the air interface. This requirement assumes that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty of 2 x TTIDCCH resulting when inserting the measurement report to the TTI of the uplink DCCH. This measurement reporting delay excludes any delay caused by lack of UL resources for UE to send the measurement report.

The CGI reporting delay shall be less than Tidentify\_CGI defined in clause 9.11.2 plus RRC procedure delay defined in clause 12 in TS 38.331 [2], and additional 20ms margin if target cell is on FR2.

## 9.11A NR measurements with autonomous gaps for RedCap

### 9.11A.1 Introduction

The requirements in this clause are applicable for CGI identification of an intra frequency and inter frequency NR target cell.

The requirements in this clause are specified for CGI identification of an NR target cell and are applicable for a UE:

- in RRC\_CONNECTED state, and

- configured with SA operation mode.

The overall CGI reporting delay is defined in clause 9.11A.3.

### 9.11A.2 CGI identification of an NR cell with autonomous gaps

The UE shall identify and report the CGI of a known NR target cell when requested by the network for the purpose of reportCGI. Only one cell is provided to the UE with *cellForWhichToReportCGI* for identifying the CGI.The UE may make autonomous gaps in both downlink reception and uplink transmission for receiving MIB and SIB1 message according to clause 5.5.3 of TS 38.331 [2]. Note that a UE is not required to use autonomous gap if *useAutonomousGaps* is set to false. If autonomous gaps are used for measurement with the purpose of reportCGI, regardless of whether DRX is used or not, the UE shall be able to identify a new CGI of NR cell within:

Tidentify\_CGI\_redcap = (TMIB\_redcap + T SIB1\_redcap) ms

Where:

For 2 Rx RedCap UE:

TMIB\_redcap is the time period used to acquire MIB message. TMIB\_redcap = 6 \* TSMTC ms for target cell carrier frequency on FR1 and TMIB\_redcap = 25 \* TSMTC ms for target cell carrier frequency on FR2.

TSIB1\_redcap is the time period used to acquire SIB1 message. TSIB1\_redcap = 6 \* TRMSI-scheduling ms.

For 1 Rx RedCap UE:

TMIB\_redcap is the time period used to acquire MIB message. TMIB\_redcap = 6 \* TSMTC ms for target cell carrier frequency on FR1 and TMIB\_redcap = 25 \* TSMTC ms for target cell carrier frequency on FR2.

TSIB1\_redcap is the time period used to acquire SIB1 message. TSIB1\_redcap = 12 \* TRMSI-scheduling ms.

Where TSMTC is the SMTC periodicity configured for the target cell measurement, and TRMSI-scheduling is

- the periodicity with which the SIB1 is actually transmitted by the NR target cell when SSB and RMSI CORESET multiplexing pattern is 1

- the maximum between the periodicity with which the SIB1 is actually transmitted by the NR target cell and TSMTC when SSB and RMSI CORESET multiplexing pattern is 2 or 3.

The requirement for identifying the CGI of an NR cell within Tidentify\_CGI\_redcap is applicable when no DRX is used as well as when any of the DRX cycles specified in TS 38.331 [2] is used.

Within the time Tidentify\_CGI\_redcap, over which the UE identifies the CGI of an NR cell, the UE shall fulfil interruption requirements specified in,

- Clause [8.2.2.2.14] if the UE is configured with SA operation mode.

In the requirement a cell is known if,

- During the last 5 seconds for FR1 or 3 seconds for FR2 before the reception of the report CGI command:

- The UE has sent a valid L3-RSRP measurement report with SSB index for the target cell and

- During MIB decoding at least reported SSBs remains detectable according to the cell identification conditions specified in clauses 9.2B or 9.3B of TS 38.133, and

- During SIB1 decoding the SSB used for MIB decoding remains detectable according to the cell identification conditions specified in clauses 9.2B or 9.3B of TS 38.133, and

- During MIB decoding, the SSB for MIB decoding remains detectable with SNR ≥-3dB

- During SIB1 decoding, the PDSCH for SIB1 decoding remains detectable with SNR ≥-3dB

### 9.11A.3 CGI reporting delay

The CGI reporting delay is defined as the time between a command that will trigger a CGI report and the point when the UE starts to transmit the measurement report over the air interface. This requirement assumes that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty of 2 x TTIDCCH resulting when inserting the measurement report to the TTI of the uplink DCCH. This measurement reporting delay excludes any delay caused by lack of UL resources for UE to send the measurement report.

The CGI reporting delay shall be less than Tidentify\_CGI\_redcap defined in clause 9.11A.2 plus RRC procedure delay defined in clause 12 in TS 38.331 [2], and additional 20ms margin if target cell is on FR2.

### 9.11A.4 CGI reporting scheduling restriction

When a RedCap UE is identifying CGI of an NR cell with autonomous gaps, the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on PCell for the following slots:

- with up to K1 interruptions with interrupted slots up to X1 specified in Table 9.11A.4-1 for each interruption during MIB decoding time period TMIB\_redcap (ms) specified in clause 9.11A.2.

- with up to L1 interruptions with interrupted slots up to Y1 specified in Table 9.11A.4-1 during SIB1 decoding time period TSIB1\_redcap (ms) specified in clause 9.11A.2 for SSB and CORESET for RMSI scheduling multiplexing patterns 1.

- with up to L2 interruptions with interrupted slots up to interruption length Y2 specified in Table 9.11A.4-1 during SIB1 decoding time period TSIB1\_redcap (ms) specified in clause 9.11A.2 for SSB and CORESET for RMSI scheduling multiplexing patterns 2 and 3.

Where:

- K1 = 6 for the target cell carrier frequency on FR1 and K1 = 25 for the target cell carrier frequency on FR2, and

- L1 = TSIB1\_redcap /20 and

- L2 = TSIB1\_redcap /TSMTC, where TSMTC is the periodicity of the SMTC occasion configured for the target cell carrier.

Table 9.11A.4-1: Interruption length X1, Y1 and Y2 during measurements with autonomous gaps

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | NR Slot length (ms) of victim cell | Interruption length X1 (slots) | Interruption length Y1 (slots) | Interruption length Y2 (slots) |
| 0 | 1 | 6 | 7 | 6 |
| 1 | 0.5 | 12 | 13 | 10 |
| 2 | 0.25 | 24 | 25 | 19 |
| 3 | 0.125 | 48 | 49 | 37 |

## 9.12 Measurement for Propagation Delay Compensation

### 9.12.1 Introduction

The requirements in this clause are applicable for UE capable of RTT-based propagation delay compensation based on PRS/TRS and SRS, where the UE is configured with *measObjectRxTxDiff* in *MeasObjectToAddModList* defined in TS38.331 [2].

### 9.12.2 Requirements Applicability

The requirements in clause 9.12 apply for periodic triggered UE Rx-Tx time difference measurements, provided:

- If UE Rx-Tx time difference measurement is based on PRS, the related side conditions given in clause 10.1.X.1 are met for a corresponding band.

- If UE Rx-Tx time difference measurement is based on TRS, the related side conditions given in clause 10.1.X.2 are met for a corresponding band.

- SRS is configured on at least one of the PCell.

All measurement requirements specified in clause 9.12.4 shall apply when no DRX is in use as well as for when DRX is in use (clause 3.6.1) for any DRX configuration specified in TS 38.331 [2].

### 9.12.3 Measurement Capability

If UE Rx-Tx time difference measurement is based on PRS, the capability is as indicated by the UE in *rtt-BasedPDC-PRS-r17* in TS38.331 [2].

If UE Rx-Tx time difference measurement is based on TRS, the capability is as indicated by the UE in *rtt-BasedPDC-CSI-RS-ForTracking-r17* in TS38.331 [2].

### 9.12.4 Measurement period requirements

#### 9.12.4.1 PRS Measurement Period

When UE is configured with *prs-Ref-r17* in *MeasObjectRxTxDiff*-r17 defined in TS 38.331 [2] and provided with PRS resource configuration, the UE shall be able to measure UE Rx-Tx time difference on PCell within the measurement period TUERx-Tx\_PRS, where:

Where:

is the maximum number of DL PRS resources configured in a slot,

is UE capability for number of DL PRS resources that it can process in a slot corresponding to *maxNumberPRS-ResourceProcessedPerSlot-r17* as specified in TS38.331 [2],

is the number of UE Rx-Tx time difference measurement samples and = 4,

is the PRS resource periodicity specific for RTT-based propagation delay compensation,

is the DRX cycle length when DRX is in use, 1ms otherwise.

is

Ntotal / Navailable, when Navailable>0

Where,

- For a window W of duration LCM(TPRS, MGRP, TSMTC), where TSMTC is the periodicity of SMTC for intra-frequency measurement without gap, starting at the beginning of any PRS resource occasion:

- Ntotal is the total number of PRS resource occasions within the window, including those overlapped with measurement gap occasions or SMTC occasions within the window, and

- Navailable is the number of PRS resource occasions that are not overlapped with:

- For FR1: any measurement gap occasions within the window W

- For FR2: any measurement gap occasions nor any SMTC occasions within the window W.

No requirements shall apply if Navailable=0.

*Editor Note: FFS requirements if concurrent measurement gaps are configured.*

UE is only required to perform UE Rx-Tx time difference on PRS within the active DL BWP.

When UE is configured to perform UE Rx-Tx time difference measurement based on PRS, the requirements apply provided that the SCS of the PRS is same as that of the active BWP on PCell.

For FR2, the requirements apply if QCL information is provided for all the PRS resources in the resource set and for each resource one RS has QCL-TypeD.

If PRS resources overlap with Type 1A/1B/2 PPW, the UE is allowed longer measurement period to measure UE Rx-Tx time difference on PCell.

#### 9.12.4.2 TRS Measurement Period

When UE is configured with *csi-RS-Ref-r17* in *MeasObjectRxTxDiff*-r17 defined in TS 38.331 [2] and provided with TRS resource configuration, the UE shall be able to measure UE Rx-Tx time difference on PCell within the measurement period TUERx-Tx\_TRS, where:

Where

is the number of UE Rx-Tx time difference measurement samples and is [4],

is the TRS resource periodicity specific for RTT-based propagation delay compensation,

is the DRX cycle length when DRX is in use, 1ms otherwise.

is

Ntotal / Navailable when Navailable>0

Where,

- For a window W of duration LCM(TTRS, MGRP, TSMTC), where TSMTC is the periodicity of SMTC for intra-frequency measurement without gap, starting at the beginning of any TRS resource occasion:

- Ntotal is the total number of TRS resource occasions within the window, including those overlapped with measurement gap occasions or SMTC occasions within the window, and

- Navailable is the number of TRS resource occasions that are not overlapped with

- For FR1: any measurement gap occasions within the window W

- For FR2: any measurement gap occasions nor any SMTC occasions within the window W.

No requirements shall apply if Navailable=0.

*Editor Note: FFS requirements if concurrent measurement gaps are configured.*

UE is only required to perform UE Rx-Tx time difference on TRS within the active DL BWP. When UE is configured to perform UE Rx-Tx time difference measurement based on TRS, the requirements apply provided that the SCS of the TRS is same as that of the active BWP on PCell.

For FR2, the requirements apply if QCL information is provided for all the TRS resources in the resource set and for each resource one RS has QCL-TypeD.

If TRS resources overlap with Type 1A/1B/2 PPW, the UE is allowed longer measurement period to measure UE Rx-Tx time difference on PCell.

### 9.12.5 Measurement Reporting Requirements

The UE shall report UE Rx-Tx time difference measurement results if UE supports *gNB-SideRTT-BasedPDC-r17*.

The measurement reporting delay excludes the delay uncertainty caused by inserting the measurement report into the TTI of the uplink DCCH. The delay uncertainty is: 2 x TTIDCCH where TTIDCCH is the duration of subframe or slot or subslot when the measurement report is transmitted on the PUSCH with subframe or slot or subslot duration. This measurement reporting delay excludes any delay caused by no UL resources for UE to send the measurement report.

The UE Rx-Tx time difference measurement values contained in measurement report shall be based on the measurement report mapping requirements specified in clause 10.1.25.3, with k = 5.

The UE Rx-Tx time difference measurement accuracy shall be fulfilled according to the accuracy requirements specified in clause 10.1.X.1 and 10.1.X.2 for PRS and TRS, respectively.

### 9.12.6 Scheduling availability during measurement for Propagation Delay Compensation

During measurement for Propagation Delay Compensation in an FR2 cell,

- For the case where the PRS or TRS for PDC measurement is QCLed with active TCI state for PDCCH/PDSCH, there are no scheduling restrictions due to PDC measurement performed based on PRS or TRS.

- Otherwise, the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/CSI-RS for tracking/CSI-RS for CQI on symbols corresponding to the PRS or TRS resource configured for PDC measurement.

### 9.12.7 Measurement restriction for measurement for Propagation Delay Compensation

During measurement for Propagation Delay Compensation in an FR2 cell, when the PRS or TRS for PDC measurement on one CC is in the same OFDM symbol as SSB or CSI-RS for RLM, BFD, CBD or L1-RSRP measurement on the same CC or different CCs in the same band, UE is required to measure one of but not both PRS or TRS for PDC measurement and the other RS if they are not QCL-ed w.r.t. QCL-TypeD, or the QCL information is not known to UE. Longer measurement period for PRS or TRS for PDC measurement is expected.

## 9.13 L1-RSRP measurements for a cell with different PCI from serving cell

### 9.13.1 Introduction

When configured by the network, the UE shall be able to perform L1-RSRP measurements of configured measurement resources from a cell with different PCI in addition to serving cell (PCI indicated in *additionalPCI-r17*), with the measurement resources configured as SSBs of the cell with different PCI.

The UE shall be able to measure all SSB resources of the cell with different PCI in *csi-SSB-ResourceSet* within the CSI-Resource*Config* settings for the active BWP, while the *additionalPCI-r17* of the SSB resources are different from serving cell PCI. The number of resources, including the number of resources configured for serving cell L1-RSRP measurement in 9.5, does not exceed the UE capability indicated by *beamManagementSSB-CSI-RS*.

The UE shall report the measurement quantity (*reportQuantity*) and send periodic, semi-persistent or aperiodic reports, according to the higher layer parameter *reportConfigType* of each reporting setting *CSI-ReportConfig* for the active BWP.

### 9.13.2 Requirements Applicability

The requirements in the clause 9.13 are applicable to inter-cell beam management and inter-cell multi-TRP scenarios.

The requirements in clause 9.13 apply, provided the SSB from cell with PCI different from serving cell configured for L1-RSRP if the following conditions are met:

- the number of cells with PCI different from seving cells Nmax = 1 for FR2 and Nmax = maxNrofAdditionalPCI for FR1. Where, maxNrofAdditionalPCI is defined in TS 38.331 [2].

- The SSB from the cell with different PCI completely contained in the active BWP or associated with initial downlink BWP of the UE

- The SSB of the cell with different PCI from serving cell has the same SCS, *sfn-SSB-Offset* and center frequency as the SSB of the serving cell

- The timing difference of arrival at UE between the SSBs of serving cell and cell with different PCI is less than CP length of the corresponding SCS

- The cell with different PCI from serving cell is known

- The SSB resources configured for L1-RSRP measurements are measurable

An SSB resource configured for L1-RSRP for cell with different PCI from serving cell shall be considered measurable when for each relevant SSB the following conditions are met:

- L1-RSRP related side conditions given in clauses 10.1.19.1 and 10.1.20.1 for FR1 and FR2, respectively, for a corresponding band,

- SSB\_RP and SSB Ês/Iot according to Annex B.2.4.1 for a corresponding band.

The cell with different PCI from serving cell is considered as known if the following conditions are met in this requirement:

- The UE has sent a valid L3 measurement report during the last 5 seconds, and

- The SSB from the cell with different PCI remains detectable according to the cell identification requirements specified in clause 9.2.

Otherwise, the cell is unknown.

### 9.13.3 Measurement Reporting Requirements

The UE shall send L1-RSRP reports only for report configurations configured for the active BWP.

The UE shall report the L1-RSRP value as a 7-bit value in the range [-140, -44] dBm with 1dB step size according to clause 10.1.19 for FR1 and 10.1.20 for FR2 if *nrofReportedRS* is configured to one. If *nrofReportedRS* is configured to be larger than one, or if *groupBasedBeamReporting-r17* is enabled, the UE shall use differential L1-RSRP based reporting as defined in clause 10.1.19 for FR1 and 10.1.20 for FR2. The differential L1-RSRP is quantized to a 4-bit value with 2dB step size. The mapping between the reported L1-RSRP value and the measured quantity is described in 10.1.6.

In EN-DC and NE-DC operation, when the UE is configured to perform E-UTRA SRS carrier-based switching an additional delay can be expected in FR1 if the UE is capable of per-FR gap, or an additional delay can be expected in both FR1 and FR2 if the UE is not capable of per-FR gap.

#### 9.13.3.1 Periodic Reporting

Reported L1-RSRP measurements contained in periodic L1-RSRP measurement reports shall meet the requirements in clauses 10.1.19 for FR1 and 10.1.20 for FR2, respectively.

The UE shall only send periodic L1-RSRP measurement reports for an active BWP.

The UE shall transmit the periodic L1-RSRP reporting on PUCCH over the air interface according to the periodicity defined in clause 5.2.1.4 in TS 38.214 [26].

#### 9.13.3.2 Semi-Persistent Reporting

Reported L1-RSRP measurements contained in a Semi-Persistent L1-RSRP measurement report shall meet the requirements in clauses 10.1.19 for FR1 and 10.1.20 for FR2, respectively. This requirement applies for semi-persistent L1-RSRP reports send on PUSCH or PUCCH.

The UE shall only send semi-persistent L1-RSRP measurement reports on PUSCH, if a DCI request has been received.

The UE shall only send semi-persistent L1-RSRP measurement reports on PUCCH, if an activation command [7] has been received.

The UE shall transmit the semi-persistent L1-RSRP reporting on PUSCH or PUCCH over the air interface according to the periodicity defined in clause 5.2.1.4 in TS 38.214 [26].

#### 9.13.3.3 Aperiodic Reporting

Reported L1-RSRP measurements contained in aperiodic triggered, aperiodic triggered periodic and aperiodic triggered semi-persistent L1-RSRP reports shall meet the requirements in clauses 10.1.19 for FR1 and 10.1.20 for FR2, respectively.

The UE shall only send aperiodic L1-RSRP measurement report if a DCI trigger has been received.

After the UE receives CSI request in DCI, the UE shall transmit the aperiodic L1-RSRP reporting on PUSCH over the air interface at the time specified according to clause 6.1.2.1 in TS 38.214 [26].

### 9.13.4 L1-RSRP measurement requirements

#### 9.13.4.1 Inter-cell SSB based L1-RSRP Reporting

If a cell with PCI different from serving cell is known according 9.13.2, the UE shall be capable of performing L1-RSRP measurements based on the configured SSB resource for L1-RSRP computation, and the UE physical layer shall be capable of reporting L1-RSRP measured over the measurement period of TL1-RSRP\_Measurement\_Period\_SSB\_CDP. The requirements specified in this clause are only applicable when

- *highSpeedMeasFlag-r16* is not configured, and

- *highSpeedMeasFlagFR2-r17* is not configured, and

- highSpeedMeasCA-Scell-r17 is not configured

*Editor’s Note: FFS the requirements applicability when L1-RSRP measurement resources are overlapped with concurrent gaps.*

The value of TL1-RSRP\_Measurement\_Period\_SSB\_CDP is defined in Table 9.13.4.1-1 for FR1, The value of TL1-RSRP\_Measurement\_Period\_SSB\_CDP is defined in Table 9.13.4.1-2 for FR2 when *highSpeedMeasFlagFR2-r17* is not configured, where

- M=1 if higher layer parameter *timeRestrictionForChannelMeasurement* is configured, and M=3 otherwise

- N= 8.

For FR1,

- P=, when in the monitored cell there are measurement gaps configured for intra-frequency, inter-frequency or inter-RAT measurements, which are overlapping with some but not all occasions of the SSB; and

- P=1 when in the monitored cell there are no measurement gaps overlapping with any occasion of the SSB.

For FR2,

- P2=, when SSB is not overlapped with measurement gap and SSB is partially overlapped with SMTC occasion (TSSB\_CDP < TSMTCperiod).

- P2=, when SSB is partially overlapped with measurement gap and SSB is partially overlapped with SMTC occasion (TSSB\_CDP < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and

- TSMTCperiod ≠ MGRP or

- TSMTCperiod = MGRP and TSSB\_CDP < 0.5\*TSMTCperiod

- P2= ,when SSB is partially overlapped with measurement gap (TSSB\_CDP <MGRP) and SSB is partially overlapped with SMTC occasion (TSSB\_CDP < TSMTCperiod) and SMTC occasion is partially or fully overlapped with measurement gap.

- [If SSB resource from serving cell is configured for L1-RSRP measurements, and P1 is valid accoding to 9.5.4.1, and any symbol of the SSBs from serving cell and cell with different PCI are overlapping or adjacent (in time domain)

- P = , if P2\*TSSB\_CDP < P1\*TSSB\_SC.

- P = P2, if P2\*TSSB\_CDP> P1\*TSSB\_SC.

- P = 2\*P2, if P1\*TSSB\_SC = P2\*TSSB\_CDP.

- Otherwise, ]P = P2Where:

- TSSB\_CDP = SSB periodicity of the cell with PCI different from serving cell

- TSMTCperiod = the configured SMTC period

- TSSB\_SC = ssb-periodicityServingCell of the serving cell

If the high layer in TS 38.331 [2] signaling of *smtc2* is configured, TSMTCperiod corresponds to the value of higher layer parameter *smtc2*; Otherwise TSMTCperiod corresponds to the value of higher layer parameter *smtc1*. TSMTCperiod is the shortest SMTC period among all CCs in the same FR2 band, provided the SMTC offset of all CCs in FR2 have the same offset.

Longer evaluation period would be expected if the combination of SSB, SMTC occasion and measurement gap configurations does not meet pervious conditions.

For either an FR1 or FR2 cell with PCI different from serving cell, longer evaluation period would be expected during the period Tidentify\_CGI when the UE is requested to decode an NR CGI.

For either an FR1 or FR2 cell with PCI different from serving cell, longer L1 RSRP measurement period would be expected during the period Tidentify\_CGI,E-UTRAN when the UE is requested to decode an LTE CGI.

Table 9.13.4.1-1: Inter-cell L1-RSRP measurement period TL1-RSRP\_Measurement\_Period\_SSB\_CDP for known cells with different PCIs in FR1

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_SSB\_CDP (ms) |
| non-DRX | max(TReport, ceil(M\*P)\*TSSB\_CDP) |
| DRX cycle ≤ 320ms | max(TReport, ceil(K \*M\*P)\*max(TDRX,TSSB\_CDP)) |
| DRX cycle > 320ms | ceil(M\*P)\*TDRX |
| Note 1: TSSB\_CDP is the periodicity of the SSB-Index configured for inter-cell L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting.  Note 2: K = 1.5. | |

Table 9.13.4.1-2: Inter-cell L1-RSRP measurement period TL1-RSRP\_Measurement\_Period\_SSB\_CDP for known cells with different PCIs in FR2

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_SSB\_CDP (ms) |
| non-DRX | max(TReport, ceil(M\*P\*N)\*TSSB\_CDP) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P\*N)\*max(TDRX,TSSB\_CDP)) |
| DRX cycle > 320ms | ceil(1.5\*M\*P\*N)\*TDRX |
| Note: TSSB\_CDP is the periodicity of the SSB-Index configured for inter-cell L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting. | |

### 9.13.5 Measurement restriction for L1-RSRP measurement

The UE is required to be capable of measuring SSB for L1-RSRP without measurement gaps. The UE is required to perform the SSB measurements with measurement restrictions as described in the following clauses.

Unless explicitly stated, the SSB to be measured for L1-RSRP measurement is transmitted from cell(s) with PCI different from serving cell(s).

#### 9.13.5.1 Measurement restriction for SSB based L1-RSRP

For FR1,

when the SSB for L1-RSRP measurement is in the same OFDM symbol as SSB transmitted from serving cell(s) for RLM, BFD, CBD or L1-RSRP measurement,

- UE shall be able to measure the SSB for L1-RSRP measurement without any restriction;

when the SSB for L1-RSRP measurement is in the same OFDM symbol as CSI-RS transmitted from serving cell(s) for RLM, BFD, CBD or L1-RSRP measurement,

- If SSB and CSI-RS have same SCS, UE shall be able to measure the SSB for L1-RSRP measurement without any restriction;

- If SSB and CSI-RS have different SCS,

- If UE supports *simultaneousRxDataSSB-DiffNumerology*, UE shall be able to measure the SSB for L1-RSRP measurement without any restriction;

- If UE does not support *simultaneousRxDataSSB-DiffNumerology*, UE is required to measure one of but not both SSB for L1-RSRP measurement and CSI-RS. Longer measurement period for SSB based L1-RSRP measurement is expected, and no requirements are defined.

For FR2,

when the SSB for L1-RSRP measurement on one CC is in the same OFDM symbol as SSB transmitted from serving cell(s) for RLM, BFD, or CBD measurement on the same CC or different CCs in the same band, UE is required to measure one of but not both the two SSBs. Longer measurement period for SSB based L1-RSRP measurement is expected, and no requirements are defined.

when the SSB for L1-RSRP measurement on one CC is in the same OFDM symbol as SSB for L1-RSRP measurement on the different CCs in the same band, UE is required to measure one of but not both the two SSBs. Longer measurement period for SSB based L1-RSRP measurement is expected, and no requirements are defined.

when the SSB for L1-RSRP measurement on one CC is in the same OFDM symbol as CSI-RS transmitted from serving cell(s) for RLM, BFD, CBD or L1-RSRP measurement on the same CC or different CCs in the same band, UE is required to measure one of but not both SSB for L1-RSRP measurement and CSI-RS. Longer measurement period for SSB based L1-RSRP measurement is expected, and no requirements are defined.

For FR2, if the network configures same or mixed numerology between SSB for L1-RSRP measurement on one FR2 band and CSI-RS for RLM, BFD, CBD, L1-RSRP or L1-SINR measurement on the other FR2 band, UE shall be able to perform the related SSB based measurements in one band without any measurement restrictions in the other band, provided that UE is capable of independent beam management on this FR2 band pair.

### 9.13.6 Scheduling availability of UE during L1-RSRP measurement

Scheduling availability restrictions described in the following clauses apply when UE is performing L1-RSRP measurement on cell(s) with PCI different from serving cell, and UE is receiving PDCCH/PDSCH from serving cell and/or cell(s) with different PCI.

#### 9.13.6.1 Scheduling availability of UE performing L1-RSRP measurement with a same subcarrier spacing as PDSCH/PDCCH on FR1

There are no scheduling restrictions due to L1-RSRP measurement performed on SSB as RS for L1-RSRP measurement with the same SCS as PDSCH/PDCCH in FR1.

#### 9.13.6.2 Scheduling availability of UE performing L1-RSRP measurement with a different subcarrier spacing than PDSCH/PDCCH on FR1

For UEs which support *simultaneousRxDataSSB-DiffNumerology* [14] there are no restrictions on scheduling availability due to L1-RSRP measurement based on SSB as RS for L1-RSRP measurement. For UEs which do not support *simultaneousRxDataSSB-DiffNumerology* [14] the following restrictions apply due to L1-RSRP measurement based on SSB configured for L1-RSRP measurement.

- The UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/CSI-RS for tracking/CSI-RS for CQI on symbols corresponding to the SSB indexes configured for L1-RSRP measurement.

When intra-band carrier aggregation in FR1 is configured, the scheduling restrictions apply to cell(s) in the same band on the symbols that fully or partially overlap with restricted symbols. When inter-band carrier aggregation within FR1 is configured, there are no scheduling restrictions on FR1 cells configured in other bands than the bands in which the cell where L1-RSRP measurement is performed is configured.

#### 9.13.6.3 Scheduling availability of UE performing L1-RSRP measurement on FR2

The following scheduling restriction applies due to L1-RSRP measurement.

- The UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/CSI-RS for tracking/CSI-RS for CQI on symbols corresponding to the SSB indexes configured for L1-RSRP measurement.

When intra-band carrier aggregation in FR2 is performed, the scheduling restrictions is performed apply to cell(s) in the band on the symbols that fully or partially overlap with restricted symbols.

When inter-band carrier aggregation in FR2 is performed, there are no scheduling restrictions on FR2 cells in the bands due to L1-RSRP measurement performed on FR2 cell(s) in different band(s), provided that UE is capable of independent beam management on this FR2 band pair. Additionally, there is no scheduling restriction if the UE is configured with different numerology between SSB on one FR2 band and data on the other FR2 band provided the UE is configured for IBM operation for the band pair.

If following conditions are met,

- UE has been notified about system information update through paging,

- The gap between UE’s reception of PDCCH that UE monitors in the Type 2-PDCCH CSS set and that notifies system information update, and the PDCCH that UE monitors in the Type0-PDCCH CSS set, is greater than 2 slots,

For the SSB and CORESET for RMSI scheduling multiplexing patterns 3, UE is expected to receive the PDCCH that UE monitors in the Type0-PDCCH CSS set, and the corresponding PDSCH, on SSB symbols to be measured for L1-RSRP measurement; and

For the SSB and CORESET for RMSI scheduling multiplexing patterns 2, UE is expected to receive PDSCH that corresponds to the PDCCH that UE monitors in the Type0-PDCCH CSS set, on SSB symbols to be measured for L1-RSRP measurement.

#### 9.13.6.4 Scheduling availability of UE performing L1-RSRP measurement on FR1 or FR2 in case of FR1-FR2 inter-band CA

There are no scheduling restrictions on FR1 cell(s) due to L1-RSRP measurement performed on FR2 cell(s).

There are no scheduling restrictions on FR2 cell(s) due to L1-RSRP measurement performed on FR1 cell(s).

#### 9.13.6.5 Scheduling availability of UE performing L1-RSRP measurement in TDD bands on FR1

When UE performs L1-RSRP measurement on cell with different PCI from serving cell in a TDD band, the following restrictions apply due to L1-RSRP measurement

- The UE is not expected to transmit PUCCH/PUSCH/SRS on symbols corresponding to the SSB indexes configured for L1-RSRP measurement, where the transmission of PUCCH/PUSCH/SRS may be on serving cell(s) and cell(s) with PCI different from serving cell(s), and restricted symbols may partially or fully overlap with UL symbols

# 10 Measurement Performance requirements

## 10.1 NR measurements

### 10.1.1 Introduction

The requirements in clause 10.1 apply as follows:

- intra-frequency requirements apply for PCell measurements in SA, NR-DC, or NE-DC operaion mode,

- intra-frequency requirements apply for PSCell measurements in NR-DC or EN-DC operaion mode,

- intra-frequency requirements apply for SCell measurements in SA operation mode with NR CA or any MR-DC operaion mode with NR CA,

- inter-frequency requirements apply for non-serving cell measurements on NR carrier frequencies.

- inter-frequency requirements apply for measurements from one cell on a frequency compared to the measurement from another cell on a different frequency.

In the requirements of clause 10.1, the exceptions for side conditions apply as follows:

- for the UE capable of CA but not configured with any SCell, the applicable exceptions for side conditions are specified in Annex B, clause B.3.2.1 for UE supporting CA in FR1, and clause B.3.2.3 for UE supporting CA in FR2, respectively;

- for the UE capable of CA and configured with at least one SCell, the applicable exceptions for side conditions are specified in Annex B, clause B.3.2.2 for UE configured with CA in FR1, and clause B.3.2.4 for UE supporting CA in FR2 respectively;

- for the UE capable of SUL but not configured with SUL, the applicable exceptions for side conditions are specified in Annex B, clause B.3.4.1 for UE supporting SUL in FR1;

- for the UE capable of SUL and configured with at least one SUL, the applicable exceptions for side conditions are specified in Annex B, clause B.3.4.2 for UE configured with SUL in FR1.

### 10.1.2 Intra-frequency RSRP accuracy requirements for FR1

#### 10.1.2.1 Intra-frequency SS-RSRP accuracy requirements

##### 10.1.2.1.1 Absolute SS-RSRP Accuracy

Unless otherwise specified, the requirements for absolute accuracy of SS-RSRP in this clause apply to a cell on the same frequency as that of the serving cell in FR1. The accuracy requirements in this clause are also applicable when *highSpeedMeasFlag-r16* or *highSpeedMeasCA-Scell-r17* is configured.

The accuracy requirements in Table 10.1.2.1.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for intra-frequency measurements are fulfilled according to Annex B.2.2 for a corresponding Band for each relevant SSB.

Table 10.1.2.1.1-1: SS-RSRP Intra frequency absolute accuracy in FR1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot | Io Note 1 range | | | | |
|  |  |  | NR operating band groups Note 2 | Minimum Io | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |  |
|  |  |  | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -118 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_B | -120.5 | -117.5 | N/A | -70 |
|  |  |  | NR\_TDD\_FR1\_C | -120 | -117 | N/A | -70 |
| ±4.5 | ±9 | ≥-6 | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_F | -118.5 | -115.5 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_G | -118 | -115 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_H | -117.5 | -114.5 | N/A | -70 |
| ±8 | ±11 | ≥-6 | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A,  NR\_FDD\_FR1\_B, NR\_TDD\_FR1\_C, NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D, NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E, NR\_FDD\_FR1\_F,  NR\_FDD\_FR1\_G, NR\_FDD\_FR1\_H | N/A | N/A | -70 | -50 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: NR operating band groups in FR1 are as defined in clause 3.5.2. | | | | | | | |

##### 10.1.2.1.2 Relative SS-RSRP Accuracy

The relative accuracy of SS-RSRP is defined as the SS-RSRP measured from one cell compared to the SS-RSRP measured from another cell on the same frequency, or between any two SS-RSRP levels measured on the same cell in FR1. The accuracy requirements in this clause are also applicable when *highSpeedMeasFlag-r16* or *highSpeedMeasCA-Scell-r17* is configured.

The accuracy requirements in Table 10.1.2.1.2-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for intra-frequency measurements are fulfilled according to Annex B.2.2 for a corresponding Band for each relevant SSB.

Table 10.1.2.1.2-1: SS-RSRP Intra frequency relative accuracy in FR1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot Note 2 | Io Note 1 range | | | | |
|  |  |  | NR operating band groups Note 4 | Minimum Io | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |  |
|  |  |  | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -118 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_B | -120.5 | -117.5 | N/A | -50 |
|  |  |  | NR\_TDD\_FR1\_C | -120 | -117 | N/A | -50 |
| ±2 | ±3 | ≥-3 | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_F | -118.5 | -115.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_G | -118 | -115 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_H | -117.5 | -114.5 | N/A | -50 |
| ±3 | ±3 | ≥-6 | Note 3 | Note 3 | Note 3 | N/A | Note 3 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: The parameter SSB Ês/Iot is the minimum SSB Ês/Iot of the pair of cells to which the requirement applies.  NOTE 3: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding highest accuracy requirement.  NOTE 4: NR operating band groups in FR1 are as defined in clause 3.5.2. | | | | | | | |

#### 10.1.2.2 Void

#### 10.1.2.3 Intra-frequency CSI-RSRP accuracy requirements

##### 10.1.2.3.1 Absolute CSI-RSRP Accuracy

Unless otherwise specified, the requirements for absolute accuracy of CSI-RSRP in this clause apply to a cell where the CSI-RS resources to be measured have the same center frequency as the CSI-RS resources indicated for measurement in the serving cell in FR1.

The accuracy requirements in Table 10.1.2.3.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for intra-frequency measurements are fulfilled according to Annex B.2.2 for a corresponding Band for each associated SSB.

- Conditions for intra-frequency measurements are fulfilled according to Annex B.2.8 for a corresponding Band for each relevant CSI-RS to be measured.

- The bandwidth of CSI-RS is 48 PRBs and the density is 3. The performance with larger bandwidth of CSI-RS is equal to or better than the accuracy requirements in Table 10.1.2.3.1-1.- The timing offset between the reference measurement timing and the target CSI-RS in one layer is no larger than CP.

Note: The reference measurement timing for one layer for intra-frequency measurement is serving cell timing.

Table 10.1.2.3.1-1: CSI-RSRP Intra frequency absolute accuracy in FR1

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | | | |
| Normal condition | Extreme condition | CSI-RS Ês/Iot | Io Note 1 range | | | | | | |
| NR operating band groups Note 2 | Minimum Io | | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSCSI-RS | | | dBm/BWChannel | dBm/BWChannel | |
| SCSCSI-RS = 15 kHz | SCSCSI-RS = 30 kHz | SCSCSI-RS = 60 kHz |
| ±4.5 | ±9 | ≥-6 | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -118 | -115 | N/A | -70 | |
| NR\_FDD\_FR1\_B | -120.5 | -117.5 | -114.5 | N/A | -70 | |
| NR\_TDD\_FR1\_C | -120 | -117 | -114 | N/A | -70 | |
| NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | -113.5 | N/A | -70 | |
| NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | -113 | N/A | -70 | |
| NR\_FDD\_FR1\_F | -118.5 | -115.5 | -112.5 | N/A | -70 | |
| NR\_FDD\_FR1\_G | -118 | -115 | -112 | N/A | -70 | |
| NR\_FDD\_FR1\_H | -117.5 | -114.5 | -111.5 | N/A | -70 | |
| ±8 | ±11 | ≥-6 | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A,  NR\_FDD\_FR1\_B, NR\_TDD\_FR1\_C, NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D, NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E, NR\_FDD\_FR1\_F,  NR\_FDD\_FR1\_G, NR\_FDD\_FR1\_H | N/A | N/A | N/A | -70 | -50 | |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: NR operating band groups in FR1 are as defined in clause 3.5.2. | | | | | | | | | |

##### 10.1.2.3.2 Relative CSI-RSRP Accuracy

The relative accuracy of CSI-RSRP is defined as the CSI-RSRP measured from one cell compared to the CSI-RSRP measured from another cell on the same center frequency, or between any two CSI-RSRP levels measured on the same cell in FR1.

The accuracy requirements in Table 10.1.2.3.2-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for intra-frequency measurements are fulfilled according to Annex B.2.2 for a corresponding Band for each associated SSB.

- Conditions for intra-frequency measurements are fulfilled according to Annex B.2.8 for a corresponding Band for each relevant CSI-RS to be measured.

- The bandwidth of CSI-RS is 48 PRBs and the density is 3. The performance with larger bandwidth of CSI-RS is equal to or better than the accuracy requirements in Table 10.1.2.3.2-1. - The timing offset between the reference measurement timing and the target CSI-RS in one layer is no larger than CP.

Note: The reference measurement timing for one layer for intra-frequency measurement is serving cell timing.

Table 10.1.2.3.2-1: CSI-RSRP Intra frequency relative accuracy in FR1

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | | | | | |
| Normal condition | Extreme condition | CSI-RS Ês/Iot Note 2 | Io Note 1 range | | | | | | | | |
| NR operating band groups Note 4 | Minimum Io | | | | | Maximum Io | | |
| dB | dB | dB |  | dBm / SCSCSI-RS | | | dBm/BWChannel | dBm/BWChannel | |
| SCSCSI-RS = 15 kHz | SCSCSI-RS = 30 kHz | SCSCSI-RS = 60 kHz |  |  | | |
| ±2 | ±3 | ≥-3 | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -118 | -115 | N/A | -50 | | |
| NR\_FDD\_FR1\_B | -120.5 | -117.5 | -114.5 | N/A | -50 | | |
| NR\_TDD\_FR1\_C | -120 | -117 | -114 | N/A | -50 | | |
| NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | -113.5 | N/A | -50 | | |
| NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | -113 | N/A | -50 | | |
| NR\_FDD\_FR1\_F | -118.5 | -115.5 | -112.5 | N/A | -50 | | |
| NR\_FDD\_FR1\_G | -118 | -115 | -112 | N/A | -50 | | |
| NR\_FDD\_FR1\_H | -117.5 | -114.5 | -111.5 | N/A | -50 | | |
| ±3 | ±3 | ≥-6 | Note 3 | Note 3 | Note 3 | Note 3 | N/A | Note 3 | | |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: The parameter CSI-RS Ês/Iot is the minimum CSI-RS Ês/Iot of the pair of cells to which the requirement applies.  NOTE 3: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding highest accuracy requirement.  NOTE 4: NR operating band groups in FR1 are as defined in clause 3.5.2. | | | | | | | | | | | |

### 10.1.2B Intra-frequency RSRP accuracy requirements for FR1 for CA/DC Idle Mode Measurements

#### 10.1.2B.1 Intra-frequency SS-RSRP accuracy requirements

The requirements in this clause are applicable for a UE:

- in state RRC\_IDLE or RRC INACTIVE

- that is synchronised to the cell that is measured.

The requirements are for absolute accuracy of SS-RSRP.

##### 10.1.2B.1.1 Absolute SS-RSRP Accuracy

Unless otherwise specified, the requirements for absolute accuracy of SS-RSRP in this clause apply to the serving cell in FR1.

The accuracy requirements in Table 10.1.2B.1.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for intra-frequency measurements are fulfilled according to Annex B.1.2 for a corresponding Band for each relevant SSB.

Table 10.1.2B.1.1-1: SS-RSRP Intra frequency absolute accuracy in FR1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot | Io Note 1 range | | | | |
|  |  |  | NR operating band groups Note 2 | Minimum Io | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |  |
|  |  |  | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -118 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_B | -120.5 | -117.5 | N/A | -70 |
|  |  |  | NR\_TDD\_FR1\_C | -120 | -117 | N/A | -70 |
| ±6 | ±10.5 | ≥-4 | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_F | -118.5 | -115.5 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_G | -118 | -115 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_H | -117.5 | -114.5 | N/A | -70 |
| ±9.5 | ±12.5 | ≥-4 | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A,  NR\_FDD\_FR1\_B, NR\_TDD\_FR1\_C, NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D, NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E, NR\_FDD\_FR1\_F,  NR\_FDD\_FR1\_G, NR\_FDD\_FR1\_H | N/A | N/A | -70 | -50 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: NR operating band groups in FR1 are as defined in clause 3.5.2. | | | | | | | |

### 10.1.2C Intra-frequency RSRP accuracy requirements for FR1 SAN

#### 10.1.2C.1 Intra-frequency SS-RSRP accuracy requirements

##### 10.1.2C.1.1 Absolute SS-RSRP Accuracy

Unless otherwise specified, the requirements for absolute accuracy of SS-RSRP in this clause apply to a cell on the same frequency as that of the serving cell in FR1.

The accuracy requirements in Table 10.1.2C.1.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for intra-frequency measurements are fulfilled according to Annex B.2.2 for a corresponding Band for each relevant SSB.

- Valid information for the SAN serving the target cell has been provided.

Table 10.1.2C.1.1-1: SS-RSRP Intra frequency absolute accuracy in FR1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot | Io Note 1 range | | | | |
|  |  |  | NR operating band groups Note 2 | Minimum Io | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |  |
| ±[4.5] | ±[9] | ≥-6 | NR\_FDD\_SAB\_FR1\_A | -121 | -118 | N/A | -70 |
| ±[8] | ±[11] | ≥-6 | NR\_FDD\_SAB\_FR1\_A | N/A | N/A | -70 | -50 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: NR operating band groups in FR1 are as defined in clause 3.5.2. | | | | | | | |

##### 10.1.2C.1.2 Relative SS-RSRP Accuracy

The relative accuracy of SS-RSRP is defined as the SS-RSRP measured from one cell compared to the SS-RSRP measured from another cell on the same frequency, or between any two SS-RSRP levels measured on the same cell in FR1.

The accuracy requirements in Table 10.1.2C.1.2-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for intra-frequency measurements are fulfilled according to Annex B.2.2 for a corresponding Band for each relevant SSB.

- Valid information for the SAN serving the target cell has been provided.

Table 10.1.2C.1.2-1: SS-RSRP Intra frequency relative accuracy in FR1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot Note 2 | Io Note 1 range | | | | |
|  |  |  | NR operating band groups Note 4 | Minimum Io | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |  |
| ±[2] | ±[3] | ≥-3 | NR\_FDD\_SAB\_FR1\_A | -121 | -118 | N/A | -50 |
| ±[3] | ±[3] | ≥-6 | Note 3 | Note 3 | Note 3 | N/A | Note 3 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: The parameter SSB Ês/Iot is the minimum SSB Ês/Iot of the pair of cells to which the requirement applies.  NOTE 3: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding highest accuracy requirement.  NOTE 4: NR operating band groups in FR1 are as defined in clause 3.5.2. | | | | | | | |

### 10.1.3 Intra-frequency RSRP accuracy requirements for FR2

#### 10.1.3.1 Intra-frequency SS-RSRP accuracy requirements

##### 10.1.3.1.1 Absolute SS-RSRP Accuracy

Unless otherwise specified, the requirements for absolute accuracy of SS-RSRP in this clause apply to a cell on the same frequency as that of the serving cell in FR2.

The accuracy requirements in Table 10.1.3.1.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-2 [19] for reference sensitivity are fulfilled.

- Conditions for intra-frequency measurements are fulfilled according to Annex B.2.2 for a corresponding Band for each relevant SSB.

- The measured signals are in the directions covered by the percentile EIS spherical coverage of the UE, defined in clause 7.3.4 of TS 38.101-2 [19].

Table 10.1.3.1.1-1: SS-RSRP Intra frequency absolute accuracy in FR2

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot | Io Note 2 range | | | |
|  |  |  | Minimum Io | | | Maximum Io |
| dB | dB | dB | dBm / SCSSSB Note 1 | | dBm/BWChannel | dBm/BWChannel |
|  |  |  | SCSSSB = 120kHz | SCSSSB = 240kHz |  |  |
| ±6 | ±9 | ≥-6 | Same value as SSB\_RP in Table B.2.2-2, according to UE Power class, operating band and angle of arrival | | N/A | -70 |
| ±8 | ±11 |  | N/A | | -70 | -50 |
| Note 1: Values based on Refsens and EIS spherical coverage as defined in clauses 7.3.2 and 7.3.4 of TS 38.101-2 [19]. Applicable side condition selected depending on angle of arrival.  Note 2: Io specified at the Reference point, and assumed to have constant EPRE across the bandwidth.  Note 3: In the test cases, the SSB Ês/Iot and related parameters may need to be adjusted to ensure Ês/Iot at UE baseband is above the value defined in this table. | | | | | | |

##### 10.1.3.1.2 Relative SS-RSRP Accuracy

The relative accuracy of SS-RSRP is defined as the SS-RSRP measured from one cell compared to the SS-RSRP measured from another cell on the same frequency, or between any two SS-RSRP levels measured on the same cell in FR2.

- Conditions defined in clause 7.3 of TS 38.101-2 [19] for reference sensitivity are fulfilled.

- Conditions for intra-frequency measurements are fulfilled according to Annex B.2.2 for a corresponding Band for each relevant SSB.

- The measured signals are in the directions covered by the percentile EIS spherical coverage of the UE, defined in clause 7.3.4 of TS 38.101-2 [19].

Table 10.1.3.1.2-1: SS-RSRP Intra frequency relative accuracy in FR2

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | |
| Normal condition | Extreme condition | SSB Ês/Iot | Io Note 2 range | | |
|  |  |  | Minimum Io | | Maximum Io |
| dB | dB | dB | dBm / SCSSSB Note 1 | | dBm/BWChannel |
|  |  |  | SCSSSB = 120kHz | SCSSSB = 240kHz |  |
| ±6 | ±9 | ≥-6 | Same value as SSB\_RP in Table B.2.2-2, according to UE Power class, operating band and angle of arrival | | -50 |
| Note 1: Values based on Refsens and EIS spherical coverage as defined in clauses 7.3.2 and 7.3.4 of TS 38.101-2 [19]. Applicable side condition selected depending on angle of arrival.  Note 2: Io specified at the Reference point, and assumed to have constant EPRE across the bandwidth.  Note 3: In the test cases, the SSB Ês/Iot and related parameters may need to be adjusted to ensure Ês/Iot at UE baseband is above the value defined in this table.  Note 4: The parameter SSB Ês/Iot is the minimum SSB Ês/Iot of the pair of cells to which the requirement applies. | | | | | |

#### 10.1.3.2 Void

#### 10.1.3.3 Intra-frequency CSI-RSRP accuracy requirements

##### 10.1.3.3.1 Absolute CSI-RSRP Accuracy

Unless otherwise specified, the requirements for absolute accuracy of CSI-RSRP in this clause apply to a cell where the CSI-RS resources to be measured have the same center frequency as the CSI-RS resources indicated for measurement in the serving cell in FR2.

The accuracy requirements in Table 10.1.3.3.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-2 [19] for reference sensitivity are fulfilled.

- Conditions for intra-frequency measurements are fulfilled according to Annex B.2.2 for a corresponding Band for each associated SSB(s).

- Conditions for intra-frequency measurements are fulfilled according to Annex B.2.8 for a corresponding Band for each relevant CSI-RS to be measured.

- The bandwidth of CSI-RS is 48 PRBs and the density is 3. The performance with larger bandwidth of CSI-RS is equal to or better than the accuracy requirements in Table 10.1.3.3.1-1.

- The timing offset between the reference measurement timing and the target CSI-RS in one layer is no larger than CP.

Note: The reference measurement timing for one layer for intra-frequency measurement is serving cell timing.

- The measured signals are in the directions covered by the percentile EIS spherical coverage of the UE, defined in clause 7.3.4 of TS 38.101-2 [19].

Table 10.1.3.3.1-1: CSI-RSRP Intra frequency absolute accuracy in FR2

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | |
| Normal condition | Extreme condition | CSI-RS Ês/Iot | Io Note 2 range | | | |
| Minimum Io | | | Maximum Io |
| dB | dB | dB | dBm / SCSCSI-RS Note 1 | | dBm/BWChannel | dBm/BWChannel |
| SCSCSI-RS = 60kHz | SCSCSI-RS = 120kHz |
| ±6 | ±9 | ≥-6 | Same value as CSI-RS\_RP in Table B.2.8-2, according to UE Power class, operating band and angle of arrival | | N/A | -70 |
| ±8 | ±11 | N/A | | -70 | -50 |
| Note 1: Values based on Refsens and EIS spherical coverage as defined in clauses 7.3.2 and 7.3.4 of TS 38.101-2 [19]. Applicable side condition selected depending on angle of arrival.  Note 2: Io specified at the Reference point, and assumed to have constant EPRE across the bandwidth.  Note 3: In the test cases, the CSI-RS Ês/Iot and related parameters may need to be adjusted to ensure Ês/Iot at UE baseband is above the value defined in this table. | | | | | | |

##### 10.1.3.3.2 Relative CSI-RSRP Accuracy

The relative accuracy of CSI-RSRP is defined as the CSI-RSRP measured from one cell compared to the CSI-RSRP measured from another cell on the same center frequency, or between any two CSI-RSRP levels measured on the same cell in FR2.

- Conditions defined in clause 7.3 of TS 38.101-2 [19] for reference sensitivity are fulfilled.

- Conditions for intra-frequency measurements are fulfilled according to Annex B.2.2 for a corresponding Band for each associated SSB(s).

- Conditions for intra-frequency measurements are fulfilled according to Annex B.2.8 for a corresponding Band for each CSI-RS to be measured.

- The bandwidth of CSI-RS is 48 PRBs and the density is 3. The performance with larger bandwidth of CSI-RS is equal to or better than the accuracy requirements in Table 10.1.3.3.2-1.

- The timing offset between the reference measurement timing and the target CSI-RS in one layer is no larger than CP.

Note: The reference measurement timing for one layer for intra-frequency measurement is serving cell timing.

- The measured signals are in the directions covered by the percentile EIS spherical coverage of the UE, defined in clause 7.3.4 of TS 38.101-2 [19].

Table 10.1.3.3.2-1: CSI-RSRP Intra frequency relative accuracy in FR2

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | |
| Normal condition | Extreme condition | CSI-RS Ês/Iot | Io Note 2 range | | |
| Minimum Io | | Maximum Io |
| dB | dB | dB | dBm / SCS CSI-RS Note 1 | | dBm/BWChannel |
| SCS CSI-RS = 60kHz | SCS CSI-RS = 120kHz |
| ±6 | ±9 | ≥-6 | Same value as CSI-RS\_RP in Table B.2.8-2, according to UE Power class, operating band and angle of arrival | | -50 |
| Note 1: Values based on Refsens and EIS spherical coverage as defined in clauses 7.3.2 and 7.3.4 of TS 38.101-2 [19]. Applicable side condition selected depending on angle of arrival.  Note 2: Io specified at the Reference point, and assumed to have constant EPRE across the bandwidth.  Note 3: In the test cases, the CSI-RS Ês/Iot and related parameters may need to be adjusted to ensure Ês/Iot at UE baseband is above the value defined in this table.  Note 4: The parameter CSI-RS Ês/Iot is the minimum CSI-RS Ês/Iot of the pair of cells to which the requirement applies. | | | | | |

### 10.1.3B Intra-frequency RSRP accuracy requirements for FR2 for CA/DC Idle Mode Measurements

#### 10.1.3B.1 Intra-frequency SS-RSRP accuracy requirements

The requirements in this clause are applicable for a UE:

- in state RRC\_IDLE or RRC INACTIVE

- that is synchronised to the cell that is measured.

The requirements are for absolute accuracy of SS-RSRP.

##### 10.1.3B.1.1 Absolute SS-RSRP Accuracy

Unless otherwise specified, the requirements for absolute accuracy of SS-RSRP in this clause apply to the serving cell in FR2.

The accuracy requirements in Table 10.1.3B.1.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-2 [19] for reference sensitivity are fulfilled.

- Conditions for intra-frequency measurements are fulfilled according to Annex B.1.2 for a corresponding Band for each relevant SSB.

- The measured signals are in the directions covered by the percentile EIS spherical coverage of the UE, defined in clause 7.3.4 of TS 38.101-2 [19].

Table 10.1.3B.1.1-1: SS-RSRP Intra frequency absolute accuracy in FR2

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot | Io Note 2 range | | | |
|  |  |  | Minimum Io | | | Maximum Io |
| dB | dB | dB | dBm / SCSSSB Note 1 | | dBm/BWChannel | dBm/BWChannel |
|  |  |  | SCSSSB = 120kHz | SCSSSB = 240kHz |  |  |
| ±7.5 | ±10.5 | ≥-4 | Same value as SSB\_RP in Table B.2.2-2, according to UE Power class, operating band and angle of arrival | | N/A | -70 |
| ±9.5 | ±12.5 |  | N/A | | -70 | -50 |
| Note 1: Values based on Refsens and EIS spherical coverage as defined in clauses 7.3.2 and 7.3.4 of TS 38.101-2 [19]. Applicable side condition selected depending on angle of arrival.  Note 2: Io specified at the Reference point and assumed to have constant EPRE across the bandwidth.  Note 3: In the test cases, the SSB Ês/Iot and related parameters may need to be adjusted to ensure Ês/Iot at UE baseband is above the value defined in this table. | | | | | | |

### 10.1.4 Inter-frequency RSRP accuracy requirements for FR1

#### 10.1.4.1 Inter-frequency SS-RSRP accuracy requirements

##### 10.1.4.1.1 Absolute Accuracy of SS-RSRP in FR1

The requirements for absolute accuracy of SS-RSRP in this clause apply to a cell on a frequency in FR1 that has different carrier frequency from the serving cell. The accuracy requirements in this clause are also applicable when *highSpeedMeasInterFreq-r17* is configured.

The accuracy requirements in Table 10.1.4.1.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.2.3 for a corresponding Band for each relevant SSB.

Table 10.1.4.1.1-1: SS-RSRP Inter frequency Absolute accuracy in FR1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot Note 2 | Io Note 1 range | | | | |
|  |  |  | NR operating band groups Note 3 | Minimum Io | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |  |
|  |  |  | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -118 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_B | -120.5 | -117.5 | N/A | -70 |
|  |  |  | NR\_TDD\_FR1\_C | -120 | -117 | N/A | -70 |
| ±4.5 | ±9 | ≥-6 | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_F | -118.5 | -115.5 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_G | -118 | -115 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_H | -117.5 | -114.5 | N/A | -70 |
| ±8 | ±11 | ≥-6 | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A, NR\_FDD\_FR1\_B, NR\_TDD\_FR1\_C, NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D, NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E, NR\_FDD\_FR1\_F,  NR\_FDD\_FR1\_G, NR\_FDD\_FR1\_H | N/A | N/A | -70 | -50 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: Void  NOTE 3: NR operating band groups in FR1 are as defined in clause 3.5.2. | | | | | | | |

##### 10.1.4.1.2 Relative Accuracy of SS-RSRP in FR1

The relative accuracy of SS-RSRP in inter frequency case is defined as the RSRP measured from one cell on a frequency in FR1compared to the RSRP measured from another cell on a different frequency in FR1. The accuracy requirements in this clause are also applicable when *highSpeedMeasInterFreq-r17* is configured.

The accuracy requirements in Table 10.1.4.1.2-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] Clause 7.3 for reference sensitivity are fulfilled.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.2.3 for a corresponding Band for each relevant SSB.

- |SSB\_RP1dBm - SSB\_RP2dBm| ≤ 27 dB

- |Channel 1\_Io ‑Channel 2\_Io | ≤ 20 dB

Table 10.1.4.1.2-1: SS-RSRP Inter frequency relative accuracy in FR1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot Note 2 | Io Note 1 range | | | | |
|  |  |  | NR operating band groups Note 3 | Minimum Io | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |  |
|  |  |  | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -118 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_B | -120.5 | -117.5 | N/A | -50 |
|  |  |  | NR\_TDD\_FR1\_C | -120 | -117 | N/A | -50 |
| ±4.5 | ±6 | ≥-6 | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_F | -118.5 | -115.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_G | -118 | -115 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_H | -117.5 | -114.5 | N/A | -50 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: The parameter SSB Ês/Iot is the minimum SSB Ês/Iot of the pair of cells to which the requirement applies.  NOTE 3: NR operating band groups in FR1 are as defined in clause 3.5.2. | | | | | | | |

#### 10.1.4.2 Void

#### 10.1.4.3 Inter-frequency CSI-RSRP accuracy requirements

##### 10.1.4.3.1 Absolute Accuracy of CSI-RSRP in FR1

The requirements for absolute accuracy of CSI-RSRP in this clause apply to a cell where the CSI-RS resources to be measured have the different center frequency as the CSI-RS resources indicated for measurement in the serving cell in FR1.

The accuracy requirements in Table 10.1.4.3.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.2.3 for a corresponding Band for each relevant SSB.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.2.9 for a corresponding Band for each relevant CSI-RS to be measured.

- The bandwidth of CSI-RS is 48 PRBs and the density is 3. The performance with larger bandwidth of CSI-RS is equal to or better than the accuracy requirements in Table 10.1.4.3.1-1.

- The timing offset between the reference measurement timing and the target CSI-RS in one layer is no larger than CP.

Note: The reference measurement timing for one layer for inter-frequency measurement is up to UE implementation and shall be based on the timing of one of the target cells.

Table 10.1.4.3.1-1: CSI-RSRP Inter frequency Absolute accuracy in FR1

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | | |
| Normal condition | Extreme condition | CSI-RS Ês/Iot | Io Note 1 range | | | | | |
|  |  |  | NR operating band groups Note 2 | Minimum Io | | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSCSI-RS | | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSCSI-RS = 15 kHz | SCSCSI-RS = 30 kHz | SCSCSI-RS = 60 kHz |  |  |
|  |  |  | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -118 | -115 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_B | -120.5 | -117.5 | -114.5 | N/A | -70 |
|  |  |  | NR\_TDD\_FR1\_C | -120 | -117 | -114 | N/A | -70 |
| ±4.5 | ±9 | ≥-6 | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | -113.5 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | -113 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_F | -118.5 | -115.5 | -112.5 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_G | -118 | -115 | -112 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_H | -117.5 | -114.5 | -111.5 | N/A | -70 |
| ±8 | ±11 | ≥-6 | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A,  NR\_FDD\_FR1\_B, NR\_TDD\_FR1\_C, NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D, NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E, NR\_FDD\_FR1\_F,  NR\_FDD\_FR1\_G, NR\_FDD\_FR1\_H | N/A | N/A | N/A | -70 | -50 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: NR operating band groups in FR1 are as defined in clause 3.5.2. | | | | | | | | |

##### 10.1.4.3.2 Relative Accuracy of CS-RSRP in FR1

The relative accuracy of CSI-RSRP in inter frequency case is defined as the CSI-RSRP measured from one cell on a frequency in FR1compared to the CSI-RSRP measured from another cell on a different frequency in FR1.

The accuracy requirements in Table 10.1.4.3.2-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] Clause 7.3 for reference sensitivity are fulfilled.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.2.3 for a corresponding Band for each relevant SSB.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.2.9 for a corresponding Band for each relevant CSI-RS to be measured.

- The bandwidth of CSI-RS is 48 PRBs and the density is 3. The performance with larger bandwidth of CSI-RS is equal to or better than the accuracy requirements in Table 10.1.4.3.2-1.

- The timing offset between the reference measurement timing and the target CSI-RS in one layer is no larger than CP.

• Note: The reference measurement timing for one layer for inter-frequency measurement is up to UE implementation and shall be based on the timing of one of the target cells.

- |CSI\_RP1dBm - CSI\_RP2dBm| ≤ 27 dB

- |Channel 1\_Io ‑Channel 2\_Io | ≤ 20 dB

Table 10.1.4.3.2-1: CSI-RSRP Inter frequency relative accuracy in FR1

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | | |
| Normal condition | Extreme condition | CSI-RS Ês/Iot Note 2 | Io Note 1 range | | | | | |
|  |  |  | NR operating band groups Note 4 | Minimum Io | | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSCSI-RS | | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSCSI-RS = 15 kHz | SCSCSI-RS = 30 kHz | SCSCSI-RS = 60 kHz |  |  |
|  |  |  | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -118 | -115 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_B | -120.5 | -117.5 | -114.5 | N/A | -50 |
|  |  |  | NR\_TDD\_FR1\_C | -120 | -117 | -114 | N/A | -50 |
| ±4.5 | ±6 | ≥-6 | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | -113.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | -113 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_F | -118.5 | -115.5 | -112.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_G | -118 | -115 | -112 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_H | -117.5 | -114.5 | -111.5 | N/A | -50 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: The parameter CSI-RS Ês/Iot is the minimum CSI-RS Ês/Iot of the pair of CSI-RS resources to which the requirement applies.  NOTE 3: Void  NOTE 4: NR operating band groups in FR1 are as defined in clause 3.5.2. | | | | | | | | |

### 10.1.4B Inter-frequency RSRP accuracy requirements for FR1 for CA/DC Idle Mode Measurements

#### 10.1.4B.1 Inter-frequency SS-RSRP accuracy requirements

The requirements in this clause are applicable for a UE:

- in state RRC\_IDLE or RRC INACTIVE

- that is synchronised to the cell that is measured.

The requirements are for absolute accuracy of SS-RSRP.

##### 10.1.4B.1.1 Absolute Accuracy of SS-RSRP in FR1

The requirements for absolute accuracy of SS-RSRP in this clause apply to a cell on a frequency in FR1 that has different carrier frequency from the serving cell.

The accuracy requirements in Table 10.1.4B.1.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.1.3 for a corresponding Band for each relevant SSB.

Table 10.1.4B.1.1-1: SS-RSRP Inter frequency Absolute accuracy in FR1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot Note 2 | Io Note 1 range | | | | |
|  |  |  | NR operating band groups Note 3 | Minimum Io | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |  |
|  |  |  | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -118 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_B | -120.5 | -117.5 | N/A | -70 |
|  |  |  | NR\_TDD\_FR1\_C | -120 | -117 | N/A | -70 |
| ±6 | ±10.5 | ≥-4 | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_F | -118.5 | -115.5 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_G | -118 | -115 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_H | -117.5 | -114.5 | N/A | -70 |
| ±9.5 | ±12.5 | ≥-4 | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A, NR\_FDD\_FR1\_B, NR\_TDD\_FR1\_C, NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D, NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E, NR\_FDD\_FR1\_F,  NR\_FDD\_FR1\_G, NR\_FDD\_FR1\_H | N/A | N/A | -70 | -50 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: Void  NOTE 3: NR operating band groups in FR1 are as defined in clause 3.5.2. | | | | | | | |

### 10.1.4C Inter-frequency RSRP accuracy requirements for FR1 SAN

#### 10.1.4C.1 Inter-frequency SS-RSRP accuracy requirements

##### 10.1.4C.1.1 Absolute Accuracy of SS-RSRP in FR1

The requirements for absolute accuracy of SS-RSRP in this clause apply to a cell on a frequency in FR1 that has different carrier frequency from the serving cell.

The accuracy requirements in Table 10.1.4C.1.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.2.3 for a corresponding Band for each relevant SSB.

- Valid information for the SAN serving the target cell has been provided.

Table 10.1.4C.1.1-1: SS-RSRP Inter frequency Absolute accuracy in FR1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot Note 2 | Io Note 1 range | | | | |
|  |  |  | NR operating band groups Note 3 | Minimum Io | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |  |
| ±[4.5] | ±[9] | ≥-6 | NR\_FDD\_SAB\_FR1\_A | -121 | -118 | N/A | -70 |
| ±[8] | ±[11] | ≥-6 | NR\_FDD\_SAB\_FR1\_A | N/A | N/A | -70 | -50 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: Void  NOTE 3: NR operating band groups in FR1 are as defined in clause 3.5.2. | | | | | | | |

##### 10.1.4C.1.2 Relative Accuracy of SS-RSRP in FR1

The relative accuracy of SS-RSRP in inter frequency case is defined as the RSRP measured from one cell on a frequency in FR1compared to the RSRP measured from another cell on a different frequency in FR1.

The accuracy requirements in Table 10.1.4C.1.2-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] Clause 7.3 for reference sensitivity are fulfilled.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.2.3 for a corresponding Band for each relevant SSB.

- |SSB\_RP1dBm - SSB\_RP2dBm| ≤ 27 dB

- |Channel 1\_Io ‑Channel 2\_Io | ≤ 20 dB

- Valid information for the SAN serving the target cell has been provided.

Table 10.1.4C.1.2-1: SS-RSRP Inter frequency relative accuracy in FR1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot Note 2 | Io Note 1 range | | | | |
|  |  |  | NR operating band groups Note 3 | Minimum Io | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |  |
| ±[4.5] | ±[6] | ≥-6 | NR\_FDD\_SAB\_FR1\_A | -121 | -118 | N/A | -50 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: The parameter SSB Ês/Iot is the minimum SSB Ês/Iot of the pair of cells to which the requirement applies.  NOTE 3: NR operating band groups in FR1 are as defined in clause 3.5.2. | | | | | | | |

### 10.1.5 Inter-frequency RSRP accuracy requirements for FR2

#### 10.1.5.1 Inter-frequency SS-RSRP accuracy requirements

##### 10.1.5.1.1 Absolute SS-RSRP Accuracy

Unless otherwise specified, the requirements for absolute accuracy of SS-RSRP in this clause apply to a cell on a frequency in FR2 that is on a different frequency than the serving cell.

The accuracy requirements in Table 10.1.5.1.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-2 [19] for reference sensitivity are fulfilled.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.2.3 for a corresponding Band for each relevant SSB.

- The measured signals are in the directions covered by the percentile EIS spherical coverage of the UE, defined in clause 7.3.4 of TS 38.101-2 [19].

**Table 10.1.5.1.1-1: SS-RSRP Inter frequency absolute accuracy in FR2**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot | Io Note 2 range | | | |
|  |  |  | Minimum Io | | | Maximum Io |
| dB | dB | dB | dBm / SCSSSB Note 1 | | dBm/BWChannel | dBm/BWChannel |
|  |  |  | SCSSSB = 120kHz | SCSSSB = 240kHz |  |  |
| ±6 | ±9 | ≥-4 | Same value as SSB\_RP in Table B.2.3-2, according to UE Power class, operating band and angle of arrival | | N/A | -70 |
| ±8 | ±11 |  | N/A | | -70 | -50 |
| Note 1: Values based on Refsens and EIS spherical coverage as defined in clauses 7.3.2 and 7.3.4 of TS 38.101-2 [19]. Applicable side condition selected depending on angle of arrival.  Note 2: Io specified at the Reference point, and assumed to have constant EPRE across the bandwidth.  Note 3: In the test cases, the SSB Ês/Iot and related parameters may need to be adjusted to ensure Ês/Iot at UE baseband is above the value defined in this table. | | | | | | |

##### 10.1.5.1.2 Relative SS-RSRP Accuracy

The relative accuracy of SS-RSRP is defined as the SS-RSRP measured from one cell on a frequency in FR2 compared to the SS-RSRP measured from another cell on another frequency in FR2.

The accuracy requirements in Table 10.1.5.1.2-1 are valid under the following conditions:

- Conditions defined in 38.101-2 [19] Clause 7.3 for reference sensitivity are fulfilled.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.2.3 for a corresponding Band for each relevant SSB.

- |SSB\_RP1dBm - SSB\_RP2dBm| ≤ 27dB

- |Channel 1\_Io ‑Channel 2\_Io | ≤ 20 dB

- The measured signals are in the directions covered by the percentile EIS spherical coverage of the UE, defined in clause 7.3.4 of TS 38.101-2 [19].

Table 10.1.5.1.2-1: SS-RSRP Inter frequency relative accuracy in FR2

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | |
| Normal condition | Extreme condition | SSB Ês/Iot | Io Note 2 range | | |
|  |  |  | Minimum Io | | Maximum Io |
| dB | dB | dB | dBm / SCSSSB Note 1 | | dBm/BWChannel |
|  |  |  | SCSSSB = 120kHz | SCSSSB = 240kHz |  |
| ±6 | ±9 | ≥-4 | Same value as SSB\_RP in Table B.2.3-2, according to UE Power class, operating band and angle of arrival | | -50 |
| Note 1: Values based on Refsens and EIS spherical coverage as defined in clauses 7.3.2 and 7.3.4 of TS 38.101-2 [19]. Applicable side condition selected depending on angle of arrival.  Note 2: Io specified at the Reference point, and assumed to have constant EPRE across the bandwidth.  Note 3: In the test cases, the SSB Ês/Iot and related parameters may need to be adjusted to ensure Ês/Iot at UE baseband is above the value defined in this table.  Note 4: The parameter SSB Ês/Iot is the minimum SSB Ês/Iot of the pair of cells to which the requirement applies. | | | | | |

#### 10.1.5.2 Void

#### 10.1.5.3 Inter-frequency CSI-RSRP accuracy requirements

##### 10.1.5.3.1 Absolute CSI-RSRP Accuracy

Unless otherwise specified, the requirements for absolute accuracy of CSI-RSRP in this clause apply to a cell on a frequency in FR2 where the CSI-RS resources to be measured have the different center frequency as the CSI-RS resources indicated for measurement in the serving cell.

The accuracy requirements in Table 10.1.5.3.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-2 [19] for reference sensitivity are fulfilled.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.2.3 for a corresponding Band for each relevant associated SSB.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.2.9 for a corresponding Band for each relevant CSI-RS to be measured.

- The bandwidth of CSI-RS is 48 PRBs and the density is 3. The performance with larger bandwidth of CSI-RS is equal to or better than the accuracy requirements in Table 10.1.5.3.1-1.

- The timing offset between the reference measurement timing and the target CSI-RS in one layer is no larger than CP.

Note: The reference measurement timing for one layer for inter-frequency measurement is up to UE implementation and shall be based on the timing of one of the target cells.

- The measured signals are in the directions covered by the percentile EIS spherical coverage of the UE, defined in clause 7.3.4 of TS 38.101-2 [19].

Table 10.1.5.3.1-1: CSI-RSRP Inter frequency absolute accuracy in FR2

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | |
| Normal condition | Extreme condition | CSI-RS Ês/Iot | Io Note 2 range | | | |
|  |  |  | Minimum Io | | | Maximum Io |
| dB | dB | dB | dBm / SCSCSI-RS Note 1 | | dBm/BWChannel | dBm/BWChannel |
|  |  |  | SCSCSI-RS = 60kHz | SCSCSI-RS = 120kHz |  |  |
| ±6 | ±9 | ≥-4 | Same value as CSI\_RP in Table B.2.9-2, according to UE Power class, operating band and angle of arrival | | N/A | -70 |
| ±8 | ±11 |  | N/A | | -70 | -50 |
| Note 1: Values based on Refsens and EIS spherical coverage as defined in clauses 7.3.2 and 7.3.4 of TS 38.101-2 [19]. Applicable side condition selected depending on angle of arrival.  Note 2: Io specified at the Reference point, and assumed to have constant EPRE across the bandwidth.  Note 3: In the test cases, the CSI-RS Ês/Iot and related parameters may need to be adjusted to ensure Ês/Iot at UE baseband is above the value defined in this table. | | | | | | |

##### 10.1.5.3.2 Relative CSI-RSRP Accuracy

The relative accuracy of CSI-RSRP in inter frequency case is defined as the CSI-RSRP measured from one cell on a frequency in FR2 compared to the CSI-RSRP measured from another cell on another frequency in FR2.

The accuracy requirements in Table 10.1.5.3.2-1 are valid under the following conditions:

- Conditions defined in 38.101-2 [19] Clause 7.3 for reference sensitivity are fulfilled.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.2.3 for a corresponding Band for each relevant associated SSB.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.2.9 for a corresponding Band for each relevant CSI-RS to be measured.

- The bandwidth of CSI-RS is 48 PRBs and the density is 3. The performance with larger bandwidth of CSI-RS is equal to or better than the accuracy requirements in Table 10.1.5.3.2-1.

- The timing offset between the reference measurement timing and the target CSI-RS in one layer is no larger than CP.

Note: The reference measurement timing for one layer for inter-frequency measurement is up to UE implementation and shall be based on the timing of one of the target cells.

- |CSI\_RP1dBm - CSI\_RP2dBm| ≤ 27dB

- |Channel 1\_Io ‑Channel 2\_Io | ≤ 20 dB

- The measured signals are in the directions covered by the percentile EIS spherical coverage of the UE, defined in clause 7.3.4 of TS 38.101-2 [19].

Table 10.1.5.3.2-1: CSI-RSRP Inter frequency relative accuracy in FR2

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | |
| Normal condition | Extreme condition | CSI-RS Ês/Iot | Io Note 2 range | | |
|  |  |  | Minimum Io | | Maximum Io |
| dB | dB | dB | dBm / SCSCSI-RS Note 1 | | dBm/BWChannel |
|  |  |  | SCSCSI-RS = 60kHz | SCSCSI-RS = 120kHz |  |
| ±6 | ±9 | ≥-4 | Same value as CSI\_RP in Table B.2.9-2, according to UE Power class, operating band and angle of arrival | | -50 |
| Note 1: Values based on Refsens and EIS spherical coverage as defined in clauses 7.3.2 and 7.3.4 of TS 38.101-2 [19]. Applicable side condition selected depending on angle of arrival.  Note 2: Io specified at the Reference point, and assumed to have constant EPRE across the bandwidth.  Note 3: In the test cases, the CSI-RS Ês/Iot and related parameters may need to be adjusted to ensure Ês/Iot at UE baseband is above the value defined in this table.  Note 4: The parameter CSI-RS Ês/Iot is the minimum CSI-RS Ês/Iot of the pair of cells to which the requirement applies. | | | | | |

### 10.1.5B Inter-frequency RSRP accuracy requirements for FR2 for CA/DC Idle Mode Measurements

#### 10.1.5B.1 Inter-frequency SS-RSRP accuracy requirements

The requirements in this clause are applicable for a UE:

- in state RRC\_IDLE or RRC INACTIVE

- that is synchronised to the cell that is measured.

The requirements are for absolute accuracy of SS-RSRP.

##### 10.1.5B.1.1 Absolute SS-RSRP Accuracy

Unless otherwise specified, the requirements for absolute accuracy of SS-RSRP in this clause apply to a cell on a frequency in FR2 that is on a different frequency than the serving cell.

The accuracy requirements in Table 10.1.5B.1.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-2 [19] for reference sensitivity are fulfilled.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.1.3 for a corresponding Band for each relevant SSB.

- The measured signals are in the directions covered by the percentile EIS spherical coverage of the UE, defined in clause 7.3.4 of TS 38.101-2 [19].

Table 10.1.5B.1.1-1: SS-RSRP Inter frequency absolute accuracy in FR2

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot | Io Note 2 range | | | |
|  |  |  | Minimum Io | | | Maximum Io |
| dB | dB | dB | dBm / SCSSSB Note 1 | | dBm/BWChannel | dBm/BWChannel |
|  |  |  | SCSSSB = 120kHz | SCSSSB = 240kHz |  |  |
| ±7.5 | ±10.5 | ≥-4 | Same value as SSB\_RP in Table B.2.3-2, according to UE Power class, operating band and angle of arrival | | N/A | -70 |
| ±9.5 | ±12.5 |  | N/A | | -70 | -50 |
| Note 1: Values based on Refsens and EIS spherical coverage as defined in clauses 7.3.2 and 7.3.4 of TS 38.101-2 [19]. Applicable side condition selected depending on angle of arrival.  Note 2: Io specified at the Reference point, and assumed to have constant EPRE across the bandwidth.  Note 3: In the test cases, the SSB Ês/Iot and related parameters may need to be adjusted to ensure Ês/Iot at UE baseband is above the value defined in this table. | | | | | | |

### 10.1.6 RSRP Measurement Report Mapping

The reporting range of SS-RSRP and CSI-RSRP for L3 reporting is defined from -156 dBm to -31 dBm with 1 dB resolution. The reporting range of SS-RSRP and CSI-RSRP for L1 reporting is defined from -140 to -44 dBm with 1 dB resolution.

The mapping of measured quantity is defined in Table 10.1.6.1-1. The range in the signalling may be larger than the guaranteed accuracy range.

The reporting range of differential SS-RSRP and CSI-RSRP for L1 reporting and L3 reporting is defined from 0 dB to -30 dB with 2 dB resolution.

The mapping of measured quantity is defined in Table 10.1.6.1-2. The range in the signalling may be larger than the guaranteed accuracy range.

Table 10.1.6.1-1: SS-RSRP and CSI-RSRP measurement report mapping

|  |  |  |  |
| --- | --- | --- | --- |
| Reported value | Measured quantity value (L3 SS-RSRP) and CSI-RSRP | Measured quantity value (L1 SS-RSRP and CSI-RSRP) | Unit |
| RSRP\_0 | SS-RSRP<-156 | Not valid | dBm |
| RSRP\_1 | -156≤ SS-RSRP<-155 | Not valid | dBm |
| RSRP\_2 | -155≤ SS-RSRP<-154 | Not valid | dBm |
| RSRP\_3 | -154≤ SS-RSRP<-153 | Not valid | dBm |
| RSRP\_4 | -153≤ SS-RSRP<-152 | Not valid | dBm |
| RSRP\_5 | -152≤ SS-RSRP<-151 | Not valid | dBm |
| RSRP\_6 | -151≤ SS-RSRP<-150 | Not valid | dBm |
| RSRP\_7 | -150≤ SS-RSRP<-149 | Not valid | dBm |
| RSRP\_8 | -149≤ SS-RSRP<-148 | Not valid | dBm |
| RSRP\_9 | -148≤ SS-RSRP<-147 | Not valid | dBm |
| RSRP\_10 | -147≤ SS-RSRP<-146 | Not valid | dBm |
| RSRP\_11 | -146≤ SS-RSRP<-145 | Not valid | dBm |
| RSRP\_12 | -145≤ SS-RSRP<-144 | Not valid | dBm |
| RSRP\_13 | -144≤ SS-RSRP<-143 | Not valid | dBm |
| RSRP\_14 | -143≤ SS-RSRP<-142 | Not valid | dBm |
| RSRP\_15 | -142≤ SS-RSRP<-141 | Not valid | dBm |
| RSRP\_16 | -141≤ SS-RSRP<-140 | RSRP<-140 | dBm |
| RSRP\_17 | -140≤ SS-RSRP<-139 | -140≤RSRP<-139 | dBm |
| RSRP\_18 | -139≤ SS-RSRP<-138 | -139≤ RSRP<-138 | dBm |
| … | … |  | … |
| RSRP\_111 | -46≤ SS-RSRP<-45 | -46≤ RSRP<-45 | dBm |
| RSRP\_112 | -45≤ SS-RSRP<-44 | -45≤ RSRP<-44 | dBm |
| RSRP\_113 | -44≤ SS-RSRP<-43 | -44≤ RSRP | dBm |
| RSRP\_114 | -43≤ SS-RSRP<-42 | Not valid | dBm |
| RSRP\_115 | -42≤ SS-RSRP<-41 | Not valid | dBm |
| RSRP\_116 | -41≤ SS-RSRP<-40 | Not valid | dBm |
| RSRP\_117 | -40≤ SS-RSRP<-39 | Not valid | dBm |
| RSRP\_118 | -39≤ SS-RSRP<-38 | Not valid | dBm |
| RSRP\_119 | -38≤ SS-RSRP<-37 | Not valid | dBm |
| RSRP\_120 | -37≤ SS-RSRP<-36 | Not valid | dBm |
| RSRP\_121 | -36≤ SS-RSRP<-35 | Not valid | dBm |
| RSRP\_122 | -35≤ SS-RSRP<-34 | Not valid | dBm |
| RSRP\_123 | -34≤ SS-RSRP<-33 | Not valid | dBm |
| RSRP\_124 | -33≤ SS-RSRP<-32 | Not valid | dBm |
| RSRP\_125 | -32≤ SS-RSRP<-31 | Not valid | dBm |
| RSRP\_126 | -31≤ SS-RSRP | Not valid | dBm |
| RSRP\_127 (Note) | Infinity | Infinity | dBm |
| Note: The value of RSRP\_127 is applicable for RSRP threshold configured by the network as defined in TS 38.331 [2], but not for the purpose of measurement reporting. | | | |

Table 10.1.6.1-2: Differential SS-RSRP and CSI-RSRP measurement (for L1 reporting and L3 reporting) report mapping

|  |  |  |
| --- | --- | --- |
| Reported value | Measured quantity value (difference in measured RSRP from strongest RSRP) | Unit |
| DIFFRSRP\_0 | 0≥ΔRSRP>-2 | dB |
| DIFFRSRP\_1 | -2≥ΔRSRP>-4 | dB |
| DIFFRSRP\_2 | -4≥ΔRSRP>-6 | dB |
| DIFFRSRP\_3 | -6≥ΔRSRP>-8 | dB |
| DIFFRSRP\_4 | -8≥ΔRSRP>-10 | dB |
| DIFFRSRP\_5 | -10≥ΔRSRP>-12 | dB |
| DIFFRSRP\_6 | -12≥ΔRSRP>-14 | dB |
| DIFFRSRP\_7 | -14≥ΔRSRP>-16 | dB |
| DIFFRSRP\_8 | -16≥ΔRSRP>-18 | dB |
| DIFFRSRP\_9 | -18≥ΔRSRP>-20 | dB |
| DIFFRSRP\_10 | -20≥ΔRSRP>-22 | dB |
| DIFFRSRP\_11 | -22≥ΔRSRP>-24 | dB |
| DIFFRSRP\_12 | -24≥ΔRSRP>-26 | dB |
| DIFFRSRP\_13 | -26≥ΔRSRP>-28 | dB |
| DIFFRSRP\_14 | -28≥ΔRSRP>-30 | dB |
| DIFFRSRP\_15 | -30≥ΔRSRP | dB |

### 10.1.7 Intra-frequency RSRQ accuracy requirements for FR1

#### 10.1.7.1 Intra-frequency SS-RSRQ accuracy requirements in FR1

##### 10.1.7.1.1 Absolute SS-RSRQ Accuracy in FR1

Unless otherwise specified, the requirements for absolute accuracy of SS-RSRQ in this clause apply to a cell on the same frequency as that of the serving cell in FR1. The accuracy requirements in this clause are also applicable when *highSpeedMeasFlag-r16* or *highSpeedMeasCA-Scell-r17* is configured.

The accuracy requirements in Table 10.1.7.1.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for intra-frequency measurements are fulfilled according to Annex B.2.2 for a corresponding Band for each relevant SSB.

Table 10.1.7.1.1-1: SS-RSRQ Intra frequency absolute accuracy in FR1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot | Io Note 1 range | | | | |
|  |  |  | NR operating band groups Note 3 | Minimum Io | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |  |
|  |  |  | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -118 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_B | -120.5 | -117.5 | N/A | -50 |
|  |  |  | NR\_TDD\_FR1\_C | -120 | -117 | N/A | -50 |
| ±2.5 | ±4 | ≥-3 | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_F | -118.5 | -115.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_G | -118 | -115 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_H | -117.5 | -114.5 | N/A | -50 |
| ±3.5 | ±4 | ≥-6 | Note 2 | Note 2 | Note 2 | Note 2 | Note 2 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding highest accuracy requirement.  NOTE 3: NR operating band groups in FR1 are as defined in clause 3.5.2. | | | | | | | |

#### 10.1.7.2 Intra-frequency CSI-RSRQ accuracy requirements

##### 10.1.7.2.1 Absolute CSI-RSRQ Accuracy

Unless otherwise specified, the requirements for absolute accuracy of CSI-RSRQ in this clause apply to the intra-frequency measurement defined in 9.10.2.1 in FR1.

The accuracy requirements in Table 10.1.7.2.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for intra-frequency measurements are fulfilled according to Annex B.2.2 for a corresponding Band for associated SSB.

- Conditions for intra-frequency measurements are fulfilled according to Annex B.2.8 for a corresponding Band for each relevant CSI-RS.

- The bandwidth of CSI-RS is 48 PRBs and the density is 3.

• The performance with larger bandwidth of CSI-RS is equal to or better than the accuracy requirements in Table 10.1.7.2.1-1.

- The timing offset between the reference measurement timing and the target CSI-RS in one layer is no larger than CP.

Note: The reference measurement timing for one layer for intra-frequency measurement is serving cell timing.

Table 10.1.7.2.1-1: CSI-RSRQ Intra frequency absolute accuracy in FR1

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | | |
| Normal condition | Extreme condition | CSI-RS Ês/Iot | Io Note 1 range | | | | | |
|  |  |  | NR operating band groups Note 3 | Minimum Io | | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSCSI-RS | | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSCSI-RS = 15 kHz | SCSCSI-RS = 30 kHz | SCSCSI-RS = 60 kHz |  |  |
|  |  |  | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -118 | -115 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_B | -120.5 | -117.5 | -114.5 | N/A | -50 |
|  |  |  | NR\_TDD\_FR1\_C | -120 | -117 | -114 | N/A | -50 |
| ±2.5 | ±4 | ≥-3 | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | -113.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | -113 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_F | -118.5 | -115.5 | -112.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_G | -118 | -115 | -112 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_H | -117.5 | -114.5 | -111.5 | N/A | -50 |
| ±3.5 | ±4 | ≥-6 | Note 2 | Note 2 | Note 2 | Note 2 | Note 2 | Note 2 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding highest accuracy requirement.  NOTE 3: NR operating band groups in FR1 are as defined in clause 3.5.2. | | | | | | | | |

### 10.1.7B Intra-frequency RSRQ accuracy requirements for FR1 for CA/DC Idle Mode Measurements

#### 10.1.7B.1 Intra-frequency SS-RSRQ accuracy requirements in FR1

The requirements in this clause are applicable for a UE:

- in state RRC\_IDLE or RRC INACTIVE

- that is synchronised to the cell that is measured.

The requirements are for absolute accuracy of SS-RSRQ.

##### 10.1.7B.1.1 Absolute SS-RSRQ Accuracy in FR1

Unless otherwise specified, the requirements for absolute accuracy of SS-RSRQ in this clause apply to the serving cell in FR1.

The accuracy requirements in Table 10.1.7B.1.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for intra-frequency measurements are fulfilled according to Annex B.1.2 for a corresponding Band for each relevant SSB.

Table 10.1.7B.1.1-1: SS-RSRQ Intra frequency absolute accuracy in FR1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot | Io Note 1 range | | | | |
|  |  |  | NR operating band groups Note 3 | Minimum Io | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |  |
|  |  |  | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -118 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_B | -120.5 | -117.5 | N/A | -50 |
|  |  |  | NR\_TDD\_FR1\_C | -120 | -117 | N/A | -50 |
| ±4 | ±5.5 | ≥-3 | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_F | -118.5 | -115.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_G | -118 | -115 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_H | -117.5 | -114.5 | N/A | -50 |
| ±5 | ±5.5 | ≥-4 | Note 2 | Note 2 | Note 2 | Note 2 | Note 2 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding highest accuracy requirement.  NOTE 3: NR operating band groups in FR1 are as defined in clause 3.5.2. | | | | | | | |

### 10.1.7C Intra-frequency RSRQ accuracy requirements for FR1 SAN

#### 10.1.7C.1 Intra-frequency SS-RSRQ accuracy requirements in FR1

##### 10.1.7C.1.1 Absolute SS-RSRQ Accuracy in FR1

Unless otherwise specified, the requirements for absolute accuracy of SS-RSRQ in this clause apply to a cell on the same frequency as that of the serving cell in FR1.

The accuracy requirements in Table 10.1.7C.1.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for intra-frequency measurements are fulfilled according to Annex B.2.2 for a corresponding Band for each relevant SSB.

- Valid information for the SAN serving the target cell has been provided.

Table 10.1.7C.1.1-1: SS-RSRQ Intra frequency absolute accuracy in FR1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot | Io Note 1 range | | | | |
|  |  |  | NR operating band groups Note 3 | Minimum Io | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |  |
| ±[2.5] | ±[4] | ≥-3 | NR\_FDD\_SAB\_FR1\_A | -121 | -118 | N/A | -50 |
| ±[3.5] | ±[4] | ≥-6 | Note 2 | Note 2 | Note 2 | Note 2 | Note 2 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding highest accuracy requirement.  NOTE 3: NR operating band groups in FR1 are as defined in clause 3.5.2. | | | | | | | |

### 10.1.8 Intra-frequency RSRQ accuracy requirements for FR2

#### 10.1.8.1 Intra-frequency SS-RSRQ accuracy requirements in FR2

##### 10.1.8.1.1 Absolute SS-RSRQ Accuracy in FR2

Unless otherwise specified, the requirements for absolute accuracy of SS-RSRQ in this clause apply to a cell on the same frequency as that of the serving cell in FR2.

The accuracy requirements in Table 10.1.8.1.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-2 [19] for reference sensitivity are fulfilled.

- Conditions for intra-frequency measurements are fulfilled according to Annex B.2.2 for a corresponding Band for each relevant SSB.

- The measured signals are in the directions covered by the percentile EIS spherical coverage of the UE, defined in clause 7.3.4 of TS 38.101-2 [19].

Table 10.1.8.1.1-1: SS-RSRQ Intra frequency absolute accuracy in FR2

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | |
| Normal condition | Extreme condition | SSB Ês/Iot | Io Note 2 range | | |
|  |  |  | Minimum Io | | Maximum Io |
| dB | dB | dB | dBm / SCSSSB Note 1 | | dBm/BWChannel |
|  |  |  | SCSSSB = 120kHz | SCSSSB = 240kHz |  |
| ±2.5 | ±4 | ≥-3 | Same value as SSB\_RP in Table B.2.2-2, according to UE Power class, operating band and angle of arrival | | -50 |
| ±3.5 | ±4 | ≥-6 |  | |  |
| Note 1: Values based on Refsens and EIS spherical coverage as defined in clauses 7.3.2 and 7.3.4 of TS 38.101-2 [19]. Applicable side condition selected depending on angle of arrival.  Note 2: Io specified at the Reference point, and assumed to have constant EPRE across the bandwidth.  Note 3: In the test cases, the SSB Ês/Iot and related parameters may need to be adjusted to ensure Ês/Iot at UE baseband is above the value defined in this table. | | | | | |

#### 10.1.8.2 Intra-frequency CSI-RSRQ accuracy requirements

##### 10.1.8.2.1 Absolute CSI-RSRQ Accuracy

Unless otherwise specified, the requirements for absolute accuracy of CSI-RSRQ in this clause apply to the intra-frequency measurement defined in 9.10.2.1 in FR2.

The accuracy requirements in Table 10.1.8.2.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-2 [19] for reference sensitivity are fulfilled.

- Conditions for intra-frequency measurements are fulfilled according to Annex B.2.2 for a corresponding Band for each relevant SSB.

- Conditions for intra-frequency measurements are fulfilled according to Annex B.2.8 for a corresponding Band for each relevant CSI-RS.

- The bandwidth of CSI-RS is 48 PRBs and the density is 3.

• The performance with larger bandwidth of CSI-RS is equal to or better than the accuracy requirements in Table 10.1.8.2.1-1.

- The timing offset between the reference measurement timing and the target CSI-RS in one layer is no larger than CP.

Note: The reference measurement timing for one layer for intra-frequency measurement is serving cell timing.

- The measured signals are in the directions covered by the percentile EIS spherical coverage of the UE, defined in clause 7.3.4 of TS 38.101-2 [19].

Table 10.1.8.2.1-1: CSI-RSRQ Intra frequency absolute accuracy in FR2

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | |
| Normal condition | Extreme condition | CSI-RS Ês/Iot | Io Note 2 range | | |
|  |  |  | Minimum Io | | Maximum Io |
| dB | dB | dB | dBm / SCSCSI-RS Note 1 | | dBm/BWChannel |
|  |  |  | SCSCSI-RS = 60kHz | SCSCSI-RS = 120kHz |  |
| ±2.5 | ±4 | ≥-3 | Same value as CSI\_RP in Table B.2.8-2, according to UE Power class, operating band and angle of arrival | | -50 |
| ±3.5 | ±4 | ≥-6 |  | |  |
| Note 1: Values based on Refsens and EIS spherical coverage as defined in clauses 7.3.2 and 7.3.4 of TS 38.101-2 [19]. Applicable side condition selected depending on angle of arrival.  Note 2: Io specified at the Reference point, and assumed to have constant EPRE across the bandwidth.  Note 3: In the test cases, the CSI-RS Ês/Iot and related parameters may need to be adjusted to ensure Ês/Iot at UE baseband is above the value defined in this table. | | | | | |

### 10.1.8B Intra-frequency RSRQ accuracy requirements for FR2 for CA/DC Idle Mode Measurements

#### 10.1.8B.1 Intra-frequency SS-RSRQ accuracy requirements in FR2

The requirements in this clause are applicable for a UE:

- in state RRC\_IDLE or RRC INACTIVE

- that is synchronised to the cell that is measured.

The requirements are for absolute accuracy of SS-RSRQ.

##### 10.1.8B.1.1 Absolute SS-RSRQ Accuracy in FR2

Unless otherwise specified, the requirements for absolute accuracy of SS-RSRQ in this clause apply to the serving cell in FR2.

The accuracy requirements in Table 10.1.8B.1.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-2 [19] for reference sensitivity are fulfilled.

- Conditions for intra-frequency measurements are fulfilled according to Annex B.1.2 for a corresponding Band for each relevant SSB.

- The measured signals are in the directions covered by the percentile EIS spherical coverage of the UE, defined in clause 7.3.4 of TS 38.101-2 [19].

Table 10.1.8B.1.1-1: SS-RSRQ Intra frequency absolute accuracy in FR2

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | |
| Normal condition | Extreme condition | SSB Ês/Iot | Io Note 2 range | | |
|  |  |  | Minimum Io | | Maximum Io |
| dB | dB | dB | dBm / SCSSSB Note 1 | | dBm/BWChannel |
|  |  |  | SCSSSB = 120kHz | SCSSSB = 240kHz |  |
| ±4 | ±5.5 | ≥-3 | Same value as SSB\_RP in Table B.2.2-2, according to UE Power class, operating band and angle of arrival | | -50 |
| ±5 | ±5.5 | ≥-4 |  | |  |
| Note 1: Values based on Refsens and EIS spherical coverage as defined in clauses 7.3.2 and 7.3.4 of TS 38.101-2 [19]. Applicable side condition selected depending on angle of arrival.  Note 2: Io specified at the Reference point, and assumed to have constant EPRE across the bandwidth.  Note 3: In the test cases, the SSB Ês/Iot and related parameters may need to be adjusted to ensure Ês/Iot at UE baseband is above the value defined in this table. | | | | | |

### 10.1.9 Inter-frequency RSRQ accuracy requirements for FR1

#### 10.1.9.1 Inter-frequency SS-RSRQ accuracy requirements in FR1

##### 10.1.9.1.1 Absolute Accuracy of SS-RSRQ in FR1

The requirements for absolute accuracy of SS-RSRQ in this clause apply to a cell on a frequency in FR1 that has different carrier frequency from the serving cell. The accuracy requirements in this clause are also applicable when *highSpeedMeasInterFreq-r17* is configured.

The accuracy requirements in Table 10.1.9.1.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.2.3 for a corresponding Band for each relevant SSB.

Table 10.1.9.1.1-1: SS-RSRQ Inter frequency absolute accuracy in FR1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot | Io Note 1 range | | | | |
|  |  |  | NR operating band groups Note 3 | Minimum Io | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |  |
|  |  |  | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -118 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_B | -120.5 | -117.5 | N/A | -50 |
|  |  |  | NR\_TDD\_FR1\_C | -120 | -117 | N/A | -50 |
| ±2.5 | ±4 | ≥-3 | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_F | -118.5 | -115.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_G | -118 | -115 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_H | -117.5 | -114.5 | N/A | -50 |
| ±3.5 | ±4 | ≥-6 | Note 2 | Note 2 | Note 2 | Note 2 | Note 2 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding highest accuracy requirement.  NOTE 3: NR operating band groups in FR1 are as defined in clause 3.5.2. | | | | | | | |

##### 10.1.9.1.2 Relative Accuracy of SS-RSRQ in FR1

The relative accuracy of SS-RSRQ in inter frequency case is defined as the RSRQ measured from one cell on a frequency in FR1 compared to the RSRP measured from another cell on a different frequency in FR1. The accuracy requirements in this clause are also applicable when *highSpeedMeasInterFreq-r17* is configured.

The accuracy requirements in Table 10.1.9.1.2-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.2.3 for a corresponding Band for each relevant SSB.

- |SSB\_RP1dBm - SSB\_RP2dBm| ≤ 27 dB

- |Channel 1\_Io ‑Channel 2\_Io | ≤ 20 dB

Table 10.1.9.1.2-1: SS-RSRQ Inter frequency relative accuracy in FR1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot | Io Note 1 range | | | | |
|  |  | Note 2 | NR operating band groups Note 4 | Minimum Io | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |  |
|  |  |  | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -118 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_B | -120.5 | -117.5 | N/A | -50 |
|  |  |  | NR\_TDD\_FR1\_C | -120 | -117 | N/A | -50 |
| ±3 | ±4 | ≥-3 | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_F | -118.5 | -115.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_G | -118 | -115 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_H | -117.5 | -114.5 | N/A | -50 |
| ±4 | ±4 | ≥-6 | Note 3 | Note 3 | Note 3 | Note 3 | Note 3 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: The parameter SSB Ês/Iot is the minimum SSB Ês/Iot of the pair of cells to which the requirement applies.  NOTE 3: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding highest accuracy requirement.  NOTE 4: NR operating band groups in FR1 are as defined in clause 3.5.2. | | | | | | | |

#### 10.1.9.2 Inter-frequency CSI-RSRQ accuracy requirements

##### 10.1.9.2.1 Absolute CSI-RSRQ Accuracy

Unless otherwise specified, the requirements for absolute accuracy of CSI-RSRQ in this clause apply to the inter-frequency measurement defined in 9.10.3.1 in FR1.

The accuracy requirements in Table 10.1.9.2.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.2.3 for a corresponding Band for associated SSB.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.2.9 for a corresponding Band for each relevant CSI-RS.

- The bandwidth of CSI-RS is 48 PRBs and the density is 3.

• The performance with larger bandwidth of CSI-RS is equal to or better than the accuracy requirements in Table 10.1.9.2.1-1.

- The timing offset between the reference measurement timing and the target CSI-RS in one layer is no larger than CP.

Note: The reference measurement timing for one layer for inter-frequency measurement is up to UE implementation and shall be based on the timing of one of the target cells.

Table 10.1.9.2.1-1: CSI-RSRQ Inter frequency absolute accuracy in FR1

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | | |
| Normal condition | Extreme condition | CSI-RS Ês/Iot | Io Note 1 range | | | | | |
|  |  |  | NR operating band groups Note 3 | Minimum Io | | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSCSI-RS | | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSCSI-RS = 15 kHz | **SCSCSI-RS = 30 kHz** | **SCSCSI-RS = 60 kHz** |  |  |
|  |  |  | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -118 | -115 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_B | -120.5 | -117.5 | -114.5 | N/A | -50 |
|  |  |  | NR\_TDD\_FR1\_C | -120 | -117 | -114 | N/A | -50 |
| ±2.5 | ±4 | ≥-3 | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | -113.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | -113 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_F | -118.5 | -115.5 | -112.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_G | -118 | -115 | -112 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_H | -117.5 | -114.5 | -111.5 | N/A | -50 |
| ±3.5 | ±4 | ≥-6 | Note 2 | Note 2 | Note 2 | Note 2 | Note 2 | Note 2 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding highest accuracy requirement.  NOTE 3: NR operating band groups in FR1 are as defined in clause 3.5.2. | | | | | | | | |

##### 10.1.9.2.2 Relative CSI-RSRQ Accuracy

The relative accuracy of CSI-RSRQ is defined as the CSI-RSRQ measured from one cell compared to the CSI-RSRQ measured from another cell with the same center frequency, or between any two CSI-RSRQ levels measured on the same cell in FR1.

The accuracy requirements in Table 10.1.9.2.2-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.2.3 for a corresponding Band for the associated SSB.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.2.9 for a corresponding Band for each relevant CSI-RS.

- The bandwidth of CSI-RS is 48 PRBs and the density is 3.

• The performance with larger bandwidth of CSI-RS is equal to or better than the accuracy requirements in Table 10.1.9.2.2-1.

- The timing offset between the reference measurement timing and the target CSI-RS in one layer is no larger than CP.

Note: The reference measurement timing for one layer for inter-frequency measurement is up to UE implementation and shall be based on the timing of one of the target cells.

Table 10.1.9.2.2-1: CSI-RSRQ Inter frequency relative accuracy in FR1

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | | |
| Normal condition | Extreme condition | CSI-RS Ês/Iot | Io Note 1 range | | | | | |
|  |  | Note 2 | NR operating band groups Note 4 | Minimum Io | | | | Maximum Io |
| **dB** | **dB** | **dB** |  | **dBm / SCSCSI-RS** | | | **dBm/BWChannel** | **dBm/BWChannel** |
|  |  |  |  | **SCSCSI-RS = 15 kHz** | **SCSCSI-RS = 30 kHz** | **SCSCSI-RS = 60 kHz** |  |  |
|  |  |  | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -118 | -115 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_B | -120.5 | -117.5 | -114.5 | N/A | -50 |
|  |  |  | NR\_TDD\_FR1\_C | -120 | -117 | -114 | N/A | -50 |
| ±3 | ±4 | ≥-3 | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | -113.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | -113 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_F | -118.5 | -115.5 | -112.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_G | -118 | -115 | -112 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_H | -117.5 | -114.5 | -111.5 | N/A | -50 |
| ±4 | ±4 | ≥-6 | Note 3 | Note 3 | Note 3 | Note 3 | Note 3 | Note 3 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: The parameter CSI-RS Ês/Iot is the minimum CSI-RS Ês/Iot of the pair of cells to which the requirement applies.  NOTE 3: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding highest accuracy requirement.  NOTE 4: NR operating band groups in FR1 are as defined in clause 3.5.2. | | | | | | | | |

### 10.1.9B Inter-frequency RSRQ accuracy requirements for FR1 for CA/DC Idle Mode Measurements

#### 10.1.9B.1 Inter-frequency SS-RSRQ accuracy requirements in FR1

The requirements in this clause are applicable for a UE:

- in state RRC\_IDLE or RRC INACTIVE

- that is synchronised to the cell that is measured.

The requirements are for absolute accuracy of SS-RSRQ.

##### 10.1.9B.1.1 Absolute Accuracy of SS-RSRQ in FR1

The requirements for absolute accuracy of SS-RSRQ in this clause apply to a cell on a frequency in FR1 that has different carrier frequency from the serving cell.

The accuracy requirements in Table 10.1.9B.1.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.1.3 for a corresponding Band for each relevant SSB.

Table 10.1.9B.1.1-1: SS-RSRQ Inter frequency absolute accuracy in FR1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot | Io Note 1 range | | | | |
|  |  |  | NR operating band groups Note 3 | Minimum Io | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |  |
|  |  |  | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -118 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_B | -120.5 | -117.5 | N/A | -50 |
|  |  |  | NR\_TDD\_FR1\_C | -120 | -117 | N/A | -50 |
| ±4 | ±5.5 | ≥-3 | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_F | -118.5 | -115.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_G | -118 | -115 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_H | -117.5 | -114.5 | N/A | -50 |
| ±5 | ±5.5 | ≥-4 | Note 2 | Note 2 | Note 2 | Note 2 | Note 2 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding highest accuracy requirement.  NOTE 3: NR operating band groups in FR1 are as defined in clause 3.5.2. | | | | | | | |

### 10.1.9C Inter-frequency RSRQ accuracy requirements for FR1 SAN

#### 10.1.9C.1 Inter-frequency SS-RSRQ accuracy requirements in FR1

##### 10.1.9C.1.1 Absolute Accuracy of SS-RSRQ in FR1

The requirements for absolute accuracy of SS-RSRQ in this clause apply to a cell on a frequency in FR1 that has different carrier frequency from the serving cell.

The accuracy requirements in Table 10.1.9C.1.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.2.3 for a corresponding Band for each relevant SSB.

- Valid information for the SAN serving the target cell has been provided.

Table 10.1.9C.1.1-1: SS-RSRQ Inter frequency absolute accuracy in FR1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot | Io Note 1 range | | | | |
|  |  |  | NR operating band groups Note 3 | Minimum Io | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |  |
| ±[2.5] | ±[4] | ≥-3 | NR\_FDD\_SAB\_FR1\_A | -121 | -118 | N/A | -50 |
| ±[3.5] | ±[4] | ≥-6 | Note 2 | Note 2 | Note 2 | Note 2 | Note 2 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding highest accuracy requirement.  NOTE 3: NR operating band groups in FR1 are as defined in clause 3.5.2. | | | | | | | |

##### 10.1.9C.1.2 Relative Accuracy of SS-RSRQ in FR1

The relative accuracy of SS-RSRQ in inter frequency case is defined as the RSRQ measured from one cell on a frequency in FR1 compared to the RSRP measured from another cell on a different frequency in FR1.

The accuracy requirements in Table 10.1.9C.1.2-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.2.3 for a corresponding Band for each relevant SSB.

- |SSB\_RP1dBm - SSB\_RP2dBm| ≤ 27 dB

- |Channel 1\_Io ‑Channel 2\_Io | ≤ 20 dB

- Valid information for the SAN serving the target cell has been provided.

Table 10.1.9C.1.2-1: SS-RSRQ Inter frequency relative accuracy in FR1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot | Io Note 1 range | | | | |
|  |  | Note 2 | NR operating band groups Note 4 | Minimum Io | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |  |
| ±[3] | ±[4] | ≥-3 | NR\_FDD\_SAB\_FR1\_A | -121 | -118 | N/A | -50 |
| ±[4] | ±[4] | ≥-6 | Note 3 | Note 3 | Note 3 | Note 3 | Note 3 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: The parameter SSB Ês/Iot is the minimum SSB Ês/Iot of the pair of cells to which the requirement applies.  NOTE 3: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding highest accuracy requirement.  NOTE 4: NR operating band groups in FR1 are as defined in clause 3.5.2. | | | | | | | |

### 10.1.10 Inter-frequency RSRQ accuracy requirements for FR2

#### 10.1.10.1 Inter-frequency SS-RSRQ accuracy requirements in FR2

##### 10.1.10.1.1 Absolute Accuracy of SS-RSRQ in FR2

The requirements for absolute accuracy of SS-RSRQ in this clause apply to a cell on a frequency in FR2 that has different carrier frequency from the serving cell.

The accuracy requirements in Table 10.1.10.1.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-2 [19] for reference sensitivity are fulfilled.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.2.3 for a corresponding Band for each relevant SSB.

- The measured signals are in the directions covered by the percentile EIS spherical coverage of the UE, defined in clause 7.3.4 of TS 38.101-2 [19].

Table 10.1.10.1.1-1: SS-RSRQ Inter frequency absolute accuracy in FR2

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | |
| Normal condition | Extreme condition | SSB Ês/Iot | Io Note 2 range | | |
|  |  |  | Minimum Io | | Maximum Io |
| dB | dB | dB | dBm / SCSSSB Note 1 | | dBm/BWChannel |
|  |  |  | SCSSSB = 120kHz | SCSSSB = 240kHz |  |
| ±2.5 | ±4 | ≥-3 | Same value as SSB\_RP in Table B.2.2-2, according to UE Power class, operating band and angle of arrival | | -50 |
| ±3.5 | ±4 | ≥-4 |  | |  |
| Note 1: Values based on Refsens and EIS spherical coverage as defined in clauses 7.3.2 and 7.3.4 of TS 38.101-2 [19]. Applicable side condition selected depending on angle of arrival.  Note 2: Io specified at the Reference point, and assumed to have constant EPRE across the bandwidth.  Note 3: In the test cases, the SSB Ês/Iot and related parameters may need to be adjusted to ensure Ês/Iot at UE baseband is above the value defined in this table. | | | | | |

##### 10.1.10.1.2 Relative Accuracy of SS-RSRQ in FR2

The relative accuracy of SS-RSRQ in inter frequency case is defined as the RSRQ measured from one cell on a frequency in FR2 compared to the RSRP measured from another cell on a different frequency in FR2.

The accuracy requirements in Table 10.1.10.1.2-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-2 [19] for reference sensitivity are fulfilled.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.2.3 for a corresponding Band for each relevant SSB.

- |SSB\_RP1dBm - SSB\_RP2dBm| ≤ 27 dB

- | Channel 1\_Io ‑Channel 2\_Io | ≤ 20 dB

- The measured signals are in the directions covered by the percentile EIS spherical coverage of the UE, defined in clause 7.3.4 of TS 38.101-2 [19].

Table 10.1.10.1.2-1: SS-RSRQ Inter frequency relative accuracy in FR2

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | |
| Normal condition | Extreme condition | SSB Ês/Iot | Io Note 2 range | | |
|  |  |  | Minimum Io | | Maximum Io |
| dB | dB | dB | dBm / SCSSSB Note 1 | | dBm/BWChannel |
|  |  |  | SCSSSB = 120kHz | SCSSSB = 240kHz |  |
| ±3 | ±4 | ≥-3 | Same value as SSB\_RP in Table B.2.2-2, according to UE Power class, operating band and angle of arrival | | -50 |
| ±4 | ±4 | ≥-4 |  | |  |
| Note 1: Values based on Refsens and EIS spherical coverage as defined in clauses 7.3.2 and 7.3.4 of TS 38.101-2 [19]. Applicable side condition selected depending on angle of arrival.  Note 2: Io specified at the Reference point, and assumed to have constant EPRE across the bandwidth.  Note 3: The parameter SSB Ês/Iot is the minimum SSB Ês/Iot of the pair of cells to which the requirement applies.  Note 4: In the test cases, the SSB Ês/Iot and related parameters may need to be adjusted to ensure Ês/Iot at UE baseband is above the value defined in this table. | | | | | |

#### 10.1.10.2 Inter-frequency CSI-RSRQ accuracy requirements

##### 10.1.10.2.1 Absolute CSI-RSRQ Accuracy

Unless otherwise specified, the requirements for absolute accuracy of CSI-RSRQ in this clause apply the inter-frequency measurement defined in 9.10.3.1 in FR2.

The accuracy requirements in Table 10.1.10.2.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-2 [19] for reference sensitivity are fulfilled.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.2.3 for a corresponding Band for associated SSB.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.2.9 for a corresponding Band for each relevant CSI-RS.

- The bandwidth of CSI-RS is 48 PRBs and the density is 3.

• The performance with larger bandwidth of CSI-RS is equal to or better than the accuracy requirements in Table 10.1.10.2.1-1.

- The timing offset between the reference measurement timing and the target CSI-RS in one layer is no larger than CP.

Note: The reference measurement timing for one layer for inter-frequency measurement is up to UE implementation and shall be based on the timing of one of the target cells.

Table 10.1.10.2.1-1: CSI-RSRQ Inter frequency absolute accuracy in FR2

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | |
| Normal condition | Extreme condition | CSI-RS Ês/Iot | Io Note 2 range | | |
|  |  |  | Minimum Io | | Maximum Io |
| dB | dB | dB | dBm / SCSCSI-RS Note 1 | | dBm/BWChannel |
|  |  |  | SCSCSI-RS = 60kHz | SCSCSI-RS = 120kHz |  |
| ±2.5 | ±4 | ≥-3 | Same value as CSI\_RP in Table B.2.9-2, according to UE Power class, operating band and angle of arrival | | -50 |
| ±3.5 | ±4 | ≥-4 |  | |  |
| Note 1: Values based on Refsens and EIS spherical coverage as defined in clauses 7.3.2 and 7.3.4 of TS 38.101-2 [19]. Applicable side condition selected depending on angle of arrival.  Note 2: Io specified at the Reference point, and assumed to have constant EPRE across the bandwidth.  Note 3: In the test cases, the CSI-RS Ês/Iot and related parameters may need to be adjusted to ensure Ês/Iot at UE baseband is above the value defined in this table. | | | | | |

##### 10.1.10.2.2 Relative CSI-RSRQ Accuracy

The relative accuracy of CSI-RSRQ is defined as the CSI-RSRQ measured from one cell compared to the CSI-RSRQ measured from another cell with the same center frequency, or between any two CSI-RSRQ levels measured on the same cell in FR2.

The accuracy requirements in Table 10.1.10.2.2-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-2 [19] for reference sensitivity are fulfilled.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.2.3 for a corresponding Band for the associated SSB.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.2.9 for a corresponding Band for each relevant CSI-RS.

- The bandwidth of CSI-RS is 48 PRBs and the density is 3.

• The performance with larger bandwidth of CSI-RS is equal to or better than the accuracy requirements in Table 10.1.10.2.2-1.

- The timing offset between the reference measurement timing and the target CSI-RS in one layer is no larger than CP.

Note: The reference measurement timing for one layer for inter-frequency measurement is up to UE implementation and shall be based on the timing of one of the target cells.

Table 10.1.10.2.2-1: CSI-RSRQ Inter frequency relative accuracy in FR2

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | |
| Normal condition | Extreme condition | CSI-RS Ês/Iot | Io Note 2 range | | |
|  |  |  | Minimum Io | | Maximum Io |
| dB | dB | dB | dBm / SCSCSI-RS Note 1 | | dBm/BWChannel |
|  |  |  | SCSCSI-RS = 60kHz | SCSCSI-RS = 120kHz |  |
| ±3 | ±4 | ≥-3 | Same value as CSI\_RP in Table B.2.9-2, according to UE Power class, operating band and angle of arrival | | -50 |
| ±4 | ±4 | ≥-4 |  | |  |
| Note 1: Values based on Refsens and EIS spherical coverage as defined in clauses 7.3.2 and 7.3.4 of TS 38.101-2 [19]. Applicable side condition selected depending on angle of arrival.  Note 2: Io specified at the Reference point, and assumed to have constant EPRE across the bandwidth.  Note 3: The parameter CSI-RS Ês/Iot is the minimum CSI-RS Ês/Iot of the pair of cells to which the requirement applies.  Note 4: In the test cases, the CSI-RS Ês/Iot and related parameters may need to be adjusted to ensure Ês/Iot at UE baseband is above the value defined in this table. | | | | | |

### 10.1.10B Inter-frequency RSRQ accuracy requirements for FR2 for CA/DC Idle Mode Measurements

#### 10.1.10B.1 Inter-frequency SS-RSRQ accuracy requirements in FR2

The requirements in this clause are applicable for a UE:

- in state RRC\_IDLE or RRC INACTIVE

- that is synchronised to the cell that is measured.

The requirements are for absolute accuracy of SS-RSRQ.

##### 10.1.10B.1.1 Absolute Accuracy of SS-RSRQ in FR2

The requirements for absolute accuracy of SS-RSRQ in this clause apply to a cell on a frequency in FR2 that has different carrier frequency from the serving cell.

The accuracy requirements in Table 10.1.10B.1.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-2 [19] for reference sensitivity are fulfilled.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.1.3 for a corresponding Band for each relevant SSB.

- The measured signals are in the directions covered by the percentile EIS spherical coverage of the UE, defined in clause 7.3.4 of TS 38.101-2 [19].

Table 10.1.10B.1.1-1: SS-RSRQ Inter frequency absolute accuracy in FR2

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | |
| Normal condition | Extreme condition | SSB Ês/Iot | Io Note 2 range | | |
|  |  |  | Minimum Io | | Maximum Io |
| dB | dB | dB | dBm / SCSSSB Note 1 | | dBm/BWChannel |
|  |  |  | SCSSSB = 120kHz | SCSSSB = 240kHz |  |
| ±4 | ±5.5 | ≥-3 | Same value as SSB\_RP in Table B.2.2-2, according to UE Power class, operating band and angle of arrival | | -50 |
| ±5 | ±5.5 | ≥-4 |  | |  |
| Note 1: Values based on Refsens and EIS spherical coverage as defined in clauses 7.3.2 and 7.3.4 of TS 38.101-2 [19]. Applicable side condition selected depending on angle of arrival.  Note 2: Io specified at the Reference point, and assumed to have constant EPRE across the bandwidth.  Note 3: In the test cases, the SSB Ês/Iot and related parameters may need to be adjusted to ensure Ês/Iot at UE baseband is above the value defined in this table. | | | | | |

### 10.1.11 RSRQ report mapping

10.1.11.1 SS-RSRQ and CSI-RSRQ measurement report mapping

The reporting range of SS-RSRQ and CSI-RSRQ measurement is defined from -43 dB to 20 dB with 0.5 dB resolution. The mapping of measured quantity is defined in Table 10.1.11.1-1. The range in the signalling may be larger than the guaranteed accuracy range.

Table 10.1.11.1-1: SS-RSRQ and CSI-RSRQ measurement report mapping

|  |  |  |
| --- | --- | --- |
| Reported value | Measured quantity value | Unit |
| SS-RSRQ\_0 | SS-RSRQ<-43 | dB |
| SS-RSRQ\_1 | -43≤ SS-RSRQ<-42.5 | dB |
| SS-RSRQ\_2 | -42.5≤ SS-RSRQ<-42 | dB |
| SS-RSRQ\_3 | -42≤ SS-RSRQ<-41.5 | dB |
| SS-RSRQ\_4 | -41.5≤ SS-RSRQ<-41 | dB |
| .. | .. | … |
| SS-RSRQ\_122 | 17.5≤ SS-RSRQ<18 | dB |
| SS-RSRQ\_123 | 18≤ SS-RSRQ<18.5 | dB |
| SS-RSRQ\_124 | 18.5≤ SS-RSRQ<19 | dB |
| SS-RSRQ\_125 | 19≤ SS-RSRQ<19.5 | dB |
| SS-RSRQ\_126 | 19.5≤ SS-RSRQ<20 | dB |
| SS-RSRQ\_127 | 20 ≤ SS-RSRQ | dB |

### 10.1.12 Intra-frequency SINR accuracy requirements for FR1

#### 10.1.12.1 Intra-frequency SS-SINR accuracy requirements in FR1

##### 10.1.12.1.1 Absolute SS-SINR Accuracy in FR1

Unless otherwise specified, the requirements for absolute accuracy of SS-SINR in this clause apply to a cell on the same frequency as that of the serving cell in FR1.

The accuracy requirements in Table 10.1.12.1.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for intra-frequency measurements are fulfilled according to Annex B.2.2 for a corresponding Band.

Table 10.1.12.1.1-1: SS-SINR Intra frequency absolute accuracy in FR1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot | Io Note 1 range | | | | |
|  |  | Note 3 | NR operating band groups Note 4 | Minimum Io | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |  |
|  |  |  | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -118 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_B | -120.5 | -117.5 | N/A | -50 |
|  |  |  | NR\_TDD\_FR1\_C | -120 | -117 | N/A | -50 |
| ±3.0 | ±4 | ≥-3 | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_F | -118.5 | -115.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_G | -118 | -115 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_H | -117.5 | -114.5 | N/A | -50 |
| ±3.5 | ±4 | ≥-6 | Note 2 | Note 2 | Note 2 | Note 2 | Note 2 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding highest accuracy requirement.  NOTE 3: The requirements apply for SSB Ês/Iot ≤ 25 dB under non-HST scenarios.  NOTE 4: NR operating band groups in FR1 are as defined in clause 3.5.2.  NOTE 5: The requirements apply for SSB Ês/Iot ≤5 dB with SCS 15kHz or 30kHz under NR high speed scenarios. | | | | | | | |

#### 10.1.12.2 Intra-frequency CSI-SINR accuracy requirements in FR1

##### 10.1.12.2.1 Absolute CSI-SINR Accuracy in FR1

Unless otherwise specified, the requirements for absolute accuracy of CSI-SINR in this clause apply to a cell on the same frequency as that of the serving cell in FR1.

The accuracy requirements in Table 10.1.12.2.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for intra-frequency measurements are fulfilled according to Annex B.2.8 for a corresponding Band.

- The timing offset between the reference measurement timing and the target CSI-RS in one layer is no larger than CP.

• Note: The reference measurement timing for intra-frequency measurement is serving cell timing.

- The bandwidth of CSI-RS is 48 PRBs and the density is 3.

• The performance with larger bandwidth of CSI-RS is equal to or better than the accuracy requirements in Table 10.1.12.2.1-1.

Table 10.1.12.2.1-1: CSI-SINR Intra frequency absolute accuracy in FR1

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | | |
| Normal condition | Extreme condition | CSI-RS Ês/Iot | Io Note 1 range | | | | | |
| NR operating band groups | Minimum Io | | | | Maximum Io |
| dB | dB | dB |  | dBm / SCS | | | dBm/BW Channel | dBm/BW Channel |
| SCS (kHz) | | |
| ±3 | ±4 | ≥-3 | 15 | 30 | 60 |
| NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -118 | -115 | N/A | -70 |
| NR\_FDD\_FR1\_B | -120.5 | -117.5 | -114.5 | N/A | -70 |
| NR\_TDD\_FR1\_C | -120 | -117 | -114 | N/A | -70 |
| NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | -113.5 | N/A | -70 |
| NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | -113 | N/A | -70 |
| NR\_FDD\_FR1\_F | -118.5 | -115.5 | -112.5 | N/A | -70 |
| NR\_FDD\_FR1\_G | -118 | -115 | -112 | N/A | -70 |
| NR\_FDD\_FR1\_H | -117.5 | -114.5 | -111.5 | N/A | -70 |
| ±3.5 | ±4 | ≥-6 | Note 2 | Note 2 | Note 2 | Note 2 | N/A | Note 2 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding highest accuracy requirement.  NOTE 3: NR operating band groups in FR1 are as defined in clause 3.5.2.  NOTE 4: The requirements apply for CSI-RS Ês/Iot ≤XdB. X=15 if timing offset between the reference measurement timing and the target CSI-RS is no larger than 0.5\*CP, and X=4 if timing offset between the reference measurement timing and the target CSI-RS is larger than 0.5\*CP but no larger than CP. | | | | | | | | |

### 10.1.12C Intra-frequency SINR accuracy requirements for FR1 SAN

#### 10.1.12C.1 Intra-frequency SS-SINR accuracy requirements in FR1

##### 10.1.12C.1.1 Absolute SS-SINR Accuracy in FR1

Unless otherwise specified, the requirements for absolute accuracy of SS-SINR in this clause apply to a cell on the same frequency as that of the serving cell in FR1.

The accuracy requirements in Table 10.1.12C.1.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for intra-frequency measurements are fulfilled according to Annex B.2.2 for a corresponding Band.

- Valid information for the SAN serving the target cell has been provided.

Table 10.1.12C.1.1-1: SS-SINR Intra frequency absolute accuracy in FR1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot | Io Note 1 range | | | | |
|  |  | Note 3 | NR operating band groups Note 4 | Minimum Io | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |  |
| ±[3] | ±[4] | ≥-3 | NR\_FDD\_SAB\_FR1\_A | -121 | -118 | N/A | -50 |
| ±[3.5] | ±[4] | ≥-6 | Note 2 | Note 2 | Note 2 | Note 2 | Note 2 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding highest accuracy requirement.  NOTE 3: The requirements apply for SSB Ês/Iot ≤ 25 dB under non-HST scenarios.  NOTE 4: NR operating band groups in FR1 are as defined in clause 3.5.2.  NOTE 5: The requirements apply for SSB Ês/Iot ≤5 dB with SCS 15kHz or 30kHz under NR high speed scenarios. | | | | | | | |

### 10.1.13 Intra-frequency SINR accuracy requirements for FR2

#### 10.1.13.1 Intra-frequency SS-SINR accuracy requirements in FR2

##### 10.1.13.1.1 Absolute SS-SINR Accuracy in FR2

Unless otherwise specified, the requirements for absolute accuracy of SS-SINR in this clause apply to a cell on the same frequency as that of the serving cell in FR2.

The accuracy requirements in Table 10.1.13.1.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-2 [19] for reference sensitivity are fulfilled.

- Conditions for intra-frequency measurements are fulfilled according to Annex B.2.2 for a corresponding Band.

- The measured signals are in the directions covered by the percentile EIS spherical coverage of the UE, defined in clause 7.3.4 of TS 38.101-2 [19].

Table 10.1.13.1.1-1: SS-SINR Intra frequency absolute accuracy in FR2

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | |
| Normal condition | Extreme condition | SSB Ês/Iot | Io Note 2 range | | |
|  |  |  | Minimum Io | | Maximum Io |
| dB | dB | dB | dBm / SCSSSB Note 1 | | dBm/BWChannel |
|  |  |  | SCSSSB = 120kHz | SCSSSB = 240kHz |  |
| ±3 | ±4 | ≥-3 | Same value as SSB\_RP in Table B.2.2-2, according to UE Power class, operating band and angle of arrival | | -50 |
| ±3.5 | ±4 | ≥-6 |  | |  |
| Note 1: Values based on Refsens and EIS spherical coverage as defined in clauses 7.3.2 and 7.3.4 of TS 38.101-2 [19]. Applicable side condition selected depending on angle of arrival.  Note 2: Io specified at the Reference point, and assumed to have constant EPRE across the bandwidth.  Note 3: In the test cases, the SSB Ês/Iot and related parameters may need to be adjusted to ensure Ês/Iot at UE baseband is above the value defined in this table.  Note 4: The requirements apply for SSB Ês/Iot ≤ 25 dB. | | | | | |

#### 10.1.13.2 Intra-frequency CSI-SINR accuracy requirements in FR2

##### 10.1.13.2.1 Absolute CSI-SINR Accuracy in FR2

Unless otherwise specified, the requirements for absolute accuracy of CSI-SINR in this clause apply to a cell on the same frequency as that of the serving cell in FR2.

The accuracy requirements in Table 10.1.13.2.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-2 [19] for reference sensitivity are fulfilled.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.2.8 for a corresponding Band.

- The measured signals are in the directions covered by the percentile EIS spherical coverage of the UE, defined in clause 7.3.4 of TS 38.101-2 [19].

- The timing offset between the reference measurement timing and the target CSI-RS in one layer is no larger than CP.

• Note: The reference measurement timing for intra-frequency measurement is serving cell timing.

- The bandwidth of CSI-RS is 48 PRBs and the density is 3.

• The performance with larger bandwidth of CSI-RS is equal to or better than the accuracy requirements in Table 10.1.13.2.1-1.

Table 10.1.13.2.1-1: CSI-SINR Intra frequency absolute accuracy in FR2

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | |
| Normal condition | Extreme condition | CSI-RS Ês/Iot | Io Note 2 range | | |
|  |  |  | Minimum Io | | Maximum Io |
| dB | dB | dB | dBm / SCSCSI-RS Note 1 | | dBm/BWChannel |
|  |  |  | SCSCSI-RS = 60kHz | SCSCSI-RS = 120kHz |  |
| ±3 | ±4 | ≥-3 | Same value as CSI\_RP in Table B.2.8-2, according to UE Power class, operating band and angle of arrival | | -50 |
| ±3.5 | ±4 | ≥-6 |
| Note 1: Values based on Refsens and EIS spherical coverage as defined in clauses 7.3.2 and 7.3.4 of TS 38.101-2 [19]. Applicable side condition selected depending on angle of arrival.  Note 2: Io specified at the Reference point, and assumed to have constant EPRE across the bandwidth.  Note 3: In the test cases, the CSI-RS Ês/Iot and related parameters may need to be adjusted to ensure Ês/Iot at UE baseband is above the value defined in this table.  Note 4: The requirements apply for CSI-RS Ês/Iot ≤XdB. X=15 if timing offset between the reference measurement timing and the target CSI-RS is no larger than 0.5\*CP, and X=4 if timing offset between the reference measurement timing and the target CSI-RS is larger than 0.5\*CP but no larger than CP. | | | | | |

### 10.1.14 Inter-frequency SINR accuracy requirements for FR1

#### 10.1.14.1 Inter-frequency SS-SINR accuracy requirements in FR1

##### 10.1.14.1.1 Aboslute Accuracy of SS-SINR in FR1

The requirements for absolute accuracy of SS-SINR in this clause apply to a cell on a frequency in FR1 that has different carrier frequency from the serving cell.

The accuracy requirements in Table 10.1.14.1.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.2.3 for a corresponding Band.

Table 10.1.14.1.1-1: SS-SINR Inter frequency absolute accuracy in FR1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot Note 3 | Io Note 1 range | | | | |
|  |  | NR operating band groups Note 4 | Minimum Io | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |  |
|  |  |  | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -118 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_B | -120.5 | -117.5 | N/A | -50 |
|  |  |  | NR\_TDD\_FR1\_C | -120 | -117 | N/A | -50 |
| ±3.0 | ±4 | ≥-3 | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_F | -118.5 | -115.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_G | -118 | -115 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_H | -117.5 | -114.5 | N/A | -50 |
| ±3.5 | ±4 | ≥-6 | Note 2 | Note 2 | Note 2 | Note 2 | Note 2 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding highest accuracy requirement.  NOTE 3: The requirements apply for SSB Ês/Iot ≤ 25 dB.  NOTE 4: NR operating band groups in FR1 are as defined in clause 3.5.2.  NOTE 5: The requirements apply for SSB Ês/Iot ≤ [5] dB with SCS 15kHz or 30kHz under NR high speed scenarios. | | | | | | | |

##### 10.1.14.1.2 Relative Accuracy of SS-SINR in FR1

The relative accuracy of SS-SINR in inter frequency case is defined as the SS-SINR measured from one cell on a frequency in FR1 compared to the SS-SINR measured from another cell on a different frequency in FR1.

The accuracy requirements in Table 10.1.14.1.2-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.2.3 for a corresponding Band.

- |SSB\_RP1dBm - SSB\_RP2dBm| ≤ 27 dB

- | Channel 1\_Io ‑Channel 2\_Io | ≤ 20 dB

Table 10.1.14.1.2-1: SS-SINR Inter frequency relative accuracy in FR1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot | Io Note 1 range | | | | |
|  |  | Note 2,4 | NR operating band groups Note 5 | Minimum Io | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 120 kHz | SCSSSB = 240 kHz |  |  |
|  |  |  | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A, NR\_SDL\_FR1\_A | -121 | -118 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_B | -120.5 | -117.5 | N/A | -50 |
|  |  |  | NR\_TDD\_FR1\_C | -120 | -117 | N/A | -50 |
| ±3.5 | ±4 | ≥-3 | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_F | -118.5 | -115.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_G | -118 | -115 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_H | -117.5 | -114.5 | N/A | -50 |
| ±4 | ±4 | ≥-6 | Note 3 | Note 3 | Note 3 | Note 3 | Note 3 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: The parameter SSB Ês/Iot is the minimum SSB Ês/Iot of the pair of cells to which the requirement applies.  NOTE 3: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding highest accuracy requirement.  NOTE 4: The requirements apply for SSB Ês/Iot ≤ [25] dB.  NOTE 5: NR operating band groups in FR1 are as defined in clause 3.5.2.  NOTE 6: The requirements apply for SSB Ês/Iot ≤ [5] dB with SCS 15kHz or 30kHz under NR high speed scenarios. | | | | | | | |

#### 10.1.14.2 Inter-frequency CSI-SINR accuracy requirements in FR1

##### 10.1.14.2.1 Aboslute Accuracy of CSI-SINR in FR1

The requirements for absolute accuracy of CSI-SINR in this clause apply to a cell on a frequency in FR1 that has different carrier frequency from the serving cell.

The accuracy requirements in Table 10.1.14.2.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.2.9 for a corresponding Band.

- The timing offset between the reference measurement timing and the target CSI-RS in one layer is no larger than CP.

• Note: The reference measurement timing for inter-frequency measurement is up to UE implementation and shall be based on the timing of one of the target cells.

- The bandwidth of CSI-RS is 48 PRBs and the density is 3.

• The performance with larger bandwidth of CSI-RS is equal to or better than the accuracy requirements in Table 10.1.14.2.1-1.

Table 10.1.14.2.1-1: CSI-SINR Inter frequency absolute accuracy in FR1

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | | |
| Normal condition | Extreme condition | CSI-RS Ês/Iot | Io Note 1 range | | | | | |
| NR operating band groups | Minimum Io | | | | Maximum Io |
| dB | dB | dB |  | dBm / SCS | | | dBm/BW Channel | dBm/BW Channel |
| SCS (kHz) | | |
| ±3 | ±4 | ≥-3 | **15** | **30** | **60** |
| NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -118 | -115 | N/A | -70 |
| NR\_FDD\_FR1\_B | -120.5 | -117.5 | -114.5 | N/A | -70 |
| NR\_TDD\_FR1\_C | -120 | -117 | -114 | N/A | -70 |
| NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | -113.5 | N/A | -70 |
| NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | -113 | N/A | -70 |
| NR\_FDD\_FR1\_F | -118.5 | -115.5 | -112.5 | N/A | -70 |
| NR\_FDD\_FR1\_G | -118 | -115 | -112 | N/A | -70 |
| NR\_FDD\_FR1\_H | -117.5 | -114.5 | -111.5 | N/A | -70 |
| ±3.5 | ±4 | ≥-6 | Note 2 | Note 2 | Note 2 | Note 2 | N/A | Note 2 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding highest accuracy requirement.  NOTE 3: NR operating band groups in FR1 are as defined in clause 3.5.2.  NOTE 4: The requirements apply for CSI-RS Ês/Iot ≤XdB. X=15 if timing offset between the reference measurement timing and the target CSI-RS is no larger than 0.5\*CP, and X=4 if timing offset between the reference measurement timing and the target CSI-RS is larger than 0.5\*CP but no larger than CP. | | | | | | | | |

##### 10.1.14.2.2 Relative Accuracy of CSI-SINR in FR1

The relative accuracy of CSI-SINR in inter frequency case is defined as the CSI-SINR measured from one cell on a frequency in FR1 compared to the CSI-SINR measured from another cell on a different frequency in FR1.

The accuracy requirements in Table 10.1.14.2.2-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.2.9 for a corresponding Band.

- |CSI\_RP1dBm - CSI\_RP2dBm| ≤ 27 dB

- | Channel 1\_Io ‑Channel 2\_Io | ≤ 20 dB

- The timing offset between the reference measurement timing and the target CSI-RS in one layer is no larger than CP.

* Note: The reference measurement timing for inter-frequency measurement is up to UE implementation and shall be based on the timing of one of the target cells.

- The bandwidth of CSI-RS is 48 PRBs and the density is 3.

• The performance with larger bandwidth of CSI-RS is equal to or better than the accuracy requirements in Table 10.1.14.2.2-1.

Table 10.1.14.2.2-1: CSI-SINR Inter frequency relative accuracy in FR1

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Accuracy** | | **Conditions** | | | | | | |
| **Normal condition** | **Extreme condition** | **CSI-RS Ês/Iot****Note 3** | **Io Note 1 range** | | | | | |
| **NR operating band groups** | **Minimum Io** | | | | **Maximum Io** |
| **dB** | **dB** | **dB** |  | **dBm / SCS** | | | **dBm/BW Channel** | **dBm/BW Channel** |
| **SCS (kHz)** | | |
| ±3.5 | ±4 | ≥-3 | **15** | **30** | **60** |
| NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -118 | -115 | N/A | -70 |
| NR\_FDD\_FR1\_B | -120.5 | -117.5 | -114.5 | N/A | -70 |
| NR\_TDD\_FR1\_C | -120 | -117 | -114 | N/A | -70 |
| NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | -113.5 | N/A | -70 |
| NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | -113 | N/A | -70 |
| NR\_FDD\_FR1\_F | -118.5 | -115.5 | -112.5 | N/A | -70 |
| NR\_FDD\_FR1\_G | -118 | -115 | -112 | N/A | -70 |
| NR\_FDD\_FR1\_H | -117.5 | -114.5 | -111.5 | N/A | -70 |
| ±4 | ±4 | ≥-6 | Note 2 | Note 2 | Note 2 | Note 2 | N/A | Note 2 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding highest accuracy requirement.  NOTE 3: The parameter CSI-RS Ês/Iot is the minimum CSI-RS Ês/Iot of the pair of cells to which the requirement applies.  NOTE 4: NR operating band groups in FR1 are as defined in clause 3.5.2.  NOTE 5: The requirements apply for CSI-RS Ês/Iot ≤ XdB. X=15 if timing offset between the reference measurement timing and the target CSI-RS is no larger than 0.5\*CP, and X=4 if timing offset between the reference measurement timing and the target CSI-RS is larger than 0.5\*CP but no larger than CP. | | | | | | | | |

### 10.1.14C Inter-frequency SINR accuracy requirements for FR1 SAN

#### 10.1.14C.1 Inter-frequency SS-SINR accuracy requirements in FR1

##### 10.1.14C.1.1 Aboslute Accuracy of SS-SINR in FR1

The requirements for absolute accuracy of SS-SINR in this clause apply to a cell on a frequency in FR1 that has different carrier frequency from the serving cell.

The accuracy requirements in Table 10.1.14C.1.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.2.3 for a corresponding Band.

- Valid information for the SAN serving the target cell has been provided.

Table 10.1.14C.1.1-1: SS-SINR Inter frequency absolute accuracy in FR1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot Note 3 | Io Note 1 range | | | | |
|  |  | NR operating band groups Note 4 | Minimum Io | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |  |
| ±[3] | ±[4] | ≥-3 | NR\_FDD\_SAB\_FR1\_A | -121 | -118 | N/A | -50 |
| ±[3.5] | ±[4] | ≥-6 | Note 2 | Note 2 | Note 2 | Note 2 | Note 2 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding highest accuracy requirement.  NOTE 3: The requirements apply for SSB Ês/Iot ≤ 25 dB.  NOTE 4: NR operating band groups in FR1 are as defined in clause 3.5.2. | | | | | | | |

##### 10.1.14C.1.2 Relative Accuracy of SS-SINR in FR1

The relative accuracy of SS-SINR in inter frequency case is defined as the SS-SINR measured from one cell on a frequency in FR1 compared to the SS-SINR measured from another cell on a different frequency in FR1.

The accuracy requirements in Table 10.1.14C.1.2-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.2.3 for a corresponding Band.

- |SSB\_RP1dBm - SSB\_RP2dBm| ≤ 27 dB

- | Channel 1\_Io ‑Channel 2\_Io | ≤ 20 dB

- Valid information for the SAN serving the target cell has been provided.

Table 10.1.14C.1.2-1: SS-SINR Inter frequency relative accuracy in FR1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot | Io Note 1 range | | | | |
|  |  | Note 2,4 | NR operating band groups Note 5 | Minimum Io | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 120 kHz | SCSSSB = 240 kHz |  |  |
| ±[3.5] | ±[4] | ≥-3 | NR\_FDD\_SAB\_FR1\_A | -121 | -118 | N/A | -50 |
| ±[4] | ±[4] | ≥-6 | Note 3 | Note 3 | Note 3 | Note 3 | Note 3 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: The parameter SSB Ês/Iot is the minimum SSB Ês/Iot of the pair of cells to which the requirement applies.  NOTE 3: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding highest accuracy requirement.  NOTE 4: The requirements apply for SSB Ês/Iot ≤ [25] dB.  NOTE 5: NR operating band groups in FR1 are as defined in clause 3.5.2. | | | | | | | |

### 10.1.15 Inter-frequency SINR accuracy requirements for FR2

#### 10.1.15.1 Inter-frequency SS-SINR accuracy requirements in FR2

##### 10.1.15.1.1 Aboslute Accuracy of SS-SINR in FR2

The requirements for absolute accuracy of SS-SINR in this clause apply to a cell on a frequency in FR2 that has different carrier frequency from the serving cell.

The accuracy requirements in Table 10.1.15.1.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-2 [19] for reference sensitivity are fulfilled.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.2.3 for a corresponding Band.

- The measured signals are in the directions covered by the percentile EIS spherical coverage of the UE, defined in clause 7.3.4 of TS 38.101-2 [19].

Table 10.1.15.1.1-1: SS-SINR Inter frequency absolute accuracy in FR2

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | |
| Normal condition | Extreme condition | SSB Ês/Iot | Io Note 2 range | | |
|  |  |  | Minimum Io | | Maximum Io |
| dB | dB | dB | dBm / SCSSSB Note 1 | | dBm/BWChannel |
|  |  |  | SCSSSB = 120kHz | SCSSSB = 240kHz |  |
| ±3 | ±4 | ≥-3 | Same value as SSB\_RP in Table B.2.2-2, according to UE Power class, operating band and angle of arrival | | -50 |
| ±3.5 | ±4 | ≥-4 |  | |  |
| Note 1: Values based on Refsens and EIS spherical coverage as defined in clauses 7.3.2 and 7.3.4 of TS 38.101-2 [19]. Applicable side condition selected depending on angle of arrival.  Note 2: Io specified at the Reference point, and assumed to have constant EPRE across the bandwidth.  Note 3: In the test cases, the SSB Ês/Iot and related parameters may need to be adjusted to ensure Ês/Iot at UE baseband is above the value defined in this table.  Note 4: The requirements apply for SSB Ês/Iot ≤ 25 dB. | | | | | |

##### 10.1.15.1.2 Relative Accuracy of SS-SINR in FR2

The relative accuracy of SS-SINR in inter frequency case is defined as the SS-SINR measured from one cell on a frequency in FR2 compared to the SS-SINR measured from another cell on a different frequency in FR2.

The accuracy requirements in Table 10.1.15.1.2-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-2 [19] for reference sensitivity are fulfilled.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.2.3 for a corresponding Band.

- |SSB\_RP1dBm - SSB\_RP2dBm| ≤ 27 dB

- | Channel 1\_Io ‑Channel 2\_Io | ≤ 20 dB

- The measured signals are in the directions covered by the percentile EIS spherical coverage of the UE, defined in clause 7.3.4 of TS 38.101-2 [19].

Table 10.1.15.1.2-1: SS-SINR Inter frequency relative accuracy in FR2

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | |
| Normal condition | Extreme condition | SSB Ês/Iot | Io Note 2 range | | |
|  |  |  | Minimum Io | | Maximum Io |
| dB | dB | dB | dBm / SCSSSB Note 1 | | dBm/BWChannel |
|  |  |  | SCSSSB = 120kHz | SCSSSB = 240kHz |  |
| ±3.5 | ±4 | ≥-3 | Same value as SSB\_RP in Table B.2.2-2, according to UE Power class, operating band and angle of arrival | | -50 |
| ±4 | ±4 | ≥-6 |  | |  |
| Note 1: Values based on Refsens and EIS spherical coverage as defined in clauses 7.3.2 and 7.3.4 of TS 38.101-2 [19]. Applicable side condition selected depending on angle of arrival.  Note 2: Io specified at the Reference point, and assumed to have constant EPRE across the bandwidth.  Note 3: The parameter SSB Ês/Iot is the minimum SSB Ês/Iot of the pair of cells to which the requirement applies.  Note 4: In the test cases, the SSB Ês/Iot and related parameters may need to be adjusted to ensure Ês/Iot at UE baseband is above the value defined in this table.  Note 5: The requirements apply for SSB Ês/Iot ≤ 25 dB. | | | | | |

#### 10.1.15.2 Inter-frequency CSI-SINR accuracy requirements in FR2

##### 10.1.15.2.1 Aboslute Accuracy of CSI-SINR in FR2

The requirements for absolute accuracy of CSI-SINR in this clause apply to a cell on a frequency in FR2 that has different carrier frequency from the serving cell.

The accuracy requirements in Table 10.1.15.2.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-2 [19] for reference sensitivity are fulfilled.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.2.9 for a corresponding Band.

- The measured signals are in the directions covered by the percentile EIS spherical coverage of the UE, defined in clause 7.3.4 of TS 38.101-2 [19].

- The timing offset between the reference measurement timing and the target CSI-RS in one layer is no larger than CP.

• Note: The reference measurement timing for inter-frequency measurement is up to UE implementation and shall be based on the timing of one of the target cells.

- The bandwidth of CSI-RS is 48 PRBs and the density is 3.

• The performance with larger bandwidth of CSI-RS is equal to or better than the accuracy requirements in Table 10.1.15.2.1-1.

Table 10.1.15.2.1-1: CSI-SINR Inter frequency absolute accuracy in FR2

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | |
| Normal condition | Extreme condition | CSI-RS Ês/Iot | Io Note 2 range | | |
|  |  |  | Minimum Io | | Maximum Io |
| dB | dB | dB | dBm / SCSCSI-RS Note 1 | | dBm/BWChannel |
|  |  |  | SCSCSI-RS = 60kHz | SCSCSI-RS = 120kHz |  |
| ±3 | ±4 | ≥-3 | Same value as CSI\_RP in Table B.2.9-2, according to UE Power class, operating band and angle of arrival | | -50 |
| 3.5 | ±4 | ≥-4 |
| Note 1: Values based on Refsens and EIS spherical coverage as defined in clauses 7.3.2 and 7.3.4 of TS 38.101-2 [19]. Applicable side condition selected depending on angle of arrival.  Note 2: Io specified at the Reference point, and assumed to have constant EPRE across the bandwidth.  Note 3: In the test cases, the CSI-RS Ês/Iot and related parameters may need to be adjusted to ensure Ês/Iot at UE baseband is above the value defined in this table.  Note 4: The requirements apply for CSI-RS Ês/Iot ≤XdB. X=15 if timing offset between the reference measurement timing and the target CSI-RS is no larger than 0.5\*CP, and X=4 if timing offset between the reference measurement timing and the target CSI-RS is larger than 0.5\*CP but no larger than CP. | | | | | |

##### 10.1.15.2.2 Relative Accuracy of CSI-SINR in FR2

The relative accuracy of CSI-SINR in inter frequency case is defined as the CSI-SINR measured from one cell on a frequency in FR2 compared to the CSI-SINR measured from another cell on a different frequency in FR2.

The accuracy requirements in Table 10.1.15.2.2-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-2 [19] for reference sensitivity are fulfilled.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.2.y for a corresponding Band.

- |CSI\_RP1dBm - CSI\_RP2dBm| ≤ 27 dB

- | Channel 1\_Io ‑Channel 2\_Io | ≤ 20 dB

- The measured signals are in the directions covered by the percentile EIS spherical coverage of the UE, defined in clause 7.3.4 of TS 38.101-2 [19].

- The timing offset between the reference measurement timing and the target CSI-RS in one layer is no larger than CP.

• Note: The reference measurement timing for inter-frequency measurement is up to UE implementation and shall be based on the timing of one of the target cells.

- The bandwidth of CSI-RS is 48 PRBs and the density is 3.

• The performance with larger bandwidth of CSI-RS is equal to or better than the accuracy requirements in Table 10.1.15.2.2-1.

Table 10.1.15.2.2-1: CSI-SINR Inter frequency relative accuracy in FR2

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | |
| Normal condition | Extreme condition | CSI-RS Ês/Iot | Io Note 2 range | | |
|  |  |  | Minimum Io | | Maximum Io |
| dB | dB | dB | dBm / SCSCSI-RS Note 1 | | dBm/BWChannel |
|  |  |  | SCSCSI-RS = 60kHz | SCSCSI-RS = 120kHz |  |
| ±3.5 | ±4 | ≥-3 | Same value as CSI\_RP in Table B.2.9-2, according to UE Power class, operating band and angle of arrival | | -50 |
| ±4 | ±4 | ≥-6 |
| Note 1: Values based on Refsens and EIS spherical coverage as defined in clauses 7.3.2 and 7.3.4 of TS 38.101-2 [19]. Applicable side condition selected depending on angle of arrival.  Note 2: Io specified at the Reference point, and assumed to have constant EPRE across the bandwidth.  Note 3: In the test cases, the CSI-RS Ês/Iot and related parameters may need to be adjusted to ensure Ês/Iot at UE baseband is above the value defined in this table.  Note 4: The requirements apply for CSI-RS Ês/Iot ≤XdB. X=15 if timing offset between the reference measurement timing and the target CSI-RS is no larger than 0.5\*CP, and X=4 if timing offset between the reference measurement timing and the target CSI-RS is larger than 0.5\*CP but no larger than CP. | | | | | |

### 10.1.16 SINR report mapping

#### 10.1.16.1 SS-SINR and CSI-SINR measurement report mapping

The reporting range of SS-SINR and CSI-SINR for L3 reporting and L1 reporing is defined from -23 dB to 40 dB with 0.5 dB resolution. The mapping of measured quantity is defined in Table 10.1.16.1-1. The range in the signalling may be larger than the guaranteed accuracy range.

The reporting range of differential SS-SINR and CSI-SINR for L1 reporting and L3 reporting is defined from -15 dB to 0 dB with 1 dB resolution.

The mapping of measured quantity is defined in Table 10.1.16.1-2. The range in the signalling may be larger than the guaranteed accuracy range.

Table 10.1.16.1-1: SS-SINR and CSI-SINR measurement report mapping

|  |  |  |  |
| --- | --- | --- | --- |
| Reported value | Measured quantity value (L3 SS-SINR and L3 CSI-SINR) | Measured quantity value (L1 SS-SINR and L1 CSI-SINR) | Unit |
| SINR\_0 | SINR<-23 | SINR<-23 | dB |
| SINR\_1 | -23≤ SINR<-22.5 | -23≤SINR<-22.5 | dB |
| SINR\_2 | -22.5≤ SINR<-22 | -22.5≤SINR<-22 | dB |
| SINR\_3 | -22≤ SINR<-21.5 | -22≤SINR<-21.5 | dB |
| SINR\_4 | -21.5≤ SINR<-21 | -21.5≤SINR<-21 | dB |
| .. | .. | .. | … |
| SINR\_123 | 38≤ SINR<38.5 | 38≤SINR<38.5 | dB |
| SINR\_124 | 38.5≤ SINR<39 | 38.5≤SINR<39 | dB |
| SINR\_125 | 39≤ SINR<39.5 | 39≤SINR<39.5 | dB |
| SINR\_126 | 39.5≤ SINR<40 | 39.5≤SINR<40 | dB |
| SINR\_127 | 40≤ SINR | 40≤SINR | dB |

Table 10.1.16.1-2: Differential SS-SINR and CSI-SINR measurement (for L1 reporting and L3 reporting) report mapping

|  |  |  |
| --- | --- | --- |
| Reported value | Measured quantity value (difference in measured SINR from largest SINR) | Unit |
| DIFFSINR\_0 | 0≥ΔSINR>-1 | dB |
| DIFFSINR\_1 | -1≥ΔSINR>-2 | dB |
| DIFFSINR\_2 | -2≥ΔSINR>-3 | dB |
| DIFFSINR\_3 | -3≥ΔSINR>-4 | dB |
| DIFFSINR\_4 | -4≥ΔSINR>-5 | dB |
| DIFFSINR\_5 | -5≥ΔSINR>-6 | dB |
| DIFFSINR\_6 | -6≥ΔSINR>-7 | dB |
| DIFFSINR\_7 | -7≥ΔSINR>-8 | dB |
| DIFFSINR\_8 | -8≥ΔSINR>-9 | dB |
| DIFFSINR\_9 | -9≥ΔSINR>-10 | dB |
| DIFFSINR\_10 | -10≥ΔSINR>-11 | dB |
| DIFFSINR\_11 | -11≥ΔSINR>-12 | dB |
| DIFFSINR\_12 | -12≥ΔSINR>-13 | dB |
| DIFFSINR\_13 | -13≥ΔSINR>-14 | dB |
| DIFFSINR\_14 | -14≥ΔSINR>-15 | dB |
| DIFFSINR\_15 | -15≥ΔSINR | dB |

### 10.1.17 Power Headroom

#### 10.1.17.1 Power Headroom Report

##### 10.1.17.1.1 Power Headroom Report Mapping

The power headroom reporting range is from -32 ...+38 dB. Table 10.1.17.1-1 defines the report mapping.

Table 10.1.17.1-1: Power headroom report mapping

|  |  |
| --- | --- |
| Reported value | Measured quantity value (dB) |
| POWER\_HEADROOM\_0 | PH < -32 |
| POWER\_HEADROOM\_1 | -32 ≤ PH < -31 |
| POWER\_HEADROOM\_2 | -31 ≤ PH < -30 |
| POWER\_HEADROOM\_3 | -30 ≤ PH < -29 |
| … | … |
| POWER\_HEADROOM\_53 | 20  PH  21 |
| POWER\_HEADROOM\_54 | 21  PH  22 |
| POWER\_HEADROOM\_55 | 22  PH  24 |
| POWER\_HEADROOM\_56 | 24  PH  26 |
| POWER\_HEADROOM\_57 | 26  PH  28 |
| POWER\_HEADROOM\_58 | 28  PH  30 |
| POWER\_HEADROOM\_59 | 30  PH  32 |
| POWER\_HEADROOM\_60 | 32  PH  34 |
| POWER\_HEADROOM\_61 | 34  PH  36 |
| POWER\_HEADROOM\_62 | 36  PH  38 |
| POWER\_HEADROOM\_63 | PH ≥ 38 |

### 10.1.18 PCMAX,c,f

The UE is required to report the UE configured maximum output power (PCMAX,c,f) together with the power headroom. This clause defines the requirements for the PCMAX,c,f reporting.

#### 10.1.18.1 Report Mapping

The PCMAX,c,f reporting range is defined from -29 dBm to 33 dBm with 1 dB resolution. Table 10.1.18.1-1 defines the reporting mapping.

Table 10.1.18.1-1 Mapping of PCMAX,c.f

|  |  |  |
| --- | --- | --- |
| Reported value | Measured quantity value | Unit |
| PCMAX\_C\_00 | PCMAX,c,f < -29 | dBm |
| PCMAX\_C\_01 | -29 ≤ PCMAX,c,f < -28 | dBm |
| PCMAX\_C\_02 | -28 ≤ PCMAX,c,f < -27 | dBm |
| … | … | … |
| PCMAX\_C\_61 | 31 ≤ PCMAX,c,f < 32 | dBm |
| PCMAX\_C\_62 | 32 ≤ PCMAX,c,f < 33 | dBm |
| PCMAX\_C\_63 | 33 ≤ PCMAX,c,f | dBm |

### 10.1.19 L1-RSRP accuracy requirements for FR1

#### 10.1.19.1 SSB based L1-RSRP accuracy requirements

Unless otherwise specified, the requirements for absolute accuracy and relative accuracy of SSB based L1-RSRP in this clause apply to all SSBs of the serving cell configured for L1-RSRP measurement and all SSBs of cell(s) with different PCI from serving cell configured for L1-RSRP measurement in FR1.

##### 10.1.19.1.1 Absolute Accuracy

The accuracy requirements in Table 10.1.19.1.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for L1-RSRP measurements are fulfilled according to Annex B.2.4.1 for a corresponding Band for each relevant SSB.

Table 10.1.19.1.1-1: SSB based L1-RSRP absolute accuracy in FR1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot | Io Note 1 range | | | | |
|  |  |  | NR operating band groups Note 2 | Minimum Io | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |  |
|  |  |  | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A, NR\_SDL\_FR1\_A | -121 | -118 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_B | -120.5 | -117.5 | N/A | -70 |
|  |  |  | NR\_TDD\_FR1\_C | -120 | -117 | N/A | -70 |
| ±5.0 | ±9.5 | ≥-3 | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_F | -118.5 | -115.5 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_G | -118 | -115 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_H | -117.5 | -114.5 | N/A | -70 |
| ±8.5 | ±11.5 | ≥-3 | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A, NR\_SDL\_FR1\_A, NR\_FDD\_FR1\_B, NR\_TDD\_FR1\_C, NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D, NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E, NR\_FDD\_FR1\_F, NR\_FDD\_FR1\_G, NR\_FDD\_FR1\_H, | N/A | N/A | -70 | -50 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: NR operating band groups in FR1 are as defined in clause 3.5.2. | | | | | | | |

##### 10.1.19.1.2 Relative Accuracy

The relative accuracy of SSB based L1-RSRP is defined as the L1-RSRP measured from one SSB compared to the largest measured value of L1-RSRP among all SSBs of the cell (serving cell or cell with different PCI from serving cell) on which UE performs L1-RSRP measurements.

The accuracy requirements in Table 10.1.19.1.2-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for L1-RSRP measurements are fulfilled according to Annex B.2.4.1 for a corresponding Band for each relevant SSB.

Table 10.1.19.1.2-1: SSB based L1-RSRP relative accuracy in FR1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot Note 2 | Io Note 1 range | | | | |
|  |  |  | NR operating band groups Note 4 | Minimum Io | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |  |
|  |  |  | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -118 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_B | -120.5 | -117.5 | N/A | -50 |
|  |  |  | NR\_TDD\_FR1\_C | -120 | -117 | N/A | -50 |
| ±3 | ±4 | ≥-3 | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_F | -118.5 | -115.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_G | -118 | -115 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_H | -117.5 | -114.5 | N/A | -50 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: The parameter SSB Ês/Iot is the minimum SSB Ês/Iot of the pair of SSBs to which the requirement applies.  NOTE 3: Void  NOTE 4: NR operating band groups in FR1 are as defined in clause 3.5.2. | | | | | | | |

#### 10.1.19.2 CSI-RS based L1-RSRP accuracy requirements

##### 10.1.19.2.1 Absolute Accuracy

Unless otherwise specified, the requirements for absolute accuracy of CSI-RS based L1-RSRP in this clause apply to all CSI-RS resources of the serving cell configured for L1-RSRP measurement.

The accuracy requirements in Table 10.1.19.2.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for L1-RSRP measurements are fulfilled according to Annex B.2.4.2 for a corresponding Band for each relevant CSI-RS.

- The bandwidth of CSI-RS is 48 PRBs and the density is 3.

The performance with larger bandwidth of CSI-RS is equal to or better than the accuracy requirements in Table 10.1.19.2.1-1.

Table 10.1.19.2.1-1: CSI-RS based L1-RSRP absolute accuracy in FR1

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | | |
| Normal condition | Extreme condition | CSI-RS Ês/Iot | Io Note 1 range | | | | | |
|  |  |  | NR operating band groups Note 2 | Minimum Io | | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSCSI-RS | | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSCSI-RS = 15 kHz | SCSCSI-RS = 30 kHz | SCSCSI-RS = 60 kHz |  |  |
|  |  |  | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -118 | -115 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_B | -120.5 | -117.5 | -114.5 | N/A | -70 |
|  |  |  | NR\_TDD\_FR1\_C | -120 | -117 | -114 | N/A | -70 |
| ±5.0 | ±9.5 | ≥-3 | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | -113.5 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | -113 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_F | -118.5 | -115.5 | -112.5 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_G | -118 | -115 | -112 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_H | -117.5 | -114.5 | -111.5 | N/A | -70 |
| ±8.5 | ±11.5 | ≥-3 | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A,  NR\_FDD\_FR1\_B, NR\_TDD\_FR1\_C, NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D, NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E, NR\_FDD\_FR1\_F,  NR\_FDD\_FR1\_G, NR\_FDD\_FR1\_H | N/A | N/A | N/A | -70 | -50 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: NR operating band groups in FR1 are as defined in clause 3.5.2. | | | | | | | | |

##### 10.1.19.2.2 Relative Accuracy

The relative accuracy of CSI-RS based L1-RSRP is defined as the L1-RSRP measured from one CSI-RS compared to the largest measured value of L1-RSRP among all CSI-RS resources of the serving cell.

The accuracy requirements in Table 10.1.19.2.2-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for L1-RSRP measurements are fulfilled according to Annex B.2.4.2 for a corresponding Band for each relevant CSI-RS.

- The bandwidth of CSI-RS is 48 PRBs and the density is 3.

The performance with larger bandwidth of CSI-RS is equal to or better than the accuracy requirements in Table 10.1.19.2.2-1.

Table 10.1.19.2.2-1: CSI-RS based L1-RSRP relative accuracy in FR1

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | | |
| Normal condition | Extreme condition | CSI-RS Ês/Iot Note 2 | Io Note 1 range | | | | | |
|  |  |  | NR operating band groups Note 4 | Minimum Io | | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSCSI-RS | | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSCSI-RS = 15 kHz | SCSCSI-RS = 30 kHz | SCSCSI-RS = 60 kHz |  |  |
|  |  |  | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -118 | -115 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_B | -120.5 | -117.5 | -114.5 | N/A | -50 |
|  |  |  | NR\_TDD\_FR1\_C | -120 | -117 | -114 | N/A | -50 |
| ±3 | ±4 | ≥-3 | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | -113.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | -113 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_F | -118.5 | -115.5 | -112.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_G | -118 | -115 | -112 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_H | -117.5 | -114.5 | -111.5 | N/A | -50 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: The parameter CSI-RS Ês/Iot is the minimum CSI-RS Ês/Iot of the pair of CSI-RS resources to which the requirement applies.  NOTE 3: Void  NOTE 4: NR operating band groups in FR1 are as defined in clause 3.5.2. | | | | | | | | |

### 10.1.19C L1-RSRP accuracy requirements for FR1 SAN

#### 10.1.19C.1 SSB based L1-RSRP accuracy requirements

##### 10.1.19C.1.1 Absolute Accuracy

Unless otherwise specified, the requirements for absolute accuracy of SSB based L1-RSRP in this clause apply to all SSBs of the serving cell configured for L1-RSRP measurement.

The accuracy requirements in Table 10.1.19C.1.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for L1-RSRP measurements are fulfilled according to Annex B.2.4.1 for a corresponding Band for each relevant SSB.

- Valid information for the SAN serving the target cell has been provided.

Table 10.1.19C.1.1-1: SSB based L1-RSRP absolute accuracy in FR1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot | Io Note 1 range | | | | |
|  |  |  | NR operating band groups Note 2 | Minimum Io | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |  |
| ±[5] | ±[9.5] | ≥-3 | NR\_FDD\_SAB\_FR1\_A | -121 | -118 | N/A | -70 |
| ±[8.5] | ±[11.5] | ≥-3 | NR\_FDD\_SAB\_FR1\_A | N/A | N/A | -70 | -50 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: NR operating band groups in FR1 are as defined in clause 3.5.2. | | | | | | | |

##### 10.1.19C.1.2 Relative Accuracy

The relative accuracy of SSB based L1-RSRP is defined as the L1-RSRP measured from one SSB compared to the largest measured value of L1-RSRP among all SSBs of the serving cell.

The accuracy requirements in Table 10.1.19C.1.2-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for L1-RSRP measurements are fulfilled according to Annex B.2.4.1 for a corresponding Band for each relevant SSB.

- Valid information for the SAN serving the target cell has been provided.

Table 10.1.19C.1.2-1: SSB based L1-RSRP relative accuracy in FR1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot Note 2 | Io Note 1 range | | | | |
|  |  |  | NR operating band groups Note 4 | Minimum Io | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |  |
| ±[3] | ±[4] | ≥-3 | NR\_FDD\_SAB\_FR1\_A | -121 | -118 | N/A | -50 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: The parameter SSB Ês/Iot is the minimum SSB Ês/Iot of the pair of SSBs to which the requirement applies.  NOTE 3: Void  NOTE 4: NR operating band groups in FR1 are as defined in clause 3.5.2. | | | | | | | |

### 10.1.20 L1-RSRP accuracy requirements for FR2

#### 10.1.20.1 SSB based L1-RSRP accuracy requirements

Unless otherwise specified, the requirements for absolute accuracy and relative accuracy of SSB based L1-RSRP in this clause apply to all SSBs of the serving cell configured for L1-RSRP measurement and all SSBs of cell(s) with different PCI from serving cell configured for L1-RSRP measurement in FR2.

##### 10.1.20.1.1 Absolute Accuracy

The accuracy requirements in Table 10.1.20.1.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-2 [19] for reference sensitivity are fulfilled.

- Conditions for L1-RSRP measurements are fulfilled according to Annex B.2.4.1 for a corresponding Band for each relevant SSB.

- The measured signals are in the directions covered by the percentile EIS spherical coverage of the UE, defined in clause 7.3.4 of TS 38.101-2 [19].

Table 10.1.20.1.1-1: SSB based L1-RSRP absolute accuracy in FR2

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot | Io Note 1 range | | | |
|  |  |  | Minimum Io | | | Maximum Io |
| dB | dB | dB | dBm / SCSSSB Note 2 | | dBm/BWChannel | dBm/BWChannel |
|  |  |  | SCSSSB = 120kHz | SCSSSB = 240kHz |  |  |
| ±6.5 | ±9.5 | ≥-3 | Same value as SSB\_RP in Table B.2.4.1-2, according to UE Power class, operating band and angle of arrival | | N/A | -70 |
| ±8.5 | ±11.5 | ≥-3 | N/A | | -70 | -50 |
| NOTE 1: Io specified at the Reference point, and assumed to have constant EPRE across the bandwidth.  NOTE 2: Values based on Refsens and EIS spherical coverage as defined in clauses 7.3.2 and 7.3.4 of TS 38.101-2 [19]. Applicable side condition selected depending on angle of arrival.  NOTE 3: In the test cases, the SSB Ês/Iot and related parameters may need to be adjusted to ensure Ês/Iot at UE baseband is above the value defined in this table. | | | | | | |

##### 10.1.20.1.2 Relative Accuracy

The relative accuracy of SSB based L1-RSRP is defined as the L1-RSRP measured from one SSB compared to the largest measured value of L1-RSRP among all SSBs of the cell (serving cell or cell with different PCI from serving cell) on which UE performs L1-RSRP measurements.

The accuracy requirements in Table 10.1.20.1.2-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-2 [19] for reference sensitivity are fulfilled.

- Conditions for L1-RSRP measurements are fulfilled according to Annex B.2.4.1 for a corresponding Band for each relevant SSB.

- The measured signals are in the directions covered by the percentile EIS spherical coverage of the UE, defined in clause 7.3.4 of TS 38.101-2 [19].

Table 10.1.20.1.2-1: SSB based L1-RSRP relative accuracy in FR2

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | |
| Normal condition | Extreme condition | SSB Ês/Iot | Io Note 1 range | | |
|  |  |  | Minimum Io | | Maximum Io |
| dB | dB | dB | dBm / SCSSSB Note 3 | | dBm/BWChannel |
|  |  |  | SCSSSB = 120kHz | SCSSSB = 240kHz |  |
| ±6.5 | ±9.5 | ≥-3 | Same value as SSB\_RP in Table B.2.4.1-2, according to UE Power class, operating band and angle of arrival | | -50 |
| NOTE 1: Io specified at the Reference point, and assumed to have constant EPRE across the bandwidth.  NOTE 2: The parameter SSB Ês/Iot is the minimum SSB Ês/Iot of the pair of SSBs to which the requirement applies.  NOTE 3: Values based on Refsens and EIS spherical coverage as defined in clauses 7.3.2 and 7.3.4 of TS 38.101-2 [19]. Applicable side condition selected depending on angle of arrival.  NOTE 4: In the test cases, the SSB Ês/Iot and related parameters may need to be adjusted to ensure Ês/Iot at UE baseband is above the value defined in this table. | | | | | |

#### 10.1.20.2 CSI-RS based L1-RSRP accuracy requirements

##### 10.1.20.2.1 Absolute Accuracy

Unless otherwise specified, the requirements for absolute accuracy of CSI-RS based L1-RSRP in this clause apply to all CSI-RS resources of the serving cell configured for L1-RSRP measurement.

The accuracy requirements in Table 10.1.20.2.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-2 [19] for reference sensitivity are fulfilled.

- Conditions for L1-RSRP measurements are fulfilled according to Annex B.2.4.2 for a corresponding Band for each relevant CSI-RS.

- The bandwidth of CSI-RS is 48 PRBs and the density is 3.

- The measured signals are in the directions covered by the percentile EIS spherical coverage of the UE, defined in clause 7.3.4 of TS 38.101-2 [19].

The performance with larger bandwidth of CSI-RS is equal to or better than the accuracy requirements in Table 10.1.20.2.1-1.

Table 10.1.20.2.1-1: CSI-RS based L1-RSRP absolute accuracy in FR2

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | |
| Normal condition | Extreme condition | CSI-RS Ês/Iot | Io Note 1 range | | | |
|  |  |  | Minimum Io | | | Maximum Io |
| dB | dB | dB | dBm / SCSCSI-RS Note 2 | | dBm/BWChannel | dBm/BWChannel |
|  |  |  | SCSCSI-RS = 60kHz | SCSCSI-RS = 120kHz |  |  |
| ±6.5 | ±9.5 | ≥-3 | Same value as CSI-RS\_RP in Table B.2.4.2-2, according to UE Power class, operating band and angle of arrival | | N/A | -70 |
| ±8.5 | ±11.5 | ≥-3 | N/A | | -70 | -50 |
| NOTE 1: Io specified at the Reference point, and assumed to have constant EPRE across the bandwidth.  NOTE 2: Values based on Refsens and EIS spherical coverage as defined in clauses 7.3.2 and 7.3.4 of TS 38.101-2 [19]. Applicable side condition selected depending on angle of arrival.  NOTE 3: In the test cases, the CSI-RS Ês/Iot and related parameters may need to be adjusted to ensure Ês/Iot at UE baseband is above the value defined in this table. | | | | | | |

##### 10.1.20.2.2 Relative Accuracy

The relative accuracy of CSI-RS based L1-RSRP is defined as the L1-RSRP measured from one CSI-RS compared to the largest measured value of L1-RSRP among all CSI-RS resources of the serving cell.

The accuracy requirements in Table 10.1.20.2.2-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-2 [19] for reference sensitivity are fulfilled.

- Conditions for L1-RSRP measurements are fulfilled according to Annex B.2.4.2 for a corresponding Band for each relevant CSI-RS.

- The bandwidth of CSI-RS is 48 PRBs and the density is 3.

- The measured signals are in the directions covered by the percentile EIS spherical coverage of the UE, defined in clause 7.3.4 of TS 38.101-2 [19].

The performance with larger bandwidth of CSI-RS is equal to or better than the accuracy requirements in Table 10.1.20.2.2-1.

Table 10.1.20.2.2-1: CSI-RS based L1-RSRP relative accuracy in FR2

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | |
| Normal condition | Extreme condition | CSI-RS Ês/Iot | Io Note 1 range | | |
|  |  |  | Minimum Io | | Maximum Io |
| dB | dB | dB | dBm / SCSCSI-RS | | dBm/BWChannel |
|  |  |  | SCSCSI-RS = 60kHz | SCSCSI-RS = 120kHz |  |
| ±6.5 | ±9.5 | ≥-3 | Same value as CSI-RS RP in Table B.2.4.2-2, according to UE Power class, operating band and angle of arrival | | -50 |
| NOTE 1: Io specified at the Reference point, and assumed to have constant EPRE across the bandwidth.  NOTE 2: The parameter CSI-RS Ês/Iot is the minimum CSI-RS Ês/Iot of the pair of CSI-RS resources to which the requirement applies.  NOTE 3: Values based on Refsens and EIS spherical coverage as defined in clauses 7.3.2 and 7.3.4 of TS 38.101-2 [19]. Applicable side condition selected depending on angle of arrival.  NOTE 4: In the test cases, the CSI-RS Ês/Iot and related parameters may need to be adjusted to ensure Ês/Iot at UE baseband is above the value defined in this table. | | | | | |

### 10.1.21 SFTD accuracy requirements

#### 10.1.21.1 SFTD acuracy requirements for NE-DC

The SFN and frame timing difference (SFTD) is measured between PCell and E-UTRAN PSCell under NE-DC.

The accuracy requirements in Table 10.1.21.1-4 are appilicable under the following conditions:

For FR1 PCell SFN and frame timing measurement:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Io range deifined in Table 10.1.21.1-1.

Table 10.1.21.1-1: PCell Io range conditions in FR1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | Io Note 1 range | | | |
|  | NR operating band groups Note 4, 5 | Minimum Io Note 2, 3 | | Maximum Io |
|  |  | dBm/ SCSSSB | | dBm/BWChannel |
|  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |
| Conditions | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A | -121 | -118 | -50 |
|  | NR\_FDD\_FR1\_B | -120.5 | -117.5 | -50 |
|  | NR\_TDD\_FR1\_C | -120 | -117 | -50 |
|  | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | -50 |
|  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | -50 |
|  | NR\_FDD\_FR1\_F | -118.5 | -115.5 | -50 |
|  | NR\_FDD\_FR1\_G | -118 | -115 | -50 |
|  | NR\_FDD\_FR1\_H | -117.5 | -114.5 | -50 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: The condition level is increased by ΔRIB,c as defined in clause 7.3B in TS 38.101-3 [20], depending on E-UTRA – NR band combination.  NOTE 3: The condition level is increased by MSD as defined in clause 7.3B in TS 38.101-3 [20], if applicable depending on E-UTRA – NR band combination.  NOTE 4: NR operating band groups are as defined in clause 3.5.  NOTE 5: Only NR bands within EN-DC band combinations as specified in clause 5.5B in TS 38.101-3 [20] are applicable. | | | | |

For FR2 PCell SFN and frame timing measurement:

- Conditions defined in clause 7.3 of TS 38.101-2 [19] for reference sensitivity are fulfilled.

- Io range deifined in Table 10.1.21.1-2.

Table 10.1.21.1-2: PCell Io range conditions in FR2

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | Io Note 1 range | | |
|  | Minimum Io Note 2, 3 | | Maximum Io |
|  | dBm/ SCSSSB | | dBm/BWChannel |
|  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |
| Conditions | Same value as SSB\_RP in Table B.2.4.1-2, according to UE Power class, operating band and angle of arrival | Same value as SSB\_RP in Table B.2.4.1-2, according to UE Power class, operating band and angle of arrival | -50 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth and specified at the Reference point.  NOTE 2: Values based on Refsens and EIS spherical coverage as defined in clauses 7.3.2 and 7.3.4 of TS 38.101-2 [19]. Applicable side condition selected depending on angle of arrival.  NOTE 3: In the test cases, the SSB Ês/Iot and related parameters may need to be adjusted to ensure Ês/Iot at UE baseband is above the value defined in this table. | | | |

For E-UTRA PSCell SFN and frame timing measurement:

- Cell specific reference signals are transmitted either from one, two or four antenna ports.

- Conditions defined in TS 36.101 [25] Clause 7.3 for reference sensitivity are fulfilled.

- No changes to the uplink transmission timing are applied during the measurement period.

- RSRP|dBm according to Annex B.3.5 in TS 36.101 [25] for a corresponding Band.

- Io range deifined in Table 10.1.21.1-3.

Table 10.1.21.1-3: E-UTRA PSCell Io range conditions

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | Io Note 1 range | | |
|  | E-UTRA operating band groups Note 3 | Minimum Io | Maximum Io |
| Conditions |  | dBm/15kHz Note 2 | dBm/BWChannel |
|  | FDD\_A, TDD\_A | -121 | -50 |
|  | FDD\_C, TDD\_C | -120 | -50 |
|  | FDD\_D | -119.5 | -50 |
|  | FDD\_E, TDD\_E | -119 | -50 |
|  | FDD\_F | -118.5 | -50 |
|  | FDD\_G | -118 | -50 |
|  | FDD\_H | -117.5 | -50 |
|  | FDD\_N | -114.5 | -50 |
| NOTE 1: When in dBm/15kHz, the minimum Io condition is expressed as the average Io per RE over all REs in that symbol. Io may be different in different symbols within a subframe.  NOTE 2: The condition level is increased by ∆>0, when applicable, as described in clauses B.4.2 and B.4.3 in TS36.133 [15].  NOTE 3: E-UTRA operating band groups are as defined in clause 3.5 in TS 36.133 [15]. | | | |

Table 10.1.21.1-4: SFTD measurement accuracy

|  |  |  |
| --- | --- | --- |
| Accuracy | Conditions | |
|  | Ês/Iot Note 2 | Frequency range |
| Ts Note 1 | dB |  |
| 40\*64\*Tc | ≥-3 | FR1 |
| 40\*64\*Tc |  | FR2 |
| NOTE 1: Tc is the basic timing unit defined in TS 38.211 [6].  NOTE 2: The parameter Ês/Iot is the minimum Ês/Iot of the pair of cells to which the requirement applies. | | |

#### 10.1.21.2 SFTD acuracy requirements for NR-DC

The SFN and frame timing difference (SFTD) is measured between PCell in FR1 and PSCell in FR2 under NR dual connectivity.

The accuracy requirements in Table 10.1.21.2-3 are appilicable under the following conditions:

For FR1 PCell SFN and frame timing measurement:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Io range deifined in Table 10.1.21.2-1.

Table 10.1.21.2-1: PCell Io range conditions in FR1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | Io Note 1 range | | | |
|  | NR operating band groups Note 2 | Minimum Io | | Maximum Io |
|  |  | dBm/ SCSSSB | | dBm/BWChannel |
|  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |
| Conditions | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A | -121 | -118 | -50 |
|  | NR\_FDD\_FR1\_B | -120.5 | -117.5 | -50 |
|  | NR\_TDD\_FR1\_C | -120 | -117 | -50 |
|  | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | -50 |
|  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | -50 |
|  | NR\_FDD\_FR1\_F | -118.5 | -115.5 | -50 |
|  | NR\_FDD\_FR1\_G | -118 | -115 | -50 |
|  | NR\_FDD\_FR1\_H | -117.5 | -114.5 | -50 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: NR operating band groups are as defined in clause 3.5.2. | | | | |

For FR2 PSCell SFN and frame timing measurement:

- Conditions defined in clause 7.3 of TS 38.101-2 [19] for reference sensitivity are fulfilled.

- Io range deifined in Table 10.1.21.2-2.

- The measured signals are in the directions covered by the percentile EIS spherical coverage of the UE, defined in clause 7.3.4 of TS 38.101-2 [19].

Table 10.1.21.2-2: PSCell Io range conditions in FR2

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | Io Note 1 range | | |
|  | Minimum Io Note 2, 3 | | Maximum Io |
|  | dBm/ SCSSSB | | dBm/BWChannel |
|  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |
| Conditions | Same value as SSB\_RP in Table B.2.4.1-2, according to UE Power class, operating band and angle of arrival | Same value as SSB\_RP in Table B.2.4.1-2, according to UE Power class, operating band and angle of arrival | -50 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth and specified at the Reference point.  NOTE 2: Values based on Refsens and EIS spherical coverage as defined in clauses 7.3.2 and 7.3.4 of TS 38.101-2 [19]. Applicable side condition selected depending on angle of arrival.  NOTE 3: In the test cases, the SSB Ês/Iot and related parameters may need to be adjusted to ensure Ês/Iot at UE baseband is above the value defined in this table. | | | |

**Table 10.1.21.2-3: SFTD measurement accuracy**

|  |  |  |
| --- | --- | --- |
| Accuracy | Conditions | |
|  | Ês/Iot Note 2 | Frequency range |
| Ts Note 1 | dB |  |
| 40\*64\*Tc | ≥ -3 | Between FR1 and FR2 |
| NOTE 1: Tc is the basic timing unit defined in TS 38.211 [6].  NOTE 2: The parameter Ês/Iot is the minimum Ês/Iot of the pair of cells to which the requirement applies. | | |

#### 10.1.21.3 Inter frequency SFTD acuracy requirements

The SFN and frame timing difference (SFTD) is measured between PCell and inter-frequency neighbour cell.

The accuracy requirements in Table 10.1.21.3-3 are appilicable under the following conditions:

For FR1 PCell, inter frequency neighbour cell SFN and frame timing measurement:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Io range deifined in Table 10.1.21.3-1.

Table 10.1.21.3-1: PCell, inter frequency neighbour cell Io range conditions in FR1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | Io Note 1 range | | | |
|  | NR operating band groups Note 2 | Minimum Io | | Maximum Io |
|  |  | dBm/ SCSSSB | | dBm/BWChannel |
|  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |
| Conditions | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A | -121 | -118 | -50 |
|  | NR\_FDD\_FR1\_B | -120.5 | -117.5 | -50 |
|  | NR\_TDD\_FR1\_C | -120 | -117 | -50 |
|  | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | -50 |
|  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | -50 |
|  | NR\_FDD\_FR1\_F | -118.5 | -115.5 | -50 |
|  | NR\_FDD\_FR1\_G | -118 | -115 | -50 |
|  | NR\_FDD\_FR1\_H | -117.5 | -114.5 | -50 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: NR operating band groups are as defined in clause 3.5.2. | | | | |

For FR2 PCell, inter frequency neighbour cell SFN and frame timing measurement:

- Conditions defined in clause 7.3 of TS 38.101-2 [19] for reference sensitivity are fulfilled.

- Io range deifined in Table 10.1.21.3-2.

- The measured signals are in the directions covered by the percentile EIS spherical coverage of the UE, defined in clause 7.3.4 of TS 38.101-2 [19].

Table 10.1.21.3-2: PCell, inter frequency neighbour cell Io range conditions in FR2

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | Io Note 1 range | | |
|  | Minimum Io Note 2, 3 | | Maximum Io |
|  | dBm/ SCSSSB | | dBm/BWChannel |
|  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |
| Conditions | Same value as SSB\_RP in Table B.2.4.1-2, according to UE Power class, operating band and angle of arrival | Same value as SSB\_RP in Table B.2.4.1-2, according to UE Power class, operating band and angle of arrival | -50 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth and specified at the Reference point.  NOTE 2: Values based on Refsens and EIS spherical coverage as defined in clauses 7.3.2 and 7.3.4 of TS 38.101-2 [19]. Applicable side condition selected depending on angle of arrival.  NOTE 3: In the test cases, the SSB Ês/Iot and related parameters may need to be adjusted to ensure Ês/Iot at UE baseband is above the value defined in this table. | | | |

Table 10.1.21.3-3: Inter frequency SFTD measurement accuracy

|  |  |  |
| --- | --- | --- |
| Accuracy | Conditions | |
|  | Ês/Iot Note 2 | Frequency range |
| Ts Note 1 | dB |  |
| 40\*64\*Tc | ≥ -3 | FR1, FR2 |
| NOTE 1: Tc is the basic timing unit defined in TS 38.211 [6].  NOTE 2: The parameter Ês/Iot is the minimum Ês/Iot of the pair of cells to which the requirement applies. | | |

### 10.1.22 CLI measurement accuracy requirements

#### 10.1.22.1 SRS-RSRP

##### 10.1.22.1.1 SRS-RSRP Accuracy

The SRS-RSRP measurement reported by the UE shall fulfil the accuracy requirements defined in Table 10.1.22.1.1-1 for FR1 and Table 10.1.22.1.1-2 for FR2, provided that the following conditions are met. The accuracy requirements in this clause are derived based on AWGN radio propagation conditions.

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for SRS-RSRP measurements are fulfilled according to Annex B.2.z for a corresponding Band for each relevant SRS resource configured for measurement.

- The time difference between UE’s DL reference timing in the serving cell and SRS arrival time is no larger than Terror\_SRS\_RSRP, where

- Terror\_SRS\_RSRP = TC × NTA\_offset + 4.67us for FR1

- Terror\_SRS\_RSRP = TC × NTA\_offset + 3.67us for FR2

- NTA\_offset is defined in Table 7.1.2-2

- TC is 0.509ns

- The number of SRS ports in the SRS resource configured for measurement is 1,

- The number of symbols in the SRS resource configured for measurement is 1,

- The number of repetitions in the SRS resource configured for measurement is 1,

- Frequency hopping, sequence group hopping or sequence hopping is disabled in the SRS resource configured for measurement,

- The bandwidth of the SRS resource is 48 PRBs.

- One of the following conditions is met

- There is no other SRS resource with the same root sequence and on the same symbol and with same comb as the relevant SRS resource.

- If multiple SRS resources are on the same symbol and with same comb, the distance between cyclic shifts of any two resources is no less than 6 if transmissionComb = n4, and no less than 4 if transmissionComb = n2.

Table 10.1.22.1.1-1: SRS-RSRP absolute accuracy in FR1

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | | | | | Conditions | | | | | | |
| Normal condition | | | Extreme condition | | | SRS Ês/Iot | Io Note 1 range | | | | | |
|  | | |  | | |  | NR operating band groups Note 2 | Minimum Io | | | | Maximum Io |
| dB | | | | | | dB |  | dBm / SCSSRS | | | dBm/BW Channel | dBm/BW Channel |
| SCSSRS (kHz) | | | SCSSRS (kHz) | | |  |  |  | | |  |  |
| 15 | 30 | 60 | 15 | 30 | 60 |  |  | SCSSRS = 15 kHz | SCSSRS = 30 kHz | SCSSRS = 60 kHz |  |  |
| ±3 | ±3.5 | ±5 | ±7.5 | ±8 | ±9.5 | ≥1 | NR\_TDD\_FR1\_A, | -120 | -117 | -114 | N/A | -70 |
|  |  |  |  |  |  |  | NR\_TDD\_FR1\_C | -119 | -116 | -113 | N/A | -70 |
|  |  |  |  |  |  |  | NR\_TDD\_FR1\_D | -118.5 | -115.5 | -112.5 | N/A | -70 |
|  |  |  |  |  |  |  | NR\_TDD\_FR1\_E | -118 | -115 | -112 | N/A | -70 |
| ±6.5 | ±7 | ±8.5 | ±9.5 | ±10 | ±11.5 | ≥1 | NR\_TDD\_FR1\_A,  NR\_TDD\_FR1\_C, NR\_TDD\_FR1\_D, NR\_TDD\_FR1\_E | N/A | N/A | N/A | -70 | -50 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: NR operating band groups in FR1 are as defined in clause 3.5.2. | | | | | | | | | | | | |

Table 10.1.22.1.1-2: SRS-RSRP absolute accuracy in FR2

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | | | Conditions | | | | |
| Normal condition | | Extreme condition | | SRS Ês/Iot | Io Note 1 range | | | |
|  | |  | |  | Minimum Io | | | Maximum Io |
| dB | | | | dB | dBm / SCSSRS Note 2 | | dBm/BWChannel | dBm/BWChannel |
| SCSSRS (kHz) | | SCSSRS (kHz) | |  | SCSSRS = | SCSSRS = |  |  |
| 60 | 120 | 60 | 120 |  | 60kHz | 120kHz |  |  |
| ±6 | ±8.5 | ±9 | ±11.5 | ≥1 | Same value as SRS\_RP in Table B.2.7-2, according to UE Power class, operating band and angle of arrival | | N/A | -70 |
| ±9 | ±11.5 | ±11 | ±13.5 | ≥1 | N/A | | -70 | -50 |
| NOTE 1: Io specified at the Reference point, and assumed to have constant EPRE across the bandwidth.  NOTE 2: Values based on Refsens and EIS spherical coverage as defined in clauses 7.3.2 and 7.3.4 of TS 38.101-2 [19]. Applicable side condition selected depending on angle of arrival.  NOTE 3: In the test cases, the SSB Ês/Iot and related parameters may need to be adjusted to ensure Ês/Iot at UE baseband is above the value defined in this table. | | | | | | | | |

##### 10.1.22.1.2 SRS-RSRP report mapping

The reporting range of SRS-RSRP is defined from -140 dBm to -44 dBm with 1 dB resolution. The mapping of measured quantity is defined in Table 10.1.22.1.2-1. The range in the signalling may be larger than the guaranteed accuracy range.

Table 10.1.22.1.2-1: SRS-RSRP measurement report mapping

|  |  |  |
| --- | --- | --- |
| Reported value | Measured quantity value | Unit |
| SRS-RSRP\_0 | SRS-RSRP<-140 | dBm |
| SRS-RSRP\_1 | -140≤ SRS-RSRP<-139 | dBm |
| SRS-RSRP\_2 | -139≤ SRS-RSRP<-138 | dBm |
| SRS-RSRP\_3 | -138≤ SRS-RSRP<-137 | dBm |
| SRS-RSRP\_4 | -137≤ SRS-RSRP<-136 | dBm |
| .. | .. | … |
| SRS-RSRP\_95 | -46≤ SRS-RSRP<-45 | dBm |
| SRS-RSRP\_96 | -45≤ SRS-RSRP<-44 | dBm |
| SRS-RSRP\_97 | -44≤ SRS-RSRP | dBm |
| SRS-RSRP\_98 | Infinity |  |
| Note: ‘Infinity’ means that UE cannot detect SRS due to too strong signal to measure. | | |

#### 10.1.22.2 CLI-RSSI

##### 10.1.22.2.1 CLI-RSSI Accuracy

The CLI-RSSI measurement reported by the UE shall fulfil the accuracy requirements defined in Table 10.1.22.2.1-1 for FR1 and Table 10.1.22.2.1-2 for FR2, provided that the following conditions are met.

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

Table 10.1.22.2.1-1: CLI-RSSI absolute accuracy in FR1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | Io Note 1 range | | | | | |
|  |  | NR operating band groups Note 2 | Minimum Io | | | | Maximum Io |
| dB | dB |  | dBm / SCSSRS | | | dBm/BWChannel | dBm/BWChannel |
|  |  |  | SCSSRS = 15 kHz | SCSSRS = 30 kHz | SCSSRS = 60 kHz |  |  |
| ±3.5 | ±6.5 | NR\_TDD\_FR1\_A, | -120 | -117 | -114 | N/A | -70 |
|  |  | NR\_TDD\_FR1\_C | -119 | -116 | -113 | N/A | -70 |
|  |  | NR\_TDD\_FR1\_D | -118.5 | -115.5 | -112.5 | N/A | -70 |
|  |  | NR\_TDD\_FR1\_E | -118 | -115 | -112 | N/A | -70 |
| ±5.5 | ±8.5 | Note 3 | Note 3 | Note 3 | Note 3 | -70 | -50 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: NR operating band groups in FR1 are as defined in clause 3.5.2.  NOTE 3: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding highest accuracy requirement. | | | | | | | |

Table 10.1.22.2.1-2: CLI-RSSI absolute accuracy in FR2

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | |
| Normal condition | Extreme condition | Io Note 1 range | | | |
|  |  | Minimum Io | | | Maximum Io |
| dB | dB | dBm / SCSSRS Note 2 | | dBm/BWChannel | dBm/BWChannel |
|  |  | SCSSRS = 60kHz | SCSSRS = 120kHz |  |  |
| ±5 | ±8 | Same value as SRS\_RP in Table B.2.7-2, according to UE Power class, operating band and angle of arrival | | N/A | -70 |
| ±7 | ±10 | Note 4 | | -70 | -50 |
| NOTE 1: Io specified at the Reference point, and assumed to have constant EPRE across the bandwidth.  NOTE 2: Values based on Refsens and EIS spherical coverage as defined in clauses 7.3.2 and 7.3.4 of TS 38.101-2 [19]. Applicable side condition selected depending on angle of arrival.  NOTE 3: In the test cases, the SSB Ês/Iot and related parameters may need to be adjusted to ensure Ês/Iot at UE baseband is above the value defined in this table.  NOTE 4: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding highest accuracy requirement. | | | | | |

##### 10.1.22.2.2 CLI-RSSI report mapping

The reporting range of CLI-RSSI is defined from -100 dBm to -25 dBm with 1 dB resolution. The mapping of measured quantity is defined in Table 10.1.22.2.2-1. The range in the signalling may be larger than the guaranteed accuracy range. UE shall scale the measured CLI-RSSI to report a nominal RSSI equivalent to 6RB measurement with 15kHz SCS.

Table 10.1.22.2.2-1: CLI-RSSI measurement report mapping

|  |  |  |
| --- | --- | --- |
| Reported value | Measured quantity value | Unit |
| CLI-RSSI\_00 | CLI-RSSI < ‑100 | dBm |
| CLI-RSSI\_01 | -100 ≤ CLI-RSSI < ‑99 | dBm |
| CLI-RSSI\_02 | -99 ≤ CLI-RSSI < ‑98 | dBm |
| … | … | … |
| CLI-RSSI\_74 | -27 ≤ CLI-RSSI < -26 | dBm |
| CLI-RSSI\_75 | -26 ≤ CLI-RSSI < -25 | dBm |
| CLI-RSSI\_76 | -25 ≤ CLI-RSSI | dBm |

### 10.1.23 RSTD Measurements

#### 10.1.23.1 Introduction

The requirements in Clause 10.1.23 shall apply, provided the UE has received *nr-DL-TDOA-RequestLocationInformation* message from LMF via LPP [34] requesting the UE to report one or more DL RSTD measurements defined in TS 38.215 [4]. The requirements in Clause 10.1.23 shall apply:

- when UE is in RRC\_CONNECTED state and the measurement is performed with MG or without MG,

- when UE is in RRC\_INACTIVE state.

#### 10.1.23.2 Measurement Accuracy Requirements

The accuracy requirements for RSTD measurement shall be within ±(X+Y+Z) Tc.

X is defined in Table 10.1.23.2-1 for AWGN channel and Table 10.1.23.2-3 for fading channel for FR1, provided that the following conditions are met.

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for RSTD measurements are fulfilled according to Annex B.2.14 for a corresponding Band for each relevant PRS resource configured for measurement.

- UE does not perform positioning measurement with reduced number of samples.

X is defined in Table 10.1.23.2-2 for AWGN channel and Table 10.1.23.2-4 for fading channel for FR2, provided that the following conditions are met.

- Conditions defined in clause 7.3 of TS 38.101-2 [19] for reference sensitivity are fulfilled.

- Conditions for RSTD measurements are fulfilled according to Annex B.2.14 for a corresponding Band for each relevant PRS resource configured for measurement.

- UE does not perform positioning measurement with reduced number of samples.

X is defined in Table 10.1.23.2-7 for AWGN channel in FR1 provided that the following conditions are met.

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for RSTD measurements are fulfilled according to Annex B.2.14 for a corresponding Band for each relevant PRS resource configured for measurement.

- UE supports positioning measurement with reduced number of sample and is indicated by LMF to perform positioning measurement with reduced number of samples.

X is defined in Table 10.1.23.2-8 for AWGN channel in FR2 provided that the following conditions are met.

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for RSTD measurements are fulfilled according to Annex B.2.14 for a corresponding Band for each relevant PRS resource configured for measurement.

- UE supports positioning measurement with reduced number of sample and is indicated by LMF to perform positioning measurement with reduced number of samples.

Note: The requriements for fading channel in this clause are derived based on TDL-A (30 ns delay spread, 5Hz) and TDL-C (60 ns delay spread, 300 Hz) channel models for FR1 and FR2 respectively.

When UE measures RSTD on PRS resources belonging to different PFLs, then the RSTD accuracy is defined as the accuracy corresponding to the largest accuracy value among different PFLs.

If the UE doesn’t support Rx TEG reporting for RSTD measurement or when the measurements of reference cell and neighbour cell belong to different Rx TEGs, Y and Z are defined as follows:

- When UE measures RSTD on PRS resources belonging to same PFL, Y=32 Tc, provided that the time offset between the two PRS resource instances from the reference cell and the neighbor cell, which are used for a single RSTD estimate, is no greater than 160 ms.

- When UE measures RSTD on PRS resources belonging different PFLs, Y=256 Tc, provided that the time offset between the two PRS resource instances from the reference cell and the neighbor cell, which are used for a single RSTD estimate, is no greater than 1280 ms.

- Z is defined in Table 10.1.23.2-5 for FR1 and Table 10.1.23.2-6 for FR2, respectively.

If the measurements of reference cell and neighbour cell belong to the same Rx TEG, i.e. associated and reported with a common Rx TEG ID, then the sum of Y+Z is equal to the timing error margin of the Rx TEG reported in *nr-UE-RxTEG-TimingErrorMargin*.

Table 10.1.23.2-1: RSTD absolute accuracy in FR1 for AWGN channel

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | Conditions | | | | | | |
| PRS Ês/Iot | PRS SCS | PRS bandwidth  Note 1 | PRS resource repetition ()  Note 2 | Io Note 3 range | | |
| NR operating band groups Note 4 | Minimum Io | Maximum Io |
| Tc Note 5 | dB | kHz | RB |  |  | dBm/SCS | dBm/BWChannel |
| 132 +ΔNote 7 | (PRS Ês/Iot)ref ≥-6dB  (PRS Ês/Iot)*i* ≥-13dB | 15 | ≥ 24 | ≥ 4 | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -50 |
| NR\_FDD\_FR1\_B | -120.5 | -50 |
| NR\_TDD\_FR1\_C | -120 | -50 |
| NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -50 |
| NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -50 |
| NR\_FDD\_FR1\_F | -118.5 | -50 |
| NR\_FDD\_FR1\_G | -118 | -50 |
| NR\_FDD\_FR1\_H | -117.5 | -50 |
| 98 +Δ | ≥ 52 | ≥ 1 | Note 6 | Note 6 | Note 6 |
| 42 +Δ | ≥ 104 | ≥ 1 | Note 6 | Note 6 | Note 6 |
| 75 +Δ | 30 | ≥ 24 | ≥ 4 | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -118 | -50 |
| NR\_FDD\_FR1\_B | -117.5 | -50 |
| NR\_TDD\_FR1\_C | -117 | -50 |
| NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -116.5 | -50 |
| NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -116 | -50 |
| NR\_FDD\_FR1\_F | -115.5 | -50 |
| NR\_FDD\_FR1\_G | -115 | -50 |
| NR\_FDD\_FR1\_H | -114.5 | -50 |
| 48 +Δ | ≥ 48 | ≥ 1 | Note 6 | Note 6 | Note 6 |
| 24 +Δ | ≥ 132 | ≥ 1 | Note 6 | Note 6 | Note 6 |
| 50 +Δ | 60 | ≥ 24 | ≥ 4 | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -115 | -50 |
| NR\_FDD\_FR1\_B | -114.5 | -50 |
| NR\_TDD\_FR1\_C | -114 | -50 |
| NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -113.5 | -50 |
| NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -113 | -50 |
| NR\_FDD\_FR1\_F | -113.5 | -50 |
| NR\_FDD\_FR1\_G | -113 | -50 |
| NR\_FDD\_FR1\_H | -111.5 | -50 |
| 24 +Δ | ≥ 64 | ≥ 1 | Note 6 | Note 6 | Note 6 |
| 10 +Δ | ≥ 132 | ≥ 1 | Note 6 | Note 6 | Note 6 |
| NOTE 1: Minimum PRS bandwidth, which is minimum of the PRS bandwidths of the reference resource and the measured neighbour resource i.  NOTE 2: Minimum number of PRS resource repetitions among the reference resource and the measured neighbour resource i. are configured by higher layer parameter *dl-PRS-ResourceRepetitionFactor, dl-PRS-NumSymbols and dl-PRS-CombSizeN*defined in TS 37.355 [34], respectively.  NOTE 3: Io is assumed to have constant EPRE across the bandwidth.  NOTE 4: NR operating band groups in FR1 are as defined in clause 3.5.2.  NOTE 5: Tc is the basic timing unit defined in TS 38.211 [6].  NOTE 6: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding requirement with the PRS bandwidth of the smallest RB number for the corresponding SCS.  NOTE 7: Δ= 0 for single PFL, Δ is defined in Table 10.1.23.2-5a for dual PFL. | | | | | | | |

Table 10.1.23.2-2: RSTD absolute accuracy in FR2 for AWGN channel

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Accuracy | Conditions | | | | | |
| PRS Ês/Iot | PRS SCS | PRS bandwidth  Note 1 | PRS resource repetition  () Note 2 | Io Note 3 range | |
| Minimum Io | Maximum Io |
| Tc Note 4 | dB | kHz | RB |  | dBm/SCS | dBm/BWChannel |
| 35 +ΔNote 6 | (PRS Ês/Iot)ref ≥-6dB  (PRS Ês/Iot)*i* ≥-13dB | 60 | ≥ 24 | ≥ 4 | Same value as PRS\_RP in Table B.2.z-2, according to UE Power class, operating band and angle of arrival | -50 |
| 24 +Δ | ≥ 64 | ≥ 1 | Note 5 | Note 5 |
| 11 +Δ | ≥ 132 | ≥ 1 | Note 5 | Note 5 |
| 24 +Δ | 120 | ≥ 32 | ≥ 4 | Same value as PRS\_RP in Table B.2.z-2, according to UE Power class, operating band and angle of arrival | -50 |
| 13 +Δ | ≥ 64 | ≥ 1 | Note 5 | Note 5 |
| 6 +Δ | ≥ 128 | ≥ 1 | Note 5 | Note 5 |
| NOTE 1: Minimum PRS bandwidth, which is minimum of the PRS bandwidths of the reference resource and the measured neighbour resource i.  NOTE 2: Minimum number of PRS resource repetitions among the reference resource and the measured neighbour resource i. are configured by higher layer parameter *dl-PRS-ResourceRepetitionFactor, dl-PRS-NumSymbols and dl-PRS-CombSizeN*defined in TS 37.355 [34], respectively.  NOTE 3: Io is assumed to have constant EPRE across the bandwidth.  NOTE 4: Tc is the basic timing unit defined in TS 38.211 [6].  NOTE 5: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding requirement with the PRS bandwidth of the smallest RB number for the corresponding SCS.  NOTE 6: Δ= 0 for single PFL, Δ is defined in Table 10.1.23.2-6a for dual PFL. | | | | | | |

Table 10.1.23.2-3: RSTD absolute accuracy in FR1 for fading channel

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | Conditions | | | | | | |
| PRS Ês/Iot | PRS SCS | PRS bandwidth  Note 1 | PRS resource repetition ()  Note 2 | Io Note 3 range | | |
| NR operating band groups Note 4 | Minimum Io | Maximum Io |
| Tc Note 5 | dB | kHz | RB |  |  | dBm/SCS | dBm/BWChannel |
| 247 +ΔNote 7 | (PRS Ês/Iot)ref ≥-6dB  (PRS Ês/Iot)*i* ≥-13dB | 15 | ≥ 24 | ≥ 4 | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -50 |
| NR\_FDD\_FR1\_B | -120.5 | -50 |
| NR\_TDD\_FR1\_C | -120 | -50 |
| NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -50 |
| NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -50 |
| NR\_FDD\_FR1\_F | -118.5 | -50 |
| NR\_FDD\_FR1\_G | -118 | -50 |
| NR\_FDD\_FR1\_H | -117.5 | -50 |
| 140 +Δ | ≥ 52 | ≥ 1 | Note 6 | Note 6 | Note 6 |
| 86 +Δ | ≥ 104 | ≥ 1 | Note 6 | Note 6 | Note 6 |
| 118 +Δ | 30 | ≥ 24 | ≥ 4 | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -118 | -50 |
| NR\_FDD\_FR1\_B | -117.5 | -50 |
| NR\_TDD\_FR1\_C | -117 | -50 |
| NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -116.5 | -50 |
| NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -116 | -50 |
| NR\_FDD\_FR1\_F | -115.5 | -50 |
| NR\_FDD\_FR1\_G | -115 | -50 |
| NR\_FDD\_FR1\_H | -114.5 | -50 |
| 109 +Δ | ≥ 48 | ≥ 1 | Note 6 | Note 6 | Note 6 |
| 28 +Δ | ≥ 132 | ≥ 1 | Note 6 | Note 6 | Note 6 |
| 147 +Δ | 60 | ≥ 24 | ≥ 4 | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -115 | -50 |
| NR\_FDD\_FR1\_B | -114.5 | -50 |
| NR\_TDD\_FR1\_C | -114 | -50 |
| NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -113.5 | -50 |
| NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -113 | -50 |
| NR\_FDD\_FR1\_F | -113.5 | -50 |
| NR\_FDD\_FR1\_G | -113 | -50 |
| NR\_FDD\_FR1\_H | -111.5 | -50 |
| 27 +Δ | ≥ 64 | ≥ 1 | Note 6 | Note 6 | Note 6 |
| 21 +Δ | ≥ 132 | ≥ 1 | Note 6 | Note 6 | Note 6 |
| NOTE 1: Minimum PRS bandwidth, which is minimum of the PRS bandwidths of the reference resource and the measured neighbour resource i.  NOTE 2: Minimum number of PRS resource repetitions among the reference resource and the measured neighbour resource i. are configured by higher layer parameter *dl-PRS-ResourceRepetitionFactor, dl-PRS-NumSymbols and dl-PRS-CombSizeN*defined in TS 37.355 [34], respectively.  NOTE 3: Io is assumed to have constant EPRE across the bandwidth.  NOTE 4: NR operating band groups in FR1 are as defined in clause 3.5.2.  NOTE 5: Tc is the basic timing unit defined in TS 38.211 [6].  NOTE 6: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding requirement with the PRS bandwidth of the smallest RB number for the corresponding SCS.  NOTE 7: Δ= 0 for single PFL, Δ is defined in Table 10.1.23.2-5a for dual PFL. | | | | | | | |

Table 10.1.23.2-4: RSTD absolute accuracy in FR2 for fading channel

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Accuracy | Conditions | | | | | |
| PRS Ês/Iot | PRS SCS | PRS bandwidth  Note 1 | PRS resource repetition  () Note 2 | Io Note 3 range | |
| Minimum Io | Maximum Io |
| Tc Note 4 | dB | kHz | RB |  | dBm/SCS | dBm/BWChannel |
| 83 +ΔNote 6 | (PRS Ês/Iot)ref ≥-6dB  (PRS Ês/Iot)*i* ≥-13dB | 60 | ≥ 24 | ≥ 4 | Same value as PRS\_RP in Table B.2.z-2, according to UE Power class, operating band and angle of arrival | -50 |
| 64 +Δ | ≥ 64 | ≥ 1 | Note 5 | Note 5 |
| 46 +Δ | ≥ 132 | ≥ 1 | Note 5 | Note 5 |
| 48 +Δ | 120 | ≥ 32 | ≥ 4 | Same value as PRS\_RP in Table B.2.z-2, according to UE Power class, operating band and angle of arrival | -50 |
| 54 +Δ | ≥ 64 | ≥ 1 | Note 5 | Note 5 |
| 36 +Δ | ≥ 128 | ≥ 1 | Note 5 | Note 5 |
| NOTE 1: Minimum PRS bandwidth, which is minimum of the PRS bandwidths of the reference resource and the measured neighbour resource i.  NOTE 2: Minimum number of PRS resource repetitions among the reference resource and the measured neighbour resource i. are configured by higher layer parameter *dl-PRS-ResourceRepetitionFactor, dl-PRS-NumSymbols and dl-PRS-CombSizeN*defined in TS 37.355 [34], respectively.  NOTE 3: Io is assumed to have constant EPRE across the bandwidth.  NOTE 4: Tc is the basic timing unit defined in TS 38.211 [6].  NOTE 5: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding requirement with the PRS bandwidth of the smallest RB number for the corresponding SCS.  NOTE 6: Δ= 0 for single PFL, Δ is defined in Table 10.1.23.2-6a for dual PFL. | | | | | | |

**Table 10.1.23.2-5: Margin for RSTD measurement accuracy in FR1**

|  |  |  |  |
| --- | --- | --- | --- |
| **PRS BW (RB number)** | | | **Margin (Tc)** |
| **SCS=15kHz** | **SCS=30kHz** | **SCS=60kHz** |
| ≥ 24 | N/A | N/A | 120 |
| ≥ 52 | ≥ 24 | N/A | 72 |
| ≥ 104 | ≥ 48 | ≥ 24 | 36 |
| N/A | ≥ 132 | ≥ 64 | 16 |
| N/A | N/A | ≥ 132 | 12 |

Table 10.1.23.2-5a: Margin Δ for RSTD measurement accuracy in FR1

|  |  |  |  |
| --- | --- | --- | --- |
| PRS BW (RB number) | | | Margin (Tc) |
| SCS=15kHz | SCS=30kHz | SCS=60kHz |
| ≥ 24 | N/A | N/A | [128] |
| ≥ 52 | ≥ 24 | N/A | [64] |
| ≥ 104 | ≥ 48 | ≥ 24 | [32] |
| N/A | ≥ 132 | ≥ 64 | [16] |
| N/A | N/A | ≥ 132 | [8] |

**Table 10.1.23.2-6: Margin for RSTD measurement accuracy in FR2**

|  |  |  |
| --- | --- | --- |
| **PRS BW (RB number)** | | **Margin (Tc)** |
| **SCS=60kHz** | **SCS=120kHz** |
| ≥ 24 | N/A | 72 |
| ≥ 64 | ≥ 32 | 32 |
| ≥ 132 | ≥ 64 | 16 |
| N/A | ≥ 128 | 12 |

Table 10.1.23.2-6a: Margin Δ for RSTD measurement accuracy in FR2

|  |  |  |
| --- | --- | --- |
| PRS BW (RB number) | | Margin (Tc) |
| SCS=60kHz | SCS=120kHz |
| ≥ 24 | N/A | [32] |
| ≥ 64 | ≥ 32 | [16] |
| ≥ 132 | ≥ 64 | [8] |
| N/A | ≥ 128 | [4] |

Table 10.1.23.2-7: RSTD absolute accuracy in FR1 for AWGN channel with reduced number of samples

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | Conditions | | | | | | |
| PRS Ês/Iot | PRS SCS | PRS bandwidth  Note 1 | PRS resource repetition ()  Note 2 | Io Note 3 range | | |
| NR operating band groups Note 4 | Minimum Io | Maximum Io |
| Tc Note 5 | dB | kHz | RB |  |  | dBm/SCS | dBm/BWChannel |
| [98] +ΔNOTE 7 | (PRS Ês/Iot)ref ≥-3dB  (PRS Ês/Iot)*i* ≥-6dB | 15 | ≥ [52] | ≥ [1] | Note 6 | Note 6 | Note 6 |
| [42] +Δ | ≥ [104] | ≥ [1] | Note 6 | Note 6 | Note 6 |
| [48] +Δ | 30 | ≥ [48] | ≥ [1] | Note 6 | Note 6 | Note 6 |
| [24] +Δ | ≥ [132] | ≥ [1] | Note 6 | Note 6 | Note 6 |
| [24] +Δ | 60 | ≥ [64] | ≥ [1] | Note 6 | Note 6 | Note 6 |
| [10] +Δ | ≥ [132] | ≥ [1] | Note 6 | Note 6 | Note 6 |
| NOTE 1: Minimum PRS bandwidth, which is minimum of the PRS bandwidths of the reference resource and the measured neighbour resource i.  NOTE 2: Minimum number of PRS resource repetitions among the reference resource and the measured neighbour resource i. are configured by higher layer parameter *dl-PRS-ResourceRepetitionFactor, dl-PRS-NumSymbols and dl-PRS-CombSizeN*defined in TS 37.355 [34], respectively.  NOTE 3: Io is assumed to have constant EPRE across the bandwidth.  NOTE 4: NR operating band groups in FR1 are as defined in clause 3.5.2.  NOTE 5: Tc is the basic timing unit defined in TS 38.211 [6].  NOTE 6: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding requirement with the PRS bandwidth of the smallest RB number for the corresponding SCS.  NOTE 7: Δ= 0 for single PFL, Δ is defined in Table 10.1.23.2-6a for dual PFL. | | | | | | | |

Table 10.1.23.2-8: RSTD absolute accuracy in FR2 for AWGN channel with reduced number of samples

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Accuracy | Conditions | | | | | |
| PRS Ês/Iot | PRS SCS | PRS bandwidth  Note 1 | PRS resource repetition  () Note 2 | Io Note 3 range | |
| Minimum Io | Maximum Io |
| Tc Note 4 | dB | kHz | RB |  | dBm/SCS | dBm/BWChannel |
| [24] +ΔNOTE 6 | (PRS Ês/Iot)ref ≥-3dB  (PRS Ês/Iot)*i* ≥-6dB | 60 | ≥ [64] | ≥ [1] | Note 5 | Note 5 |
| [11] +Δ | ≥ [132] | ≥ [1] | Note 5 | Note 5 |
| [13] +Δ | 120 | ≥ [64] | ≥ [1] | Note 5 | Note 5 |
| [6] +Δ | ≥ [128] | ≥ [1] | Note 5 | Note 5 |
| NOTE 1: Minimum PRS bandwidth, which is minimum of the PRS bandwidths of the reference resource and the measured neighbour resource i.  NOTE 2: Minimum number of PRS resource repetitions among the reference resource and the measured neighbour resource i. are configured by higher layer parameter *dl-PRS-ResourceRepetitionFactor, dl-PRS-NumSymbols and dl-PRS-CombSizeN*defined in TS 37.355 [34], respectively.  NOTE 3: Io is assumed to have constant EPRE across the bandwidth.  NOTE 4: Tc is the basic timing unit defined in TS 38.211 [6].  NOTE 5: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding requirement with the PRS bandwidth of the smallest RB number for the corresponding SCS.  NOTE 6: Δ= 0 for single PFL, Δ is defined in Table 10.1.23.2-6a for dual PFL. | | | | | | |

#### 10.1.23.3 Report mapping

##### 10.1.23.3.1 Absolute DL RSTD Measurement Reporting

The reporting range for the DL RSTD measurement is defined from -985024×Tc to 985024×Tc with the resolution step of 2*k*×Tc, where

Tc is defined in TS 38.211 [6],

*kmin*≤*k*≤*kmax*,

*kmin*=[2] and *kmax*=5, when configured PRS resource of at least one of the reference cell and neighbor cell measured for the RSTD measurement is in FR1,

*kmin*=0 and *kmax*=5, when configured PRS resource of both the reference cell and neighbor cell measured for the RSTD measurement are in FR2,

*k≥* *timingReportingGranularityFactor* [34] configured by LMF via LPP for the RSTD measurement.

The measurement report mapping for different *k* values are specified in Tables 10.1.23.3.1-1 − 10.1.23.3.1-6.

Table 10.1.23.3.1-1: Report mapping for *k*=0

|  |  |  |
| --- | --- | --- |
| Reported Quantity Value, | Measured Quantity Value, | Unit |
| RSTD\_i | RSTD |  |
| RSTD\_0000000 | RSTD < -985024 | Tc |
| RSTD\_0000001 | -985024 ≤ RSTD < -985023 | Tc |
| RSTD\_0000002 | -985023 ≤ RSTD < -985022 | Tc |
| … | … | … |
| RSTD\_0985024 | -1 ≤ RSTD < 0 | Tc |
| RSTD\_0985025 | 0 ≤ RSTD < 1 | Tc |
| … | … | … |
| RSTD\_1970047 | 985022 ≤ RSTD < 985023 | Tc |
| RSTD\_1970048 | 985023 ≤ RSTD < 985024 | Tc |
| RSTD\_1970049 | 985024 ≤ RSTD | Tc |

Table 10.1.23.3.1-2: Report mapping for *k*=1

|  |  |  |
| --- | --- | --- |
| Reported Quantity Value, | Measured Quantity Value, | Unit |
| RSTD\_i | RSTD |  |
| RSTD\_000000 | RSTD < -985024 | Tc |
| RSTD\_000001 | -985024 ≤ RSTD < -985022 | Tc |
| RSTD\_000002 | -985022 ≤ RSTD < -985020 | Tc |
| … | … | … |
| RSTD\_492512 | -2 ≤ RSTD < 0 | Tc |
| RSTD\_492513 | 0 ≤ RSTD < 2 | Tc |
| … | … | … |
| RSTD\_985023 | 985020 ≤ RSTD < 985022 | Tc |
| RSTD\_985024 | 985022 ≤ RSTD < 985024 | Tc |
| RSTD\_985025 | 985024 ≤ RSTD | Tc |

Table 10.1.23.3.1-3: Report mapping for *k*=2

|  |  |  |
| --- | --- | --- |
| Reported Quantity Value, | Measured Quantity Value, | Unit |
| RSTD\_i | RSTD |  |
| RSTD\_000000 | RSTD < -985024 | Tc |
| RSTD\_000001 | -985024 ≤ RSTD < -985020 | Tc |
| RSTD\_000002 | -985020 ≤ RSTD < -985016 | Tc |
| … | … | … |
| RSTD\_246256 | -4 ≤ RSTD < 0 | Tc |
| RSTD\_246257 | 0 ≤ RSTD < 4 | Tc |
| … | … | … |
| RSTD\_492511 | 985016 ≤ RSTD < 985020 | Tc |
| RSTD\_492512 | 985020 ≤ RSTD < 985024 | Tc |
| RSTD\_492513 | 985024 ≤ RSTD | Tc |

Table 10.1.23.3.1-4: Report mapping for *k*=3

|  |  |  |
| --- | --- | --- |
| Reported Quantity Value | Measured Quantity Value, | Unit |
| RSTD\_i | RSTD |  |
| RSTD\_000000 | RSTD < -985024 | Tc |
| RSTD\_000001 | -985024 ≤ RSTD < -985016 | Tc |
| RSTD\_000002 | -985016 ≤ RSTD < -985008 | Tc |
| … | … | … |
| RSTD\_123128 | -8 ≤ RSTD < 0 | Tc |
| RSTD\_123129 | 0 ≤ RSTD < 8 | Tc |
| … | … | … |
| RSTD\_246255 | 985008 ≤ RSTD < 985016 | Tc |
| RSTD\_246256 | 985016 ≤ RSTD < 985024 | Tc |
| RSTD\_246257 | 985024 ≤ RSTD | Tc |

Table 10.1.23.3.1-5: Report mapping for *k*=4

|  |  |  |
| --- | --- | --- |
| Reported Quantity Value, | Measured Quantity Value, | Unit |
| RSTD\_i | RSTD |  |
| RSTD\_000000 | RSTD < -985024 | Tc |
| RSTD\_000001 | -985024 ≤ RSTD < -985008 | Tc |
| RSTD\_000002 | -985008 ≤ RSTD < -984992 | Tc |
| … | … | … |
| RSTD\_061564 | -16 ≤ RSTD < 0 | Tc |
| RSTD\_061565 | 0 ≤ RSTD < 16 | Tc |
| … | … | … |
| RSTD\_123127 | 984992 ≤ RSTD < 985008 | Tc |
| RSTD\_123128 | 985008 ≤ RSTD < 985024 | Tc |
| RSTD\_123129 | 985024 ≤ RSTD | Tc |

Table 10.1.23.3.1-6: Report mapping for *k*=5

|  |  |  |
| --- | --- | --- |
| Reported Quantity Value, | Measured Quantity Value, | Unit |
| RSTD\_i | RSTD |  |
| RSTD\_00000 | RSTD < -985024 | Tc |
| RSTD\_00001 | -985024 ≤ RSTD < -984992 | Tc |
| RSTD\_00002 | -984992 ≤ RSTD < -984960 | Tc |
| … | … | … |
| RSTD\_30782 | -32 ≤ RSTD < 0 | Tc |
| RSTD\_30783 | 0 ≤ RSTD < 32 | Tc |
| … | … | … |
| RSTD\_61563 | 984960 ≤ RSTD < 984992 | Tc |
| RSTD\_61564 | 984992 ≤ RSTD < 985024 | Tc |
| RSTD\_61565 | 985024 ≤ RSTD | Tc |

##### 10.1.23.3.2 Differential Reporting for DL RSTD Measurement

A first DL RSTD measurement is reported by means of differential reporting, i.e. as ΔRSTD, relative to a second DL RSTD measurement (RSTD2), provided that:

- the absolute measured quantity value of the second DL RSTD measurement (RSTD2) is not larger than the absolute measured quantity value of the first DL RSTD measurement (RSTD1), i.e., ΔRSTD=RSTD1-RSTD2≥0, and

- the absolute value of the second DL RSTD measurement (RSTD2) is reported together with ΔRSTD for the first DL RSTD measurement.

The reporting range for differential reporting ΔRSTD of the first DL RSTD measurement is defined from 0 up to 8191×Tc with the resolution step of 2*k*×Tc, where

Tc is defined in TS 38.211 [6],

*kmin*≤*k*≤*kmax*,

*kmin*=[2] and *kmax*=5, when configured PRS resource of at least one of the reference cell and neighbor cell measured for the first RSTD measurement or second RSTD measurement is in FR1,

*kmin*=0 and *kmax*=5, when configured PRS resource of both the reference cell and neighbor cell measured for both of the first RSTD measurement and the second RSTD measurement are in FR2,

*k≥* *timingReportingGranularityFactor* [34] configured by LMF via LPP for the RSTD measurement.

The measurement report mapping for different *k* values are specified in Tables 10.1.23.3.2-1 − 10.1.23.3.2-6.

Table 10.1.23.3.2-1: Report mapping for *k*=0

|  |  |  |
| --- | --- | --- |
| Reported Quantity Value,  DIFFRSTD\_i | ΔRSTD = RSTD1 − RSTD2 | Unit |
| DIFFRSTD\_0000 | 0 ≤ ΔRSTD < 1 | Tc |
| DIFFRSTD\_0001 | 1 ≤ ΔRSTD < 2 | Tc |
| DIFFRSTD\_0002 | 2 ≤ ΔRSTD < 3 | Tc |
| … | … | … |
| DIFFRSTD\_8189 | 8189 ≤ ΔRSTD < 8190 | Tc |
| DIFFRSTD\_8190 | 8190 ≤ ΔRSTD < 8191 | Tc |
| DIFFRSTD\_8191 | 8191 ≤ ΔRSTD | Tc |

Table 10.1.23.3.2-2: Report mapping for *k*=1

|  |  |  |
| --- | --- | --- |
| Reported Quantity Value,  DIFFRSTD\_i | ΔRSTD = RSTD1 − RSTD2 | Unit |
| DIFFRSTD\_0000 | 0 ≤ ΔRSTD < 2 | Tc |
| DIFFRSTD\_0001 | 2 ≤ ΔRSTD < 4 | Tc |
| DIFFRSTD\_0002 | 4 ≤ ΔRSTD < 6 | Tc |
| … | … | … |
| DIFFRSTD\_4093 | 8186 ≤ ΔRSTD < 8188 | Tc |
| DIFFRSTD\_4094 | 8188 ≤ ΔRSTD < 8190 | Tc |
| DIFFRSTD\_4095 | 8190 ≤ ΔRSTD | Tc |

Table 10.1.23.3.2-3: Report mapping for *k*=2

|  |  |  |
| --- | --- | --- |
| Reported Quantity Value,  DIFFRSTD\_i | ΔRSTD = RSTD1 − RSTD2 | Unit |
| DIFFRSTD\_0000 | 0 ≤ ΔRSTD < 4 | Tc |
| DIFFRSTD\_0001 | 4 ≤ ΔRSTD < 8 | Tc |
| DIFFRSTD\_0002 | 8 ≤ ΔRSTD < 12 | Tc |
| … | … | … |
| DIFFRSTD\_2045 | 8180 ≤ ΔRSTD < 8184 | Tc |
| DIFFRSTD\_2046 | 8184 ≤ ΔRSTD < 8188 | Tc |
| DIFFRSTD\_2047 | 8188 ≤ ΔRSTD | Tc |

Table 10.1.23.3.2-4: Report mapping for *k*=3

|  |  |  |
| --- | --- | --- |
| Reported Quantity Value,  DIFFRSTD\_i | ΔRSTD = RSTD1 − RSTD2 | Unit |
| DIFFRSTD\_0000 | 0 ≤ ΔRSTD < 8 | Tc |
| DIFFRSTD\_0001 | 8 ≤ ΔRSTD < 16 | Tc |
| DIFFRSTD\_0002 | 16 ≤ ΔRSTD < 24 | Tc |
| … | … | … |
| DIFFRSTD\_1021 | 8168 ≤ ΔRSTD < 8176 | Tc |
| DIFFRSTD\_1022 | 8176 ≤ ΔRSTD < 8184 | Tc |
| DIFFRSTD\_1023 | 8184 ≤ ΔRSTD | Tc |

Table 10.1.23.3.2-5: Report mapping for *k*=4

|  |  |  |
| --- | --- | --- |
| Reported Quantity Value,  DIFFRSTD\_i | ΔRSTD = RSTD1 − RSTD2 | Unit |
| DIFFRSTD\_000 | 0 ≤ ΔRSTD < 16 | Tc |
| DIFFRSTD\_001 | 16 ≤ ΔRSTD < 32 | Tc |
| DIFFRSTD\_002 | 32 ≤ ΔRSTD < 48 | Tc |
| … | … | … |
| DIFFRSTD\_509 | 8144 ≤ ΔRSTD < 8160 | Tc |
| DIFFRSTD\_510 | 8160 ≤ ΔRSTD < 8176 | Tc |
| DIFFRSTD\_511 | 8176 ≤ ΔRSTD | Tc |

Table 10.1.23.3.2-6: Report mapping for *k*=5

|  |  |  |
| --- | --- | --- |
| Reported Quantity Value,  DIFFRSTD\_i | ΔRSTD = RSTD1 − RSTD2 | Unit |
| DIFFRSTD\_000 | 0 ≤ ΔRSTD < 32 | Tc |
| DIFFRSTD\_001 | 32 ≤ ΔRSTD < 64 | Tc |
| DIFFRSTD\_002 | 64 ≤ ΔRSTD < 96 | Tc |
| … | … | … |
| DIFFRSTD\_253 | 8096 ≤ ΔRSTD < 8128 | Tc |
| DIFFRSTD\_254 | 8128 ≤ ΔRSTD < 8160 | Tc |
| DIFFRSTD\_255 | 8160 ≤ ΔRSTD | Tc |

##### 10.1.23.3.3 Additional Path Report Mapping for DL RSTD

The reporting range for the additional path reporting for an RSTD measurement is defined up to the range from -8175×Tc to 8175×Tc with the resolution step of 2*k*×Tc, where

Tc is defined in TS 38.211 [6],

*kmin*≤*k*≤*kmax*,

*kmin*=[2] and *kmax*=5, when configured PRS resource of at least one of the reference cell and neighbor cell measured for the RSTD measurement is in FR1,

*kmin*=0 and *kmax*=5, when configured PRS resource of both the reference cell and neighbor cell measured for the RSTD measurement are in FR2,

*k≥* *timingReportingGranularityFactor* [34] configured by LMF via LPP for the RSTD measurement.

The UE can report the timing of up to two additional paths with respect to the path timing determining the RSTD measurement.

A UE capable of *additionalPathsExtSupport-r17* can report the timing for a number additional paths, up to its capability, with respect to the path timing determining the RSTD measurement.

The report mappings for different *k* values are specified in Tables 10.1.23.3.3-1 − 10.1.23.3.3-6.

Table 10.1.23.3.3-1: Report mapping for *k*=0

|  |  |  |
| --- | --- | --- |
| Reported Quantity Value,  path\_i | Measured Quantity Value,  Δpath | Unit |
|
| path\_00000 | Δpath < -8175 | Tc |
| path\_00001 | -8175 ≤ Δpath < -8174 | Tc |
| path\_00002 | -8174 ≤ Δpath < -8173 | Tc |
| … | … | … |
| path\_08175 | -1 ≤ Δpath < 0 | Tc |
| path\_08176 | 0 ≤ Δpath < 1 | Tc |
| … | … | … |
| path\_ 16349 | 8173 ≤ Δpath < 8174 | Tc |
| path\_ 16350 | 8174 ≤ Δpath < 8175 | Tc |
| path\_ 16351 | 8175 ≤ Δpath | Tc |

Table 10.1.23.3.3-2: Report mapping for *k*=1

|  |  |  |
| --- | --- | --- |
| Reported Quantity Value,  path\_i | Measured Quantity Value,  Δpath | Unit |
| path\_0000 | Δpath < -8175 | Tc |
| path\_0001 | -8175 ≤ Δpath < -8173 | Tc |
| path\_0002 | -8173 ≤ Δpath < -8171 | Tc |
| … | … | … |
| path\_4088 | -1 ≤ Δpath < 1 | Tc |
| … | … | … |
| path\_8174 | 8171 ≤ Δpath < 8173 | Tc |
| path\_8175 | 8173 ≤ Δpath < 8175 | Tc |
| path\_8176 | 8175 ≤ Δpath | Tc |

Table 10.1.23.3.3-3: Report mapping for *k*=2

|  |  |  |
| --- | --- | --- |
| Reported Quantity Value,  path\_i | Measured Quantity Value,  Δpath | Unit |
| path\_0000 | Δpath < -8174 | Tc |
| path\_0001 | -8174 ≤ Δpath < -8170 | Tc |
| path\_0002 | -8170 ≤ Δpath < -8166 | Tc |
| … | … | … |
| path\_2044 | -2 ≤ Δpath < 2 | Tc |
| … | … | … |
| path\_4086 | 8166 ≤ Δpath < 8170 | Tc |
| path\_4087 | 8170 ≤ Δpath < 8174 | Tc |
| path\_4088 | 8174 ≤ Δpath | Tc |

Table 10.1.23.3.3-4: Report mapping for *k*=3

|  |  |  |
| --- | --- | --- |
| Reported Quantity Value,  path\_i | Measured Quantity Value,  Δpath | Unit |
| path\_0000 | Δpath < -8172 | Tc |
| path\_0001 | -8172 ≤ Δpath < -8164 | Tc |
| path\_0002 | -8164 ≤ Δpath < -8156 | Tc |
| … | … | … |
| path\_1022 | -4 ≤ Δpath < 4 | Tc |
| … | … | … |
| path\_2042 | 8156 ≤ Δpath < 8164 | Tc |
| path\_2043 | 8164 ≤ Δpath < 8172 | Tc |
| path\_2044 | 8172 ≤ Δpath | Tc |

Table 10.1.23.3.3-5: Report mapping for *k*=4

|  |  |  |
| --- | --- | --- |
| Reported Quantity Value,  path\_i | Measured Quantity Value,  Δpath | Unit |
| path\_0000 | Δpath < -8168 | Tc |
| path\_0001 | -8168 ≤ Δpath < -8152 | Tc |
| path\_0002 | -8152 ≤ Δpath < -8136 | Tc |
| … | … | … |
| path\_511 | -8 ≤ Δpath < 8 | Tc |
| … | … | … |
| path\_1020 | 8136 ≤ Δpath < 8152 | Tc |
| path\_1021 | 8152 ≤ Δpath < 8168 | Tc |
| path\_1022 | 8168 ≤ Δpath | Tc |

Table 10.1.23.3.3-6: Report mapping for *k*=5

|  |  |  |
| --- | --- | --- |
| Reported Quantity Value,  path\_i | Measured Quantity Value,  Δpath | Unit |
| path\_000 | Δpath < -8160 | Tc |
| path\_001 | -8160 ≤ Δpath < -8128 | Tc |
| path\_002 | -8128 ≤ Δpath < -8096 | Tc |
| … | … | … |
| path\_256 | 0 ≤ Δpath < 32 | Tc |
| … | … | … |
| path\_509 | 8096 ≤ Δpath < 8128 | Tc |
| path\_510 | 8128 ≤ Δpath < 8160 | Tc |
| path\_511 | 8160 ≤ Δpath | Tc |

### 10.1.24 PRS-RSRP Measurements

#### 10.1.24.1 Introduction

The requirements in Clause 10.1.24 shall apply, provided the UE has received *nr-DL-TDOA-RequestLocationInformation* or *nr-Multi-RTT-RequestLocationInformation* or *nr-DL-AoD-RequestLocationInformation* message from LMF via LPP [34] requesting the UE to report one or more DL PRS-RSRP measurements defined in TS 38.215 [4].

The requirements in clause 10.1.24 apply for UE in RRC\_CONNECTED, including PRS-RSRP measurement with MG and outside MG, as well as for UE in RRC\_INACTIVE. For PRS-RSRP measurement in FR2, the requirements apply with and without reduced Rx beam sweeping factor.

#### 10.1.24.2 Measurement Accuracy Requirements

##### 10.1.24.2.1 Absolute PRS RSRP accuracy

The absolute accuracy requirements for PRS-RSRP measurement for FR1 defined in Table 10.1.24.2.1-1 are valid under the following conditions:

- Conditions defined in 38.101-1 Clause 7.3 for reference sensitivity are fulfilled.

- PRP 1,2|dBm according to Annex B.2.14 for a corresponding Band

- UE does not support positioning measurements with reduced number of samples, or LMF does not indicate UE to perform positioning measurements with reduced number of samples

The absolute accuracy requirements for PRS-RSRP measurement for FR2 defined in Table 10.1.24.2.1-2 are valid under the following conditions:

- Conditions defined in 38.101-2 Clause 7.3 for reference sensitivity are fulfilled.

- PRP 1,2|dBm according to Annex B.2.14 for a corresponding Band

- UE does not support positioning measurements with reduced number of samples, or LMF does not indicate UE to perform positioning measurements with reduced number of samples

Table 10.1.24.2.1-1: PRS-RSRP absolute accuracy for FR1

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | | | |
| Normal condition | Extreme condition | PRS Ês/Iot | PRS BW | Repetition factor  ( | Io Note 7 range | | | | |
| NR operating band groups Note 8 | Minimum Io Note 1  dBm / SCSPRS | | | Maximum Io |
| dB | dB | dB | PRB | - |  | dBm / SCSPRS | | | dBm/BWChannel |
| dBm/15kHz Note 6 | dBm/30kHz Note 6 | dBm/60kHz Note 6 |
| ±3.5 | ±8 | ≥-3dB | ≥24 | All | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A, NR\_SDL\_FR1\_A | -127 | -124 | -121 | -50 |
| NR\_FDD\_FR1\_B | -126.5 | -123.5 | -120.5 | -50 |
| NR\_TDD\_FR1\_C | -126 | -123 | -120 | -50 |
| NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -125.5 | -122.5 | -119.5 | -50 |
| NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -125 | -122 | -119 | -50 |
| NR\_FDD\_FR1\_F | -124.5 | -121.5 | -118.5 | -50 |
| NR\_FDD\_FR1\_G | -124 | -121 | -118 | -50 |
| NR\_FDD\_FR1\_H | -123.5 | -120.5 | -117.5 | -50 |
| Note 4 | | | | |
| Note 4 | | | | |
| ±8.5 | ±13 | ≥-13dB | 24 ≤ BW ≤ 52 | All | Note 4 | | | | |
| ±6 | ±10.5 | 52< BW≤ 104 | All | Note 4 | | | | |
| ±4.5 | ±9 | BW >104 | All | Note 4 | | | | |
| NOTE 1: This minimum Io condition is expressed as the average Io per RE over all REs in an OFDM symbol.  NOTE 2: Void.  NOTE 3: PRS bandwidth is as indicated in *prs-Bandwidth* in the OTDOA or DL-AoD assistance data defined in [34].  NOTE 4: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding requirement with the PRS bandwidth ≥ 24 RB.  NOTE 5: The serving cell, the reference cell, and the measured neighbour cell i are on the same carrier frequency.  NOTE 6: The condition level is increased by ∆>0, when applicable, as described in Sections B.3.2 and B.3.3.  NOTE 7: The Io is defined in PRS positioning subframes. The same Io range applies to PRS and non-PRS symbols. Io levels are different in PRS and non-PRS symbols within the same subframe.  NOTE 8: NR operating band groups are as defined in Section 3.5.2. | | | | | | | | | |

Table 10.1.24.2.1-2: PRS-RSRP absolute accuracy for FR2

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | PRS Ês/Iot | PRS BW | Repetition factor  ( | Io Note 7 range | | |
| Minimum Io Note 1  dBm / SCSPRS | | Maximum Io |
| dB | dB | dB | PRB | - | dBm / SCSPRS | | dBm/BWChannel |
| dBm/120kHz Note 6 | dBm/60kHz Note 6 |
| ±5 | ±8 | ≥-3dB | ≥24 | All | Same value as PRP in Table B.2.14-2, according to UE Power class, operating band and angle of arrival | | -50 |
| Note 4 | | |
| Note 4 | | |
| ±8.5 | ±11.5 | ≥-13dB | 24 ≤ BW ≤ 64 | All | Note 4 | | |
| ±6 | ±9 | BW >64 | All | Note 4 | | |
| NOTE 1: This minimum Io condition is expressed as the average Io per RE over all REs in an OFDM symbol.  NOTE 2: Void.  NOTE 3: PRS bandwidth is as indicated in *prs-Bandwidth* in the OTDOA or DL-AoD assistance data defined in [34].  NOTE 4: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding requirement with the PRS bandwidth ≥ 24 RB.  NOTE 5: The serving cell, the reference cell, and the measured neighbour cell i are on the same carrier frequency.  NOTE 6: The condition level is increased by ∆>0, when applicable, as described in Sections B.3.2 and B.3.3.  NOTE 7: The Io is defined in PRS positioning subframes. The same Io range applies to PRS and non-PRS symbols. Io levels are different in PRS and non-PRS symbols within the same subframe.  NOTE 8: NR operating band groups are as defined in Section 3.5.2. | | | | | | | |

The absolute accuracy requirements for PRS-RSRP measurement for FR1 defined in Table 10.1.24.2.1-3 are valid under the following conditions:

- Conditions defined in 38.101-1 Clause 7.3 for reference sensitivity are fulfilled.

- PRP 1,2|dBm according to Annex B.2.14 for a corresponding Band

- UE supports positioning measurements with reduced number of samples, and LMF indicates UE to perform positioning measurements with reduced number of samples

- AWGN channel

The absolute accuracy requirements for PRS-RSRP measurement for FR2 defined in Table 10.1.24.2.1-4 are valid under the following conditions:

- Conditions defined in 38.101-2 Clause 7.3 for reference sensitivity are fulfilled.

- PRP 1,2|dBm according to Annex B.2.14 for a corresponding Band

- UE supports positioning measurements with reduced number of samples, and LMF indicates UE to perform positioning measurements with reduced number of samples

- AWGN channel

Table 10.1.24.2.1-3: PRS-RSRP absolute accuracy for FR1 with reduced sample number

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Accuracy** | | **Conditions** | | | | | | | | |
| **Normal condition** | **Extreme condition** | **PRS Ês/Iot** | **PRS BW** | **Repetition factor**  **(** | **Io Note 6 range** | | | | | |
| **NR operating band groups Note 7** | **Minimum Io Note 1**  **dBm / SCSPRS** | | | | **Maximum Io** |
| **dB** | **dB** | **dB** | **PRB** | **-** |  | **dBm / SCSPRS** | | | | **dBm/BWChannel** |
| **dBm/15kHz Note 5** | | **dBm/30kHz Note 5** | **dBm/60kHz Note 5** |
| ±3.5 | ±8 | ≥[0]dB | ≥48 | All | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A, NR\_SDL\_FR1\_A | -127 | -124 | | -121 | -50 |
| NR\_FDD\_FR1\_B | -126.5 | -123.5 | | -120.5 | -50 |
| NR\_TDD\_FR1\_C | -126 | -123 | | -120 | -50 |
| NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -125.5 | -122.5 | | -119.5 | -50 |
| NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -125 | -122 | | -119 | -50 |
| NR\_FDD\_FR1\_F | -124.5 | -121.5 | | -118.5 | -50 |
| NR\_FDD\_FR1\_G | -124 | -121 | | -118 | -50 |
| NR\_FDD\_FR1\_H | -123.5 | -120.5 | | -117.5 | -50 |
| ±8.5 | ±13 | ≥-6dB | 48 ≤ BW ≤ 52 | All | Note 3 | | | | | |
| ±6 | ±10.5 | 52< BW≤ 104 | All | Note 3 | | | | | |
| ±4.5 | ±9 | BW >104 | All | Note 3 | | | | | |
| NOTE 1: This minimum Io condition is expressed as the average Io per RE over all REs in an OFDM symbol.  NOTE 2: PRS bandwidth is as indicated in *prs-Bandwidth* in the OTDOA or DL-AoD assistance data defined in [34].  NOTE 3: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding requirement with the PRS bandwidth ≥ 48 RB.  NOTE 4: The serving cell, the reference cell, and the measured neighbour cell i are on the same carrier frequency.  NOTE 5: The condition level is increased by ∆>0, when applicable, as described in Sections B.3.2 and B.3.3.  NOTE 6: The Io is defined in PRS positioning subframes. The same Io range applies to PRS and non-PRS symbols. Io levels are different in PRS and non-PRS symbols within the same subframe.  NOTE 7: NR operating band groups are as defined in Section 3.5.2. | | | | | | | | | | |

Table 10.1.24.2.1-4: PRS-RSRP absolute accuracy for FR2 with reduced sample number

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Accuracy** | | **Conditions** | | | | | |
| **Normal condition** | **Extreme condition** | **PRS Ês/Iot** | **PRS BW** | **Repetition factor**  **(** | **Io Note 6 range** | | |
| **Minimum Io Note 1**  **dBm / SCSPRS** | | **Maximum Io** |
| **dB** | **dB** | **dB** | **PRB** | **-** | **dBm / SCSPRS** | | **dBm/BWChannel** |
| **dBm/120kHz Note 5** | **dBm/60kHz Note 5** |
| ±5 | ±8 | ≥[0]dB | ≥48 | All | Same value as PRP in Table B.2.14-2, according to UE Power class, operating band and angle of arrival | | -50 |
| ±8.5 | ±11.5 | ≥-6dB | 48 ≤ BW ≤ 64 | All | Note 3 | | |
| ±6 | ±9 | BW >64 | All | Note 3 | | |
| NOTE 1: This minimum Io condition is expressed as the average Io per RE over all REs in an OFDM symbol.  NOTE 2: PRS bandwidth is as indicated in *prs-Bandwidth* in the OTDOA or DL-AoD assistance data defined in [34].  NOTE 3: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding requirement with the PRS bandwidth ≥ 48 RB.  NOTE 4: The serving cell, the reference cell, and the measured neighbour cell i are on the same carrier frequency.  NOTE 5: The condition level is increased by ∆>0, when applicable, as described in Sections B.3.2 and B.3.3.  NOTE 6: The Io is defined in PRS positioning subframes. The same Io range applies to PRS and non-PRS symbols. Io levels are different in PRS and non-PRS symbols within the same subframe.  NOTE 7: NR operating band groups are as defined in Section 3.5.2. | | | | | | | |

##### 10.1.24.2.2 Relative PRS RSRP accuracy

The relative accuracy of PRS-RSRP is defined as accuracy of the difference between two PRS-RSRP measurements.

The relative PRS-RSRP accuracy requirements apply for the cases when PRS-RSRP is measured from PRS resources in the same PRS resource set in FR1 or FR2, and measured with same Rx beam in case of FR2.

The accuracy requirements for PRS-RSRP measurement for FR1 defined in Table 10.1.24.2.2-1 are valid under the following conditions:

- Conditions defined in 38.101-1 Clause 7.3 for reference sensitivity are fulfilled.

- PRP 1,2|dBm according to Annex B.2.14 for a corresponding Band

- UE does not support positioning measurements with reduced number of samples, or LMF does not indicate UE to perform positioning measurements with reduced number of samples

The accuracy requirements for PRS-RSRP measurement for FR2 defined in Table 10.1.24.2.2-2 are valid under the following conditions:

- Conditions defined in 38.101-2 Clause 7.3 for reference sensitivity are fulfilled.

- PRP 1,2|dBm according to Annex B.2.14 for a corresponding Band

- UE does not support positioning measurements with reduced number of samples, or LMF does not indicate UE to perform positioning measurements with reduced number of samples

Table 10.1.24.2.2-1: PRS-RSRP relative accuracy for FR1

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | | | |
| Normal condition | Extreme condition | PRS Ês/Iot | PRS BW | Repetition factor  ( | Io Note 7 range | | | | |
| NR operating band groups Note 8 | Minimum Io Note 1  dBm / SCSPRS | | | Maximum Io |
| dB | dB | dB | PRB | - |  | dBm / SCSPRS | | | dBm/BWChannel |
| dBm/15kHz Note 6 | dBm/30kHz Note 6 | dBm/60kHz Note 6 |
| [±3.5] | ±5.0 | ≥-3dB | ≥24 | All | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A, NR\_SDL\_FR1\_A | -127 | -124 | -121 | -50 |
| NR\_FDD\_FR1\_B | -126.5 | -123.5 | -120.5 | -50 |
| NR\_TDD\_FR1\_C | -126 | -123 | -120 | -50 |
| NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -125.5 | -122.5 | -119.5 | -50 |
| NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -125 | -122 | -119 | -50 |
| NR\_FDD\_FR1\_F | -124.5 | -121.5 | -118.5 | -50 |
| NR\_FDD\_FR1\_G | -124 | -121 | -118 | -50 |
| NR\_FDD\_FR1\_H | -123.5 | -120.5 | -117.5 | -50 |
| Note 4 | | | | |
| Note 4 | | | | |
| ±9.5 | ±11.0 | ≥-13dB | 24 ≤ BW ≤ 52 | All | Note 4 | | | | |
| ±6.5 | ±8.0 | 52< BW≤ 104 | All | Note 4 | | | | |
| ±5.0 | ±6.5 | BW >104 | All | Note 4 | | | | |
| NOTE 1: This minimum Io condition is expressed as the average Io per RE over all REs in an OFDM symbol.  NOTE 2: Void.  NOTE 3: PRS bandwidth is as indicated in *prs-Bandwidth* in the OTDOA or DL-AoD assistance data defined in [34].  NOTE 4: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding requirement with the PRS bandwidth ≥ 24 RB.  NOTE 5: The serving cell, the reference cell, and the measured neighbour cell i are on the same carrier frequency.  NOTE 6: The condition level is increased by ∆>0, when applicable, as described in Sections B.3.2 and B.3.3.  NOTE 7: The Io is defined in PRS positioning subframes. The same Io range applies to PRS and non-PRS symbols. Io levels are different in PRS and non-PRS symbols within the same subframe.  NOTE 8: NR operating band groups are as defined in Section 3.5.2. | | | | | | | | | |

Table 10.1.24.2.2-2: PRS-RSRP relative accuracy for FR2

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | PRS Ês/Iot | PRS BW | Repetition factor  ( | Io Note 7 range | | |
| Minimum Io Note 1  dBm / SCSPRS | | Maximum Io |
| dB | dB | dB | PRB | - | dBm / SCSPRS | | dBm/BWChannel |
| dBm/120kHz Note 6 | dBm/60kHz Note 6 |
| ±5.0 | ±8.0 | ≥-3dB | ≥24 | All | Same value as PRP in Table B. B.2.14-2, according to UE Power class, operating band and angle of arrival | | -50 |
| Note 4 | | |
| Note 4 | | |
| ±10 | ±13 | ≥-13dB | 24 ≤ BW ≤ 64 | All | Note 4 | | |
| ±7.5 | ±10.5 | BW >64 | All | Note 4 | | |
| NOTE 1: This minimum Io condition is expressed as the average Io per RE over all REs in an OFDM symbol.  NOTE 2: Void.  NOTE 3: PRS bandwidth is as indicated in *prs-Bandwidth* in the OTDOA or DL-AoD assistance data defined in [34].  NOTE 4: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding requirement with the PRS bandwidth ≥ 24 RB.  NOTE 5: The serving cell, the reference cell, and the measured neighbour cell i are on the same carrier frequency.  NOTE 6: The condition level is increased by ∆>0, when applicable, as described in Sections B.3.2 and B.3.3.  NOTE 7: The Io is defined in PRS positioning subframes. The same Io range applies to PRS and non-PRS symbols. Io levels are different in PRS and non-PRS symbols within the same subframe.  NOTE 8: NR operating band groups are as defined in Section 3.5.2. | | | | | | | |

The absolute accuracy requirements for PRS-RSRP measurement for FR1 defined in Table 10.1.24.2.2-3 are valid under the following conditions:

- Conditions defined in 38.101-1 Clause 7.3 for reference sensitivity are fulfilled.

- PRP 1,2|dBm according to Annex B.2.14 for a corresponding Band

- UE supports positioning measurements with reduced number of samples, and LMF indicates UE to perform positioning measurements with reduced number of samples

- AWGN channel

The absolute accuracy requirements for PRS-RSRP measurement for FR2 defined in Table 10.1.24.2.2-4 are valid under the following conditions:

- Conditions defined in 38.101-2 Clause 7.3 for reference sensitivity are fulfilled.

- PRP 1,2|dBm according to Annex B.2.14 for a corresponding Band

- UE supports positioning measurements with reduced number of samples, and LMF indicates UE to perform positioning measurements with reduced number of samples

- AWGN channel

Table 10.1.24.2.2-3: PRS-RSRP relative accuracy for FR1 with reduced sample number

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Accuracy** | | **Conditions** | | | | | | | |
| **Normal condition** | **Extreme condition** | **PRS Ês/Iot** | **PRS BW** | **Repetition factor**  **(** | **Io Note 6 range** | | | | |
| **NR operating band groups Note 7** | **Minimum Io Note 1**  **dBm / SCSPRS** | | | **Maximum Io** |
| **dB** | **dB** | **dB** | **PRB** | **-** |  | **dBm / SCSPRS** | | | **dBm/BWChannel** |
| **dBm/15kHz Note 5** | **dBm/30kHz Note 5** | **dBm/60kHz Note 5** |
| [±3.5] | ±5.0 | ≥[0]dB | ≥48 | All | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A, NR\_SDL\_FR1\_A | -127 | -124 | -121 | -50 |
| NR\_FDD\_FR1\_B | -126.5 | -123.5 | -120.5 | -50 |
| NR\_TDD\_FR1\_C | -126 | -123 | -120 | -50 |
| NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -125.5 | -122.5 | -119.5 | -50 |
| NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -125 | -122 | -119 | -50 |
| NR\_FDD\_FR1\_F | -124.5 | -121.5 | -118.5 | -50 |
| NR\_FDD\_FR1\_G | -124 | -121 | -118 | -50 |
| NR\_FDD\_FR1\_H | -123.5 | -120.5 | -117.5 | -50 |
| ±9.5 | ±11.0 | ≥-6dB | 48 ≤ BW ≤ 52 | All | Note 3 | | | | |
| ±6.5 | ±8.0 | 52< BW≤ 104 | All | Note 3 | | | | |
| ±5.0 | ±6.5 | BW >104 | All | Note 3 | | | | |
| NOTE 1: This minimum Io condition is expressed as the average Io per RE over all REs in an OFDM symbol.  NOTE 2: PRS bandwidth is as indicated in *prs-Bandwidth* in the OTDOA or DL-AoD assistance data defined in [34].  NOTE 3: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding requirement with the PRS bandwidth ≥ 48 RB.  NOTE 4: The serving cell, the reference cell, and the measured neighbour cell i are on the same carrier frequency.  NOTE 5: The condition level is increased by ∆>0, when applicable, as described in Sections B.3.2 and B.3.3.  NOTE 6: The Io is defined in PRS positioning subframes. The same Io range applies to PRS and non-PRS symbols. Io levels are different in PRS and non-PRS symbols within the same subframe.  NOTE 7: NR operating band groups are as defined in Section 3.5.2. | | | | | | | | | |

Table 10.1.24.2.2-4: PRS-RSRP relative accuracy for FR2 with reduced sample number

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Accuracy** | | **Conditions** | | | | | |
| **Normal condition** | **Extreme condition** | **PRS Ês/Iot** | **PRS BW** | **Repetition factor**  **(** | **Io Note 6 range** | | |
| **Minimum Io Note 1**  **dBm / SCSPRS** | | **Maximum Io** |
| **dB** | **dB** | **dB** | **PRB** | **-** | **dBm / SCSPRS** | | **dBm/BWChannel** |
| **dBm/120kHz Note 5** | **dBm/60kHz Note 5** |
| ±5.0 | ±8.0 | ≥[0]dB | ≥48 | All | Same value as PRP in Table B.2.14-2, according to UE Power class, operating band and angle of arrival | | -50 |
| ±10 | ±13 | ≥-6dB | 48 ≤ BW ≤ 64 | All | Note 3 | | |
| ±7.5 | ±10.5 | BW >64 | All | Note 3 | | |
| NOTE 1: This minimum Io condition is expressed as the average Io per RE over all REs in an OFDM symbol.  NOTE 2: PRS bandwidth is as indicated in *prs-Bandwidth* in the OTDOA or DL-AoD assistance data defined in [34].  NOTE 3: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding requirement with the PRS bandwidth ≥ 24 RB.  NOTE 4: The serving cell, the reference cell, and the measured neighbour cell i are on the same carrier frequency.  NOTE 5: The condition level is increased by ∆>0, when applicable, as described in Sections B.3.2 and B.3.3.  NOTE 6: The Io is defined in PRS positioning subframes. The same Io range applies to PRS and non-PRS symbols. Io levels are different in PRS and non-PRS symbols within the same subframe.  NOTE 8: NR operating band groups are as defined in Section 3.5.2. | | | | | | | |

#### 10.1.24.3 Report mapping

##### 10.1.24.3.1 Absolute PRS-RSRP Measurement Report Mapping

The reporting range of absolute PRS-RSRP measurement is defined from -156 dBm to -31 dBm with 1 dB resolution.

The mapping of measured quantity is defined in Table 10.1.24.3.1-1. The range in the signalling may be larger than the guaranteed accuracy range.

Table 10.1.24.3.1-1: Measurement report mapping for PRS-RSRP

|  |  |  |
| --- | --- | --- |
| **Reported value** | **Measured quantity value** | **Unit** |
| PRS\_RSRP\_0 | PRS-RSRP<-156 | dBm |
| PRS\_RSRP\_1 | -156≤PRS-RSRP<-155 | dBm |
| PRS\_RSRP\_2 | -155≤PRS-RSRP<-154 | dBm |
| PRS\_RSRP\_3 | -154≤PRS-RSRP<-153 | dBm |
| PRS\_RSRP\_4 | -153≤PRS-RSRP<-152 | dBm |
| PRS\_RSRP\_5 | -152≤PRS-RSRP<-151 | dBm |
| PRS\_RSRP\_6 | -151≤PRS-RSRP<-150 | dBm |
| PRS\_RSRP\_7 | -150≤PRS-RSRP<-149 | dBm |
| PRS\_RSRP\_8 | -149≤PRS-RSRP<-148 | dBm |
| PRS\_RSRP\_9 | -148≤PRS-RSRP<-147 | dBm |
| PRS\_RSRP\_10 | -147≤PRS-RSRP<-146 | dBm |
| PRS\_RSRP\_11 | -146≤PRS-RSRP<-145 | dBm |
| PRS\_RSRP\_12 | -145≤PRS-RSRP<-144 | dBm |
| PRS\_RSRP\_13 | -144≤PRS-RSRP<-143 | dBm |
| PRS\_RSRP\_14 | -143≤PRS-RSRP<-142 | dBm |
| PRS\_RSRP\_15 | -142≤PRS-RSRP<-141 | dBm |
| PRS\_RSRP\_16 | -141≤PRS-RSRP<-140 | dBm |
| PRS\_RSRP\_17 | -140≤PRS-RSRP<-139 | dBm |
| PRS\_RSRP\_18 | -139≤PRS-RSRP<-138 | dBm |
| … | … | … |
| PRS\_RSRP\_111 | -46≤PRS-RSRP<-45 | dBm |
| PRS\_RSRP\_112 | -45≤PRS-RSRP<-44 | dBm |
| PRS\_RSRP\_113 | -44≤PRS-RSRP<-43 | dBm |
| PRS\_RSRP\_114 | -43≤PRS-RSRP<-42 | dBm |
| PRS\_RSRP\_115 | -42≤PRS-RSRP<-41 | dBm |
| PRS\_RSRP\_116 | -41≤PRS-RSRP<-40 | dBm |
| PRS\_RSRP\_117 | -40≤PRS-RSRP<-39 | dBm |
| PRS\_RSRP\_118 | -39≤PRS-RSRP<-38 | dBm |
| PRS\_RSRP\_119 | -38≤PRS-RSRP<-37 | dBm |
| PRS\_RSRP\_120 | -37≤PRS-RSRP<-36 | dBm |
| PRS\_RSRP\_121 | -36≤PRS-RSRP<-35 | dBm |
| PRS\_RSRP\_122 | -35≤PRS-RSRP<-34 | dBm |
| PRS\_RSRP\_123 | -34≤PRS-RSRP<-33 | dBm |
| PRS\_RSRP\_124 | -33≤PRS-RSRP<-32 | dBm |
| PRS\_RSRP\_125 | -32≤PRS-RSRP<-31 | dBm |
| PRS\_RSRP\_126 | -31≤PRS-RSRP | dBm |

##### 10.1.24.3.2 Differential Report Mapping for PRS-RSRP Measurement

The reporting range of differential PRS-RSRP is defined from -30 dB to 0 dB with 1 dB resolution when *nr-DL-AoD-RequestLocationInformation* message is received.

The mapping of measured quantity is defined in Table 10.1.24.3.2-1. The range in the signalling may be larger than the guaranteed accuracy range.

The reporting range of differential PRS-RSRP is defined from -30 dB to 30 dB with 1 dB resolution when *nr-DL-TDOA-RequestLocationInformation* or *nr-Multi-RTT-RequestLocationInformation* is received.

The mapping of measured quantity is defined in Table 10.1.24.3.2-2. The range in the signalling may be larger than the guaranteed accuracy range or the range supported by the UE receiver for differentail RSRP measured on different PRS resources in frequency domain at the same time.

Table 10.1.24.3.2-1: Measurement report mapping for differential PRS-RSRP

|  |  |  |
| --- | --- | --- |
| Reported value | Measured quantity value | Unit |
| DIFFRSRP\_0 | -30≥ΔRSRP | dB |
| DIFFRSRP\_1 | -29≥ΔRSRP>-30 | dB |
| DIFFRSRP\_2 | -28≥ΔRSRP>-29 | dB |
| DIFFRSRP\_3 | -27≥ΔRSRP>-28 | dB |
| DIFFRSRP\_4 | -26≥ΔRSRP>-27 | dB |
| DIFFRSRP\_5 | -25≥ΔRSRP>-26 | dB |
| DIFFRSRP\_6 | -24≥ΔRSRP>-25 | dB |
| DIFFRSRP\_7 | -23≥ΔRSRP>-24 | dB |
| DIFFRSRP\_8 | -22≥ΔRSRP>-23 | dB |
| DIFFRSRP\_9 | -21≥ΔRSRP>-22 | dB |
| DIFFRSRP\_10 | -20≥ΔRSRP>-21 | dB |
| DIFFRSRP\_11 | -19≥ΔRSRP>-20 | dB |
| DIFFRSRP\_12 | -18≥ΔRSRP>-19 | dB |
| DIFFRSRP\_13 | -17≥ΔRSRP>-18 | dB |
| DIFFRSRP\_14 | -16≥ΔRSRP>-17 | dB |
| DIFFRSRP\_15 | -15≥ΔRSRP>-16 | dB |
| DIFFRSRP\_16 | -14≥ΔRSRP>-15 | dB |
| DIFFRSRP\_17 | -13≥ΔRSRP>-14 | dB |
| DIFFRSRP\_18 | -12≥ΔRSRP>-13 | dB |
| DIFFRSRP\_19 | -11≥ΔRSRP>-12 | dB |
| DIFFRSRP\_20 | -10≥ΔRSRP>-11 | dB |
| DIFFRSRP\_21 | -9≥ΔRSRP>-10 | dB |
| DIFFRSRP\_22 | -8≥ΔRSRP>-9 | dB |
| DIFFRSRP\_23 | -7≥ΔRSRP>-8 | dB |
| DIFFRSRP\_24 | -6≥ΔRSRP>-7 | dB |
| DIFFRSRP\_25 | -5≥ΔRSRP>-6 | dB |
| DIFFRSRP\_26 | -4≥ΔRSRP>-5 | dB |
| DIFFRSRP\_27 | -3≥ΔRSRP>-4 | dB |
| DIFFRSRP\_28 | -2≥ΔRSRP>-3 | dB |
| DIFFRSRP\_29 | -1≥ΔRSRP>-2 | dB |
| DIFFRSRP\_30 | 0≥ΔRSRP>-1 | dB |

Table 10.1.24.3.2-2: Measurement report mapping for differential PRS-RSRP

|  |  |  |
| --- | --- | --- |
| Reported value | Measured quantity value | Unit |
| DIFFRSRP\_0 | -30≥ΔRSRP | dB |
| DIFFRSRP\_1 | -29≥ΔRSRP>-30 | dB |
| DIFFRSRP\_2 | -28≥ΔRSRP>-29 | dB |
| DIFFRSRP\_3 | -27≥ΔRSRP>-28 | dB |
| DIFFRSRP\_4 | -26≥ΔRSRP>-27 | dB |
| DIFFRSRP\_5 | -25≥ΔRSRP>-26 | dB |
| DIFFRSRP\_6 | -24≥ΔRSRP>-25 | dB |
| DIFFRSRP\_7 | -23≥ΔRSRP>-24 | dB |
| DIFFRSRP\_8 | -22≥ΔRSRP>-23 | dB |
| DIFFRSRP\_9 | -21≥ΔRSRP>-22 | dB |
| DIFFRSRP\_10 | -20≥ΔRSRP>-21 | dB |
| DIFFRSRP\_11 | -19≥ΔRSRP>-20 | dB |
| DIFFRSRP\_12 | -18≥ΔRSRP>-19 | dB |
| DIFFRSRP\_13 | -17≥ΔRSRP>-18 | dB |
| DIFFRSRP\_14 | -16≥ΔRSRP>-17 | dB |
| … | … | … |
| DIFFRSRP\_25 | -5≥ΔRSRP>-6 | dB |
| DIFFRSRP\_26 | -4≥ΔRSRP>-5 | dB |
| DIFFRSRP\_27 | -3≥ΔRSRP>-4 | dB |
| DIFFRSRP\_28 | -2≥ΔRSRP>-3 | dB |
| DIFFRSRP\_29 | -1≥ΔRSRP>-2 | dB |
| DIFFRSRP\_30 | 0≥ΔRSRP>-1 | dB |
| DIFFRSRP\_31 | 1≥ΔRSRP>0 | dB |
| DIFFRSRP\_32 | 2≥ΔRSRP>1 | dB |
| DIFFRSRP\_33 | 3≥ΔRSRP>2 | dB |
| DIFFRSRP\_34 | 4≥ΔRSRP>3 | dB |
| DIFFRSRP\_35 | 5≥ΔRSRP>4 | dB |
| DIFFRSRP\_36 | 6≥ΔRSRP>5 | dB |
| … | … | … |
| DIFFRSRP\_47 | 17≥ΔRSRP>16 | dB |
| DIFFRSRP\_48 | 18≥ΔRSRP>17 | dB |
| DIFFRSRP\_49 | 19≥ΔRSRP>18 | dB |
| DIFFRSRP\_50 | 20≥ΔRSRP>19 | dB |
| DIFFRSRP\_51 | 21≥ΔRSRP>20 | dB |
| DIFFRSRP\_52 | 22≥ΔRSRP>21 | dB |
| DIFFRSRP\_53 | 23≥ΔRSRP>-22 | dB |
| DIFFRSRP\_54 | 24≥ΔRSRP>23 | dB |
| DIFFRSRP\_55 | 25≥ΔRSRP>24 | dB |
| DIFFRSRP\_56 | 26≥ΔRSRP>25 | dB |
| DIFFRSRP\_57 | 27≥ΔRSRP>26 | dB |
| DIFFRSRP\_58 | 28≥ΔRSRP>27 | dB |
| DIFFRSRP\_59 | 29≥ΔRSRP>28 | dB |
| DIFFRSRP\_60 | 30≥ΔRSRP>29 | dB |
| DIFFRSRP\_61 | ΔRSRP>30 | dB |

### 10.1.25 UE Rx-Tx Time Difference Measurements

#### 10.1.25.1 Introduction

The requirements in Clause 10.1.25 shall apply, provided the UE has received *nr-Multi-RTT-RequestLocationInformation* message from LMF via LPP [31] requesting the UE to report one or more UE Rx-Tx time difference measurements defined in TS 38.215 [4]. The requirements in Clause 10.1.25 shall apply:

- when UE is in RRC\_CONNECTED state and the measurement is performed with MG or without MG,

- when UE is in RRC\_INACTIVE state.

#### 10.1.25.2 Measurement Accuracy Requirements

The UE Rx-Tx time difference measurement accuracy requirements in this clause shall not apply, if:

NTA\_offset defined in Table 7.1.2-2 changes during the UE Rx-Tx measurement period or

if the uplink transmission timing changes during the UE Rx-Tx measurement period due to the network-configured Timing Advance.

The UE Rx-Tx time difference measurement accuracy requirements in this clause shall apply provided that:

- The UE transmits SRS within [-160, 160] msec of at least one DL PRS resource of each of the TRPs in the assistance data.

If the uplink transmission timing changes during the UE Rx-Tx measurement period due to the autonomous timing adjustment defined in clause 7.1.2 then:

- UE Rx-Tx measurement accuracy requirements shall apply for a cell, which is also the downlink reference cell (defined in section 7.1.1) for SRS transmission even if the uplink transmission timing changes during the UE Rx-Tx measurement period due to autonomous adjustment.

- UE Rx-Tx measurement accuracy requirements shall not apply for a cell, which is not the downlink reference cell (defined in section 7.1.1) for SRS transmission, if the uplink transmission timing changes during the UE Rx-Tx measurement period due to autonomous adjustment.

When a serving cell change occurs during the UE Rx-Tx measurement period, the UE Rx-Tx time difference measurement accuracy requirements in this clause shall apply provided that the serving cell change does not impact SRS configuration for the UE Rx-Tx measurement.

The accuracy requirements in Table 10.1.25.2-1 for FR1 are valid under the following conditions:

Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

PRP|dBm according to Annex B.2.14 for a corresponding Band.

AWGN propagation condition.

Table 10.1.25.2-1: UE Rx-Tx time difference measurement accuracy in FR1 in AWGN

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | Conditions | | | | | | |
| PRS Ês/Iot | Minimum PRS bandwidth | PRS SCS | PRS resource repetition Note 3 | NR operating band groupsNote 2 | IoNote 4 range | |
| Minimum IoNote 1 | Maximum Io |
| TcNote 5 | dB | RB | kHz |  |  | dBm / SCSPRS | dBm/BW |
| ± 78+δ | -3 | ≥24 | 15 | ≥4 | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -50 |
| NR\_FDD\_FR1\_B | -120.5 |
| NR\_TDD\_FR1\_C | -120 |
| NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 |
| NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 |
| NR\_FDD\_FR1\_F | -118.5 |
| NR\_FDD\_FR1\_G | -118 |
| NR\_FDD\_FR1\_H | -117.5 |
| ± 59+δ | ≥52 | ≥1 | Note 6 | Note 6 | Note 6 |
| ± 30+δ | >104 | ≥1 | Note 6 | Note 6 | Note 6 |
| ± 57+δ |  | ≥24 | 30 | ≥4 | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -118 | -50 |
| NR\_FDD\_FR1\_B | -117.5 |
| NR\_TDD\_FR1\_C | -117 |
| NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -116.5 |
| NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -116 |
| NR\_FDD\_FR1\_F | -115.5 |
| NR\_FDD\_FR1\_G | -115 |
|  | NR\_FDD\_FR1\_H | -114.5 |
| ± 30+δ |  | ≥48 | ≥1 | NOTE 6 | NOTE 6 | NOTE 6 |
| ± 15+δ |  | ≥132 | ≥1 | NOTE 6 | NOTE 6 | NOTE 6 |
| ± 29+δ | ≥24 | 60 | ≥4 | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -115 | -50 |
| NR\_FDD\_FR1\_B | -114.5 |
| NR\_TDD\_FR1\_C | -114 |
| NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -113.5 |
| NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -113 |
| NR\_FDD\_FR1\_F | -113.5 |
| NR\_FDD\_FR1\_G | -113 |
| NR\_FDD\_FR1\_H | -111.5 |
| ± 15+δ |  | ≥ 64 |  | ≥1 | NOTE 6 | NOTE 6 | NOTE 6 |
| ± 7+δ |  | ≥ 132 |  | ≥1 | NOTE 6 | NOTE 6 | NOTE 6 |
| ± 101+δ | -13 | ≥24 | 15 | ≥4 | NOTE 6 | NOTE 6 | NOTE 6 |
| ± 75+δ | ≥52 | ≥1 | NOTE 6 | NOTE 6 | NOTE 6 |
| ± 37+δ | >104 | ≥1 | NOTE 6 | NOTE 6 | NOTE 6 |
| ± 58+δ |  | ≥24 | 30 | ≥4 | NOTE 6 | NOTE 6 | NOTE 6 |
| ± 39+δ |  | ≥48 |  | ≥1 | NOTE 6 | NOTE 6 | NOTE 6 |
| ± 16+δ |  | ≥132 |  | ≥1 | NOTE 6 | NOTE 6 | NOTE 6 |
| ± 36+δ | ≥24 | 60 | ≥4 | NOTE 6 | NOTE 6 | NOTE 6 |
| ± 16+δ |  | ≥ 64 |  | ≥1 | NOTE 6 | NOTE 6 | NOTE 6 |
| ± 8+δ |  | ≥ 132 |  | ≥1 | NOTE 6 | NOTE 6 | NOTE 6 |
| NOTE 1: This minimum Io condition is expressed as the average Io per RE over all REs in an OFDM symbol.  NOTE 2: NR operating band groups are as defined in Section 3.5.  NOTE 3: are configured by higher layer parameter *dl-PRS-ResourceRepetitionFactor, dl-PRS-NumSymbols and dl-PRS-CombSizeN*defined in TS 37.355 [34].  NOTE 4: The Io is defined in PRS slots. The same Io range applies to PRS and non-PRS symbols. Io levels are different in PRS and non-PRS symbols within the same slot.  NOTE 5: Tc is the basic timing unit defined in TS 38.211 [6].  NOTE 6: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding requirement with the PRS bandwidth of the smallest RB number for the corresponding SCS.  NOTE 7: δ is the margin determined from Table 10.1.25.2-5. | | | | | | | |

The accuracy requirements in Table 10.1.25.2-1a for FR1 are valid under the following conditions:

Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

PRP|dBm according to Annex B.2.14 for a corresponding Band.

Number of measurement samples is less than 4

AWGN propagation condition.

Table 10.1.25.2-1a: UE Rx-Tx time difference measurement accuracy in FR1 in AWGN with reduced measurement samples

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | Conditions | | | | | | |
| PRS Ês/Iot | Minimum PRS bandwidth | PRS SCS | PRS resource repetition Note 3 | NR operating band groupsNote 2 | IoNote 4 range | |
| Minimum IoNote 1 | Maximum Io |
| TcNote 5 | dB | RB | kHz |  |  | dBm / SCSPRS | dBm/BW |
| ± [59+δ] | [0] | ≥[52] | 15 | ≥[1] | Note 6 | Note 6 | Note 6 |
| ± [30+δ6] |  | >[104] |  | ≥[1] | Note 6 | Note 6 | Note 6 |
| ± [30+δ] |  | ≥[48] | 30 | ≥[1] | NOTE 6 | NOTE 6 | NOTE 6 |
| ± [15+δ] |  | ≥[132] |  | ≥[1] | NOTE 6 | NOTE 6 | NOTE 6 |
| ± [15+δ] |  | ≥[64] | 60 | ≥[1] | NOTE 6 | NOTE 6 | NOTE 6 |
| ± [7+δ] |  | ≥[132] |  | ≥[1] | NOTE 6 | NOTE 6 | NOTE 6 |
| ± [75+δ] | -6 | ≥[52] | 15 | ≥[1] | NOTE 6 | NOTE 6 | NOTE 6 |
| ± [37+δ] |  | >[104] |  | ≥[1] | NOTE 6 | NOTE 6 | NOTE 6 |
| ± [39+δ] |  | ≥[48] | 30 | ≥[1] | NOTE 6 | NOTE 6 | NOTE 6 |
| ± [16+δ] |  | ≥[132] |  | ≥[1] | NOTE 6 | NOTE 6 | NOTE 6 |
| ± [16+δ] |  | ≥[64] | 60 | ≥[1] | NOTE 6 | NOTE 6 | NOTE 6 |
| ± [8+δ] |  | ≥[132] |  | ≥[1] | NOTE 6 | NOTE 6 | NOTE 6 |
| NOTE 1: This minimum Io condition is expressed as the average Io per RE over all REs in an OFDM symbol.  NOTE 2: NR operating band groups are as defined in Section 3.5.  NOTE 3: are configured by higher layer parameter *dl-PRS-ResourceRepetitionFactor, dl-PRS-NumSymbols and dl-PRS-CombSizeN*defined in TS 37.355 [34].  NOTE 4: The Io is defined in PRS slots. The same Io range applies to PRS and non-PRS symbols. Io levels are different in PRS and non-PRS symbols within the same slot.  NOTE 5: Tc is the basic timing unit defined in TS 38.211 [6].  NOTE 6: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding requirement with the PRS bandwidth of the smallest RB number for the corresponding SCS.  NOTE 7: δ is the margin determined from Table 10.1.25.2-5. | | | | | | | |

The relative accuracy requirements in Table 10.1.25.2-1b for FR1 are valid under the following conditions:

Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

PRP|dBm according to Annex B.2.14 for a corresponding Band.

AWGN propagation condition.

the two UE Rx-Tx time difference measurements are associated with the same RxTx TEG

Table 10.1.25.2-1b: UE Rx-Tx time difference relative measurement accuracy in FR1 in AWGN with TEG reporting

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | Conditions | | | | | | |
| PRS Ês/Iot | PRS SCS | PRS bandwidth  Note 1 | PRS resource repetition ()  Note 2 | Io Note 3 range | | |
| NR operating band groups Note 4 | Minimum Io | Maximum Io |
| Tc Note 5 | dB | kHz | RB |  |  | dBm/SCS | dBm/BWChannel |
| [132] +ΔNote 7 | (PRS Ês/Iot)*j*≥-6dB  (PRS Ês/Iot)*i* ≥-13dB | 15 | ≥ [24] | ≥ [4] | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -50 |
| NR\_FDD\_FR1\_B | -120.5 | -50 |
| NR\_TDD\_FR1\_C | -120 | -50 |
| NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -50 |
| NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -50 |
| NR\_FDD\_FR1\_F | -118.5 | -50 |
| NR\_FDD\_FR1\_G | -118 | -50 |
| NR\_FDD\_FR1\_H | -117.5 | -50 |
| [98] +Δ | ≥ [52] | ≥ [1] | Note 6 | Note 6 | Note 6 |
| [42] +Δ | ≥ [104] | ≥ [1] | Note 6 | Note 6 | Note 6 |
| [75] +Δ | 30 | ≥ [24] | ≥ [4] | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -118 | -50 |
| NR\_FDD\_FR1\_B | -117.5 | -50 |
| NR\_TDD\_FR1\_C | -117 | -50 |
| NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -116.5 | -50 |
| NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -116 | -50 |
| NR\_FDD\_FR1\_F | -115.5 | -50 |
| NR\_FDD\_FR1\_G | -115 | -50 |
| NR\_FDD\_FR1\_H | -114.5 | -50 |
| [48] +Δ | ≥ [48] | ≥ [1] | Note 6 | Note 6 | Note 6 |
| [24] +Δ | ≥ [132] | ≥ [1] | Note 6 | Note 6 | Note 6 |
| [50] +Δ | 60 | ≥ [24] | ≥ [4] | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -115 | -50 |
| NR\_FDD\_FR1\_B | -114.5 | -50 |
| NR\_TDD\_FR1\_C | -114 | -50 |
| NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -113.5 | -50 |
| NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -113 | -50 |
| NR\_FDD\_FR1\_F | -113.5 | -50 |
| NR\_FDD\_FR1\_G | -113 | -50 |
| NR\_FDD\_FR1\_H | -111.5 | -50 |
| [24] +Δ | ≥ [64] | ≥ [1] | Note 6 | Note 6 | Note 6 |
| [10] +Δ | ≥ [132] | ≥ [1] | Note 6 | Note 6 | Note 6 |
| NOTE 1: Minimum PRS bandwidth, which is minimum of the PRS bandwidths of resource j and resource i.  NOTE 2: Minimum number of PRS resource repetitions among resource j and resource i. are configured by higher layer parameter *dl-PRS-ResourceRepetitionFactor, dl-PRS-NumSymbols and dl-PRS-CombSizeN*defined in TS 37.355 [34], respectively.  NOTE 3: Io is assumed to have constant EPRE across the bandwidth.  NOTE 4: NR operating band groups in FR1 are as defined in clause 3.5.2.  NOTE 5: Tc is the basic timing unit defined in TS 38.211 [6].  NOTE 6: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding requirement with the PRS bandwidth of the smallest RB number for the corresponding SCS.  NOTE 7: Δ is the applicable timing error marign which can be selected by the UE from the pre-defined values ({1/2 Tc, 1 Tc, 2 Tc, 4 Tc, 8 Tc, 12 Tc, 16 Tc, 20 Tc, 24 Tc, 32 Tc, 40 Tc, 48 Tc, 64 Tc, 80 Tc, 96 Tc, 128 Tc.} ). | | | | | | | |

The accuracy requirements in Table 10.1.25.2-2 for FR1 are valid under the following conditions:

Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

PRP|dBm according to Annex B.2.14 for a corresponding Band.

Fading propagation condition.

Table 10.1.25.2-2: UE Rx-Tx time difference measurement accuracy in FR1 in fading

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | Conditions | | | | | | |
| PRS Ês/Iot | Minimum PRS bandwidth | PRS SCS | PRS resource repetition Note 3 | NR operating band groupsNote 2 | IoNote 4 range | |
| Minimum IoNote 1 | Maximum Io |
| **TcNote 5** | **dB** | **RB** | **kHz** |  |  | **dBm / SCSPRS** | **dBm/BW** |
| ± 137+δ | -3 | ≥24 | 15 | ≥4 | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -50 |
| NR\_FDD\_FR1\_B | -120.5 |
| NR\_TDD\_FR1\_C | -120 |
| NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 |
| NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 |
| NR\_FDD\_FR1\_F | -118.5 |
| NR\_FDD\_FR1\_G | -118 |
| NR\_FDD\_FR1\_H | -117.5 |
| ± 96+δ | ≥52 | ≥1 | NOTE 6 | NOTE 6 | NOTE 6 |
| ± 62+δ | >104 | ≥1 | NOTE 6 | NOTE 6 | NOTE 6 |
| ± 87+δ |  | ≥24 | 30 | ≥4 | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -118 | -50 |
| NR\_FDD\_FR1\_B | -117.5 |
| NR\_TDD\_FR1\_C | -117 |
| NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -116.5 |
| NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -116 |
| NR\_FDD\_FR1\_F | -115.5 |
| NR\_FDD\_FR1\_G | -115 |
|  | NR\_FDD\_FR1\_H | -114.5 |
| ± 68+δ |  | ≥48 | ≥1 | NOTE 6 | NOTE 6 | NOTE 6 |
| ± 44+δ |  | ≥132 | ≥1 | NOTE 6 | NOTE 6 | NOTE 6 |
| ± 59+δ | ≥24 | 60 | ≥4 | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -115 | -50 |
| NR\_FDD\_FR1\_B | -114.5 |
| NR\_TDD\_FR1\_C | -114 |
| NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -113.5 |
| NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -113 |
| NR\_FDD\_FR1\_F | -113.5 |
| NR\_FDD\_FR1\_G | -113 |
| NR\_FDD\_FR1\_H | -111.5 |
| ± 42+δ |  | ≥ 64 |  | ≥1 | NOTE 6 | NOTE 6 | NOTE 6 |
| ± 36+δ |  | ≥ 132 |  | ≥1 | NOTE 6 | NOTE 6 | NOTE 6 |
| ± 180+δ | -13 | ≥24 | 15 | ≥4 | NOTE 6 | NOTE 6 | NOTE 6 |
| ± 98+δ | ≥52 | ≥1 | NOTE 6 | NOTE 6 | NOTE 6 |
| ± 68+δ | >104 | ≥1 | NOTE 6 | NOTE 6 | NOTE 6 |
| ± 87+δ |  | ≥24 | 30 | ≥4 | NOTE 6 | NOTE 6 | NOTE 6 |
| ± 85+δ |  | ≥48 |  | ≥1 | NOTE 6 | NOTE 6 | NOTE 6 |
| ± 44+δ |  | ≥132 |  | ≥1 | NOTE 6 | NOTE 6 | NOTE 6 |
| ± 139+δ | ≥24 | 60 | ≥4 | NOTE 6 | NOTE 6 | NOTE 6 |
| ± 46+δ |  | ≥ 64 |  | ≥1 | NOTE 6 | NOTE 6 | NOTE 6 |
| ± 30+δ |  | ≥ 132 |  | ≥1 | NOTE 6 | NOTE 6 | NOTE 6 |
| NOTE 1: This minimum Io condition is expressed as the average Io per RE over all REs in an OFDM symbol.  NOTE 2: NR operating band groups are as defined in Section 3.5.  NOTE 3: are configured by higher layer parameter *dl-PRS-ResourceRepetitionFactor, dl-PRS-NumSymbols and dl-PRS-CombSizeN*defined in TS 37.355 [34].  NOTE 4: The Io is defined in PRS slots. The same Io range applies to PRS and non-PRS symbols. Io levels are different in PRS and non-PRS symbols within the same slot.  NOTE 5: Tc is the basic timing unit defined in TS 38.211 [6].  NOTE 6: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding requirement with the PRS bandwidth of the smallest RB number for the corresponding SCS.  NOTE 7: δ is the margin determined from Table 10.1.25.2-5. | | | | | | | |

The accuracy requirements in Table 10.1.25.2-3 for FR2 are valid under the following conditions:

Conditions defined in clause 7.3 of TS 38.101-2 [19] for reference sensitivity are fulfilled.

PRP|dBm according to Annex B.2.14 for a corresponding Band.

AWGN propagation condition.

Table 10.1.25.2-3: UE Rx-Tx time difference measurement accuracy in FR2 in AWGN

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Accuracy | Conditions | | | | | |
| PRS Ês/Iot | Minimum PRS bandwidth | PRS SCS | PRS resource repetitionNote 3 | IoNote 4 range | |
| Minimum IoNote 1 | Maximum Io |
| **TcNote 5** | **dB** | **RB** | **kHz** |  | **dBm / SCSPRS** | **dBm/BWChannel** |
| ± 22+δ | -3 | ≥24 | 60 | ≥1 | Same value as PRP in Table B.2.14-2, according to UE Power class, operating band and angle of arrival | -50 |
| ± 15+δ |  | ≥64 |  | ≥1 | NOTE 6 | NOTE 6 |
| ± 7+δ |  | ≥132 |  | ≥1 | NOTE 6 | NOTE 6 |
| ± 12+δ | ≥32 | 120 | ≥1 | Same value as PRP in Table B.2.14-2, according to UE Power class, operating band and angle of arrival | -50 |
| ± 7+δ |  | ≥64 |  | ≥1 | NOTE 6 | NOTE 6 |
| ± 4+δ |  | ≥128 |  | ≥1 | NOTE 6 | NOTE 6 |
| ± 35+δ | -13 | ≥24 | 60 | ≥1 | NOTE 6 | NOTE 6 |
| ± 15+δ |  | ≥64 |  | ≥1 | NOTE 6 | NOTE 6 |
| ± 7+δ |  | ≥132 |  | ≥1 | NOTE 6 | NOTE 6 |
| ± 14+δ | ≥32 | 120 | ≥1 | NOTE 6 | NOTE 6 |
| ± 9+δ |  | ≥64 |  | ≥1 | NOTE 6 | NOTE 6 |
| ± 4+δ |  | ≥128 |  | ≥1 | NOTE 6 | NOTE 6 |
| NOTE 1: This minimum Io condition is expressed as the average Io per RE over all REs in an OFDM symbol.  NOTE 2: NR operating band groups are as defined in Section 3.5.  NOTE 3: are configured by higher layer parameter *dl-PRS-ResourceRepetitionFactor, dl-PRS-NumSymbols and dl-PRS-CombSizeN*defined in TS 37.355 [34].  NOTE 4: The Io is defined in PRS slots. The same Io range applies to PRS and non-PRS symbols. Io levels are different in PRS and non-PRS symbols within the same slot.  NOTE 5: Tc is the basic timing unit defined in TS 38.211 [6].  NOTE 6: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding requirement with the PRS bandwidth of the smallest RB number for the corresponding SCS.  NOTE 7: δ is the margin determined from Table 10.1.25.2-6. | | | | | | |

The accuracy requirements in Table 10.1.25.2-3a for FR2 are valid under the following conditions:

Conditions defined in clause 7.3 of TS 38.101-2 [19] for reference sensitivity are fulfilled.

PRP|dBm according to Annex B.2.14 for a corresponding Band

Number of measurement samples is less than 4

AWGN propagation condition.

Table 10.1.25.2-3a: UE Rx-Tx time difference measurement accuracy in FR2 in AWGN with reduced measurement samples

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Accuracy | Conditions | | | | | |
| PRS Ês/Iot | Minimum PRS bandwidth | PRS SCS | PRS resource repetitionNote 3 | IoNote 4 range | |
| Minimum IoNote 1 | Maximum Io |
| **TcNote 5** | **dB** | **RB** | **kHz** |  | **dBm / SCSPRS** | **dBm/BWChannel** |
| ± [15+δ] | [0] | ≥[64] | 60 | ≥[1] | NOTE 6 | NOTE 6 |
| ± [7+δ] |  | ≥[132] |  | ≥[1] | NOTE 6 | NOTE 6 |
| ± [7+δ] |  | ≥[64] | 120 | ≥[1] | NOTE 6 | NOTE 6 |
| ± [4+δ] |  | ≥[128] |  | ≥[1] | NOTE 6 | NOTE 6 |
| ± [15+δ] | -6 | ≥[64] | 60 | ≥[1] | NOTE 6 | NOTE 6 |
| ± [7+δ] |  | ≥[132] |  | ≥[1] | NOTE 6 | NOTE 6 |
| ± [9+δ] |  | ≥[64] | 120 | ≥[1] | NOTE 6 | NOTE 6 |
| ± [4+δ] |  | ≥[128] |  | ≥[1] | NOTE 6 | NOTE 6 |
| NOTE 1: This minimum Io condition is expressed as the average Io per RE over all REs in an OFDM symbol.  NOTE 2: NR operating band groups are as defined in Section 3.5.  NOTE 3: are configured by higher layer parameter dl-PRS-ResourceRepetitionFactor, dl-PRS-NumSymbols and dl-PRS-CombSizeNdefined in TS 37.355 [34].  NOTE 4: The Io is defined in PRS slots. The same Io range applies to PRS and non-PRS symbols. Io levels are different in PRS and non-PRS symbols within the same slot.  NOTE 5: Tc is the basic timing unit defined in TS 38.211 [6].  NOTE 6: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding requirement with the PRS bandwidth of the smallest RB number for the corresponding SCS.  NOTE 7: δ is the margin determined from Table 10.1.25.2-6. | | | | | | |

The relative accuracy requirements in Table 10.1.25.2-3b for FR2 are valid under the following conditions:

Conditions defined in clause 7.3 of TS 38.101-2 [19] for reference sensitivity are fulfilled.

PRP|dBm according to Annex B.2.14 for a corresponding Band

AWGN propagation condition.

the two UE Rx-Tx time difference measurements are associated with the same RxTx TEG

Table 10.1.25.2-3b: UE Rx-Tx time difference relative measurement accuracy in FR2 in AWGN with TEG reporting

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Accuracy | Conditions | | | | | |
| PRS Ês/Iot | PRS SCS | PRS bandwidth  Note 1 | PRS resource repetition  () Note 2 | Io Note 3 range | |
| Minimum Io | Maximum Io |
| Tc Note 4 | dB | kHz | RB |  | dBm/SCS | dBm/BWChannel |
| [107] +ΔNote 6 | (PRS Ês/Iot)*j*≥-6dB  (PRS Ês/Iot)*i* ≥-13dB | 60 | ≥ [24] | ≥ [4] | Same value as PRS\_RP in Table B.2.z-2, according to UE Power class, operating band and angle of arrival | -50 |
| [56] +Δ | ≥ [64] | ≥ [1] | Note 5 | Note 5 |
| [27] +Δ | ≥ [132] | ≥ [1] | Note 5 | Note 5 |
| [56] +Δ | 120 | ≥ [32] | ≥ [4] | Same value as PRS\_RP in Table B.2.z-2, according to UE Power class, operating band and angle of arrival | -50 |
| [29] +Δ | ≥ [64] | ≥ [1] | Note 5 | Note 5 |
| [18] +Δ | ≥ [128] | ≥ [1] | Note 5 | Note 5 |
| NOTE 1: Minimum PRS bandwidth, which is minimum of the PRS bandwidths of resource j and resource i.  NOTE 2: Minimum number of PRS resource repetitions among resource j and resource i. are configured by higher layer parameter *dl-PRS-ResourceRepetitionFactor, dl-PRS-NumSymbols and dl-PRS-CombSizeN*defined in TS 37.355 [34], respectively.  NOTE 3: Io is assumed to have constant EPRE across the bandwidth.  NOTE 4: Tc is the basic timing unit defined in TS 38.211 [6].  NOTE 5: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding requirement with the PRS bandwidth of the smallest RB number for the corresponding SCS.  NOTE 6: Δ is the applicable timing error marign which can be selected by the UE from the pre-defined values ({1/2 Tc, 1 Tc, 2 Tc, 4 Tc, 8 Tc, 12 Tc, 16 Tc, 20 Tc, 24 Tc, 32 Tc, 40 Tc, 48 Tc, 64 Tc, 80 Tc, 96 Tc, 128 Tc.} ) | | | | | | |

The accuracy requirements in Table 10.1.25.2-4 for FR2 are valid under the following conditions:

Conditions defined in clause 7.3 of TS 38.101-2 [19] for reference sensitivity are fulfilled.

PRP|dBm according to Annex B.2.14 for a corresponding Band.

Fading propagation condition.

Table 10.1.25.2-4: UE Rx-Tx time difference measurement accuracy in FR2 in fading

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Accuracy | Conditions | | | | | |
| PRS Ês/Iot | Minimum PRS bandwidth | PRS SCS | PRS resource repetitionNote 3 | IoNote 4 range | |
| Minimum IoNote 1 | Maximum Io |
| TcNote 5 | dB | RB | kHz |  | dBm / SCSPRS | dBm/BWChannel |
| ± 75+δ | -3 | ≥24 | 60 | ≥4 | Same value as PRP in Table B.2.14-2, according to UE Power class, operating band and angle of arrival | -50 |
| ± 72+δ |  | ≥64 |  | ≥1 | NOTE 6 | NOTE 6 |
| ± 57+δ |  | ≥132 |  | ≥1 | NOTE 6 | NOTE 6 |
| ± 61+δ | ≥32 | 120 | ≥1 | Same value as PRP in Table B.2.14-2, according to UE Power class, operating band and angle of arrival | -50 |
| ± 64+δ |  | ≥64 |  | ≥1 | NOTE 6 | NOTE 6 |
| ± 55+δ |  | ≥128 |  | ≥1 | NOTE 6 | NOTE 6 |
| ± 92+δ | -13 | ≥24 | 60 | ≥4 | NOTE 6 | NOTE 6 |
| ± 70+δ |  | ≥64 |  | ≥1 | NOTE 6 | NOTE 6 |
| ± 57+δ |  | ≥132 |  | ≥1 | NOTE 6 | NOTE 6 |
| ± 60+δ | ≥32 | 120 | ≥1 | NOTE 6 | NOTE 6 |
| ± 66+δ |  | ≥64 |  | ≥1 | NOTE 6 | NOTE 6 |
| ± 62+δ |  | ≥128 |  | ≥1 | NOTE 6 | NOTE 6 |
| NOTE 1: This minimum Io condition is expressed as the average Io per RE over all REs in an OFDM symbol.  NOTE 2: NR operating band groups are as defined in Section 3.5.  NOTE 3: are configured by higher layer parameter *dl-PRS-ResourceRepetitionFactor, dl-PRS-NumSymbols and dl-PRS-CombSizeN*defined in TS 37.355 [34].  NOTE 4: The Io is defined in PRS slots. The same Io range applies to PRS and non-PRS symbols. Io levels are different in PRS and non-PRS symbols within the same slot.  NOTE 5: Tc is the basic timing unit defined in TS 38.211 [6].  NOTE 6: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding requirement with the PRS bandwidth of the smallest RB number for the corresponding SCS.  NOTE 7: δ is the margin determined from Table 10.1.25.2-6. | | | | | | |

**Table 10.1.25.2-5: Margin for UE Rx-Tx time difference measurement accuracy in FR1**

|  |  |  |  |
| --- | --- | --- | --- |
| Min(PRS BW, SRS BW) (RB) | | | Margin (Tc Note 1) |
| SCS = 15 kHz | SCS = 30 kHz | SCS = 60 kHz |
| ≥ 24 | N/A | N/A | 160 |
| ≥ 52 | ≥ 24 | N/A | 80 |
| ≥ 104 | ≥ 48 | ≥ 24 | 56 |
| N/A | ≥ 132 | ≥ 64 | 24 |
| N/A | N/A | ≥ 132 | 24 |
| NOTE 1: Tc is the basic timing unit defined in TS 38.211 [6].  NOTE 2: If SRS and PRS have different SCS, the margin corresponding to the smallest RS BW in MHz applies. | | | |

**Table 10.1.25.2-6: Margin for UE Rx-Tx time difference measurement accuracy in FR2**

|  |  |  |
| --- | --- | --- |
| Min(PRS BW, SRS BW) (MHz) | | Margin (Tc Note 1) |
| SCS = 60 kHz | SCS = 120 kHz |
| ≥ 24 | N/A | 76 |
| ≥ 64 | ≥ 32 | 32 |
| ≥ 132 | ≥ 64 | 24 |
| N/A | ≥ 128 | 20 |
| NOTE 1: Tc is the basic timing unit defined in TS 38.211 [6].  NOTE 2: If SRS and PRS have different SCS, the margin corresponding to the smallest RS BW in MHz applies. | | |

#### 10.1.25.3 Report mapping

Absolute UE Rx-Tx measurement reporting in clause 10.1.25.3.1, differential reporting for UE Rx-Tx measurement in clause 10.1.25.3.2, and additional path report mapping for UE Rx-Tx measurement in clause 10.1.25.3.3 applies, regardless of number of samples used to measure PRS, to report:

- TEG based measurement corresponding to UE reported Rx TEG in *nr-UE-Rx-TEG-ID-r17* [34],

- gap-based UE Rx-Tx measurement,

- gapless UE Rx-Tx measurement,

- UE Rx-Tx in RRC\_INACTIVE state.

##### 10.1.25.3.1 Absolute UE Rx-Tx Measurement Report Mapping

The reporting range for the absolute UE Rx-Tx time difference measurement (TUE Rx-Tx) is defined from -985024Tc to 985024Tc with the resolution step of 2*k*Tc, where:

Tc is defined in TS 38.211 [6],

*kmin*≤*k*≤*kmax*,

*kmin*=[2] and *kmax*=5, when at least one of the PRS and the SRS resources configured for TUE Rx-Tx is in FR1,

*kmin*=0 and *kmax*=5, when both PRS and SRS resources configured for TUE Rx-Tx are in FR2,

*k≥* *timingReportingGranularityFactor* [34] configured by LMF via LPP for the UE Rx-Tx time difference measurement.

The TUE Rx-Tx report mapping for *k* = 0, 1, 2, 3, 4, and 5 are specified in Tables 10.1.25.3.1-1, 10.1.25.3.1-2, 10.1.25.3.1-3, 10.1.25.3.1-4, 10.1.25.3.1-5, and 10.1.25.3.1-6, respectively.

Table 10.1.25.3.1-1: Absolute UE Rx-Tx time difference measurement report mapping for *k*=0

|  |  |  |
| --- | --- | --- |
| Reported Quantity Value | Measured Quantity Value | Unit |
| RX-TX\_TIME\_DIFFERENCE\_0000 | TUE Rx-Tx < -985024 | Tc |
| RX-TX\_TIME\_DIFFERENCE\_0001 | -985024  TUE Rx-Tx < -985023 | Tc |
| RX-TX\_TIME\_DIFFERENCE\_0002 | -985023  TUE Rx-Tx < -985022 | Tc |
|  |  | … |
| RX-TX\_TIME\_DIFFERENCE\_985024 | -1  TUE Rx-Tx < 0 | Tc |
| RX-TX\_TIME\_DIFFERENCE\_985025 | 0  TUE Rx-Tx < 1 | Tc |
| … | … | … |
| RX-TX\_TIME\_DIFFERENCE\_1970047 | 985022  TUE Rx-Tx < 985023 | Tc |
| RX-TX\_TIME\_DIFFERENCE\_1970048 | 985023  TUE Rx-Tx < 985024 | Tc |
| RX-TX\_TIME\_DIFFERENCE\_1970049 | 985024  TUE Rx-Tx | Tc |

Table 10.1.25.3.1-2: Absolute UE Rx-Tx time difference measurement report mapping for *k*=1

|  |  |  |
| --- | --- | --- |
| Reported Quantity Value | Measured Quantity Value | Unit |
| RX-TX\_TIME\_DIFFERENCE\_0000 | TUE Rx-Tx < -985024 | Tc |
| RX-TX\_TIME\_DIFFERENCE\_0001 | -985024  TUE Rx-Tx < -985022 | Tc |
| RX-TX\_TIME\_DIFFERENCE\_0002 | -985022  TUE Rx-Tx < -985020 | Tc |
|  |  | … |
| RX-TX\_TIME\_DIFFERENCE\_492512 | -2  TUE Rx-Tx < 0 | Tc |
| RX-TX\_TIME\_DIFFERENCE\_492513 | 0  TUE Rx-Tx < 2 | Tc |
| … | … | … |
| RX-TX\_TIME\_DIFFERENCE\_985023 | 985020  TUE Rx-Tx < 985022 | Tc |
| RX-TX\_TIME\_DIFFERENCE\_985024 | 985022  TUE Rx-Tx < 985024 | Tc |
| RX-TX\_TIME\_DIFFERENCE\_985025 | 985024  TUE Rx-Tx | Tc |

Table 10.1.25.3.1-3: Absolute UE Rx-Tx time difference measurement report mapping for *k*=2

|  |  |  |
| --- | --- | --- |
| Reported Quantity Value | Measured Quantity Value | Unit |
| RX-TX\_TIME\_DIFFERENCE\_0000 | TUE Rx-Tx < -985024 | Tc |
| RX-TX\_TIME\_DIFFERENCE\_0001 | -985024  TUE Rx-Tx < -985020 | Tc |
| RX-TX\_TIME\_DIFFERENCE\_0002 | -985020  TUE Rx-Tx < -985016 | Tc |
|  |  | … |
| RX-TX\_TIME\_DIFFERENCE\_246256 | -4  TUE Rx-Tx < 0 | Tc |
| RX-TX\_TIME\_DIFFERENCE\_246257 | 0  TUE Rx-Tx < 4 | Tc |
| … | … | … |
| RX-TX\_TIME\_DIFFERENCE\_492511 | 985016  TUE Rx-Tx < 985020 | Tc |
| RX-TX\_TIME\_DIFFERENCE\_492512 | 985020  TUE Rx-Tx < 985024 | Tc |
| RX-TX\_TIME\_DIFFERENCE\_492513 | 985024  TUE Rx-Tx | Tc |

Table 10.1.25.3.1-4: Absolute UE Rx-Tx time difference measurement report mapping for *k*=3

|  |  |  |
| --- | --- | --- |
| Reported Quantity Value | Measured Quantity Value | Unit |
| RX-TX\_TIME\_DIFFERENCE\_0000 | TUE Rx-Tx < -985024 | Tc |
| RX-TX\_TIME\_DIFFERENCE\_0001 | -985024  TUE Rx-Tx < -985016 | Tc |
| RX-TX\_TIME\_DIFFERENCE\_0002 | -985016  TUE Rx-Tx < -985008 | Tc |
|  |  | … |
| RX-TX\_TIME\_DIFFERENCE\_123128 | -8  TUE Rx-Tx < 0 | Tc |
| RX-TX\_TIME\_DIFFERENCE\_123129 | 0  TUE Rx-Tx < 8 | Tc |
| … | … | … |
| RX-TX\_TIME\_DIFFERENCE\_246255 | 985008  TUE Rx-Tx < 985016 | Tc |
| RX-TX\_TIME\_DIFFERENCE\_246256 | 985016  TUE Rx-Tx < 985024 | Tc |
| RX-TX\_TIME\_DIFFERENCE\_246257 | 985024  TUE Rx-Tx | Tc |

Table 10.1.25.3.1-5: Absolute UE Rx-Tx time difference measurement report mapping for *k*=4

|  |  |  |
| --- | --- | --- |
| Reported Quantity Value | Measured Quantity Value | Unit |
| RX-TX\_TIME\_DIFFERENCE\_0000 | TUE Rx-Tx < -985024 | Tc |
| RX-TX\_TIME\_DIFFERENCE\_0001 | -985024  TUE Rx-Tx < -985008 | Tc |
| RX-TX\_TIME\_DIFFERENCE\_0002 | -985008  TUE Rx-Tx < -984992 | Tc |
|  |  | … |
| RX-TX\_TIME\_DIFFERENCE\_61564 | -16  TUE Rx-Tx < 0 | Tc |
| RX-TX\_TIME\_DIFFERENCE\_61565 | 0  TUE Rx-Tx < 16 | Tc |
| … | … | … |
| RX-TX\_TIME\_DIFFERENCE\_123127 | 984992  TUE Rx-Tx < 985008 | Tc |
| RX-TX\_TIME\_DIFFERENCE\_123128 | 985008  TUE Rx-Tx < 985024 | Tc |
| RX-TX\_TIME\_DIFFERENCE\_123129 | 985024  TUE Rx-Tx | Tc |

**Table 10.1.25.3.1-6: Absolute UE Rx-Tx time difference measurement report mapping for *k*=5**

|  |  |  |
| --- | --- | --- |
| Reported Quantity Value | Measured Quantity Value | Unit |
| RX-TX\_TIME\_DIFFERENCE\_0000 | TUE Rx-Tx < -985024 | Tc |
| RX-TX\_TIME\_DIFFERENCE\_0001 | -985024  TUE Rx-Tx < -984992 | Tc |
| RX-TX\_TIME\_DIFFERENCE\_0002 | -984992  TUE Rx-Tx < -984960 | Tc |
|  |  | … |
| RX-TX\_TIME\_DIFFERENCE\_30782 | -32  TUE Rx-Tx < 0 | Tc |
| RX-TX\_TIME\_DIFFERENCE\_30783 | 0  TUE Rx-Tx < 32 | Tc |
| … | … | … |
| RX-TX\_TIME\_DIFFERENCE\_61563 | 984960  TUE Rx-Tx < 984992 | Tc |
| RX-TX\_TIME\_DIFFERENCE\_61564 | 984992  TUE Rx-Tx < 985024 | Tc |
| RX-TX\_TIME\_DIFFERENCE\_61565 | 985024  TUE Rx-Tx | Tc |

##### 10.1.25.3.2 Differential UE Rx-Tx Measurement Report Mapping

The reporting range for differential UE Rx-Tx time difference measurement (TUE Rx-Tx) is defined from 0 up to 8191Tc where:

TUE Rx-Tx = TUE Rx-Tx1 - TUE Rx-Tx2; where:

TUE Rx-Tx1 > TUE Rx-Tx2,

TUE Rx-Tx1 is the first absolute UE Rx-Tx time difference measurement,

TUE Rx-Tx1 is the second absolute UE Rx-Tx time difference measurement,

Tc is defined in TS 38.211 [6],

*kmin*≤*k*≤*kmax*,

*kmin*=[2] and *kmax*=5, when at least one of the PRS and the SRS resources configured for TUE Rx-Tx is in FR1,

*kmin*=0 and *kmax*=5, when all the PRS and SRS resources configured for TUE Rx-Tx are in FR2,

*k≥* *timingReportingGranularityFactor* [34] configured by LMF via LPP for the UE Rx-Tx time difference measurement.

The TUE Rx-Tx report mapping for *k* = 0, 1, 2, 3, 4, and 5 are specified in Tables 10.1.25.3.2-1, 10.1.25.3.2-2, 10.1.25.3.2-3, 10.1.25.3.2-4, 10.1.25.3.2-5, and 10.1.25.3.2-6, respectively.

Table 10.1.25.3.2-1: Differential UE Rx-Tx time difference measurement report mapping for *k*=0

|  |  |  |
| --- | --- | --- |
| Reported Quantity Value | Measured Quantity Value | Unit |
| DIFF\_RX-TX\_TIME\_DIFFERENCE\_0000 | 0  TUE Rx-Tx < 1 | Tc |
| DIFF\_RX-TX\_TIME\_DIFFERENCE\_0001 | 1  TUE Rx-Tx < 2 | Tc |
| DIFF\_RX-TX\_TIME\_DIFFERENCE\_0002 | 2  TUE Rx-Tx < 3 | Tc |
|  |  | … |
| DIFF\_RX-TX\_TIME\_DIFFERENCE\_8189 | 8189  TUE Rx-Tx < 8190 | Tc |
| DIFF\_RX-TX\_TIME\_DIFFERENCE\_8190 | 8190  TUE Rx-Tx < 8191 | Tc |
| DIFF\_RX-TX\_TIME\_DIFFERENCE\_8191 | 8191  TUE Rx-Tx | Tc |

Table 10.1.25.3.2-2: Differential UE Rx-Tx time difference measurement report mapping for *k*=1

|  |  |  |
| --- | --- | --- |
| Reported Quantity Value | Measured Quantity Value | Unit |
| DIFF\_RX-TX\_TIME\_DIFFERENCE\_0000 | 0  TUE Rx-Tx < 2 | Tc |
| DIFF\_RX-TX\_TIME\_DIFFERENCE\_0001 | 2  TUE Rx-Tx < 4 | Tc |
| DIFF\_RX-TX\_TIME\_DIFFERENCE\_0002 | 4  TUE Rx-Tx < 6 | Tc |
|  |  | … |
| DIFF\_RX-TX\_TIME\_DIFFERENCE\_4093 | 8186  TUE Rx-Tx < 8188 | Tc |
| DIFF\_RX-TX\_TIME\_DIFFERENCE\_4094 | 8188  TUE Rx-Tx < 8190 | Tc |
| DIFF\_RX-TX\_TIME\_DIFFERENCE\_4095 | 8190  TUE Rx-Tx | Tc |

Table 10.1.25.3.2-3: Differential UE Rx-Tx time difference measurement report mapping for *k*=2

|  |  |  |
| --- | --- | --- |
| Reported Quantity Value | Measured Quantity Value | Unit |
| DIFF\_RX-TX\_TIME\_DIFFERENCE\_0000 | 0  TUE Rx-Tx < 4 | Tc |
| DIFF\_RX-TX\_TIME\_DIFFERENCE\_0001 | 4  TUE Rx-Tx < 8 | Tc |
| DIFF\_RX-TX\_TIME\_DIFFERENCE\_0002 | 8  TUE Rx-Tx < 12 | Tc |
|  |  | … |
| DIFF\_RX-TX\_TIME\_DIFFERENCE\_2045 | 8180  TUE Rx-Tx < 8184 | Tc |
| DIFF\_RX-TX\_TIME\_DIFFERENCE\_2046 | 8184  TUE Rx-Tx < 8188 | Tc |
| DIFF\_RX-TX\_TIME\_DIFFERENCE\_2047 | 8188  TUE Rx-Tx | Tc |

Table 10.1.25.3.2-4: Differential UE Rx-Tx time difference measurement report mapping for *k*=3

|  |  |  |
| --- | --- | --- |
| Reported Quantity Value | Measured Quantity Value | Unit |
| DIFF\_RX-TX\_TIME\_DIFFERENCE\_0000 | 0  TUE Rx-Tx < 8 | Tc |
| DIFF\_RX-TX\_TIME\_DIFFERENCE\_0001 | 8  TUE Rx-Tx < 16 | Tc |
| DIFF\_RX-TX\_TIME\_DIFFERENCE\_0002 | 16  TUE Rx-Tx < 24 | Tc |
|  |  | … |
| DIFF\_RX-TX\_TIME\_DIFFERENCE\_1021 | 8168  TUE Rx-Tx < 8176 | Tc |
| DIFF\_RX-TX\_TIME\_DIFFERENCE\_1022 | 8176  TUE Rx-Tx < 8184 | Tc |
| DIFF\_RX-TX\_TIME\_DIFFERENCE\_1023 | 8184  TUE Rx-Tx | Tc |

Table 10.1.25.3.2-5: Differential UE Rx-Tx time difference measurement report mapping for *k*=4

|  |  |  |
| --- | --- | --- |
| Reported Quantity Value | Measured Quantity Value | Unit |
| DIFF\_RX-TX\_TIME\_DIFFERENCE\_0000 | 0  TUE Rx-Tx < 16 | Tc |
| DIFF\_RX-TX\_TIME\_DIFFERENCE\_0001 | 16  TUE Rx-Tx < 32 | Tc |
| DIFF\_RX-TX\_TIME\_DIFFERENCE\_0002 | 32  TUE Rx-Tx < 48 | Tc |
|  |  | … |
| DIFF\_RX-TX\_TIME\_DIFFERENCE\_509 | 8144  TUE Rx-Tx < 8160 | Tc |
| DIFF\_RX-TX\_TIME\_DIFFERENCE\_510 | 8160  TUE Rx-Tx < 8176 | Tc |
| DIFF\_RX-TX\_TIME\_DIFFERENCE\_511 | 8176  TUE Rx-Tx | Tc |

Table 10.1.25.3.2-6: Differential UE Rx-Tx time difference measurement report mapping for *k*=5

|  |  |  |
| --- | --- | --- |
| Reported Quantity Value | Measured Quantity Value | Unit |
| DIFF\_RX-TX\_TIME\_DIFFERENCE\_0000 | 0  TUE Rx-Tx < 32 | Tc |
| DIFF\_RX-TX\_TIME\_DIFFERENCE\_0001 | 32  TUE Rx-Tx < 64 | Tc |
| DIFF\_RX-TX\_TIME\_DIFFERENCE\_0002 | 64  TUE Rx-Tx < 96 | Tc |
|  |  | … |
| DIFF\_RX-TX\_TIME\_DIFFERENCE\_253 | 8096  TUE Rx-Tx < 8128 | Tc |
| DIFF\_RX-TX\_TIME\_DIFFERENCE\_254 | 8128  TUE Rx-Tx < 8160 | Tc |
| DIFF\_RX-TX\_TIME\_DIFFERENCE\_255 | 8160  TUE Rx-Tx | Tc |

##### 10.1.25.3.3 Additional Path Report Mapping for UE Rx-Tx Time Difference

The reporting range for the additional path reporting for an UE Rx-Tx time difference measurement is defined up to the range from -8175×Tc to 8175×Tc with the resolution step of 2*k*×Tc, where

Tc is defined in TS 38.211 [6],

*kmin*≤*k*≤*kmax*,

*kmin*=[2] and *kmax*=5, when at least one of the PRS resource and SRS resource configured for the UE Rx-Tx time difference measurement is in FR1,

*kmin*=0 and *kmax*=5, when both of the PRS resource and SRS resource configured for the UE Rx-Tx time difference measurement is in FR2,

*k≥* *timingReportingGranularityFactor* [34] configured by LMF via LPP for the UE Rx-Tx time difference measurement.

The UE can report the timing of up to two additional paths with respect to the path timing determining the UE Rx-Tx time difference measurement.

The UE capable of  *additionalPathsExtSupport-r17* can report the timing of up to its supported number of additional paths with respect to the path timing determining the UE Rx-Tx measurement.

The report mappings for different *k* values are specified in Tables 10.1.25.3.3-1 − 10.1.25.3.3-6.

Table 10.1.25.3.3-1: Report mapping for *k*=0

|  |  |  |
| --- | --- | --- |
| Reported Quantity Value,  path\_i | Measured Quantity Value,  Δpath | Unit |
|
| path\_00000 | Δpath < -8175 | Tc |
| path\_00001 | -8175 ≤ Δpath < -8174 | Tc |
| path\_00002 | -8174 ≤ Δpath < -8173 | Tc |
| … | … | … |
| path\_08175 | -1 ≤ Δpath < 0 | Tc |
| path\_08176 | 0 ≤ Δpath < 1 | Tc |
| … | … | … |
| path\_ 16349 | 8173 ≤ Δpath < 8174 | Tc |
| path\_ 16350 | 8174 ≤ Δpath < 8175 | Tc |
| path\_ 16351 | 8175 ≤ Δpath | Tc |

Table 10.1.25.3.3-2: Report mapping for *k*=1

|  |  |  |
| --- | --- | --- |
| Reported Quantity Value,  path\_i | Measured Quantity Value,  Δpath | Unit |
| path\_0000 | Δpath < -8175 | Tc |
| path\_0001 | -8175 ≤ Δpath < -8173 | Tc |
| path\_0002 | -8173 ≤ Δpath < -8171 | Tc |
| … | … | … |
| path\_4088 | -1 ≤ Δpath < 1 | Tc |
| … | … | … |
| path\_8174 | 8171 ≤ Δpath < 8173 | Tc |
| path\_8175 | 8173 ≤ Δpath < 8175 | Tc |
| path\_8176 | 8175 ≤ Δpath | Tc |

Table 10.1.25.3.3-3: Report mapping for *k*=2

|  |  |  |
| --- | --- | --- |
| Reported Quantity Value,  path\_i | Measured Quantity Value,  Δpath | Unit |
| path\_0000 | Δpath < -8174 | Tc |
| path\_0001 | -8174 ≤ Δpath < -8170 | Tc |
| path\_0002 | -8170 ≤ Δpath < -8166 | Tc |
| … | … | … |
| path\_2044 | -2 ≤ Δpath < 2 | Tc |
| … | … | … |
| path\_4086 | 8166 ≤ Δpath < 8170 | Tc |
| path\_4087 | 8170 ≤ Δpath < 8174 | Tc |
| path\_4088 | 8174 ≤ Δpath | Tc |

Table 10.1.25.3.3-4: Report mapping for *k*=3

|  |  |  |
| --- | --- | --- |
| Reported Quantity Value,  path\_i | Measured Quantity Value,  Δpath | Unit |
| path\_0000 | Δpath < -8172 | Tc |
| path\_0001 | -8172 ≤ Δpath < -8164 | Tc |
| path\_0002 | -8164 ≤ Δpath < -8156 | Tc |
| … | … | … |
| path\_1022 | -4 ≤ Δpath < 4 | Tc |
| … | … | … |
| path\_2042 | 8156 ≤ Δpath < 8164 | Tc |
| path\_2043 | 8164 ≤ Δpath < 8172 | Tc |
| path\_2044 | 8172 ≤ Δpath | Tc |

Table 10.1.25.3.3-5: Report mapping for *k*=4

|  |  |  |
| --- | --- | --- |
| Reported Quantity Value,  path\_i | Measured Quantity Value,  Δpath | Unit |
| path\_0000 | Δpath < -8168 | Tc |
| path\_0001 | -8168 ≤ Δpath < -8152 | Tc |
| path\_0002 | -8152 ≤ Δpath < -8136 | Tc |
| … | … | … |
| path\_511 | -8 ≤ Δpath < 8 | Tc |
| … | … | … |
| path\_1020 | 8136 ≤ Δpath < 8152 | Tc |
| path\_1021 | 8152 ≤ Δpath < 8168 | Tc |
| path\_1022 | 8168 ≤ Δpath | Tc |

Table 10.1.25.3.3-6: Report mapping for *k*=5

|  |  |  |
| --- | --- | --- |
| Reported Quantity Value,  path\_i | Measured Quantity Value,  Δpath | Unit |
| path\_000 | Δpath < -8160 | Tc |
| path\_001 | -8160 ≤ Δpath < -8128 | Tc |
| path\_002 | -8128 ≤ Δpath < -8096 | Tc |
| … | … | … |
| path\_256 | 0 ≤ Δpath < 32 | Tc |
| … | … | … |
| path\_509 | 8096 ≤ Δpath < 8128 | Tc |
| path\_510 | 8128 ≤ Δpath < 8160 | Tc |
| path\_511 | 8160 ≤ Δpath | Tc |

### 10.1.26 FR2 P-MPR report

The FR2 P-MPR report mapping is defined by this clause.

#### 10.1.26.1 Report mapping

Table 10.1.26.1-1 defines the FR2 P-MPR report mapping.

Table 10.1.26.1-1 Mapping of FR2 P-MPR

|  |  |  |
| --- | --- | --- |
| Reported value | Measured quantity value | Unit |
| P-MPR\_00 | 3  PMP-R < 6 | dB |
| P-MPR\_01 | 6  PMP-R < 9 | dB |
| P-MPR\_02 | 9  PMP-R < 12 | dB |
| P-MPR\_03 | PMP-R ≥ 12 | dB |

### 10.1.27 L1-SINR accuracy requirements for FR1

#### 10.1.27.1 L1-SINR accuracy requirements with CSI-RS based CMR and no dedicated IMR configured

##### 10.1.27.1.1 Absolute Accuracy

Unless otherwise specified, the requirements for absolute accuracy of CSI-RS based L1-SINR in this clause apply to all CSI-RS resources configured as CMR and no dedicated resource configured as IMR of the serving cell configured for L1-SINR measurement.

The accuracy requirements in Table 10.1.27.1.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for L1-SINR measurements are fulfilled according to Annex B.2.8.1 for a corresponding Band for each relevant CSI-RS based CMR.

- The bandwidth of CSI-RS as CMR is 48 PRBs and the density is 3.

- AWGN radio propagation conditions.

The performance with larger bandwidth of CSI-RS as CMR is equal to or better than the accuracy requirements in Table 10.1.27.1.1-1.

Table 10.1.27.1.1-1: L1-SINR absolute accuracy for CSI-RS based CMR only in FR1

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | | |
| Normal condition | Extreme condition | CSI-RS  CMR  Ês/Iot | Io Note 1 range | | | | | |
|  |  |  | NR operating band groups Note 2 | Minimum Io | | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSCSI-RS | | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSCSI-RS = 15 kHz | SCSCSI-RS = 30 kHz | SCSCSI-RS = 60 kHz |  |  |
|  |  |  | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -118 | -115 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_B | -120.5 | -117.5 | -114.5 | N/A | -50 |
|  |  |  | NR\_TDD\_FR1\_C | -120 | -117 | -114 | N/A | -50 |
| ±5.5 | ±6.5 | ≥-3 | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | -113.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | -113 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_F | -118.5 | -115.5 | -112.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_G | -118 | -115 | -112 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_H | -117.5 | -114.5 | -111.5 | N/A | -50 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: NR operating band groups in FR1 are as defined in clause 3.5.2.  NOTE 3: The requirements apply for CSI-RS CMR Ês/Iot ≤ [6] dB with SCS 15kHz or 30kHz under NR high speed scenarios. | | | | | | | | |

##### 10.1.27.1.2 Relative Accuracy

The relative accuracy of CSI-RS based L1-SINR is defined as the L1-SINR measured from one CSI-RS compared to the largest measured value of L1-SINR among all CSI-RS resources of the serving cell.

The accuracy requirements in Table 10.1.27.1.2-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for L1-SINR measurements are fulfilled according to Annex B.2.8.1 for a corresponding Band for each relevant CSI-RS based CMR.

- The bandwidth of CSI-RS is 48 PRBs and the density is 3.

- AWGN radio propagation conditions.

The performance with larger bandwidth of CSI-RS as CMR is equal to or better than the accuracy requirements in Table 10.1.27.1.2-1.

Table 10.1.27.1.2-1: L1-SINR relative accuracy for CSI-RS based CMR only in FR1

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | | |
| Normal condition | Extreme condition | CSI-RS  CMR  Ês/Iot Note 2 | Io Note 1 range | | | | | |
|  |  |  | NR operating band groups Note 3 | Minimum Io | | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSCSI-RS | | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSCSI-RS = 15 kHz | SCSCSI-RS = 30 kHz | SCSCSI-RS = 60 kHz |  |  |
|  |  |  | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -118 | -115 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_B | -120.5 | -117.5 | -114.5 | N/A | -50 |
|  |  |  | NR\_TDD\_FR1\_C | -120 | -117 | -114 | N/A | -50 |
| ±[4.5] | ±[5.5] | ≥-3 | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | -113.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | -113 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_F | -118.5 | -115.5 | -112.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_G | -118 | -115 | -112 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_H | -117.5 | -114.5 | -111.5 | N/A | -50 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: The parameter CSI-RS CMR Ês/Iot is the minimum CMR CMR Ês/Iot of the pair of CSI-RS resources to which the requirement applies.  NOTE 3: NR operating band groups in FR1 are as defined in clause 3.5.2.  NOTE 4: The requirements apply for CSI-RS CMR Ês/Iot ≤ [6] dB with SCS 15kHz or 30kHz under NR high speed scenarios. | | | | | | | | |

#### 10.1.27.2 L1-SINR accuracy requirements with SSB based CMR and dedicated IMR configured

##### 10.1.27.2.1 Absolute Accuracy

Unless otherwise specified, the requirements for absolute accuracy of SSB based L1-SINR in this clause apply to all SSBs configured as CMR and dedicated resources configured as IMR of the serving cell configured for L1-SINR measurement.

The accuracy requirements are defined in Table 10.1.27.2.1-1 for SSB based CMR and NZP-IMR and in Table 10.1.27.2.1-2 for SSB based CMR and ZP-IMR.

The accuracy requirements in Tables 10.1.27.2.1-1 and 10.1.27.2.1-2 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for L1-SINR measurements are fulfilled according to Annex B.2.8.2 for a corresponding Band for each relevant SSB based CMR and IMR.

- The bandwidth of NZP-IMR and ZP-IMR is 48 PRBs and the density is 3.

- AWGN radio propagation conditions.

The performance with larger bandwidth of NZP-IMR and ZP-IMR is equal to or better than the accuracy requirements in Tables 10.1.27.2.1-1 and 10.1.27.2.1-2.

Table 10.1.27.2.1-1: L1-SINR absolute accuracy for SSB based CMR and NZP-IMR in FR1

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | | | |
| Normal condition | Extreme condition | SSB-  CMR  Ês/Iot | NZP-IMR  Ês/Iot | | Io Note 1 range | | | | |
|  |  |  | |  | NR operating band groups Note 2 | Minimum Io | | | Maximum Io |
| dB | dB | dB | | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  | |  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |  |
|  |  |  | |  | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A, NR\_SDL\_FR1\_A | -121 | -118 | N/A | -50 |
|  |  |  | |  | NR\_FDD\_FR1\_B | -120.5 | -117.5 | N/A | -50 |
|  |  |  | |  | NR\_TDD\_FR1\_C | -120 | -117 | N/A | -50 |
| ±4.0 | ±5.0 | ≥0 | | ≥0 | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | N/A | -50 |
|  |  |  | |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | N/A | -50 |
|  |  |  | |  | NR\_FDD\_FR1\_F | -118.5 | -115.5 | N/A | -50 |
|  |  |  | |  | NR\_FDD\_FR1\_G | -118 | -115 | N/A | -50 |
|  |  |  | |  | NR\_FDD\_FR1\_H | -117.5 | -114.5 | N/A | -50 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: NR operating band groups in FR1 are as defined in clause 3.5.2.  NOTE 3: The requirements apply for SSB-CMR Ês/Iot ≤ [6] dB with SCS 15kHz or 30kHz under NR high speed scenarios. | | | | | | | | | |

Table 10.1.27.2.1-2: L1-SINR absolute accuracy for SSB based CMR and ZP-IMR in FR1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB-  CMR  Ês/Iot | Io Note 1 range | | | | |
|  |  |  | NR operating band groups Note 2 | Minimum Io | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |  |
|  |  |  | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A, NR\_SDL\_FR1\_A | -121 | -118 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_B | -120.5 | -117.5 | N/A | -50 |
|  |  |  | NR\_TDD\_FR1\_C | -120 | -117 | N/A | -50 |
| ±4.5 | ±5.5 | ≥-3 | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_F | -118.5 | -115.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_G | -118 | -115 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_H | -117.5 | -114.5 | N/A | -50 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: NR operating band groups in FR1 are as defined in clause 3.5.2.  NOTE 3: The requirements apply for SSB Ês/Iot ≤ [6] dB with SCS 15kHz or 30kHz under NR high speed scenarios. | | | | | | | |

##### 10.1.27.2.2 Relative Accuracy

The relative accuracy of SSB based L1-SINR is defined as the L1-SINR measured from one SSB configured as CMR and one IMR configured as IMR compared to the largest measured value of L1-SINR among all SSBs and IMRs of the serving cell.

The accuracy requirements are defined in Table 10.1.27.2.2-1 for SSB based CMR and NZP-IMR and in Table 10.1.27.2.2-2 for SSB based CMR and ZP-IMR.

The accuracy requirements in Tables 10.1.27.2.2-1 and 10.1.27.2.2-2 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for L1-SINR measurements are fulfilled according to Annex B.2.8.2 for a corresponding Band for each relevant SSB based CMR and IMR.

- The bandwidth of NZP-IMR and ZP-IMR is 48 PRBs and the density is 3.

- AWGN radio propagation conditions.

The performance with larger bandwidth of NZP-IMR and ZP-IMR is equal to or better than the accuracy requirements in Tables 10.1.27.2.2-1 and 10.1.27.2.2-2.

Table 10.1.27.2.2-1: L1-SINR relative accuracy for SSB based CMR and NZP-IMR in FR1

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | | | |
| Normal condition | Extreme condition | SSB-  CMR  Ês/Iot Note 2 | NZP-IMR  Ês/Iot | | Io Note 1 range | | | | |
|  |  |  | |  | NR operating band groups Note 3 | Minimum Io | | | Maximum Io |
| dB | dB | dB | | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  | |  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |  |
|  |  |  | |  | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A, NR\_SDL\_FR1\_A | -121 | -118 | N/A | -50 |
|  |  |  | |  | NR\_FDD\_FR1\_B | -120.5 | -117.5 | N/A | -50 |
|  |  |  | |  | NR\_TDD\_FR1\_C | -120 | -117 | N/A | -50 |
| ±[3.0] | ±[4.0] | ≥0 | | ≥0 | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | N/A | -50 |
|  |  |  | |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | N/A | -50 |
|  |  |  | |  | NR\_FDD\_FR1\_F | -118.5 | -115.5 | N/A | -50 |
|  |  |  | |  | NR\_FDD\_FR1\_G | -118 | -115 | N/A | -50 |
|  |  |  | |  | NR\_FDD\_FR1\_H | -117.5 | -114.5 | N/A | -50 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: The parameter SSB CMR Ês/Iot is the minimum SSB CMR Ês/Iot of the pair of SSBs to which the requirement applies.  NOTE 3: NR operating band groups in FR1 are as defined in clause 3.5.2.  NOTE 4: The requirements apply for SSB-CMR Ês/Iot ≤ [6] dB with SCS 15kHz or 30kHz under NR high speed scenarios. | | | | | | | | | |

Table 10.1.27.2.2-2: L1-SINR relative accuracy for SSB based CMR and ZP-IMR in FR1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB-  CMR  Ês/Iot Note 2 | Io Note 1 range | | | | |
|  |  |  | NR operating band groups Note 3 | Minimum Io | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |  |
|  |  |  | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A, NR\_SDL\_FR1\_A | -121 | -118 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_B | -120.5 | -117.5 | N/A | -50 |
|  |  |  | NR\_TDD\_FR1\_C | -120 | -117 | N/A | -50 |
| ±[3.5] | ±[4.5] | ≥-3 | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_F | -118.5 | -115.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_G | -118 | -115 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_H | -117.5 | -114.5 | N/A | -50 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: The parameter SSB CMR Ês/Iot is the minimum SSB CMR Ês/Iot of the pair of SSBs to which the requirement applies.  NOTE 3: NR operating band groups in FR1 are as defined in clause 3.5.2.  NOTE 4: The requirements apply for SSB Ês/Iot ≤ [6] dB with SCS 15kHz or 30kHz under NR high speed scenarios. | | | | | | | |

#### 10.1.27.3 L1-SINR accuracy requirements with CSI-RS based CMR and dedicated IMR configured

##### 10.1.27.3.1 Absolute Accuracy

Unless otherwise specified, the requirements for absolute accuracy of CSI-RS based L1-SINR in this clause apply to all CSI-RS resources configured as CMR and dedicated resources configured as IMR of the serving cell configured for L1-SINR measurement.

The accuracy requirements are defined in Table 10.1.27.3.1-1 for CSI-RS based CMR and NZP-IMR and in Table 10.1.27.3.1-2 for CSI-RS based CMR and ZP-IMR.

The accuracy requirements in Tables 10.1.27.3.1-1 and 10.1.27.3.1-2 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for L1-SINR measurements are fulfilled according to Annex B.2.8.3 for a corresponding Band for each relevant CSI-RS based CMR and IMR.

- The bandwidth of CSI-RS as CMR, NZP-IMR and ZP-IMR is 48 PRBs and the density is 3.

- AWGN radio propagation conditions.

The performance with larger bandwidth of CSI-RS as CMR, NZP-IMR and ZP-IMR is equal to or better than the accuracy requirements in Tables 10.1.27.3.1-1 and 10.1.27.3.1-2.

Table 10.1.27.3.1-1: L1-SINR absolute accuracy for CSI-RS based CMR and NZP-IMR in FR1

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | | | |
| Normal condition | Extreme condition | CSI-RS  CMR Ês/Iot | NZP-IMR  Ês/Iot | Io Note 1 range | | | | | |
|  |  |  |  | NR operating band groups Note 2 | Minimum Io | | | | Maximum Io |
| dB | dB | dB | dB |  | dBm / SCSCSI-RS | | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  |  | SCSCSI-RS = 15 kHz | SCSCSI-RS = 30 kHz | SCSCSI-RS = 60 kHz |  |  |
|  |  |  |  | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -118 | -115 | N/A | -50 |
|  |  |  |  | NR\_FDD\_FR1\_B | -120.5 | -117.5 | -114.5 | N/A | -50 |
|  |  |  |  | NR\_TDD\_FR1\_C | -120 | -117 | -114 | N/A | -50 |
| ±4.0 | ±5.0 | ≥0 | ≥0 | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | -113.5 | N/A | -50 |
|  |  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | -113 | N/A | -50 |
|  |  |  |  | NR\_FDD\_FR1\_F | -118.5 | -115.5 | -112.5 | N/A | -50 |
|  |  |  |  | NR\_FDD\_FR1\_G | -118 | -115 | -112 | N/A | -50 |
|  |  |  |  | NR\_FDD\_FR1\_H | -117.5 | -114.5 | -111.5 | N/A | -50 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: NR operating band groups in FR1 are as defined in clause 3.5.2.  NOTE 3: The requirements apply for CSI-RS CMR Ês/Iot ≤ [6] dB with SCS 15kHz or 30kHz under NR high speed scenarios. | | | | | | | | | |

Table 10.1.27.3.1-2: L1-SINR absolute accuracy for CSI-RS based CMR and ZP-IMR in FR1

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | | |
| Normal condition | Extreme condition | CSI-RS  CMR Ês/Iot | Io Note 1 range | | | | | |
|  |  |  | NR operating band groups Note 2 | Minimum Io | | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSCSI-RS | | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSCSI-RS = 15 kHz | SCSCSI-RS = 30 kHz | SCSCSI-RS = 60 kHz |  |  |
|  |  |  | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -118 | -115 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_B | -120.5 | -117.5 | -114.5 | N/A | -50 |
|  |  |  | NR\_TDD\_FR1\_C | -120 | -117 | -114 | N/A | -50 |
| ±4.5 | ±5.5 | ≥-3 | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | -113.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | -113 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_F | -118.5 | -115.5 | -112.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_G | -118 | -115 | -112 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_H | -117.5 | -114.5 | -111.5 | N/A | -50 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: NR operating band groups in FR1 are as defined in clause 3.5.2.  NOTE 3: The requirements apply for CSI-RS CMR Ês/Iot ≤ [6] dB with SCS 15kHz or 30kHz under NR high speed scenarios. | | | | | | | | |

##### 10.1.27.3.2 Relative Accuracy

The relative accuracy of CSI-RS based L1-SINR is defined as the L1-SINR measured from one CSI-RS configured as CMR and one IMR configured as IMR compared to the largest measured value of L1-SINR among all CSI-RS and IMR resources of the serving cell.

The accuracy requirements are defined in Table 10.1.27.3.2-1 for CSI-RS based CMR and NZP-IMR and in Table 10.1.27.3.2-2 for CSI-RS based CMR and ZP-IMR.

The accuracy requirements in Tables 10.1.27.3.2-1 and 10.1.27.3.2-2 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for L1-SINR measurements are fulfilled according to Annex B.2.8.3 for a corresponding Band for each relevant CSI-RS based CMR and IMR.

- The bandwidth of CSI-RS as CMR, NZP-IMR and ZP-IMR is 48 PRBs and the density is 3.

- AWGN radio propagation conditions.

The performance with larger bandwidth of CSI-RS as CMR, NZP-IMR and ZP-IMR is equal to or better than the accuracy requirements in Tables 10.1.27.3.2-1 and 10.1.27.3.2-2.

Table 10.1.27.3.2-1: L1-SINR relative accuracy for CSI-RS based CMR and NZP-IMR in FR1

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | | | |
| Normal condition | Extreme condition | CSI-RS  CMR Ês/Iot Note 2 | NZP-IMR  Ês/Iot | Io Note 1 range | | | | | |
|  |  |  |  | NR operating band groups Note 3 | Minimum Io | | | | Maximum Io |
| dB | dB | dB | dB |  | dBm / SCSCSI-RS | | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  |  | SCSCSI-RS = 15 kHz | SCSCSI-RS = 30 kHz | SCSCSI-RS = 60 kHz |  |  |
|  |  |  |  | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -118 | -115 | N/A | -50 |
|  |  |  |  | NR\_FDD\_FR1\_B | -120.5 | -117.5 | -114.5 | N/A | -50 |
|  |  |  |  | NR\_TDD\_FR1\_C | -120 | -117 | -114 | N/A | -50 |
| ±[3.0] | ±[4.0] | ≥0 | ≥0 | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | -113.5 | N/A | -50 |
|  |  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | -113 | N/A | -50 |
|  |  |  |  | NR\_FDD\_FR1\_F | -118.5 | -115.5 | -112.5 | N/A | -50 |
|  |  |  |  | NR\_FDD\_FR1\_G | -118 | -115 | -112 | N/A | -50 |
|  |  |  |  | NR\_FDD\_FR1\_H | -117.5 | -114.5 | -111.5 | N/A | -50 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: The parameter CSI-RS CMR Ês/Iot is the minimum CMR CMR Ês/Iot of the pair of CSI-RS resources to which the requirement applies.  NOTE 3: NR operating band groups in FR1 are as defined in clause 3.5.2.  NOTE 4: The requirements apply for CSI-RS CMR Ês/Iot ≤ [6] dB with SCS 15kHz or 30kHz under NR high speed scenarios. | | | | | | | | | |

Table 10.1.27.3.2-2: L1-SINR relative accuracy for CSI-RS based CMR and ZP-IMR in FR1

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | | |
| Normal condition | Extreme condition | CSI-RS  CMR Ês/Iot Note 2 | Io Note 1 range | | | | | |
|  |  |  | NR operating band groups Note 3 | Minimum Io | | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSCSI-RS | | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSCSI-RS = 15 kHz | SCSCSI-RS = 30 kHz | SCSCSI-RS = 60 kHz |  |  |
|  |  |  | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -118 | -115 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_B | -120.5 | -117.5 | -114.5 | N/A | -50 |
|  |  |  | NR\_TDD\_FR1\_C | -120 | -117 | -114 | N/A | -50 |
| ±[3.5] | ±[4.5] | ≥-3 | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | -113.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | -113 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_F | -118.5 | -115.5 | -112.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_G | -118 | -115 | -112 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_H | -117.5 | -114.5 | -111.5 | N/A | -50 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: The parameter CSI-RS CMR Ês/Iot is the minimum CMR CMR Ês/Iot of the pair of CSI-RS resources to which the requirement applies.  NOTE 3: NR operating band groups in FR1 are as defined in clause 3.5.2.  NOTE 4: The requirements apply for CSI-RS CMR Ês/Iot ≤ [6] dB with SCS 15kHz or 30kHz under NR high speed scenarios. | | | | | | | | |

### 10.1.28 L1-SINR accuracy requirements for FR2

10.1.28.1 L1-SINR accuracy requirements with CSI-RS based CMR and no dedicated IMR configured

10.1.28.1.1 Absolute Accuracy

Unless otherwise specified, the requirements for absolute accuracy of CSI-RS based L1-SINR in this clause apply to all CSI-RS resources configured as CMR and no dedicated resource configured as IMR of the serving cell configured for L1-SINR measurement.

The accuracy requirements in Table 10.1.28.1.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-2 [19] for reference sensitivity are fulfilled.

- Conditions for L1-SINR measurements are fulfilled according to Annex B.2.8.1 for a corresponding Band for each relevant CSI-RS based CMR.

- The bandwidth of CSI-RS as CMR is 48 PRBs and the density is 3.

- The measured signals are in the directions covered by the percentile EIS spherical coverage of the UE, defined in clause 7.3.4 of TS 38.101-2 [19].

- AWGN radio propagation conditions.

The performance with larger bandwidth of CSI-RS as CMR is equal to or better than the accuracy requirements in Table 10.1.28.1.1-1.

Table 10.1.28.1.1-1: L1-SINR absolute accuracy for CSI-RS based CMR only in FR2

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | |
| Normal condition | Extreme condition | CSI-RS  CMR  Ês/Iot Note 3 | Io Note 1 range | | | |
|  |  | Minimum Io | | | Maximum Io |
| dB | dB | dB | dBm / SCSCSI-RS Note 2 | | dBm/BWChannel | dBm/BWChannel |
|  |  |  | SCSCSI-RS = 60kHz | SCSCSI-RS = 120kHz |  |  |
| ±5.5 | ±6.5 | ≥-3 | Same value as CSI-RS\_RP in Table in B.2.8.1, according to UE Power class, operating band and angle of arrival | | N/A | -50 |
| NOTE 1: Io specified at the Reference point, and assumed to have constant EPRE across the bandwidth.  NOTE 2: Values based on Refsens and EIS spherical coverage as defined in clauses 7.3.2 and 7.3.4 of TS 38.101-2 [19]. Applicable side condition selected depending on angle of arrival.  NOTE 3: In the test cases, the CSI-RS CMR Ês/Iot and related parameters may need to be adjusted to ensure Ês/Iot at UE baseband is above the value defined in this table. | | | | | | |

10.1.28.1.2 Relative Accuracy

The relative accuracy of CSI-RS based L1-SINR is defined as the L1-SINR measured from one CSI-RS compared to the largest measured value of L1-SINR among all CSI-RS resources of the serving cell.

The accuracy requirements in Table 10.1.28.1.2-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-2 [19] for reference sensitivity are fulfilled.

- Conditions for L1-SINR measurements are fulfilled according to Annex B.2.8.1 for a corresponding Band for each relevant CSI-RS based CMR.

- The bandwidth of CSI-RS as CMR is 48 PRBs and the density is 3.

- The measured signals are in the directions covered by the percentile EIS spherical coverage of the UE, defined in clause 7.3.4 of TS 38.101-2 [19].

- AWGN radio propagation conditions.

The performance with larger bandwidth of CSI-RS as CMR is equal to or better than the accuracy requirements in Table 10.1.28.1.2-1.

Table 10.1.28.1.2-1: L1-SINR relative accuracy for CSI-RS based CMR only in FR2

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | |
| Normal condition | Extreme condition | CSI-RS  CMR  Ês/Iot Note 2, Note 4 | Io Note 1 range | | | |
|  |  | Minimum Io | | | Maximum Io |
| dB | dB | dB | dBm / SCSCSI-RS Note 3 | | dBm/BWChannel | dBm/BWChannel |
|  |  |  | SCSCSI-RS = 60kHz | SCSCSI-RS = 120kHz |  |  |
| ±4.5 | ±5.5 | ≥-3 | Same value as CSI-RS\_RP in Table in B.2.8.1, according to UE Power class, operating band and angle of arrival | | N/A | -50 |
| NOTE 1: Io specified at the Reference point, and assumed to have constant EPRE across the bandwidth.  NOTE 2: The parameter CSI-RS CMR Ês/Iot is the minimum CSI-RS CMR Ês/Iot of the pair of CSI-RS resources to which the requirement applies.  NOTE 3: Values based on Refsens and EIS spherical coverage as defined in clauses 7.3.2 and 7.3.4 of TS 38.101-2 [19]. Applicable side condition selected depending on angle of arrival.  NOTE 4: In the test cases, the CSI-RS CMR Ês/Iot and related parameters may need to be adjusted to ensure Ês/Iot at UE baseband is above the value defined in this table. | | | | | | |

10.1.28.2 L1-SINR accuracy requirements with SSB based CMR and dedicated IMR configured

10.1.28.2.1 Absolute Accuracy

Unless otherwise specified, the requirements for absolute accuracy of SSB based L1-SINR in this clause apply to all SSBs configured as CMR and dedicated resources configured as IMR of the serving cell configured for L1-SINR measurement.

The accuracy requirements are defined in Table 10.1.28.2.1-1 for SSB based CMR and NZP-IMR and in Table 10.1.28.2.1-2 for SSB based CMR and ZP-IMR.

The accuracy requirements in Tables 10.1.28.2.1-1 and 10.1.28.2.1-2 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-2 [19] for reference sensitivity are fulfilled.

- Conditions for L1-SINR measurements are fulfilled according to Annex B.2.8.2 for a corresponding Band for each relevant SSB based CMR and IMR.

- The bandwidth of NZP-IMR and ZP-IMR is 48 PRBs and the density is 3.

- The measured signals are in the directions covered by the percentile EIS spherical coverage of the UE, defined in clause 7.3.4 of TS 38.101-2 [19].

- AWGN radio propagation conditions.

- SSB based CMR and IMR in the test come from the same direction.

The performance with larger bandwidth of NZP-IMR and ZP-IMR is equal to or better than the accuracy requirements in Tables 10.1.28.2.1-1 and 10.1.28.2.1-2.

Table 10.1.28.2.1-1: L1-SINR absolute accuracy for SSB based CMR and NZP-IMR in FR2

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB  CMR  Ês/Iot Note 3 | NZP-IMR  Ês/Iot Note 3 | Io Note 1 range | | | |
|  |  |  | Minimum Io | | | Maximum Io |
| dB | dB | dB | dB | dBm / SCSSSB Note 2 | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 120kHz | SCSSSB = 240kHz |  |  |
| ±4.0 | ±5.0 | ≥0 | ≥0 | Same value as SSB\_RP in Table in B.2.8.2, according to UE Power class, operating band and angle of arrival | | N/A | -50 |
| NOTE 1: Io specified at the Reference point, and assumed to have constant EPRE across the bandwidth.  NOTE 2: Values based on Refsens and EIS spherical coverage as defined in clauses 7.3.2 and 7.3.4 of TS 38.101-2 [19]. Applicable side condition selected depending on angle of arrival.  NOTE 3: In the test cases, the SSB Ês/Iot, NZP-IMR Ês/Iot and related parameters may need to be adjusted to ensure Ês/Iot at UE baseband is above the value defined in this table. | | | | | | | |

Table 10.1.28.2.1-2: L1-SINR absolute accuracy for SSB based CMR and ZP-IMR in FR2

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | |
| Normal condition | Extreme condition | SSB  CMR  Ês/Iot Note 3 | Io Note 1 range | | | |
|  |  | Minimum Io | | | Maximum Io |
| dB | dB | dB | dBm / SCSSSB Note 2 | | dBm/BWChannel | dBm/BWChannel |
|  |  |  | SCSSSB = 120kHz | SCSSSB = 240kHz |  |  |
| ±4.5 | ±5.5 | ≥-3 | Same value as SSB\_RP in Table in B.2.8.2, according to UE Power class, operating band and angle of arrival | | N/A | -50 |
| NOTE 1: Io specified at the Reference point, and assumed to have constant EPRE across the bandwidth.  NOTE 2: Values based on Refsens and EIS spherical coverage as defined in clauses 7.3.2 and 7.3.4 of TS 38.101-2 [19]. Applicable side condition selected depending on angle of arrival.  NOTE 3: In the test cases, the SSB CMR Ês/Iot and related parameters may need to be adjusted to ensure Ês/Iot at UE baseband is above the value defined in this table. | | | | | | |

10.1.28.2.2 Relative Accuracy

The relative accuracy of SSB based L1-SINR is defined as the L1-SINR measured from one SSB configured as CMR and one IMR configured as IMR compared to the largest measured value of L1-SINR among all SSB based CMRs and IMRs of the serving cell.

The accuracy requirements are defined in Table 10.1.28.2.2-1 for SSB based CMR and NZP-IMR and in Table 10.1.28.2.2-2 for SSB based CMR and ZP-IMR.

The accuracy requirements in Tables 10.1.28.2.2-1 and 10.1.28.2.2-2 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-2 [19] for reference sensitivity are fulfilled.

- Conditions for L1-SINR measurements are fulfilled according to Annex B.2.8.2 for a corresponding Band for each relevant SSB based CMR and IMR.

- The bandwidth of NZP-IMR and ZP-IMR is 48 PRBs and the density is 3.

- The measured signals are in the directions covered by the percentile EIS spherical coverage of the UE, defined in clause 7.3.4 of TS 38.101-2 [19].

- AWGN radio propagation conditions.

- SSB based CMR and IMR in the test come from the same direction.

The performance with larger bandwidth of NZP-IMR and ZP-IMR is equal to or better than the accuracy requirements in Tables 10.1.28.2.2-1 and 10.1.28.2.2-2.

Table 10.1.28.2.2-1: L1-SINR relative accuracy for SSB based CMR and NZP-IMR in FR2

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB  CMR  Ês/Iot Note 2, Note 4 | NZP-IMR  Ês/Iot Note 4 | Io Note 1 range | | | |
|  |  |  | Minimum Io | | | Maximum Io |
| dB | dB | dB | dB | dBm / SCSSSB Note 3 | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 120kHz | SCSSSB = 240kHz |  |  |
| ±3.0 | ±4.0 | ≥0 | ≥0 | Same value as SSB\_RP in Table in B.2.8.2, according to UE Power class, operating band and angle of arrival | | N/A | -50 |
| NOTE 1: Io specified at the Reference point, and assumed to have constant EPRE across the bandwidth.  NOTE 2: The parameter SSB CMR Ês/Iot is the minimum SSB CMR Ês/Iot of the pair of SSBs to which the requirement applies.  NOTE 3: Values based on Refsens and EIS spherical coverage as defined in clauses 7.3.2 and 7.3.4 of TS 38.101-2 [19]. Applicable side condition selected depending on angle of arrival.  NOTE 4: In the test cases, the SSB CMR Ês/Iot, NZP-IMR Ês/Iot and related parameters may need to be adjusted to ensure Ês/Iot at UE baseband is above the value defined in this table. | | | | | | | |

Table 10.1.28.2.2-2: L1-SINR relative accuracy for SSB based CMR and ZP-IMR in FR2

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | |
| Normal condition | Extreme condition | SSB  CMR  Ês/Iot Note 2, Note 4 | Io Note 1 range | | | |
|  |  | Minimum Io | | | Maximum Io |
| dB | dB | dB | dBm / SCSSSB Note 3 | | dBm/BWChannel | dBm/BWChannel |
|  |  |  | SCSSSB = 120kHz | SCSSSB = 240kHz |  |  |
| ±3.5 | ±4.5 | ≥-3 | Same value as SSB\_RP in Table in B.2.8.2, according to UE Power class, operating band and angle of arrival | | N/A | -50 |
| NOTE 1: Io specified at the Reference point, and assumed to have constant EPRE across the bandwidth.  NOTE 2: The parameter SSB CMR Ês/Iot is the minimum SSB CMR Ês/Iot of the pair of SSBs to which the requirement applies.  NOTE 3: Values based on Refsens and EIS spherical coverage as defined in clauses 7.3.2 and 7.3.4 of TS 38.101-2 [19]. Applicable side condition selected depending on angle of arrival.  NOTE 4: In the test cases, the SSB CMR Ês/Iot and related parameters may need to be adjusted to ensure Ês/Iot at UE baseband is above the value defined in this table. | | | | | | |

10.1.28.3 L1-SINR accuracy requirements with CSI-RS based CMR and dedicated IMR configured

10.1.28.3.1 Absolute Accuracy

Unless otherwise specified, the requirements for absolute accuracy of CSI-RS based L1-SINR in this clause apply to all CSI-RS resources as CMR and dedicated resources configured as IMR of the serving cell configured for L1-SINR measurement.

The accuracy requirements are defined in Table 10.1.28.3.1-1 for CSI-RS based CMR and NZP-IMR and in Table 10.1.28.3.1-2 for CSI-RS based CMR and ZP-IMR.

The accuracy requirements in Tables 10.1.28.3.1-1 and 10.1.28.3.1-2 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-2 [19] for reference sensitivity are fulfilled.

- Conditions for L1-SINR measurements are fulfilled according to Annex B.2.8.3 for a corresponding Band for each relevant CSI-RS based CMR and IMR.

- The bandwidth of CSI-RS as CMR, NZP-IMR and ZP-IMR is 48 PRBs and the density is 3.

- The measured signals are in the directions covered by the percentile EIS spherical coverage of the UE, defined in clause 7.3.4 of TS 38.101-2 [19].

- AWGN radio propagation conditions.

- CSI-RS based CMR and IMR in the test come from the same direction.

The performance with larger bandwidth of CSI-RS as CMR, NZP-IMR and ZP-IMR is equal to or better than the accuracy requirements in Tables 10.1.28.3.1-1 and 10.1.28.3.1-2.

Table 10.1.28.3.1-1: L1-SINR absolute accuracy for CSI-RS based CMR and NZP-IMR in FR2

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | CSI-RS CMR Ês/Iot Note 3 | NZP-IMR  Ês/Iot Note 3 | Io Note 1 range | | | |
|  |  | Minimum Io | | | Maximum Io |
| dB | dB | dB | dB | dBm / SCSCSI-RS Note 2 | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSCSI-RS = 60kHz | SCSCSI-RS = 120kHz |  |  |
| ±4.0 | ±5.0 | ≥0 | ≥0 | Same value as CSI-RS\_RP in Table in B.2.8.3, according to UE Power class, operating band and angle of arrival | | N/A | -50 |
| NOTE 1: Io specified at the Reference point, and assumed to have constant EPRE across the bandwidth.  NOTE 2: Values based on Refsens and EIS spherical coverage as defined in clauses 7.3.2 and 7.3.4 of TS 38.101-2 [19]. Applicable side condition selected depending on angle of arrival.  NOTE 3: In the test cases, the CSI-RS Ês/Iot, NZP-IMR Ês/Iot and related parameters may need to be adjusted to ensure Ês/Iot at UE baseband is above the value defined in this table. | | | | | | | |

Table 10.1.28.3.1-2: L1-SINR absolute accuracy for CSI-RS based CMR and ZP-IMR in FR2

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | |
| Normal condition | Extreme condition | CSI-RS CMR Ês/Iot Note 3 | Io Note 1 range | | | |
|  |  | Minimum Io | | | Maximum Io |
| dB | dB | dB | dBm / SCSCSI-RS Note 2 | | dBm/BWChannel | dBm/BWChannel |
|  |  |  | SCSCSI-RS = 60kHz | SCSCSI-RS = 120kHz |  |  |
| ±4.5 | ±5.5 | ≥-3 | Same value as CSI-RS\_RP in Table in B.2.8.3, according to UE Power class, operating band and angle of arrival | | N/A | -50 |
| NOTE 1: Io specified at the Reference point, and assumed to have constant EPRE across the bandwidth.  NOTE 2: Values based on Refsens and EIS spherical coverage as defined in clauses 7.3.2 and 7.3.4 of TS 38.101-2 [19]. Applicable side condition selected depending on angle of arrival.  NOTE 3: In the test cases, the CSI-RS Ês/Iot and related parameters may need to be adjusted to ensure Ês/Iot at UE baseband is above the value defined in this table. | | | | | | |

10.1.28.3.2 Relative Accuracy

The relative accuracy of CSI-RS based L1-SINR is defined as the L1-SINR measured from one CSI-RS configured as CMR and one IMR configured as IMR compared to the largest measured value of L1-SINR among all CSI-RS based CMRs and IMRs of the serving cell.

The accuracy requirements are defined in Table 10.1.28.3.2-1 for CSI-RS based CMR and NZP-IMR and in Table 10.1.28.3.2-2 for CSI-RS based CMR and ZP-IMR.

The accuracy requirements in Tables 10.1.28.3.2-1 and 10.1.28.3.2-2 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-2 [19] for reference sensitivity are fulfilled.

- Conditions for L1-SINR measurements are fulfilled according to Annex B.2.8.3 for a corresponding Band for each relevant CSI-RS based CMR and IMR.

- The bandwidth of CSI-RS as CMR, NZP-IMR and ZP-IMR is 48 PRBs and the density is 3.

- The measured signals are in the directions covered by the percentile EIS spherical coverage of the UE, defined in clause 7.3.4 of TS 38.101-2 [19].

- AWGN radio propagation conditions.

- CSI-RS based CMR and IMR in the test come from the same direction.

The performance with larger bandwidth of CSI-RS as CMR, NZP-IMR and ZP-IMR is equal to or better than the accuracy requirements in Tables 10.1.28.3.2-1 and 10.1.28.3.2-2.

Table 10.1.28.3.2-1: L1-SINR relative accuracy for CSI-RS based CMR and NZP-IMR in FR2

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | CSI-RS CMR Ês/Iot Note 2, Note 4 | NZP-IMR  Ês/Iot Note 4 | Io Note 1 range | | | |
|  |  | Minimum Io | | | Maximum Io |
| dB | dB | dB | dB | dBm / SCSCSI-RS Note 3 | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSCSI-RS = 60kHz | SCSCSI-RS = 120kHz |  |  |
| ±3.0 | ±4.0 | ≥0 | ≥0 | Same value as CSI-RS\_RP in Table in B.2.8.3, according to UE Power class, operating band and angle of arrival | | N/A | -50 |
| NOTE 1: Io specified at the Reference point, and assumed to have constant EPRE across the bandwidth.  NOTE 2: The parameter CSI-RS CMR Ês/Iot is the minimum CSI-RS CMR Ês/Iot of the pair of CSI-RS resources to which the requirement applies.  NOTE 3: Values based on Refsens and EIS spherical coverage as defined in clauses 7.3.2 and 7.3.4 of TS 38.101-2 [19]. Applicable side condition selected depending on angle of arrival.  NOTE 4: In the test cases, the CSI-RS CMR Ês/Iot, NZP-IMR Ês/Iot and related parameters may need to be adjusted to ensure Ês/Iot at UE baseband is above the value defined in this table. | | | | | | | |

Table 10.1.28.3.2-2: L1-SINR relative accuracy for CSI-RS based CMR and ZP-IMR in FR2

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | |
| Normal condition | Extreme condition | CSI-RS CMR Ês/Iot Note 2, Note 4 | Io Note 1 range | | | |
|  |  | Minimum Io | | | Maximum Io |
| dB | dB | dB | dBm / SCSCSI-RS Note 3 | | dBm/BWChannel | dBm/BWChannel |
|  |  |  | SCSCSI-RS = 60kHz | SCSCSI-RS = 120kHz |  |  |
| ±3.5 | ±4.5 | ≥-3 | Same value as CSI-RS\_RP in Table in B.2.8.3, according to UE Power class, operating band and angle of arrival | | N/A | -50 |
| NOTE 1: Io specified at the Reference point, and assumed to have constant EPRE across the bandwidth.  NOTE 2: The parameter CSI-RS CMR Ês/Iot is the minimum CSI-RS CMR Ês/Iot of the pair of CSI-RS resources to which the requirement applies.  NOTE 3: Values based on Refsens and EIS spherical coverage as defined in clauses 7.3.2 and 7.3.4 of TS 38.101-2 [19]. Applicable side condition selected depending on angle of arrival.  NOTE 4: In the test cases, the CSI-RS CMR Ês/Iot and related parameters may need to be adjusted to ensure Ês/Iot at UE baseband is above the value defined in this table. | | | | | | |

### 10.1.29 Intra-frequency RSRQ accuracy requirements under CCA

#### 10.1.29.1 Intra-frequency SS-RSRQ accuracy requirements in FR1

##### 10.1.29.1.1 Absolute SS-RSRQ Accuracy

Unless otherwise specified, the requirements for absolute accuracy of SS-RSRQ in this clause apply to a cell on the same frequency as that of the serving cell under CCA.

The accuracy requirements in Table 10.1.29.1.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3F of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for intra-frequency measurements are fulfilled according to Annex B.2.8 for a corresponding Band for each relevant SSB.

Table 10.1.29.1.1-1: SS-RSRQ intra-frequency absolute accuracy under CCA

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot | Io Note 1 range | | | | |
|  |  |  | NR operating band groups Note 3 | Minimum Io | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |  |
| ±2.5 | ±4 | ≥-3 | NR\_CCA\_FR1\_I | -117 | -114 | N/A | -50 |
| NR\_CCA\_FR1\_J | -116.5 | -113.5 |
| ±3.5 | ±4 | ≥-6 | Note 2 | Note 2 | Note 2 | Note 2 | Note 2 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding highest accuracy requirement.  NOTE 3: NR operating band groups are as defined in clause 3.5.2. | | | | | | | |

### 10.1.30 Inter-frequency RSRQ accuracy requirements under CCA

#### 10.1.30.1 Inter-frequency SS-RSRQ accuracy requirements in FR1

##### 10.1.30.1.1 Aboslute Accuracy of SS-RSRQ

The requirements for absolute accuracy of SS-RSRQ in this clause apply to a cell on a frequency under CCA that has different carrier frequency from the serving cell.

The accuracy requirements in Table 10.1.30.1.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3F of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.2.9 for a corresponding Band for each relevant SSB.

Table 10.1.30.1.1-1: SS-RSRQ inter-frequency absolute accuracy under CCA

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot | Io Note 1 range | | | | |
|  |  |  | NR operating band groups Note 3 | Minimum Io | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |  |
| ±2.5 | ±4 | ≥-3 | NR\_CCA\_FR1\_I | -117 | -114 | N/A | -50 |
| NR\_CCA\_FR1\_J | -116.5 | -113.5 |
| ±3.5 | ±4 | ≥-6 | Note 2 | Note 2 | Note 2 | Note 2 | Note 2 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding highest accuracy requirement.  NOTE 3: NR operating band groups are as defined in clause 3.5.2. | | | | | | | |

##### 10.1.30.1.2 Relative Accuracy of SS-RSRQ

The relative accuracy of SS-RSRQ in inter-frequency case is defined as the RSRQ measured from one cell on a frequency compared to the RSRP measured from another cell on a different frequency, with at least one of the two frequencies being under CCA.

The accuracy requirements in Table 10.1.30.1.2-1 are valid under the following conditions:

- Conditions defined in clause 7.3F of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.2.9 for a corresponding Band for each relevant SSB.

- |SSB\_RP1dBm - SSB\_RP2dBm| ≤ 27 dB

- |Channel 1\_Io ‑Channel 2\_Io | ≤ 20 dB

Table 10.1.30.1.2-1: SS-RSRQ inter-frequency relative accuracy under CCA

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot | Io Note 1 range | | | | |
|  |  | Note 2 | NR operating band groups Note 4 | Minimum Io | | | Maximum Io |
| **dB** | **dB** | **dB** |  | **dBm / SCSSSB** | | **dBm/BWChannel** | **dBm/BWChannel** |
|  |  |  |  | **SCSSSB = 15 kHz** | **SCSSSB = 30 kHz** |  |  |
| ±3 | ±4 | ≥-3 | NR\_CCA\_FR1\_I | -117 | -114 | N/A | -50 |
| NR\_CCA\_FR1\_J | -116.5 | -113.5 |
| ±4 | ±4 | ≥-6 | Note 3 | Note 3 | Note 3 | Note 3 | Note 3 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: The parameter SSB Ês/Iot is the minimum SSB Ês/Iot of the pair of cells to which the requirement applies.  NOTE 3: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding highest accuracy requirement.  NOTE 4: NR operating band groups are as defined in clause 3.5.2. | | | | | | | |

### 10.1.31 Intra-frequency SINR accuracy requirements under CCA

#### 10.1.31.1 Intra-frequency SS-SINR accuracy requirements in FR1

##### 10.1.31.1.1 Absolute SS-SINR Accuracy

Unless otherwise specified, the requirements for absolute accuracy of SS-SINR in this clause apply to a cell on the same frequency as that of the serving cell under CCA.

The accuracy requirements in Table 10.1.31.1.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3F of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for intra-frequency measurements are fulfilled according to Annex B.2.8 for a corresponding Band.

Table 10.1.31.1.1-1: SS-SINR intra-frequency absolute accuracy under CCA

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot | Io Note 1 range | | | | |
|  |  | Note 3 | NR operating band groups Note 4 | Minimum Io | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |  |
| ±3.0 | ±4 | ≥-3 | NR\_CCA\_FR1\_I | -117 | -114 | N/A | -50 |
| NR\_CCA\_FR1\_J | -116.5 | -113.5 |
| ±3.5 | ±4 | ≥-6 | Note 2 | Note 2 | Note 2 | Note 2 | Note 2 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding highest accuracy requirement.  NOTE 3: The requirements apply for SSB Ês/Iot ≤ 25 dB.  NOTE 4: NR operating band groups are as defined in clause 3.5.2. | | | | | | | |

### 10.1.32 Inter-frequency SINR accuracy requirements under CCA

#### 10.1.32.1 Inter-frequency SS-SINR accuracy requirements in FR1

##### 10.1.32.1.1 Aboslute Accuracy of SS-SINR

The requirements for absolute accuracy of SS-SINR in this clause apply to a cell on a frequency under CCA that has different carrier frequency from the serving cell.

The accuracy requirements in Table 10.1.32.1.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3F of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.2.9 for a corresponding Band.

Table 10.1.32.1.1-1: SS-SINR inter-frequency absolute accuracy under CCA

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot Note 3 | Io Note 1 range | | | | |
|  |  | NR operating band groups Note 4 | Minimum Io | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |  |
| ±3.0 | ±4 | ≥-3 | NR\_CCA\_FR1\_I | -117 | -114 | N/A | -50 |
| NR\_CCA\_FR1\_J | 116.5 | -113.5 |
| ±3.5 | ±4 | ≥-6 | Note 2 | Note 2 | Note 2 | Note 2 | Note 2 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding highest accuracy requirement.  NOTE 3: The requirements apply for SSB Ês/Iot ≤ 25 dB.  NOTE 4: NR operating band groups are as defined in clause 3.5.2. | | | | | | | |

##### 10.1.32.1.2 Relative Accuracy of SS-SINR

The relative accuracy of SS-SINR in inter frequency case is defined as the SS-SINR measured from one cell on a frequency compared to the SS-SINR measured from another cell on a different frequency, with at least one of the two frequencies being under CCA.

The accuracy requirements in Table 10.1.32.1.2-1 are valid under the following conditions:

- Conditions defined in clause 7.3F of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.2.9 for a corresponding Band.

- SSB\_RP1dBm - SSB\_RP2dBm| ≤ 27 dB

- |Channel 1\_Io ‑Channel 2\_Io | ≤ 20 dB

Table 10.1.32.1.2-1: SS-SINR inter-frequency relative accuracy under CCA

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot | Io Note 1 range | | | | |
|  |  | Note 2,4 | NR operating band groups Note 5 | Minimum Io | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 120 kHz | SCSSSB = 240 kHz |  |  |
| ±3.5 | ±4 | ≥-3 | NR\_CCA\_FR1\_I | -117 | -114 | N/A | -50 |
| NR\_CCA\_FR1\_J | -116.5 | -113.5 |
| ±4 | ±4 | ≥-6 | Note 3 | Note 3 | Note 3 | Note 3 | Note 3 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: The parameter SSB Ês/Iot is the minimum SSB Ês/Iot of the pair of cells to which the requirement applies.  NOTE 3: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding highest accuracy requirement.  NOTE 4: The requirements apply for SSB Ês/Iot ≤ 25 dB.  NOTE 5: NR operating band groups are as defined in clause 3.5.2. | | | | | | | |

### 10.1.33 L1-RSRP accuracy requirements under CCA

#### 10.1.33.1 SSB based L1-RSRP accuracy requirements in FR1

##### 10.1.33.1.1 Absolute Accuracy

Unless otherwise specified, the requirements for absolute accuracy of SSB based L1-RSRP in this clause apply to all SSBs of the serving cell configured for L1-RSRP measurement under CCA.

The accuracy requirements in Table 10.1.33.1.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3F of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for L1-RSRP measurements are fulfilled according to Annex B.2.10.1 for a corresponding Band for each relevant SSB.

Table 10.1.33.1.1-1: SSB based L1-RSRP absolute accuracy under CCA

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot | Io Note 1 range | | | | |
|  |  |  | NR operating band groups Note 2 | Minimum Io | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |  |
| ±5.0 | ±9.5 | ≥-3 | NR\_CCA\_FR1\_I | -117 | -114 | N/A | -70 |
| NR\_CCA\_FR1\_J | -116.5 | -113.5 |
| ±8.5 | ±11.5 | ≥-3 | NR\_CCA\_FR1\_I | N/A | N/A | -70 | -50 |
| NR\_CCA\_FR1\_J |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: NR operating band groups are as defined in clause 3.5.2. | | | | | | | |

##### 10.1.33.1.2 Relative Accuracy

The relative accuracy of SSB based L1-RSRP is defined as the L1-RSRP measured from one SSB compared to the largest measured value of L1-RSRP among all SSBs of the serving cell under CCA.

The accuracy requirements in Table 10.1.33.1.2-1 are valid under the following conditions:

- Conditions defined in clause 7.3F of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for L1-RSRP measurements are fulfilled according to Annex B.2.10.1 for a corresponding Band for each relevant SSB.

Table 10.1.33.1.2-1: SSB based L1-RSRP relative accuracy under CCA

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot Note 2 | Io Note 1 range | | | | |
|  |  |  | NR operating band groups Note 3 | Minimum Io | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |  |
| ±3 | ±4 | ≥-3 | NR\_CCA\_FR1\_I | -117 | -114 | N/A | -50 |
| NR\_CCA\_FR1\_J | -116.5 | -113.5 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: The parameter SSB Ês/Iot is the minimum SSB Ês/Iot of the pair of SSBs to which the requirement applies.  NOTE 3: NR operating band groups are as defined in clause 3.5.2. | | | | | | | |

### 10.1.34 RSSI measurements under CCA

#### 10.1.34.1 Intra-frequency absolute RSSI measurement accuracy requirements in FR1

The accuracy requirements for intra-frequency RSSI measurements on a carrier frequency under CCA are specified in Table 10.1.34.1-1. The requirements apply for any configured RSSI *measDuration* [2], provided that:

- All symbols duing each RSSI measurement duration are available for RSSI sampling within the same reporting interval.

The intra-frequency RSSI measurement bandwidth is the channel bandwidth defined in Clause 4 of TS 37.213 [33], where the channel has the center frequency configured by *ARFCN-valueNR*.

Table 10.1.34.1-1: Intra-frequency RSSI accuracy under CCA

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | |
| Normal condition | Extreme condition | Io Note 1 range | | | | |
|  |  | NR operating band groups Note 2 | Minimum Io | | | Maximum Io |
| dB | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |  |
| [±3.5] | [±6.5] | NR\_CCA\_FR1\_I | -117 | -114 | N/A | -70 |
| NR\_CCA\_FR1\_J | -116.5 | -113.5 |
| [±5.5] | [±8.5] | NR\_CCA\_FR1\_I | N/A | N/A | -70 | -50 |
| NR\_CCA\_FR1\_J |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: NR operating band groups are as defined in clause 3.5.2. | | | | | | |

#### 10.1.34.2 Inter-frequency absolute RSSI measurement accuracy requirements in FR1

The accuracy requirements for inter-frequency RSSI measurements on a carrier frequency under CCA are the same as specified in clause 10.1.34.1.

The inter-frequency RSSI measurement bandwidth is the channel bandwidth defined in Clause 4 of TS 37.213 [33], where the channel has the center frequency configured by *ARFCN-valueNR*.

#### 10.1.34.3 RSSI measurement report mapping

The reporting range of RSSI measurement is defined from -100 dBm to -25 dBm with 1 dBm resolution.

The mapping of the measured quantity is defined in Table 10.1.34.3-1. The range in the signalling may be larger than the guaranteed accuracy range, provided that the following condition is met:

the RSSI measurement bandwidth is the channel bandwidth defined in Clause 4 of TS 37.213 [33], where the channel has the center frequency configured by *ARFCN-valueNR*.

Table 10.1.34.3-1: RSSI measurement report mapping

|  |  |  |
| --- | --- | --- |
| Reported value | Measured quantity value | Unit |
| RSSI\_00 | RSSI < ‑100 | dBm |
| RSSI\_01 | -100 ≤ RSSI < ‑99 | dBm |
| RSSI\_02 | -99 ≤ RSSI < ‑98 | dBm |
| … | … | … |
| RSSI\_74 | -27 ≤ RSSI < -26 | dBm |
| RSSI\_75 | -26 ≤ RSSI < -25 | dBm |
| RSSI\_76 | -25 ≤ RSSI | dBm |

### 10.1.35 Channel occupancy measurements under CCA

#### 10.1.35.1 Intra-frequency channel occupancy measurement accuracy requirements in FR1

The UE shall be able to correctly evaluate the intra-frequency channel occupancy configured according to TS 38.331 [2], provided that the following conditions are met:

- All symbols during each RSSI measurement duration are available for RSSI sampling within the same reporting interval,

- RSSI at the UE receiver meets the following condition with respect to the configured *channelOccupancyThreshold* [2]:

- RSSI at the UE receiver is below *channelOccupancyThreshold*-, or

- RSSI at the UE receiver is above *channelOccupancyThreshold*+,

- where  is the applicable RSSI measurement accuracy value from the RSSI measurement accuracy requirements specified in clause 10.1.34.1.

The channel occupancy measurement bandwidth is the same as the RSSI measurement bandwidth in Clause 10.1.34.1.

#### 10.1.35.2 Inter-frequency channel occupancy measurement accuracy requirements in FR1

The UE shall be able to correctly evaluate the inter-frequency channel occupancy configured according to TS 38.331 [2], provided that the following conditions are met:

- All symbols during each RSSI measurement duration are available for RSSI sampling within the same reporting interval,

- RSSI at the UE receiver meets the following condition with respect to the configured *channelOccupancyThreshold* [2]:

- RSSI at the UE receiver is below *channelOccupancyThreshold*-, or

- RSSI at the UE receiver is above *channelOccupancyThreshold*+,

- where  is the applicable RSSI measurement accuracy value from the RSSI measurement accuracy requirements specified in clause 10.1.34.2.

The channel occupancy measurement bandwidth is the same as the RSSI measurement bandwidth in Clause 10.1.34.2.

### 10.1.36 Intra-frequency RSRP accuracy requirements under CCA

#### 10.1.36.1 Intra-frequency SS-RSRP accuracy requirements in FR1

##### 10.1.36.1.1 Absolute SS-RSRP Accuracy

Unless otherwise specified, the requirements for absolute accuracy of SS-RSRP in this clause apply to a cell on the same frequency as that of the serving cell under CCA.

The accuracy requirements in Table 10.1.36.1.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3F of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for intra-frequency measurements are fulfilled according to Annex B.2.8 for a corresponding Band for each relevant SSB.

Table 10.1.36.1.1-1: SS-RSRP intra-frequency absolute accuracy

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot | Io Note 1 range | | | | |
|  |  |  | NR operating band groups Note 2 | Minimum Io | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |  |
| ±4.5 | ±9 | ≥-6 | NR\_CCA\_FR1\_I | -117 | -114 | N/A | -70 |
| NR\_CCA\_FR1\_J | -116.5 | -113.5 |
| ±8 | ±11 | ≥-6 | NR\_CCA\_FR1\_I | N/A | N/A | -70 | -50 |
| NR\_CCA\_FR1\_J |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: NR operating band groups are as defined in clause 3.5.2. | | | | | | | |

##### 10.1.36.1.2 Relative SS-RSRP Accuracy

The relative accuracy of SS-RSRP is defined as the SS-RSRP measured from one cell compared to the SS-RSRP measured from another cell on the same frequency, or between any two SS-RSRP levels measured on the same cell under CCA.

The accuracy requirements in Table 10.1.36.1.2-1 are valid under the following conditions:

- Conditions defined in clause 7.3F of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for intra-frequency measurements are fulfilled according to Annex B.2.8 for a corresponding Band for each relevant SSB.

Table 10.1.36.1.2-1: SS-RSRP intra-frequency relative accuracy under CCA

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot Note 2 | Io Note 1 range | | | | |
|  |  |  | NR operating band groups Note 4 | Minimum Io | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |  |
| ±2 | ±3 | ≥-3 | NR\_CCA\_FR1\_I | -117 | -114 | N/A | -50 |
| NR\_CCA\_FR1\_J | -116.5 | -113.5 |
| ±3 | ±3 | ≥-6 | Note 3 | Note 3 | Note 3 | N/A | Note 3 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: The parameter SSB Ês/Iot is the minimum SSB Ês/Iot of the pair of cells to which the requirement applies.  NOTE 3: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding highest accuracy requirement.  NOTE 4: NR operating band groups are as defined in clause 3.5.2. | | | | | | | |

### 10.1.37 Inter-frequency RSRP accuracy requirements under CCA

#### 10.1.37.1 Inter-frequency SS-RSRP accuracy requirements in FR1

##### 10.1.37.1.1 Absolute Accuracy of SS-RSRP

The requirements for absolute accuracy of SS-RSRP in this clause apply to a cell on a frequency under CCA that has different carrier frequency from the serving cell.

The accuracy requirements in Table 10.1.37.1.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3F of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.2.9 for a corresponding Band for each relevant SSB.

Table 10.1.37.1.1-1: SS-RSRP inter-frequency absolute accuracy under CCA

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot | Io Note 1 range | | | | |
|  |  |  | NR operating band groups Note 2 | Minimum Io | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |  |
| ±4.5 | ±9 | ≥-6 | NR\_CCA\_FR1\_I | -117 | -114 | N/A | -70 |
| NR\_CCA\_FR1\_J | -116.5 | -113.5 |
| ±8 | ±11 | ≥-6 | NR\_CCA\_FR1\_I | N/A | N/A | -70 | -50 |
| NR\_CCA\_FR1\_J |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: NR operating band groups are as defined in clause 3.5.2. | | | | | | | |

##### 10.1.37.1.2 Relative Accuracy of SS-RSRP

The relative accuracy of SS-RSRP in inter frequency case is defined as the RSRP measured from one cell on a frequency compared to the RSRP measured from another cell on a different frequency, with at least one of the two frequencies being under CCA.

The accuracy requirements in Table 10.1.37.1.2-1 are valid under the following conditions:

- Conditions defined in clause 7.3F of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.2.9 for a corresponding Band for each relevant SSB.

- |SSB\_RP1dBm - SSB\_RP2dBm| ≤ 27 dB

- |Channel 1\_Io ‑Channel 2\_Io | ≤ 20 dB

Table 10.1.37.1.2-1: SS-RSRP inter-frequency relative accuracy under CCA

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot Note 2 | Io Note 1 range | | | | |
|  |  |  | NR operating band groups Note 3 | Minimum Io | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |  |
| ±4.5 | ±6 | ≥-6 | NR\_CCA\_FR1\_I | -117 | -114 | N/A | -50 |
| NR\_CCA\_FR1\_J | -116.5 | -113.5 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: The parameter SSB Ês/Iot is the minimum SSB Ês/Iot of the pair of cells to which the requirement applies.  NOTE 3: NR operating band groups are as defined in clause 3.5.2. | | | | | | | |

### 10.1.38 PRS-RSRPP Measurements

#### 10.1.38.1 Introduction

The requirements in Clause 10.1.X shall apply, provided the UE has received *nr-DL-AoD-RequestLocationInformation* message from LMF via LPP [34] requesting the UE to report one or more DL PRS-RSRPP measurements defined in TS 38.215 [4]. The requirements in Clause 10.1.38 shall apply:

- when UE is in RRC\_CONNECTED state,

- when UE is in RRC\_INACTIVE state.

The requirements in Clause 10.1.X apply for the first path PRS-RSRP measurement.

#### 10.1.38.2 Measurement Accuracy Requirements

##### 10.1.38.2.1 Absolute PRS RSRPP accuracy

The absolute accuracy requirements for PRS-RSRPP measurement for FR1 defined in Table 10.1.38.2.1-1 and Table 10.1.38.2.1-3 are valid under the following conditions:

- Conditions defined in 38.101-1 Clause 7.3 for reference sensitivity are fulfilled.

- PRP 1,2|dBm according to Annex B.2.X for a corresponding Band

The absolute accuracy requirements for PRS-RSRPP measurement for FR2 defined in Table 10.1.38.2.1-2 and Table 10.1.38.2.1-4 are valid under the following conditions:

- Conditions defined in 38.101-2 Clause 7.3 for reference sensitivity are fulfilled.

- PRP 1,2|dBm according to Annex B.2.X for a corresponding Band

The absolute accuracy requirements for PRS-RSRPP measurement defined in Table 10.1.38.2.1-1 and Table 10.1.38.2.1-2 apply for the UE not supporting *supportedDL-PRS-ProcessingSamples* [34] or LMF does not indicate UE to perform positioning measurements with reduced number of samples.

The absolute accuracy requirements for PRS-RSRPP measurement defined in Table 10.1.38.2.1-3 and Table 10.1.38.2.1-4 apply for the UE supporting *supportedDL-PRS-ProcessingSamples* [34].

Note: The requriements in this clause are derived based on two-tap channel defined in 38.101-4 Annex B.2.4 (a = 1, τd=0.45 µs and fD=5 Hz).

Note: The requirements in this clause are derived based on the difference between the estimated PRS-RSRPP compared to the ideal PRS-RSRPP defined as

Where:

is the effective channel frequency response (over REs occupied by PRS) measured without receiver noise.

is the exact delay of the p-th path in the channel model.

Table 10.1.38.2.1-1: PRS-RSRPP absolute accuracy for FR1

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | | | |
| **Normal condition** | Extreme condition | PRS Ês/Iot | PRS BW | Repetition factor  ( | **Io Note 7 range** | | | | |
| NR operating band groups Note 8 | Minimum Io Note 1  dBm / SCSPRS | | | Maximum Io |
| **dB** | **dB** | **dB** | **PRB** | **-** |  | dBm / SCSPRS | | | dBm/BWChannel |
| dBm/15kHz Note 6 | dBm/30kHz Note 6 | dBm/60kHz Note 6 |
| ±TBD | ±TBD | ≥-3 | ≥24 | All | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A, NR\_SDL\_FR1\_A | -127 | -124 | -121 | -50 |
| NR\_FDD\_FR1\_B | -126.5 | -123.5 | -120.5 | -50 |
| NR\_TDD\_FR1\_C | -126 | -123 | -120 | -50 |
| NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -125.5 | -122.5 | -119.5 | -50 |
| NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -125 | -122 | -119 | -50 |
| NR\_FDD\_FR1\_F | -124.5 | -121.5 | -118.5 | -50 |
| NR\_FDD\_FR1\_G | -124 | -121 | -118 | -50 |
| NR\_FDD\_FR1\_H | -123.5 | -120.5 | -117.5 | -50 |
| Note 4 | | | | |
| Note 4 | | | | |
| ±TBD | ±TBD | ≥-13 | 24 ≤ BW ≤ 52 | All | Note 4 | | | | |
| ±TBD | ±TBD | 52< BW≤ 104 | All | Note 4 | | | | |
| ±TBD | ±TBD | BW >104 | All | Note 4 | | | | |
| NOTE 1: This minimum Io condition is expressed as the average Io per RE over all REs in an OFDM symbol.  NOTE 2: Void.  NOTE 3: PRS bandwidth is as indicated in *prs-Bandwidth* in the OTDOA or DL-AoD assistance data defined in [34].  NOTE 4: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding requirement with the PRS bandwidth ≥ [24] RB.  NOTE 5: The serving cell, the reference cell, and the measured neighbour cell i are on the same carrier frequency.  NOTE 6: The condition level is increased by ∆>0, when applicable, as described in Sections B.3.2 and B.3.3.  NOTE 7: The Io is defined in PRS positioning subframes. The same Io range applies to PRS and non-PRS symbols. Io levels are different in PRS and non-PRS symbols within the same subframe.  NOTE 8: NR operating band groups are as defined in Section 3.5.2. | | | | | | | | | |

Table 10.1.38.2.1-2: PRS-RSRPP absolute accuracy for FR2

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | PRS Ês/Iot | PRS BW | Repetition factor  ( | Io Note 7 range | | |
| Minimum Io Note 1  dBm / SCSPRS | | Maximum Io |
| dB | dB | dB | PRB | - | dBm / SCSPRS | | dBm/BWChannel |
| dBm/120kHz Note 6 | dBm/60kHz Note 6 |
| ±TBD | ±TBD | ≥-3 | ≥24 | All | Same value as PRP in Table B.2.X-2, according to UE Power class, operating band and angle of arrival | | -50 |
| Note 4 | | |
| Note 4 | | |
| ±TBD | ±TBD | ≥-13 | 24 ≤ BW ≤ 64 | All | Note 4 | | |
| ±TBD | ±TBD | BW >64 | All | Note 4 | | |
| NOTE 1: This minimum Io condition is expressed as the average Io per RE over all REs in an OFDM symbol.  NOTE 2: Void.  NOTE 3: PRS bandwidth is as indicated in *prs-Bandwidth* in the OTDOA or DL-AoD assistance data defined in [34].  NOTE 4: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding requirement with the PRS bandwidth ≥ [24] RB.  NOTE 5: The serving cell, the reference cell, and the measured neighbour cell i are on the same carrier frequency.  NOTE 6: The condition level is increased by ∆>0, when applicable, as described in Sections B.3.2 and B.3.3.  NOTE 7: The Io is defined in PRS positioning subframes. The same Io range applies to PRS and non-PRS symbols. Io levels are different in PRS and non-PRS symbols within the same subframe.  NOTE 8: NR operating band groups are as defined in Section 3.5.2. | | | | | | | |

Table 10.1.38.2.1-3: PRS-RSRPP absolute accuracy for FR1 for reduced number of samples

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | | | |
| Normal condition | Extreme condition | PRS Ês/Iot | PRS BW | Repetition factor  ( | Io Note 7 range | | | | |
| NR operating band groups Note 8 | Minimum Io Note 1  dBm / SCSPRS | | | Maximum Io |
| dB | dB | dB | PRB | - |  | dBm / SCSPRS | | | dBm/BWChannel |
| dBm/15kHz Note 6 | dBm/30kHz Note 6 | dBm/60kHz Note 6 |
| ±TBD | ±TBD | ≥TBD | ≥48 | All | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A, NR\_SDL\_FR1\_A | -127 | -124 | -121 | -50 |
| NR\_FDD\_FR1\_B | -126.5 | -123.5 | -120.5 | -50 |
| NR\_TDD\_FR1\_C | -126 | -123 | -120 | -50 |
| NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -125.5 | -122.5 | -119.5 | -50 |
| NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -125 | -122 | -119 | -50 |
| NR\_FDD\_FR1\_F | -124.5 | -121.5 | -118.5 | -50 |
| NR\_FDD\_FR1\_G | -124 | -121 | -118 | -50 |
| NR\_FDD\_FR1\_H | -123.5 | -120.5 | -117.5 | -50 |
| Note 4 | | | | |
| Note 4 | | | | |
| ±TBD | ±TBD | ≥[-6] | 48 ≤ BW ≤ 52 | All | Note 4 | | | | |
| ±TBD | ±TBD | 52< BW≤ 104 | All | Note 4 | | | | |
| ±TBD | ±TBD | BW >104 | All | Note 4 | | | | |
| NOTE 1: This minimum Io condition is expressed as the average Io per RE over all REs in an OFDM symbol.  NOTE 2: Void.  NOTE 3: PRS bandwidth is as indicated in *prs-Bandwidth* in the OTDOA or DL-AoD assistance data defined in [34].  NOTE 4: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding requirement with the PRS bandwidth ≥ [24] RB.  NOTE 5: The serving cell, the reference cell, and the measured neighbour cell i are on the same carrier frequency.  NOTE 6: The condition level is increased by ∆>0, when applicable, as described in Sections B.3.2 and B.3.3.  NOTE 7: The Io is defined in PRS positioning subframes. The same Io range applies to PRS and non-PRS symbols. Io levels are different in PRS and non-PRS symbols within the same subframe.  NOTE 8: NR operating band groups are as defined in Section 3.5.2. | | | | | | | | | |

Table 10.1.38.2.1-4: PRS-RSRPP absolute accuracy for FR2 for reduced number of samples

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Accuracy** | | **Conditions** | | | | | |
| Normal condition | Extreme condition | PRS Ês/Iot | PRS BW | Repetition factor  ( | Io Note 7 range | | |
| Minimum Io Note 1  dBm / SCSPRS | | Maximum Io |
| dB | dB | dB | PRB | - | dBm / SCSPRS | | dBm/BWChannel |
| dBm/120kHz Note 6 | dBm/60kHz Note 6 |
| ±TBD | ±TBD | ≥TBD | ≥48 | All | Same value as PRP in Table B.2.X-2, according to UE Power class, operating band and angle of arrival | | -50 |
| Note 4 | | |
| Note 4 | | |
| ±TBD | ±TBD | ≥[-6] | 48 ≤ BW ≤ 64 | All | Note 4 | | |
| ±TBD | ±TBD | BW >64 | All | Note 4 | | |
| NOTE 1: This minimum Io condition is expressed as the average Io per RE over all REs in an OFDM symbol.  NOTE 2: Void.  NOTE 3: PRS bandwidth is as indicated in *prs-Bandwidth* in the OTDOA or DL-AoD assistance data defined in [34].  NOTE 4: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding requirement with the PRS bandwidth ≥ [24] RB.  NOTE 5: The serving cell, the reference cell, and the measured neighbour cell i are on the same carrier frequency.  NOTE 6: The condition level is increased by ∆>0, when applicable, as described in Sections B.3.2 and B.3.3.  NOTE 7: The Io is defined in PRS positioning subframes. The same Io range applies to PRS and non-PRS symbols. Io levels are different in PRS and non-PRS symbols within the same subframe.  NOTE 8: NR operating band groups are as defined in Section 3.5.2. | | | | | | | |

#### 10.1.38.3 Report mapping

##### 10.1.38.3.1 Absolute PRS-RSRPP Measurement Report Mapping

The reporting range of absolute PRS-RSRPP measurement is defined from -156 dBm to -31 dBm with 1 dB resolution.

The mapping of measured quantity is defined in Table 10.1.38.3.1-1. The range in the signalling may be larger than the guaranteed accuracy range.

Table 10.1.38.3.1-1: Measurement report mapping for PRS-RSRPP

|  |  |  |
| --- | --- | --- |
| **Reported value** | **Measured quantity value** | **Unit** |
| PRS\_RSRPP\_0 | PRS-RSRPP<-156 | dBm |
| PRS\_RSRPP\_1 | -156≤PRS-RSRPP<-155 | dBm |
| PRS\_RSRPP\_2 | -155≤PRS-RSRPP<-154 | dBm |
| PRS\_RSRPP\_3 | -154≤PRS-RSRPP<-153 | dBm |
| PRS\_RSRPP\_4 | -153≤PRS-RSRPP<-152 | dBm |
| PRS\_RSRPP\_5 | -152≤PRS-RSRPP<-151 | dBm |
| PRS\_RSRPP\_6 | -151≤PRS-RSRPP<-150 | dBm |
| PRS\_RSRPP\_7 | -150≤PRS-RSRPP<-149 | dBm |
| PRS\_RSRPP\_8 | -149≤PRS-RSRPP<-148 | dBm |
| PRS\_RSRPP\_9 | -148≤PRS-RSRPP<-147 | dBm |
| PRS\_RSRPP\_10 | -147≤PRS-RSRPP<-146 | dBm |
| PRS\_RSRPP\_11 | -146≤PRS-RSRPP<-145 | dBm |
| PRS\_RSRPP\_12 | -145≤PRS-RSRPP<-144 | dBm |
| PRS\_RSRPP\_13 | -144≤PRS-RSRPP<-143 | dBm |
| PRS\_RSRPP\_14 | -143≤PRS-RSRPP<-142 | dBm |
| PRS\_RSRPP\_15 | -142≤PRS-RSRPP<-141 | dBm |
| PRS\_RSRPP\_16 | -141≤PRS-RSRPP<-140 | dBm |
| PRS\_RSRPP\_17 | -140≤PRS-RSRPP<-139 | dBm |
| PRS\_RSRPP\_18 | -139≤PRS-RSRPP<-138 | dBm |
| … | … | … |
| PRS\_RSRPP\_111 | -46≤PRS-RSRPP<-45 | dBm |
| PRS\_RSRPP\_112 | -45≤PRS-RSRPP<-44 | dBm |
| PRS\_RSRPP\_113 | -44≤PRS-RSRPP<-43 | dBm |
| PRS\_RSRPP\_114 | -43≤PRS-RSRPP<-42 | dBm |
| PRS\_RSRPP\_115 | -42≤PRS-RSRPP<-41 | dBm |
| PRS\_RSRPP\_116 | -41≤PRS-RSRPP<-40 | dBm |
| PRS\_RSRPP\_117 | -40≤PRS-RSRPP<-39 | dBm |
| PRS\_RSRPP\_118 | -39≤PRS-RSRPP<-38 | dBm |
| PRS\_RSRPP\_119 | -38≤PRS-RSRPP<-37 | dBm |
| PRS\_RSRPP\_120 | -37≤PRS-RSRPP<-36 | dBm |
| PRS\_RSRPP\_121 | -36≤PRS-RSRPP<-35 | dBm |
| PRS\_RSRPP\_122 | -35≤PRS-RSRPP<-34 | dBm |
| PRS\_RSRPP\_123 | -34≤PRS-RSRPP<-33 | dBm |
| PRS\_RSRPP\_124 | -33≤PRS-RSRPP<-32 | dBm |
| PRS\_RSRPP\_125 | -32≤PRS-RSRPP<-31 | dBm |
| PRS\_RSRPP\_126 | -31≤PRS-RSRPP | dBm |

##### 10.1.38.3.2 Differential Report Mapping for PRS-RSRPP Measurement

The reporting range of differential PRS-RSRPP is defined from -30 dB to 0 dB with 1 dB resolution when *nr-DL-AoD-RequestLocationInformation* message is received.

The mapping of measured quantity is defined in Table 10.1.38.3.2-1. The range in the signalling may be larger than the guaranteed accuracy range.

For differential reporting, PRS-RSRPP is reported as the difference in dB with respect to the first reported PRS-RSRPP.

Table 10.1.38.3.2-1: Measurement report mapping for differential PRS-RSRPP

|  |  |  |
| --- | --- | --- |
| Reported value | Measured quantity value | Unit |
| DIFFRSRPP\_0 | -30≥ΔRSRPP | dB |
| DIFFRSRPP\_1 | -29≥ΔRSRPP>-30 | dB |
| DIFFRSRPP\_2 | -28≥ΔRSRPP>-29 | dB |
| DIFFRSRPP\_3 | -27≥ΔRSRPP>-28 | dB |
| DIFFRSRPP\_4 | -26≥ΔRSRPP>-27 | dB |
| DIFFRSRPP\_5 | -25≥ΔRSRPP>-26 | dB |
| DIFFRSRPP\_6 | -24≥ΔRSRPP>-25 | dB |
| DIFFRSRPP\_7 | -23≥ΔRSRPP>-24 | dB |
| DIFFRSRPP\_8 | -22≥ΔRSRPP>-23 | dB |
| DIFFRSRPP\_9 | -21≥ΔRSRPP>-22 | dB |
| DIFFRSRPP\_10 | -20≥ΔRSRPP>-21 | dB |
| DIFFRSRPP\_11 | -19≥ΔRSRPP>-20 | dB |
| DIFFRSRPP\_12 | -18≥ΔRSRPP>-19 | dB |
| DIFFRSRPP\_13 | -17≥ΔRSRPP>-18 | dB |
| DIFFRSRPP\_14 | -16≥ΔRSRPP>-17 | dB |
| DIFFRSRPP\_15 | -15≥ΔRSRPP>-16 | dB |
| DIFFRSRPP\_16 | -14≥ΔRSRPP>-15 | dB |
| DIFFRSRPP\_17 | -13≥ΔRSRPP>-14 | dB |
| DIFFRSRPP\_18 | -12≥ΔRSRPP>-13 | dB |
| DIFFRSRPP\_19 | -11≥ΔRSRPP>-12 | dB |
| DIFFRSRPP\_20 | -10≥ΔRSRPP>-11 | dB |
| DIFFRSRPP\_21 | -9≥ΔRSRPP>-10 | dB |
| DIFFRSRPP\_22 | -8≥ΔRSRPP>-9 | dB |
| DIFFRSRPP\_23 | -7≥ΔRSRPP>-8 | dB |
| DIFFRSRPP\_24 | -6≥ΔRSRPP>-7 | dB |
| DIFFRSRPP\_25 | -5≥ΔRSRPP>-6 | dB |
| DIFFRSRPP\_26 | -4≥ΔRSRPP>-5 | dB |
| DIFFRSRPP\_27 | -3≥ΔRSRPP>-4 | dB |
| DIFFRSRPP\_28 | -2≥ΔRSRPP>-3 | dB |
| DIFFRSRPP\_29 | -1≥ΔRSRPP>-2 | dB |
| DIFFRSRPP\_30 | 0≥ΔRSRPP>-1 | dB |

### 10.1.39 UE Rx-Tx time difference measurements for RTT-based PDC

#### 10.1.39.1 Introduction

Editors note: This is to capture the applicability of the requirements in this section

#### 10.1.39.2 Measurement Accuracy Requirements for PRS

The error in the reported value of UE Rx-Tx time difference measurement, including both the measurement error and the reporting quantization error, should be within the accuracy requirements specified in this clause.

The UE Rx-Tx time difference measurement accuracy requirements in this clause shall not apply, if:

- NTA\_offset defined in Table 7.1.2-2 changes during the UE Rx-Tx measurement period or

- if the uplink transmission timing changes during the UE Rx-Tx measurement period due to the network-configured Timing Advance.

The UE Rx-Tx time difference measurement accuracy requirements in this clause shall apply provided that:

- The UE transmits SRS within [-160, 160] msec of at least one PDC DL PRS resource from the serving cell (PCell).

When a serving cell change occurs during the UE Rx-Tx measurement period, the UE Rx-Tx time difference measurement accuracy requirements in this clause shall apply provided that the serving cell change does not impact SRS configuration for the UE Rx-Tx measurement.

The accuracy requirements in Table 10.1.39.2-1 for FR1 are valid under the following conditions:

Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

PRP|dBm according to Annex [TBD] for a corresponding Band.

AWGN propagation condition.

Table 10.1.39.2-1: UE Rx-Tx time difference measurement accuracy in FR1 in AWGN

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | Conditions | | | | | | |
| PRS Ês/Iot | Minimum PRS bandwidth | PRS SCS | PRS resource repetition Note 3 | NR operating band groupsNote 2 | IoNote 4 range | |
| Minimum IoNote 1 | Maximum Io |
| TcNote 5 | dB | RB | kHz |  |  | dBm / SCSPRS | dBm/BW |
| ± [78+δ+ℇ] | -3 | ≥[24] | 15 | ≥[4] | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -50 |
|  |  |  |  |  | NR\_FDD\_FR1\_B | -120.5 |  |
|  |  |  |  |  | NR\_TDD\_FR1\_C | -120 |  |
|  |  |  |  |  | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 |  |
|  |  |  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 |  |
|  |  |  |  |  | NR\_FDD\_FR1\_F | -118.5 |  |
|  |  |  |  |  | NR\_FDD\_FR1\_G | -118 |  |
|  |  |  |  |  | NR\_FDD\_FR1\_H | -117.5 |  |
| ± [59+δ+ℇ] |  | ≥[52] |  | ≥[1] | Note 6 | NOTE 6 | NOTE 6 |
| ± [30+δ+ℇ] |  | >[104] |  | ≥[1] | Note 6 | NOTE 6 | NOTE 6 |
| ± [57+δ+ℇ] |  | ≥[24] | 30 | ≥[4] | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -118 | -50 |
|  |  |  |  |  | NR\_FDD\_FR1\_B | -117.5 |  |
|  |  |  |  |  | NR\_TDD\_FR1\_C | -117 |  |
|  |  |  |  |  | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -116.5 |  |
|  |  |  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -116 |  |
|  |  |  |  |  | NR\_FDD\_FR1\_F | -115.5 |  |
|  |  |  |  |  | NR\_FDD\_FR1\_G | -115 |  |
|  |  |  |  |  | NR\_FDD\_FR1\_H | -114.5 |  |
| ± [30+δ+ℇ] |  | ≥[48] |  | ≥[1] | NOTE 6 | NOTE 6 | NOTE 6 |
| ± [15+δ+ℇ] |  | ≥[132] |  | ≥[1] | NOTE 6 | NOTE 6 | NOTE 6 |
| ± [29+δ+ℇ] |  | ≥[24] | 60 | ≥[4] | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -115 | -50 |
|  |  |  |  |  | NR\_FDD\_FR1\_B | -114.5 |  |
|  |  |  |  |  | NR\_TDD\_FR1\_C | -114 |  |
|  |  |  |  |  | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -113.5 |  |
|  |  |  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -113 |  |
|  |  |  |  |  | NR\_FDD\_FR1\_F | -113.5 |  |
|  |  |  |  |  | NR\_FDD\_FR1\_G | -113 |  |
|  |  |  |  |  | NR\_FDD\_FR1\_H | -111.5 |  |
| ± [15+δ+ℇ] |  | ≥[64] |  | ≥[1] | NOTE 6 | NOTE 6 | NOTE 6 |
| ± [7+δ+ℇ] |  | ≥[132] |  | ≥[1] | NOTE 6 | NOTE 6 | NOTE 6 |
| NOTE 1: This minimum Io condition is expressed as the average Io per RE over all REs in an OFDM symbol.  NOTE 2: NR operating band groups are as defined in Section 3.5.  NOTE 3: are configured by higher layer parameter *dl-PRS-ResourceRepetitionFactor, dl-PRS-NumSymbols and dl-PRS-CombSizeN*defined in TS 37.355 [34].  NOTE 4: The Io is defined in PRS slots. The same Io range applies to PRS and non-PRS symbols. Io levels are different in PRS and non-PRS symbols within the same slot.  NOTE 5: Tc is the basic timing unit defined in TS 38.211 [6].  NOTE 6: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding requirement with the PRS bandwidth of the smallest RB number for the corresponding SCS.  NOTE 7: δ is the margin determined from Table 10.1.39.2-3.  NOTE 8: ℇ is the margin for reporting quantitization error and ℇ=16 Tc. | | | | | | | |

The accuracy requirements in Table 10.1.39.2-2 for FR2 are valid under the following conditions:

Conditions defined in clause 7.3 of TS 38.101-2 [19] for reference sensitivity are fulfilled.

PRP|dBm according to Annex [TBD] for a corresponding Band.

AWGN propagation condition.

Table 10.1.39.2-2: UE Rx-Tx time difference measurement accuracy in FR2 in AWGN

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Accuracy | Conditions | | | | | |
| PRS Ês/Iot | Minimum PRS bandwidth | PRS SCS | PRS resource repetitionNote 3 | IoNote 4 range | |
| Minimum IoNote 1 | Maximum Io |
| TcNote 5 | dB | RB | kHz |  | dBm / SCSPRS | dBm/BWChannel |
| ± [22+δ+ℇ] | -3 | ≥[24] | 60 | ≥[1] | Same value as PRP in Table B.2.14-2, according to UE Power class, operating band and angle of arrival | -50 |
| ± [15+δ+ℇ] |  | ≥[64] |  | ≥[1] | NOTE 6 | NOTE 6 |
| ± [7+δ+ℇ] |  | ≥[132] |  | ≥[1] | NOTE 6 | NOTE 6 |
| ± [12+δ+ℇ] |  | ≥[32] | 120 | ≥[1] | Same value as PRP in Table B.2.14-2, according to UE Power class, operating band and angle of arrival | -50 |
| ± [7+δ+ℇ] |  | ≥[64] |  | ≥[1] | NOTE 6 | NOTE 6 |
| ± [4+δ+ℇ] |  | ≥[128] |  | ≥[1] | NOTE 6 | NOTE 6 |
| NOTE 1: This minimum Io condition is expressed as the average Io per RE over all REs in an OFDM symbol.  NOTE 2: NR operating band groups are as defined in Section 3.5.  NOTE 3: are configured by higher layer parameter dl-PRS-ResourceRepetitionFactor, dl-PRS-NumSymbols and dl-PRS-CombSizeNdefined in TS 37.355 [34].  NOTE 4: The Io is defined in PRS slots. The same Io range applies to PRS and non-PRS symbols. Io levels are different in PRS and non-PRS symbols within the same slot.  NOTE 5: Tc is the basic timing unit defined in TS 38.211 [6].  NOTE 6: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding requirement with the PRS bandwidth of the smallest RB number for the corresponding SCS.  NOTE 7: δ is the margin determined from Table 10.1.39.2-4.  NOTE 8: ℇ is the margin for reporting quantitization error and ℇ=16 Tc. | | | | | | |

Table 10.1.39.2-3: Margin for UE Rx-Tx time difference measurement accuracy in FR1

|  |  |  |  |
| --- | --- | --- | --- |
| Min(PRS BW, SRS BW) (RB) | | | Margin (Tc Note 1) |
| SCS = 15 kHz | SCS = 30 kHz | SCS = 60 kHz |
| ≥ 24 | N/A | N/A | [160] |
| ≥ 52 | ≥ 24 | N/A | [80] |
| ≥ 104 | ≥ 48 | ≥ 24 | [56] |
| N/A | ≥ 132 | ≥ 64 | [24] |
| N/A | N/A | ≥ 132 | [24] |
| NOTE 1: Tc is the basic timing unit defined in TS 38.211 [6].  NOTE 2: If SRS and PRS have different SCS, the margin corresponding to the smallest RS BW in MHz applies. | | | |

Table 10.1.39.2-4: Margin for UE Rx-Tx time difference measurement accuracy in FR2

|  |  |  |
| --- | --- | --- |
| Min(PRS BW, SRS BW) (MHz) | | Margin (Tc Note 1) |
| SCS = 60 kHz | SCS = 120 kHz |
| ≥ 24 | N/A | [76] |
| ≥ 64 | ≥ 32 | [32] |
| ≥ 132 | ≥ 64 | [24] |
| N/A | ≥ 128 | [20] |
| NOTE 1: Tc is the basic timing unit defined in TS 38.211 [6].  NOTE 2: If SRS and PRS have different SCS, the margin corresponding to the smallest RS BW in MHz applies. | | |

#### 10.1.39.3 Measurement Accuracy Requirements for TRS

The error in the reported value of UE Rx-Tx time difference measurement, including both the measurement error and the reporting quantization error, should be within the accuracy requirements specified in this clause.

The UE Rx-Tx time difference measurement accuracy requirements in this clause shall not apply, if:

- NTA\_offset defined in Table 7.1.2-2 changes during the UE Rx-Tx measurement period or

- if the uplink transmission timing changes during the UE Rx-Tx measurement period due to the network-configured Timing Advance.

The UE Rx-Tx time difference measurement accuracy requirements in this clause shall apply provided that:

- The UE transmits SRS within [-160, 160] msec of at least one PDC TRS resource from the serving cell (PCell).

When a serving cell change occurs during the UE Rx-Tx measurement period, the UE Rx-Tx time difference measurement accuracy requirements in this clause shall apply provided that the serving cell change does not impact SRS configuration for the UE Rx-Tx measurement.

The accuracy requirements in Table 10.1.39.3-1 for FR1 are valid under the following conditions:

Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

PRP|dBm according to Annex [TBD] for a corresponding Band.

AWGN propagation condition.

Table 10.1.39.3-1: UE Rx-Tx time difference measurement accuracy in FR1 in AWGN

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Accuracy | Conditions | | | | | |
| TRS Ês/Iot | Minimum TRS bandwidth | TRS SCS | NR operating band groupsNote 2 | IoNote 3 range | |
| Minimum IoNote 1 | Maximum Io |
| TcNote 4 | dB | RB | kHz |  | dBm / SCSTRS | dBm/BW |
| [116+δ+ℇ] | -3 | ≥[24] | 15 | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -50 |
|  |  |  |  | NR\_FDD\_FR1\_B | -120.5 |  |
|  |  |  |  | NR\_TDD\_FR1\_C | -120 |  |
|  |  |  |  | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 |  |
|  |  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 |  |
|  |  |  |  | NR\_FDD\_FR1\_F | -118.5 |  |
|  |  |  |  | NR\_FDD\_FR1\_G | -118 |  |
|  |  |  |  | NR\_FDD\_FR1\_H | -117.5 |  |
| [60+δ+ℇ] |  | ≥[52] |  | Note 5 | NOTE 5 | NOTE 5 |
| [29+δ+ℇ] |  | >[104] |  | Note 5 | NOTE 5 | NOTE 5 |
| [56+δ+ℇ] |  | ≥[24] | 30 | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -118 | -50 |
|  |  |  |  | NR\_FDD\_FR1\_B | -117.5 |  |
|  |  |  |  | NR\_TDD\_FR1\_C | -117 |  |
|  |  |  |  | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -116.5 |  |
|  |  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -116 |  |
|  |  |  |  | NR\_FDD\_FR1\_F | -115.5 |  |
|  |  |  |  | NR\_FDD\_FR1\_G | -115 |  |
|  |  |  |  | NR\_FDD\_FR1\_H | -114.5 |  |
| [29+δ+ℇ] |  | ≥[48] |  | NOTE 5 | NOTE 5 | NOTE 5 |
| [15+δ+ℇ] |  | ≥[132] |  | NOTE 5 | NOTE 5 | NOTE 5 |
| [29+δ+ℇ] |  | ≥[24] | 60 | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -115 | -50 |
|  |  |  |  | NR\_FDD\_FR1\_B | -114.5 |  |
|  |  |  |  | NR\_TDD\_FR1\_C | -114 |  |
|  |  |  |  | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -113.5 |  |
|  |  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -113 |  |
|  |  |  |  | NR\_FDD\_FR1\_F | -113.5 |  |
|  |  |  |  | NR\_FDD\_FR1\_G | -113 |  |
|  |  |  |  | NR\_FDD\_FR1\_H | -111.5 |  |
| [14+δ+ℇ] |  | ≥[64] |  | NOTE 5 | NOTE 5 | NOTE 5 |
| [7+δ+ℇ] |  | ≥[132] |  | NOTE 5 | NOTE 5 | NOTE 5 |
| NOTE 1: This minimum Io condition is expressed as the average Io per RE over all REs in an OFDM symbol.  NOTE 2: NR operating band groups are as defined in Section 3.5.  NOTE 3: The Io is defined in TRS slots. The same Io range applies to TRS and non-TRS symbols. Io levels are different in TRS and non-TRS symbols within the same slot.  NOTE 4: Tc is the basic timing unit defined in TS 38.211 [6].  NOTE 5: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding requirement with the TRS bandwidth of the smallest RB number for the corresponding SCS.  NOTE 6: δ is the margin determined from Table 10.1.39.3-3.  NOTE 7: ℇ is the margin for reporting quantitization error and ℇ=16 Tc. | | | | | | |

The accuracy requirements in Table 10.1.39.3-2 for FR2 are valid under the following conditions:

Conditions defined in clause 7.3 of TS 38.101-2 [19] for reference sensitivity are fulfilled.

PRP|dBm according to Annex [TBD] for a corresponding Band.

AWGN propagation condition.

Table 10.1.39.3-2: UE Rx-Tx time difference measurement accuracy in FR2 in AWGN

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Accuracy | Conditions | | | | |
| TRS Ês/Iot | Minimum TRS bandwidth | TRS SCS | IoNote 3 range | |
| Minimum IoNote 1 | Maximum Io |
| TcNote 4 | dB | RB | kHz | dBm / SCSTRS | dBm/BWChannel |
| [29+δ+ℇ] | -3 | ≥[24] | 60 | Same value as PRP in Table B.2.14-2, according to UE Power class, operating band and angle of arrival | -50 |
| [14+δ+ℇ] |  | ≥[64] |  | NOTE 5 | NOTE 5 |
| [7+δ+ℇ] |  | ≥[132] |  | NOTE 5 | NOTE 5 |
| [15+δ+ℇ] |  | ≥[32] | 120 | Same value as PRP in Table B.2.14-2, according to UE Power class, operating band and angle of arrival | -50 |
| [7+δ+ℇ] |  | ≥[64] |  | NOTE 5 | NOTE 5 |
| [4+δ+ℇ] |  | ≥[128] |  | NOTE 5 | NOTE 5 |
| NOTE 1: This minimum Io condition is expressed as the average Io per RE over all REs in an OFDM symbol.  NOTE 2: NR operating band groups are as defined in Section 3.5.  NOTE 3: The Io is defined in TRS slots. The same Io range applies to TRS and non-TRS symbols. Io levels are different in TRS and non-TRS symbols within the same slot.  NOTE 4: Tc is the basic timing unit defined in TS 38.211 [6].  NOTE 5: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding requirement with the TRS bandwidth of the smallest RB number for the corresponding SCS.  NOTE 6: δ is the margin determined from Table 10.1.39.3-4.  NOTE 7: ℇ is the margin for reporting quantitization error and ℇ=16 Tc. | | | | | |

Table 10.1.39.3-3: Margin for UE Rx-Tx time difference measurement accuracy in FR1

|  |  |  |  |
| --- | --- | --- | --- |
| Min(TRS BW, SRS BW) (RB) | | | Margin (Tc Note 1) |
| SCS = 15 kHz | SCS = 30 kHz | SCS = 60 kHz |
| ≥ 24 | N/A | N/A | [160] |
| ≥ 52 | ≥ 24 | N/A | [80] |
| ≥ 104 | ≥ 48 | ≥ 24 | [56] |
| N/A | ≥ 132 | ≥ 64 | [24] |
| N/A | N/A | ≥ 132 | [24] |
| NOTE 1: Tc is the basic timing unit defined in TS 38.211 [6].  NOTE 2: If SRS and TRS have different SCS, the margin corresponding to the smallest RS BW in MHz applies. | | | |

Table 10.1.39.3-4: Margin for UE Rx-Tx time difference measurement accuracy in FR2

|  |  |  |
| --- | --- | --- |
| Min(TRS BW, SRS BW) (MHz) | | Margin (Tc Note 1) |
| SCS = 60 kHz | SCS = 120 kHz |
| ≥ 24 | N/A | [76] |
| ≥ 64 | ≥ 32 | [32] |
| ≥ 132 | ≥ 64 | [24] |
| N/A | ≥ 128 | [20] |
| NOTE 1: Tc is the basic timing unit defined in TS 38.211 [6].  NOTE 2: If SRS and TRS have different SCS, the margin corresponding to the smallest RS BW in MHz applies. | | |

### 10.1.40 Measurement Accuracy Requirements for Propagation Delay Compensation

#### *10.1.40.1* Measurement Accuracy Requirements for PRS

The error in the reported value of UE Rx-Tx time difference measurement, including both the measurement error and the reporting quantization error, should be within the accuracy requirements specified in this clause.

The accuracy requirements in Table 10.1.40.1-1 for FR1 are valid under the following conditions:

Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

PRP|dBm according to Annex [TBD] for a corresponding Band.

AWGN propagation condition.

Table 10.1.40.1-1: UE Rx-Tx time difference measurement accuracy in FR1 in AWGN

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | Conditions | | | | | | |
| PRS Ês/Iot | Minimum PRS bandwidth | PRS SCS | PRS resource repetition Note 3 | NR operating band groupsNote 2 | IoNote 4 range | |
| Minimum IoNote 1 | Maximum Io |
| TcNote 5 | dB | RB | kHz |  |  | dBm / SCSPRS | dBm/BW |
| ± [78+δ+ℇ] | -3 | ≥[24] | 15 | ≥[4] | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -50 |
|  |  |  |  |  | NR\_FDD\_FR1\_B | -120.5 |  |
|  |  |  |  |  | NR\_TDD\_FR1\_C | -120 |  |
|  |  |  |  |  | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 |  |
|  |  |  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 |  |
|  |  |  |  |  | NR\_FDD\_FR1\_F | -118.5 |  |
|  |  |  |  |  | NR\_FDD\_FR1\_G | -118 |  |
|  |  |  |  |  | NR\_FDD\_FR1\_H | -117.5 |  |
| ± [59+δ+ℇ] |  | ≥[52] |  | ≥[1] | Note 6 | NOTE 6 | NOTE 6 |
| ± [30+δ+ℇ] |  | >[104] |  | ≥[1] | Note 6 | NOTE 6 | NOTE 6 |
| ± [57+δ+ℇ] |  | ≥[24] | 30 | ≥[4] | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -118 | -50 |
|  |  |  |  |  | NR\_FDD\_FR1\_B | -117.5 |  |
|  |  |  |  |  | NR\_TDD\_FR1\_C | -117 |  |
|  |  |  |  |  | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -116.5 |  |
|  |  |  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -116 |  |
|  |  |  |  |  | NR\_FDD\_FR1\_F | -115.5 |  |
|  |  |  |  |  | NR\_FDD\_FR1\_G | -115 |  |
|  |  |  |  |  | NR\_FDD\_FR1\_H | -114.5 |  |
| ± [30+δ+ℇ] |  | ≥[48] |  | ≥[1] | NOTE 6 | NOTE 6 | NOTE 6 |
| ± [15+δ+ℇ] |  | ≥[132] |  | ≥[1] | NOTE 6 | NOTE 6 | NOTE 6 |
| ± [29+δ+ℇ] |  | ≥[24] | 60 | ≥[4] | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -115 | -50 |
|  |  |  |  |  | NR\_FDD\_FR1\_B | -114.5 |  |
|  |  |  |  |  | NR\_TDD\_FR1\_C | -114 |  |
|  |  |  |  |  | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -113.5 |  |
|  |  |  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -113 |  |
|  |  |  |  |  | NR\_FDD\_FR1\_F | -113.5 |  |
|  |  |  |  |  | NR\_FDD\_FR1\_G | -113 |  |
|  |  |  |  |  | NR\_FDD\_FR1\_H | -111.5 |  |
| ± [15+δ+ℇ] |  | ≥[64] |  | ≥[1] | NOTE 6 | NOTE 6 | NOTE 6 |
| ± [7+δ+ℇ] |  | ≥[132] |  | ≥[1] | NOTE 6 | NOTE 6 | NOTE 6 |
| NOTE 1: This minimum Io condition is expressed as the average Io per RE over all REs in an OFDM symbol.  NOTE 2: NR operating band groups are as defined in Section 3.5.  NOTE 3: are configured by higher layer parameter *dl-PRS-ResourceRepetitionFactor, dl-PRS-NumSymbols and dl-PRS-CombSizeN*defined in TS 37.355 [34].  NOTE 4: The Io is defined in PRS slots. The same Io range applies to PRS and non-PRS symbols. Io levels are different in PRS and non-PRS symbols within the same slot.  NOTE 5: Tc is the basic timing unit defined in TS 38.211 [6].  NOTE 6: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding requirement with the PRS bandwidth of the smallest RB number for the corresponding SCS.  NOTE 7: δ is the margin determined from Table 10.1.40.1-3.  NOTE 8: ℇ is the margin for reporting quantitization error and ℇ=16 Tc. | | | | | | | |

The accuracy requirements in Table 10.1.40.1-2 for FR2 are valid under the following conditions:

Conditions defined in clause 7.3 of TS 38.101-2 [19] for reference sensitivity are fulfilled.

PRP|dBm according to Annex [TBD] for a corresponding Band.

AWGN propagation condition.

Table 10.1.40.1-2: UE Rx-Tx time difference measurement accuracy in FR2 in AWGN

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Accuracy | Conditions | | | | | |
| PRS Ês/Iot | Minimum PRS bandwidth | PRS SCS | PRS resource repetitionNote 3 | IoNote 4 range | |
| Minimum IoNote 1 | Maximum Io |
| TcNote 5 | dB | RB | kHz |  | dBm / SCSPRS | dBm/BWChannel |
| ± [22+δ+ℇ] | -3 | ≥[24] | 60 | ≥[1] | Same value as PRP in Table B.2.14-2, according to UE Power class, operating band and angle of arrival | -50 |
| ± [15+δ+ℇ] |  | ≥[64] |  | ≥[1] | NOTE 6 | NOTE 6 |
| ± [7+δ+ℇ] |  | ≥[132] |  | ≥[1] | NOTE 6 | NOTE 6 |
| ± [12+δ+ℇ] |  | ≥[32] | 120 | ≥[1] | Same value as PRP in Table B.2.14-2, according to UE Power class, operating band and angle of arrival | -50 |
| ± [7+δ+ℇ] |  | ≥[64] |  | ≥[1] | NOTE 6 | NOTE 6 |
| ± [4+δ+ℇ] |  | ≥[128] |  | ≥[1] | NOTE 6 | NOTE 6 |
| NOTE 1: This minimum Io condition is expressed as the average Io per RE over all REs in an OFDM symbol.  NOTE 2: NR operating band groups are as defined in Section 3.5.  NOTE 3: are configured by higher layer parameter dl-PRS-ResourceRepetitionFactor, dl-PRS-NumSymbols and dl-PRS-CombSizeNdefined in TS 37.355 [34].  NOTE 4: The Io is defined in PRS slots. The same Io range applies to PRS and non-PRS symbols. Io levels are different in PRS and non-PRS symbols within the same slot.  NOTE 5: Tc is the basic timing unit defined in TS 38.211 [6].  NOTE 6: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding requirement with the PRS bandwidth of the smallest RB number for the corresponding SCS.  NOTE 7: δ is the margin determined from Table 10.1.40.1-4.  NOTE 8: ℇ is the margin for reporting quantitization error and ℇ=16 Tc. | | | | | | |

Table 10.1.40.1-3: Margin for UE Rx-Tx time difference measurement accuracy in FR1

|  |  |  |  |
| --- | --- | --- | --- |
| Min(PRS BW, SRS BW) (RB) | | | Margin (Tc Note 1) |
| SCS = 15 kHz | SCS = 30 kHz | SCS = 60 kHz |
| ≥ 24 | N/A | N/A | [160] |
| ≥ 52 | ≥ 24 | N/A | [80] |
| ≥ 104 | ≥ 48 | ≥ 24 | [56] |
| N/A | ≥ 132 | ≥ 64 | [24] |
| N/A | N/A | ≥ 132 | [24] |
| NOTE 1: Tc is the basic timing unit defined in TS 38.211 [6].  NOTE 2: If SRS and PRS have different SCS, the margin corresponding to the smallest RS BW in MHz applies. | | | |

Table 10.1.40.1-4: Margin for UE Rx-Tx time difference measurement accuracy in FR2

|  |  |  |
| --- | --- | --- |
| Min(PRS BW, SRS BW) (MHz) | | Margin (Tc Note 1) |
| SCS = 60 kHz | SCS = 120 kHz |
| ≥ 24 | N/A | [76] |
| ≥ 64 | ≥ 32 | [32] |
| ≥ 132 | ≥ 64 | [24] |
| N/A | ≥ 128 | [20] |
| NOTE 1: Tc is the basic timing unit defined in TS 38.211 [6].  NOTE 2: If SRS and PRS have different SCS, the margin corresponding to the smallest RS BW in MHz applies. | | |

Editor’s Note: FFS whether and which applicability conditions from clause 10.1.25.2 should be ad*ded.*

#### 10.1.40.2 Measurement Accuracy Requirements for TRS

The error in the reported value of UE Rx-Tx time difference measurement, including both the measurement error and the reporting quantization error, should be within the accuracy requirements specified in this clause.

The accuracy requirements in Table 10.1.40.2-1 for FR1 are valid under the following conditions:

Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

PRP|dBm according to Annex [TBD] for a corresponding Band.

AWGN propagation condition.

Table 10.1.40.2-1: UE Rx-Tx time difference measurement accuracy in FR1 in AWGN

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Accuracy | Conditions | | | | | |
| TRS Ês/Iot | Minimum TRS bandwidth | TRS SCS | NR operating band groupsNote 2 | IoNote 3 range | |
| Minimum IoNote 1 | Maximum Io |
| TcNote 4 | dB | RB | kHz |  | dBm / SCSTRS | dBm/BW |
| [TBD+δ+ℇ] | -3 | ≥[24] | 15 | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -50 |
|  |  |  |  | NR\_FDD\_FR1\_B | -120.5 |  |
|  |  |  |  | NR\_TDD\_FR1\_C | -120 |  |
|  |  |  |  | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 |  |
|  |  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 |  |
|  |  |  |  | NR\_FDD\_FR1\_F | -118.5 |  |
|  |  |  |  | NR\_FDD\_FR1\_G | -118 |  |
|  |  |  |  | NR\_FDD\_FR1\_H | -117.5 |  |
| [TBD+δ+ℇ] |  | ≥[52] |  | Note 5 | NOTE 5 | NOTE 5 |
| [TBD+δ+ℇ] |  | >[104] |  | Note 5 | NOTE 5 | NOTE 5 |
| [TBD+δ+ℇ] |  | ≥[24] | 30 | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -118 | -50 |
|  |  |  |  | NR\_FDD\_FR1\_B | -117.5 |  |
|  |  |  |  | NR\_TDD\_FR1\_C | -117 |  |
|  |  |  |  | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -116.5 |  |
|  |  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -116 |  |
|  |  |  |  | NR\_FDD\_FR1\_F | -115.5 |  |
|  |  |  |  | NR\_FDD\_FR1\_G | -115 |  |
|  |  |  |  | NR\_FDD\_FR1\_H | -114.5 |  |
| [TBD+δ+ℇ] |  | ≥[48] |  | NOTE 5 | NOTE 5 | NOTE 5 |
| [TBD+δ+ℇ] |  | ≥[132] |  | NOTE 5 | NOTE 5 | NOTE 5 |
| [TBD+δ+ℇ] |  | ≥[24] | 60 | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -115 | -50 |
|  |  |  |  | NR\_FDD\_FR1\_B | -114.5 |  |
|  |  |  |  | NR\_TDD\_FR1\_C | -114 |  |
|  |  |  |  | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -113.5 |  |
|  |  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -113 |  |
|  |  |  |  | NR\_FDD\_FR1\_F | -113.5 |  |
|  |  |  |  | NR\_FDD\_FR1\_G | -113 |  |
|  |  |  |  | NR\_FDD\_FR1\_H | -111.5 |  |
| [TBD+δ+ℇ] |  | ≥[64] |  | NOTE 5 | NOTE 5 | NOTE 5 |
| [TBD+δ+ℇ] |  | ≥[132] |  | NOTE 5 | NOTE 5 | NOTE 5 |
| NOTE 1: This minimum Io condition is expressed as the average Io per RE over all REs in an OFDM symbol.  NOTE 2: NR operating band groups are as defined in Section 3.5.  NOTE 3: The Io is defined in TRS slots. The same Io range applies to TRS and non-TRS symbols. Io levels are different in TRS and non-TRS symbols within the same slot.  NOTE 4: Tc is the basic timing unit defined in TS 38.211 [6].  NOTE 5: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding requirement with the TRS bandwidth of the smallest RB number for the corresponding SCS.  NOTE 6: δ is the margin determined from Table 10.1.40.2-3.  NOTE 7: ℇ is the margin for reporting quantitization error and ℇ=16 Tc. | | | | | | |

The accuracy requirements in Table 10.1.40.2-2 for FR2 are valid under the following conditions:

Conditions defined in clause 7.3 of TS 38.101-2 [19] for reference sensitivity are fulfilled.

PRP|dBm according to Annex [TBD] for a corresponding Band.

AWGN propagation condition.

Table 10.1.40.2-2: UE Rx-Tx time difference measurement accuracy in FR2 in AWGN

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Accuracy | Conditions | | | | |
| TRS Ês/Iot | Minimum TRS bandwidth | TRS SCS | IoNote 3 range | |
| Minimum IoNote 1 | Maximum Io |
| TcNote 4 | dB | RB | kHz | dBm / SCSTRS | dBm/BWChannel |
| [TBD+δ+ℇ] | -3 | ≥[24] | 60 | Same value as PRP in Table B.2.14-2, according to UE Power class, operating band and angle of arrival | -50 |
| [TBD+δ+ℇ] |  | ≥[64] |  | NOTE 5 | NOTE 5 |
| [TBD+δ+ℇ] |  | ≥[132] |  | NOTE 5 | NOTE 5 |
| [TBD+δ+ℇ] |  | ≥[32] | 120 | Same value as PRP in Table B.2.14-2, according to UE Power class, operating band and angle of arrival | -50 |
| [TBD+δ+ℇ] |  | ≥[64] |  | NOTE 5 | NOTE 5 |
| [TBD+δ+ℇ] |  | ≥[128] |  | NOTE 5 | NOTE 5 |
| NOTE 1: This minimum Io condition is expressed as the average Io per RE over all REs in an OFDM symbol.  NOTE 2: NR operating band groups are as defined in Section 3.5.  NOTE 3: The Io is defined in TRS slots. The same Io range applies to TRS and non-TRS symbols. Io levels are different in TRS and non-TRS symbols within the same slot.  NOTE 4: Tc is the basic timing unit defined in TS 38.211 [6].  NOTE 5: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding requirement with the TRS bandwidth of the smallest RB number for the corresponding SCS.  NOTE 6: δ is the margin determined from Table 10.1.40.2-4.  NOTE 7: ℇ is the margin for reporting quantitization error and ℇ=16 Tc. | | | | | |

**Table 10.1.40.2-3: Margin for UE Rx-Tx time difference measurement accuracy in FR1**

|  |  |  |  |
| --- | --- | --- | --- |
| Min(PRS BW, SRS BW) (RB) | | | Margin (Tc Note 1) |
| SCS = 15 kHz | SCS = 30 kHz | SCS = 60 kHz |
| ≥ 24 | N/A | N/A | [160] |
| ≥ 52 | ≥ 24 | N/A | [80] |
| ≥ 104 | ≥ 48 | ≥ 24 | [56] |
| N/A | ≥ 132 | ≥ 64 | [24] |
| N/A | N/A | ≥ 132 | [24] |
| NOTE 1: Tc is the basic timing unit defined in TS 38.211 [6].  NOTE 2: If SRS and PRS have different SCS, the margin corresponding to the smallest RS BW in MHz applies. | | | |

Table 10.1.40.2-4: Margin for UE Rx-Tx time difference measurement accuracy in FR2

|  |  |  |
| --- | --- | --- |
| Min(PRS BW, SRS BW) (MHz) | | Margin (Tc Note 1) |
| SCS = 60 kHz | SCS = 120 kHz |
| ≥ 24 | N/A | [76] |
| ≥ 64 | ≥ 32 | [32] |
| ≥ 132 | ≥ 64 | [24] |
| N/A | ≥ 128 | [20] |
| NOTE 1: Tc is the basic timing unit defined in TS 38.211 [6].  NOTE 2: If SRS and PRS have different SCS, the margin corresponding to the smallest RS BW in MHz applies. | | |

Editor’s Note: FFS whether and which applicability conditions from clause 10.1.25.2 should be added

## 10.1A NR measurements for RedCap

### 10.1A.1 Introduction

The requirements in this section are applicable for RedCap UE as follows:

- intra-frequency requirements apply for PCell measurements in SA,

- inter-frequency requirements apply for non-serving cell measurements on NR carrier frequencies.

- inter-frequency requirements apply for measurements from one cell on a frequency compared to the measurement from another cell on a different frequency.

The accuracy requirements in this clause are applicable for AWGN radio propagation conditions. The accuracy requirements of RSRP, RSRQ amd SINR are applicable provided that reference SSB is not changed during measurement period.

### 10.1A.2 Intra-frequency RSRP accuracy requirements for FR1

#### 10.1A.2.1 Intra-frequency SS-RSRP accuracy requirements

##### 10.1A.2.1.1 Absolute SS-RSRP Accuracy

The accuracy requirements in clause 10.1.2.1.1 shall apply when RedCap UE is capable of 2Rx. When UE is only required to support 1RX, the absolute accuracy requirements in Table 10.1A.2.1.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for intra-frequency measurements are fulfilled according to Annex B.2.2 for a corresponding Band for each relevant SSB.

Table 10.1A.2.1.1-1: SS-RSRP Intra frequency absolute accuracy for 1Rx RedCap UE in FR1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot | Io Note 1 range | | | | |
|  |  |  | NR operating band groups Note 2 | Minimum Io | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |  |
|  |  |  | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -118 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_B | -120.5 | -117.5 | N/A | -70 |
|  |  |  | NR\_TDD\_FR1\_C | -120 | -117 | N/A | -70 |
| ±5.5 | ±10 | ≥-6 | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_F | -118.5 | -115.5 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_G | -118 | -115 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_H | -117.5 | -114.5 | N/A | -70 |
| ±9 | ±12 | ≥-6 | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A,  NR\_FDD\_FR1\_B, NR\_TDD\_FR1\_C, NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D, NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E, NR\_FDD\_FR1\_F,  NR\_FDD\_FR1\_G, NR\_FDD\_FR1\_H | N/A | N/A | -70 | -50 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: NR operating band groups in FR1 are as defined in clause 3.5.2. | | | | | | | |

##### 10.1A.2.1.2 Relative SS-RSRP Accuracy

The accuracy requirements in clause 10.1.2.1.2 shall apply when RedCap UE is capable of 2Rx. When UE is only required to support 1RX, the absolute accuracy requirements in Table 10.1A.2.1.2-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for intra-frequency measurements are fulfilled according to Annex B.2.2 for a corresponding Band for each relevant SSB.

Table 10.1A.2.1.2-1: SS-RSRP Intra frequency relative accuracy for 1Rx RedCap UE in FR1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot Note 2 | Io Note 1 range | | | | |
|  |  |  | NR operating band groups Note 4 | Minimum Io | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |  |
|  |  |  | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -118 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_B | -120.5 | -117.5 | N/A | -50 |
|  |  |  | NR\_TDD\_FR1\_C | -120 | -117 | N/A | -50 |
| ±3 | ±4 | ≥-3 | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_F | -118.5 | -115.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_G | -118 | -115 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_H | -117.5 | -114.5 | N/A | -50 |
| ±4 | ±4 | ≥-6 | Note 3 | Note 3 | Note 3 | N/A | Note 3 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: The parameter SSB Ês/Iot is the minimum SSB Ês/Iot of the pair of cells to which the requirement applies.  NOTE 3: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding highest accuracy requirement.  NOTE 4: NR operating band groups in FR1 are as defined in clause 3.5.2. | | | | | | | |

### 10.1A.3 Intra-frequency RSRP accuracy requirements for FR2

#### 10.1A.3.1 Intra-frequency SS-RSRP accuracy requirements

##### 10.1A.3.1.1 Absolute SS-RSRP Accuracy

The accuracy requirements in clause 10.1.3.1.1 shall apply.

##### 10.1A.3.1.2 Relative SS-RSRP Accuracy

The accuracy requirements in clause 10.1.3.1.2 shall apply.

### 10.1A.4 Inter-frequency RSRP accuracy requirements for FR1

#### 10.1A.4.1 Inter-frequency SS-RSRP accuracy requirements

##### 10.1A.4.1.1 Absolute Accuracy of SS-RSRP in FR1

The accuracy requirements in clause 10.1.4.1.1 shall apply when RedCap UE is capable of 2Rx. When UE is only required to support 1RX, the absolute accuracy requirements in Table 10.1A.4.1.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.2.3 for a corresponding Band for each relevant SSB.

Table 10.1A.4.1.1-1: SS-RSRP Inter frequency Absolute accuracy for 1Rx RedCap UE in FR1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot Note 2 | Io Note 1 range | | | | |
|  |  |  | NR operating band groups Note 3 | Minimum Io | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |  |
|  |  |  | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -118 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_B | -120.5 | -117.5 | N/A | -70 |
|  |  |  | NR\_TDD\_FR1\_C | -120 | -117 | N/A | -70 |
| ±5.5 | ±10 | ≥-6 | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_F | -118.5 | -115.5 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_G | -118 | -115 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_H | -117.5 | -114.5 | N/A | -70 |
| ±9 | ±12 | ≥-6 | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A, NR\_FDD\_FR1\_B, NR\_TDD\_FR1\_C, NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D, NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E, NR\_FDD\_FR1\_F,  NR\_FDD\_FR1\_G, NR\_FDD\_FR1\_H | N/A | N/A | -70 | -50 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: Void  NOTE 3: NR operating band groups in FR1 are as defined in clause 3.5.2. | | | | | | | |

##### 10.1A.4.1.2 Relative Accuracy of SS-RSRP in FR1

The accuracy requirements in clause 10.1.4.1.2 shall apply when RedCap UE is capable of 2Rx. When UE is only required to support 1RX, the absolute accuracy requirements in Table 10.1A.4.1.2-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] Clause 7.3 for reference sensitivity are fulfilled.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.2.3 for a corresponding Band for each relevant SSB.

- |SSB\_RP1dBm - SSB\_RP2dBm| ≤ 27 dB

- |Channel 1\_Io ‑Channel 2\_Io | ≤ 20 dB

Table 10.1A.4.1.2-1: SS-RSRP Inter frequency relative accuracy for 1Rx RedCap UE in FR1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot Note 2 | Io Note 1 range | | | | |
|  |  |  | NR operating band groups Note 3 | Minimum Io | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |  |
|  |  |  | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -118 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_B | -120.5 | -117.5 | N/A | -50 |
|  |  |  | NR\_TDD\_FR1\_C | -120 | -117 | N/A | -50 |
| ±5.5 | ±7 | ≥-6 | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_F | -118.5 | -115.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_G | -118 | -115 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_H | -117.5 | -114.5 | N/A | -50 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: The parameter SSB Ês/Iot is the minimum SSB Ês/Iot of the pair of cells to which the requirement applies.  NOTE 3: NR operating band groups in FR1 are as defined in clause 3.5.2. | | | | | | | |

### 10.1A.5 Inter-frequency RSRP accuracy requirements for FR2

#### 10.1A.5.1 Inter-frequency SS-RSRP accuracy requirements

##### 10.1A.5.1.1 Absolute SS-RSRP Accuracy

The accuracy requirements in clause 10.1.5.1.1 shall apply.

##### 10.1A.5.1.2 Relative SS-RSRP Accuracy

The accuracy requirements in clause 10.1.5.1.2 shall apply.

### 10.1A.6 Intra-frequency RSRQ accuracy requirements for FR1

#### 10.1A.6.1 Intra-frequency SS-RSRQ accuracy requirements in FR1

##### 10.1A.6.1.1 Absolute SS-RSRQ Accuracy in FR1

The accuracy requirements in clause 10.1.7.1.1 shall apply when RedCap UE is capable of 2Rx. When UE is only required to support 1RX, the absolute accuracy requirements in Table 10.1A.6.1.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for intra-frequency measurements are fulfilled according to Annex B.2.2 for a corresponding Band for each relevant SSB.

Table 10.1A.6.1.1-1: SS-RSRQ Intra frequency absolute accuracy for 1Rx RedCap UE in FR1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot | Io Note 1 range | | | | |
|  |  |  | NR operating band groups Note 3 | Minimum Io | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |  |
|  |  |  | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -118 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_B | -120.5 | -117.5 | N/A | -50 |
|  |  |  | NR\_TDD\_FR1\_C | -120 | -117 | N/A | -50 |
| ±3.5 | ±5 | ≥-3 | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_F | -118.5 | -115.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_G | -118 | -115 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_H | -117.5 | -114.5 | N/A | -50 |
| ±4.5 | ±5 | ≥-6 | Note 2 | Note 2 | Note 2 | Note 2 | Note 2 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding highest accuracy requirement.  NOTE 3: NR operating band groups in FR1 are as defined in clause 3.5.2. | | | | | | | |

### 10.1A.7 Intra-frequency RSRQ accuracy requirements for FR2

#### 10.1A.7.1 Intra-frequency SS-RSRQ accuracy requirements in FR2

##### 10.1A.7.1.1 Absolute SS-RSRQ Accuracy in FR2

The accuracy requirements in clause 10.1.8.1.1 shall apply.

### 10.1A.8 Inter-frequency RSRQ accuracy requirements for FR1

#### 10.1A.8.1 Inter-frequency SS-RSRQ accuracy requirements in FR1

##### 10.1A.8.1.1 Absolute Accuracy of SS-RSRQ in FR1

The accuracy requirements in clause 10.1.9.1.1 shall apply when RedCap UE is capable of 2Rx. When UE is only required to support 1RX, the absolute accuracy requirements in Table 10.1A.8.1.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.2.3 for a corresponding Band for each relevant SSB.

Table 10.1A.8.1.1-1: SS-RSRQ Inter frequency absolute accuracy for 1Rx RedCap UE in FR1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot | Io Note 1 range | | | | |
|  |  |  | NR operating band groups Note 3 | Minimum Io | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |  |
|  |  |  | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -118 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_B | -120.5 | -117.5 | N/A | -50 |
|  |  |  | NR\_TDD\_FR1\_C | -120 | -117 | N/A | -50 |
| ±3.5 | ±5 | ≥-3 | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_F | -118.5 | -115.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_G | -118 | -115 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_H | -117.5 | -114.5 | N/A | -50 |
| ±4.5 | ±5 | ≥-6 | Note 2 | Note 2 | Note 2 | Note 2 | Note 2 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding highest accuracy requirement.  NOTE 3: NR operating band groups in FR1 are as defined in clause 3.5.2. | | | | | | | |

##### 10.1A.8.1.2 Relative Accuracy of SS-RSRQ in FR1

The accuracy requirements in clause 10.1.9.1.2 shall apply when RedCap UE is capable of 2Rx. When UE is only required to support 1RX, the absolute accuracy requirements in Table 10.1A.8.1.2-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.2.3 for a corresponding Band for each relevant SSB.

- |SSB\_RP1dBm - SSB\_RP2dBm| ≤ 27 dB

- |Channel 1\_Io ‑Channel 2\_Io | ≤ 20 dB

Table 10.1A.8.1.2-1: SS-RSRQ Inter frequency relative accuracy for 1Rx RedCap UE in FR1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot | Io Note 1 range | | | | |
|  |  | Note 2 | NR operating band groups Note 4 | Minimum Io | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |  |
|  |  |  | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -118 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_B | -120.5 | -117.5 | N/A | -50 |
|  |  |  | NR\_TDD\_FR1\_C | -120 | -117 | N/A | -50 |
| ±4 | ±5 | ≥-3 | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_F | -118.5 | -115.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_G | -118 | -115 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_H | -117.5 | -114.5 | N/A | -50 |
| ±5 | ±5 | ≥-6 | Note 3 | Note 3 | Note 3 | Note 3 | Note 3 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: The parameter SSB Ês/Iot is the minimum SSB Ês/Iot of the pair of cells to which the requirement applies.  NOTE 3: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding highest accuracy requirement.  NOTE 4: NR operating band groups in FR1 are as defined in clause 3.5.2. | | | | | | | |

### 10.1A.9 Inter-frequency RSRQ accuracy requirements for FR2

#### 10.1A.9.1 Inter-frequency SS-RSRQ accuracy requirements in FR2

##### 10.1A.9.1.1 Absolute Accuracy of SS-RSRQ in FR2

The accuracy requirements in clause 10.1.10.1.1 shall apply.

##### 10.1A.9.1.2 Relative Accuracy of SS-RSRQ in FR2

The accuracy requirements in clause 10.1.10.1.2 shall apply.

### 10.1A.10 Intra-frequency SINR accuracy requirements for FR1

#### 10.1A.10.1 Intra-frequency SS-SINR accuracy requirements in FR1

##### 10.1A.10.1.1 Absolute SS-SINR Accuracy in FR1

The accuracy requirements in clause 10.1.12.1.1 shall apply when RedCap UE is capable of 2Rx. When UE is only required to support 1RX, the absolute accuracy requirements in Table 10.1A.10.1.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for intra-frequency measurements are fulfilled according to Annex B.2.2 for a corresponding Band.

Table 10.1A.10.1.1-1: SS-SINR Intra frequency absolute accuracy for 1Rx RedCap UE in FR1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot | Io Note 1 range | | | | |
|  |  | Note 3 | NR operating band groups Note 4 | Minimum Io | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |  |
|  |  |  | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -118 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_B | -120.5 | -117.5 | N/A | -50 |
|  |  |  | NR\_TDD\_FR1\_C | -120 | -117 | N/A | -50 |
| ±3.0 | ±4 | ≥-3 | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_F | -118.5 | -115.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_G | -118 | -115 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_H | -117.5 | -114.5 | N/A | -50 |
| ±3.5 | ±4 | ≥-6 | Note 2 | Note 2 | Note 2 | Note 2 | Note 2 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding highest accuracy requirement.  NOTE 3: The requirements apply for SSB Ês/Iot ≤ 25 dB under non-HST scenarios.  NOTE 4: NR operating band groups in FR1 are as defined in clause 3.5.2.  NOTE 5: The requirements apply for SSB Ês/Iot ≤5 dB with SCS 15kHz or 30kHz under NR high speed scenarios. | | | | | | | |

### 10.1A.11 Intra-frequency SINR accuracy requirements for FR2

#### 10.1A.11.1 Intra-frequency SS-SINR accuracy requirements in FR2

##### 10.1A.11.1.1 Absolute SS-SINR Accuracy in FR2

The accuracy requirements in clause 10.1.13.1.1 shall apply.

### 10.1A.12 Inter-frequency SINR accuracy requirements for FR1

#### 10.1A.12.1 Inter-frequency SS-SINR accuracy requirements in FR1

##### 10.1A.12.1.1 Aboslute Accuracy of SS-SINR in FR1

The accuracy requirements in clause 10.1.14.1.1 shall apply when RedCap UE is capable of 2Rx. When UE is only required to support 1RX, the absolute accuracy requirements in Table 10.1A.12.1.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.2.3 for a corresponding Band.

Table 10.1A.12.1.1-1: SS-SINR Inter frequency absolute accuracy for 1Rx RedCap UE in FR1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot Note 3 | Io Note 1 range | | | | |
|  |  | NR operating band groups Note 4 | Minimum Io | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |  |
|  |  |  | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -118 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_B | -120.5 | -117.5 | N/A | -50 |
|  |  |  | NR\_TDD\_FR1\_C | -120 | -117 | N/A | -50 |
| ±4.0 | ±5 | ≥-3 | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_F | -118.5 | -115.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_G | -118 | -115 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_H | -117.5 | -114.5 | N/A | -50 |
| ±4.5 | ±5 | ≥-6 | Note 2 | Note 2 | Note 2 | Note 2 | Note 2 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding highest accuracy requirement.  NOTE 3: The requirements apply for SSB Ês/Iot ≤ 25 dB.  NOTE 4: NR operating band groups in FR1 are as defined in clause 3.5.2. | | | | | | | |

##### 10.1A.12.1.2 Relative Accuracy of SS-SINR in FR1

The accuracy requirements in clause 10.1.14.1.2 shall apply when RedCap UE is capable of 2Rx. When UE is only required to support 1RX, the absolute accuracy requirements in Table 10.1A.12.1.2-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for inter-frequency measurements are fulfilled according to Annex B.2.3 for a corresponding Band.

- |SSB\_RP1dBm - SSB\_RP2dBm| ≤ 27 dB

- | Channel 1\_Io ‑Channel 2\_Io | ≤ 20 dB

Table 10.1A.12.1.2-1: SS-SINR Inter frequency relative accuracy for 1Rx RedCap UE in FR1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot | Io Note 1 range | | | | |
|  |  | Note 2,4 | NR operating band groups Note 5 | Minimum Io | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 120 kHz | SCSSSB = 240 kHz |  |  |
|  |  |  | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A, NR\_SDL\_FR1\_A | -121 | -118 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_B | -120.5 | -117.5 | N/A | -50 |
|  |  |  | NR\_TDD\_FR1\_C | -120 | -117 | N/A | -50 |
| ±4.5 | ±5 | ≥-3 | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_F | -118.5 | -115.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_G | -118 | -115 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_H | -117.5 | -114.5 | N/A | -50 |
| ±5 | ±5 | ≥-6 | Note 3 | Note 3 | Note 3 | Note 3 | Note 3 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: The parameter SSB Ês/Iot is the minimum SSB Ês/Iot of the pair of cells to which the requirement applies.  NOTE 3: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding highest accuracy requirement.  NOTE 4: The requirements apply for SSB Ês/Iot ≤ [25] dB.  NOTE 5: NR operating band groups in FR1 are as defined in clause 3.5.2. | | | | | | | |

### 10.1A.13 Inter-frequency SINR accuracy requirements for FR2

#### 10.1A.13.1 Inter-frequency SS-SINR accuracy requirements in FR2

##### 10.1A.13.1.1 Aboslute Accuracy of SS-SINR in FR2

The accuracy requirements in clause 10.1.15.1.1 shall apply.

##### 10.1A.13.1.2 Relative Accuracy of SS-SINR in FR2

The accuracy requirements in clause 10.1.15.1.1 shall apply.

### 10.1A.14 L1-RSRP accuracy requirements for FR1

#### 10.1A.14.1 SSB based L1-RSRP accuracy requirements

##### 10.1A.14.1.1 Absolute Accuracy

The accuracy requirements in clause 10.1.19.1.1 shall apply when RedCap UE is capable of 2Rx. When UE is only required to support 1RX, the absolute accuracy requirements in Table 10.1A.14.1.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for L1-RSRP measurements are fulfilled according to Annex B.2.4.1 for a corresponding Band for each relevant SSB.

Table 10.1A.14.1.1-1: SSB based L1-RSRP absolute accuracy for 1Rx RedCap UE in FR1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot | Io Note 1 range | | | | |
|  |  |  | NR operating band groups Note 2 | Minimum Io | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |  |
|  |  |  | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A, NR\_SDL\_FR1\_A | -121 | -118 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_B | -120.5 | -117.5 | N/A | -70 |
|  |  |  | NR\_TDD\_FR1\_C | -120 | -117 | N/A | -70 |
| ±8.0 | ±12.5 | ≥-3 | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_F | -118.5 | -115.5 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_G | -118 | -115 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_H | -117.5 | -114.5 | N/A | -70 |
| ±11.5 | ±14.5 | ≥-3 | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A, NR\_SDL\_FR1\_A, NR\_FDD\_FR1\_B, NR\_TDD\_FR1\_C, NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D, NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E, NR\_FDD\_FR1\_F, NR\_FDD\_FR1\_G, NR\_FDD\_FR1\_H, | N/A | N/A | -70 | -50 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: NR operating band groups in FR1 are as defined in clause 3.5.2. | | | | | | | |

##### 10.1A.14.1.2 Relative Accuracy

The accuracy requirements in clause 10.1.19.1.2 shall apply when RedCap UE is capable of 2Rx. When UE is only required to support 1RX, the absolute accuracy requirements in Table 10.1A.14.1.2-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for L1-RSRP measurements are fulfilled according to Annex B.2.4.1 for a corresponding Band for each relevant SSB.

Table 10.1A.14.1.2-1: SSB based L1-RSRP relative accuracy for 1Rx RedCap UE in FR1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | |
| Normal condition | Extreme condition | SSB Ês/Iot Note 2 | Io Note 1 range | | | | |
|  |  |  | NR operating band groups Note 4 | Minimum Io | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSSSB | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSSSB = 15 kHz | SCSSSB = 30 kHz |  |  |
|  |  |  | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -118 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_B | -120.5 | -117.5 | N/A | -50 |
|  |  |  | NR\_TDD\_FR1\_C | -120 | -117 | N/A | -50 |
| ±6 | ±7 | ≥-3 | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_F | -118.5 | -115.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_G | -118 | -115 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_H | -117.5 | -114.5 | N/A | -50 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: The parameter SSB Ês/Iot is the minimum SSB Ês/Iot of the pair of SSBs to which the requirement applies.  NOTE 3: Void  NOTE 4: NR operating band groups in FR1 are as defined in clause 3.5.2. | | | | | | | |

#### 10.1A.14.2 CSI-RS based L1-RSRP accuracy requirements

##### 10.1A.14.2.1 Absolute Accuracy

The accuracy requirements in clause 10.1.19.2.2 shall apply when RedCap UE is capable of 2Rx. When UE is only required to support 1RX, the absolute accuracy requirements in Table 10.1A.14.2.1-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for L1-RSRP measurements are fulfilled according to Annex B.2.4.2 for a corresponding Band for each relevant CSI-RS.

- The bandwidth of CSI-RS is 48 PRBs and the density is 3.

The performance with larger bandwidth of CSI-RS is equal to or better than the accuracy requirements in Table 10.1A.19.2.1-1.

Table 10.1A.14.2.1-1: CSI-RS based L1-RSRP absolute accuracy for 1Rx RedCap UE in FR1

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | | |
| Normal condition | Extreme condition | CSI-RS Ês/Iot | Io Note 1 range | | | | | |
|  |  |  | NR operating band groups Note 2 | Minimum Io | | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSCSI-RS | | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSCSI-RS = 15 kHz | SCSCSI-RS = 30 kHz | SCSCSI-RS = 60 kHz |  |  |
|  |  |  | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -118 | -115 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_B | -120.5 | -117.5 | -114.5 | N/A | -70 |
|  |  |  | NR\_TDD\_FR1\_C | -120 | -117 | -114 | N/A | -70 |
| ±5.0 | ±9.5 | ≥-3 | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | -113.5 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | -113 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_F | -118.5 | -115.5 | -112.5 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_G | -118 | -115 | -112 | N/A | -70 |
|  |  |  | NR\_FDD\_FR1\_H | -117.5 | -114.5 | -111.5 | N/A | -70 |
| ±8.5 | ±11.5 | ≥-3 | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A,  NR\_FDD\_FR1\_B, NR\_TDD\_FR1\_C, NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D, NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E, NR\_FDD\_FR1\_F,  NR\_FDD\_FR1\_G, NR\_FDD\_FR1\_H | N/A | N/A | N/A | -70 | -50 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: NR operating band groups in FR1 are as defined in clause 3.5.2. | | | | | | | | |

##### 10.1A.14.2.2 Relative Accuracy

The accuracy requirements in clause 10.1.19.2.2 shall apply when RedCap UE is capable of 2Rx. When UE is only required to support 1RX, the absolute accuracy requirements in Table 10.1A.14.2.2-1 are valid under the following conditions:

- Conditions defined in clause 7.3 of TS 38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for L1-RSRP measurements are fulfilled according to Annex B.2.4.2 for a corresponding Band for each relevant CSI-RS.

- The bandwidth of CSI-RS is 48 PRBs and the density is 3.

The performance with larger bandwidth of CSI-RS is equal to or better than the accuracy requirements in Table 10.1A.14.2.2-1.

Table 10.1A.14.2.2-1: CSI-RS based L1-RSRP relative accuracy for 1Rx RedCap UE in FR1

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | | |
| Normal condition | Extreme condition | CSI-RS Ês/Iot Note 2 | Io Note 1 range | | | | | |
|  |  |  | NR operating band groups Note 4 | Minimum Io | | | | Maximum Io |
| dB | dB | dB |  | dBm / SCSCSI-RS | | | dBm/BWChannel | dBm/BWChannel |
|  |  |  |  | SCSCSI-RS = 15 kHz | SCSCSI-RS = 30 kHz | SCSCSI-RS = 60 kHz |  |  |
|  |  |  | NR\_FDD\_FR1\_A, NR\_TDD\_FR1\_A,  NR\_SDL\_FR1\_A | -121 | -118 | -115 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_B | -120.5 | -117.5 | -114.5 | N/A | -50 |
|  |  |  | NR\_TDD\_FR1\_C | -120 | -117 | -114 | N/A | -50 |
| ±3 | ±4 | ≥-3 | NR\_FDD\_FR1\_D, NR\_TDD\_FR1\_D | -119.5 | -116.5 | -113.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_E, NR\_TDD\_FR1\_E | -119 | -116 | -113 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_F | -118.5 | -115.5 | -112.5 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_G | -118 | -115 | -112 | N/A | -50 |
|  |  |  | NR\_FDD\_FR1\_H | -117.5 | -114.5 | -111.5 | N/A | -50 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: The parameter CSI-RS Ês/Iot is the minimum CSI-RS Ês/Iot of the pair of CSI-RS resources to which the requirement applies.  NOTE 3: Void  NOTE 4: NR operating band groups in FR1 are as defined in clause 3.5.2. | | | | | | | | |

### 10.1A.15 L1-RSRP accuracy requirements for FR2

#### 10.1A.15.1 SSB based L1-RSRP accuracy requirements

##### 10.1A.15.1.1 Absolute Accuracy

The accuracy requirements in clause 10.1.20.1.1 shall apply.

##### 10.1A.15.1.2 Relative Accuracy

The accuracy requirements in clause 10.1.20.1.1 shall apply.

#### 10.1A.15.2 CSI-RS based L1-RSRP accuracy requirements

##### 10.1A.15.2.1 Absolute Accuracy

The accuracy requirements in clause 10.1.20.1.1 shall apply.

##### 10.1A.15.2.2 Relative Accuracy

The accuracy requirements in clause 10.1.20.1.1 shall apply.

## 10.2 E-UTRAN measurements

### 10.2.1 Introduction

Accuracy requirements for measurements on E-UTRAN carrier frequencies are specified in clause 10.2 and apply for UE in SA or NR-DC or NE-DC operation mode, unless otherwise specified.

Unless otherwise specified, the requirements in clause 10.2 are applicable for a UE:

- in RRC\_CONNECTED state

- performing measurements with appropriate measurement gaps according to clause 9.1.2.

- that is synchronised to the cell that is measured.

The reported measurement result after layer 1 filtering shall be an estimate of the average value of the measured quantity over the measurement period. The reference point for the measurement result after layer 1 filtering is referred to as point B in the measurement model described in TS 36.300 [24].

The accuracy requirements of E-UTRA measurements in this clause are valid for the reported measurement result after layer 1 filtering. The accuracy requirements are verified from the measurement report at point D in the measurement model having the layer 3 filtering disabled.

If the UE needs measurement gaps to perform the inter-RAT NR ─ E-UTRAN FDD and NR ─ E-UTRAN TDD measurements, the relevant measurement procedure and measurement gap patterns stated in clause 9.1.2 shall apply.

### 10.2.2 E-UTRAN RSRP measurements

NOTE: This measurement is for handover between NR and E-UTRAN.

The measurement period of E-UTRA RSRP in RRC\_CONNECTED state is specified in clause 9.4.2 and 9.4.3.

The accuracy requirements of E-UTRA RSRP measurements in RRC\_CONNECTED state and the corresponding side conditions shall be the same as the inter-frequency RSRP Accuracy Requirements in clause 9.1.3 of TS 36.133 [15].

The reporting range and mapping specified for RSRP measurements in clause 9.1.4 of TS 36.133 [15] shall apply.

### 10.2.3 E-UTRAN RSRQ measurements

NOTE: This measurement is for handover between NR and E-UTRAN.

The measurement period of E-UTRA RSRQ in RRC\_CONNECTED state is specified in clause 9.4.2 and 9.4.3.

The accuracy requirements of E-UTRA RSRQ measurements in RRC\_CONNECTED state and the corresponding side conditions shall be the same as the inter-frequency RSRQ Accuracy Requirements in clause 9.1.6 of TS 36.133 [15].

The requirements for accuracy of E-UTRA RSRQ measurements in RRC\_CONNECTED state and the corresponding side conditions shall be the same as the inter-frequency RSRQ Accuracy Requirements in clause 9.1.6 of TS 36.133 [15].

The reporting range and mapping specified for RSRQ measurements in clause 9.1.7 of TS 36.133 [15] shall apply.

### 10.2.4 E-UTRAN RSTD measurements

The requirements in this clause are valid for UE supporting this capability.

The measurement period is specified in clauses 9.4.4.1 and 9.4.4.2 for inter-RAT NR ─ E-UTRAN FDD and inter-RAT NR ─ E-UTRAN TDD RSTD measurements, respectively.

The accuracy requirements and the corresponding side conditions shall be the same as the inter-frequency measurement accuracy requirements for RSTD measurements in RRC\_CONNECTED in clause 9.1.10.2 of TS 36.133 [15].

If the UE needs measurement gaps to perform the inter-RAT NR ─ E-UTRAN FDD and NR ─ E-UTRAN TDD RSTD measurements, the relevant measurement procedure and measurement gap patterns stated in clause 9.1.2 shall apply.

The reporting range and mapping for the inter-RAT NR ─ E-UTRAN FDD and NR ─ E-UTRAN TDD RSTD measurements is the same as specified for RSTD measurements in TS 36.133 [15, clauses 9.1.10.3 and 9.1.10.4].

### 10.2.5 E-UTRAN RS-SINR measurements

NOTE: This measurement is for handover between NR and E-UTRAN.

The measurement period of E-UTRA RS-SINR in RRC\_CONNECTED state is specified in clause 9.4.2 and 9.4.3.

The accuracy requirements of E-UTRA RS-SINR measurements in RRC\_CONNECTED state and the corresponding side conditions shall be the same as the inter-frequency RS-SINR Accuracy Requirements in clause 9.1.17.3 of TS 36.133 [15].

The reporting range and mapping for E-UTRA RS-SINR measurements shall be the same as specified for RS-SINR measurements in clause 9.1.17.1 of TS 36.133 [15].

### 10.2.6 E-UTRAN RSRP measurements for CA/DC Idle Mode Measurements

NOTE: This measurement is for CA/DC Idle Mode measurements between NR and E-UTRAN.

The requirements in this clause are applicable for a UE:

- in state RRC\_IDLE or RRC INACTIVE

- that is synchronised to the cell that is measured.

The requirements are for absolute accuracy of E-UTRA RSRP.

The measurement period of E-UTRA RSRP in RRC\_IDLE and RRC INACTIVE states are specified in clause 4.4.2.

The accuracy requirements of E-UTRA RSRP measurements in RRC\_IDLE and RRC INACTIVE states and the corresponding side conditions shall be as the inter-frequency RSRP Accuracy Requirements in clause 9.1.3B.2 of TS 36.133 [15].

The reporting range and mapping specified for RSRP measurements in clause 9.1.4 of TS 36.133 [15] shall apply.

### 10.2.7 E-UTRAN RSRQ measurements for CA/DC Idle Mode Measurements

NOTE: This measurement is for CA/DC Idle Mode measurements between NR and E-UTRAN.

The requirements in this clause are applicable for a UE:

- in state RRC\_IDLE or RRC INACTIVE

- that is synchronised to the cell that is measured.

The requirements are for absolute accuracy of E-UTRA RSRQ.

The measurement period of E-UTRA RSRQ in RRC\_IDLE and RRC INACTIVE states are specified in clause 4.4.2.

The accuracy requirements of E-UTRA RSRQ measurements in RRC\_IDLE and RRC INACTIVE states and the corresponding side conditions shall be as the inter-frequency RSRQ Accuracy Requirements in clause 9.1.6B.2 of TS 36.133 [15].

The reporting range and mapping specified for RSRQ measurements in clause 9.1.7 of TS 36.133 [15] shall apply.

## 10.3 UTRAN FDD Measurements

The requirements in this clause are applicable for a UE:

- in state RRC\_CONNECTED

- performing measurements according to clause 9.4.6 with appropriate measurement gaps

- that is synchronised to the cell that is measured.

The reported measurement result after layer 1 filtering shall be an estimate of the average value of the measured quantity over the measurement period. The reference point for the measurement result after layer 1 filtering is referred to as point B in the measurement model described in TS 25.302 [30].

The accuracy requirements in this clause are valid for the reported measurement result after layer 1 filtering. The accuracy requirements are verified from the measurement report at point D in the measurement model having the layer 3 filtering disabled.

### 10.3.1 UTRAN FDD CPICH RSCP

NOTE: This measurement is for handover between E-UTRAN and UTRAN FDD.

The requirements in this clause are valid for terminals supporting this capability.

The measurement period for RRC\_CONNECTED state is specified in clause 9.4.6.

In RRC\_CONNECTED state the accuracy requirements shall meet the absolute accuracy requirements in table 10.3.1-1, under the following conditions:

- CPICH Ec/Io condition for a detectable cell is as specified in clause 9.4.6;

- SCH\_Ec/Io condition for a detectable cell is as specified in clause 9.4.6.

Table 10.3.1-1: UTRAN FDD CPICH\_RSCP absolute accuracy

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | |
| Normal condition | Extreme condition | Io range | | |
|  |  | UTRA operating bands | Minimum Io | Maximum Io |
| dB | dB |  | dBm/3.84 MHz | dBm/3.84 MHz |
|  |  | Band I, IV, VI, X XI, XIX and XXI | -94 | -70 |
|  |  | Band IX | -93 | -70 |
| ±6 | ±9 | Band II, V and VII | -92 | -70 |
|  |  | Band III, VIII, XII, XIII, XIV , XX and XXII | -91 | -70 |
|  |  | Band XXV, XXVI Note 1 | -90.5 | -70 |
| ±8 | ±11 | Note 2 | -70 | -50 |
| NOTE 1: For Band XXVI, the condition has the minimum Io of -92 dBm/3.84 MHz when the carrier frequency of the assigned UTRA channel is within 869-894 MHz for the UE which supports both Band V and Band XXVI operating frequencies.  NOTE 2: The same bands apply for this requirement as for the corresponding highest accuracy requirement. | | | | |

If the UE, in RRC\_CONNECTED state, needs measurement gaps to perform UTRAN FDD measurements, the relevant UTRAN FDD measurement procedure and measurement gap pattern stated in clause 9.4.6 shall apply.

The reporting range and mapping specified for FDD CPICH RSCP in TS 25.133 [29] shall apply.

### 10.3.2 UTRAN FDD CPICH Ec/No

NOTE: This measurement is for handover between E-UTRAN and UTRAN FDD.

The requirements in this clause are valid for terminals supporting this capability.

The measurement period for RRC\_CONNECTED state is specified in clause 9.4.6.

In RRC\_CONNECTED state the accuracy requirements shall be the same as the inter-frequency measurement accuracy requirements for FDD CPICH Ec/No in TS 25.133 [29].

If the UE, in RRC\_CONNECTED state, needs measurement gaps to perform UTRAN FDD measurements, the UTRAN FDD measurement procedure and measurement gap pattern stated in clause 9.4.6 shall apply.

The reporting range and mapping specified for FDD CPICH Ec/No in TS 25.133 [29] shall apply.

## 10.4 V2X measurements

### 10.4.1 Introduction

The requirements in this section are applicable for a UE capable of V2X sidelink communication.

The accuracy requirements in this clause are:

- applicable for AWGN radio propagation conditions,

- assume independent interference (noise) at each receiver antenna port.

### 10.4.2 Intra-frequency PSBCH-RSRP accuracy requirements for FR1

#### 10.4.2.1 PSBCH-RSRP Absolute Accuracy

The requirements for absolute accuracy of PSBCH-RSRP in this clause apply to a V2X synchronization source on the same frequency as that of the own V2X UE performing the measurement in FR1.

The accuracy requirements in Table 10.4.2.1-1 are valid under the following conditions:

- Demodulation reference signals are transmitted from one port.

- Conditions defined in Clause 7.3E of TS38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for PSBCH-RSRP measurements are fulfilled according to Annex B.4.2 for a corresponding Band for each relevant PSBCH-DMRS.

**Table 10.4.2.1-1: Intra-frequency PSBCH-RSRP absolute accuracy in FR1**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Accuracy** | | **Conditions** | | | | | | |
| **Normal condition** | **Extreme condition** | **Ês/Iot Note 3** | **Io Note 1 range** | | | | | |
| **NR V2X operating band groups Note 2** | **Minimum Io** | | | | **Maximum Io** |
| **dB** | **dB** | **dB** |  | **dBm / SCSSL** | | | **dBm/BWChannel** | **dBm/BWChannel** |
| **SCSSL = 15 kHz** | **SCSSL = 30 kHz** | **SCSSL = 60 kHz** |
| ±4.5 | ±9 | ≥-6 | NR\_TDD\_FR1\_B | -120.5 | -117.5 | -114.5 | N/A | -70 |
| NR\_TDD\_FR1\_J | -116.5 | -113.5 | -110.5 | N/A | -70 |
| ±8 | ±11 | ≥-6 | NR\_TDD\_FR1\_B,  NR\_TDD\_FR1\_J | N/A | N/A | N/A | -70 | -50 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: NR V2X operating band groups in FR1 are as defined in clause 3.5.2.  NOTE 3: Ês/Iot for a SyncRef UE is the Ês/Iot of PSBCH-DMRS. | | | | | | | | |

#### 10.4.2.2 PSBCH-RSRP Relative Accuracy

The relative accuracy of PSBCH-RSRP is defined as the PSBCH-RSRP measured from one V2X synchronization source compared to the PSBCH-RSRP measured from another V2X synchronization source on the same frequency in FR1.

The accuracy requirements in Table 10.4.2.2-1 are valid under the following conditions:

- Demodulation reference signals are transmitted from one port.

- Conditions defined in Clause 7.3E of TS38.101-1 [18] for reference sensitivity are fulfilled.

- Conditions for PSBCH-RSRP accuracy measurements are fulfilled according to Annex B.4.2 for a corresponding Band for each relevant PSBCH-DMRS.

**Table 10.4.2.2-1: Intra-frequency PSBCH-RSRP relative accuracy in FR1**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Accuracy** | | **Conditions** | | | | | | |
| **Normal condition** | **Extreme condition** | **Ês/Iot Note 3** | **Io Note 1 range** | | | | | |
| **NR V2X operating band groups Note 2** | **Minimum Io** | | | | **Maximum Io** |
| **dB** | **dB** | **dB** |  | **dBm / SCSSL** | | | **dBm/BWChannel** | **dBm/BWChannel** |
| **SCSSL = 15 kHz** | **SCSSL = 30 kHz** | **SCSSL = 60 kHz** |
| ±2 | ±3 | ≥-3 | NR\_TDD\_FR1\_B | -120.5 | -117.5 | -114.5 | N/A | -50 |
| NR\_TDD\_FR1\_J | -116.5 | -113.5 | -110.5 | N/A | -50 |
| ±3 | ±3 | ≥-6 | Note 4 | Note 4 | Note 4 | Note 4 | N/A | Note 4 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: NR V2X operating band groups in FR1 are as defined in clause 3.5.2.  NOTE 3: Ês/Iot for a SyncRef UE is the Ês/Iot of PSBCH-DMRS.  NOTE 4: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding highest accuracy requirement. | | | | | | | | |

### 10.4.3 Intra-Frequency SL-RSSI Measurement Accuracy Requirements for FR1

#### 10.4.3.1 Absolute SL-RSSI Accuracy

The intra-frequency SL-RSSI requirements are specified in Table 10.4.3.1-1. The requirements apply for measurement period of 1slot and for any configured measurement bandwidth larger than 10 RBs, provided that:

- All symbols duing each RSSI measurement duration are available for RSSI sampling within the same measurement interval.

Table 10.4.3.1-1: Intra-frequency SL-RSSI absolute accuracy

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | |
| Normal condition | Extreme condition | Io Note 1 range | | | | |
| NR V2X operating band groups Note 2 | Minimum Io | | | Maximum Io |
| dB | dB |  | dBm/SCSSL | | | dBm/BWChannel |
| SCSSL = 15kHz | SCSSL = 30kHz | SCSSL = 60kHz |
| ±2.5 | ±5.5 | NR\_TDD\_FR1\_B | -120.5 | -117.5 | -114.5 | -50 |
| NR\_TDD\_FR1\_J | -116.5 | -113.5 | -110.5 | -50 |
| ±4.5 | ±7.5 | Note 3 | Note 3 | Note 3 | Note 3 | Note 3 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: NR V2X operating band groups are as defined in Section 3.5 for the corresponding NR operating bands.  NOTE 3: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding highest accuracy requirement. | | | | | | |

### 10.4.4 Intra-Frequency L1 SL-RSRP Measurement Accuracy Requirements for FR1

#### 10.4.4.1 Absolute L1 SL-RSRP Accuracy

The requirements for absolute accuracy of L1 SL-RSRP in this clause apply to a UE performing PSCCH-RSRP and/or PSSCH-RSRP measurements on the same frequency as used by operating V2X sidelink communication.

The accuracy requirements in Table 10.4.4.1-1 are valid under the following conditions:

- Demodulation reference signals for PSCCH and/or PSSCH are transmitted from one port.

- Conditions defined in clause 7.3E of TS38.101-1 [18] for reference sensitivity are fulfilled.

- PSCCH-RSRP|dBm and/or PSSCH-RSRP|dBm according to Annex B.4.4 for a corresponding Band are fulfilled.

Table 10.4.4.1-1: Intra-frequency L1 SL-RSRP absolute accuracy for UE capable of V2X sidelink communication

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | | |
| Normal condition | Extreme condition | Ês/Iot Note 3 | Io Note 1 range | | | | | |
| NR V2X operating band groups Note 2 | Minimum Io | | | | Maximum Io |
| dB | dB | dB |  | dBm/SCS | | | dBm/BWChannel | dBm/BWChannel |
| SCS = 15kHz | SCS = 30kHz | SCS = 60kHz |
| ± 4.5 | ± 9 | ≥0 dB | NR\_TDD\_FR1\_B | -120.5 | -117.5 | -114.5 | N/A | -70 |
| NR\_TDD\_FR1\_J | -116.5 | -113.5 | -110.5 | N/A | -70 |
| ± 8 | ± 11 | ≥0 dB | NR\_TDD\_FR1\_B NR\_TDD\_FR1\_J | N/A | N/A | N/A | -70 | -50 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: NR V2X operating band groups are as defined in Section 3.5 for the corresponding NR operating bands.  NOTE 3: The parameter Ês/Iot is the Ês/Iot of PSCCH-DMRS and/or PSSCH-DMRS. | | | | | | | | |

### 10.4.5 Intra-Frequency Discovery Signal Measurement Accuracy Requirements

The requirements in this clause are applicable for a remote sidelink UE:

- is out of coverage on the frequency used for sidelink, and

- that is synchronised to the sidelink relay UE that is measured.

#### 10.4.5.1 Absolute Discovery Signal Measurement Accuracy

The requirements for absolute accuracy of discovery signal measurement in this clause apply to a sidelink UE performing SD-RSRP measurements for direct to indirect path swich or SL-RSRP measurements for indirect to direct path switch on the same frequency as used by the sidelink relay UE transmitting the relay Discovery message.

The accuracy requirements in Table 10.4.5.1-1 are valid under the following conditions:

- Demodulation reference signals for PSCCH and/or PSSCH are transmitted from one port.

- Conditions defined in clause 7.3E of TS38.101-1 [18] for reference sensitivity are fulfilled.

- PSCCH-RSRP|dBm and/or PSSCH-RSRP|dBm according to Annex B.4.4 for a corresponding Band are fulfilled.

Table 10.4.5.1-1: Intra-frequency discovery signal measurement absolute accuracy for a remote sidelink UE [2] capable of sidelink Communication and sidelink Discovery and configured by upper layers for relay operation.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Accuracy | | Conditions | | | | | | |
| Normal condition | Extreme condition | Ês/Iot Note 3 | Io Note 1 range | | | | | |
| NR V2X operating band groups Note 2 | Minimum Io | | | | Maximum Io |
| dB | dB | dB |  | dBm/SCS | | | dBm/BWChannel | dBm/BWChannel |
| SCS = 15kHz | SCS = 30kHz | SCS = 60kHz |
| ± 4.5 | ± 9 | ≥0 dB | NR\_TDD\_FR1\_B | -120.5 | -117.5 | -114.5 | N/A | -70 |
| NR\_TDD\_FR1\_J | -116.5 | -113.5 | -110.5 | N/A | -70 |
| ± 8 | ± 11 | ≥0 dB | NR\_TDD\_FR1\_B NR\_TDD\_FR1\_J | N/A | N/A | N/A | -70 | -50 |
| NOTE 1: Io is assumed to have constant EPRE across the bandwidth.  NOTE 2: NR sidelink operating band groups are as defined in Section 3.5 for the corresponding NR operating bands.  NOTE 3: The parameter Ês/Iot is the Ês/Iot of PSCCH-DMRS and/or PSSCH-DMRS. | | | | | | | | |

# 11 Void

# 12 V2X Requirements

## 12.1 Introduction

This clause contains the requirements for the UE capable of V2X sidelink communication when the UE is out of coverage on the carrier used for V2X sidelink operation, as defined in TS 38.304 [1]. The requirements apply when the UE is:

- in any cell selection state, or,

- configured for V2X SL operation on a V2X carrier which is dedicated to only V2X SL operation and configured with only a PCell on WAN carrier.

- configured for inter-band con-current V2X operation.

- configured for intra-band con-current V2X operation with different carriers.

Note: Any cell selection state refers to a UE that is out of network coverage and is not associated with a serving cell on any carrier as defined in TS 38.304 [1].

Note: When a UE in RRC\_CONNECTED state is performing transmissions and/or reception for V2X sidelink communication, the UE shall meet all the requirements specified in Clause 9 assuming that UE has a dedicated RX/TX chain for V2X sidelink communication. Otherwise, the UE may interrup the V2X sidelink communication in order to meet the measurement requirements specified in Clause 9.

This clause also contains the requirements for the UE capable of V2X sidelink communication when the UE is in coverage on the carrier used for V2X sidelink operation, as defined in TS 38.304 [1]. The requirements apply when the UE is:

- configured for intra-band con-current NR V2X cooperation with same carrier.

For UE capable of Public Safety sidelink communication and/or other commercial sidelink commnunication, unless explicitly stated, V2X requirements apply.

## 12.2 UE Transmit Timing

### 12.2.1 Introduction

This clause contains requirements of transmission timing for V2X sidelink communication when:

- GNSS is used as the synchronization reference source;

- NR Cell is used as the synchronization reference source;

- E-UTRAN Cell is used as the synchronization reference source;

- SyncRef UE is used as the synchronization reference source.

### 12.2.2 GNSS as synchronization reference source

The requirements in this subclause are applicable when the reference timing used by the UE for V2X sidelink communication is derived from GNSS.

The sidelink transmissions takes place  before the subframe starting boundary as defined in TS 38.331 [2], where  = 0 and=0.

The transmission timing error for sidelink transmissions shall be less than or equal to ±Te where the timing error limit value Te is defined in Table 12.2.2-1.

Table 12.2.2-1: Te Timing Error Limit

|  |  |
| --- | --- |
| Frequency Range of sidelink | Te\_ |
| FR1 | 12\*64\*Tc |
| Note 1: Tc is the basic timing unit defined in TS 38.211 [6]. | |

### 12.2.3 NR Cell as synchronization reference source

The requirements in this subclause are applicable when the reference timing used for sidelink transmissions is a NR serving cell on a non-V2X sidelink carrier or a V2X sidelink carrier.

The sidelink transmissions takes place  before the reception of the first detected path (in time) of the corresponding downlink frame from the reference cell, where = 0. If uplink transmission and sidelink transmission are in the same band,  is defined in Table 7.1.2-2, otherwise  is 0.

The transmission timing error for sidelink transmissions shall be less than or equal to ±Te where the timing error limit value Te is defined in Table 12.2.3-1.

Table 12.2.3-1: Te Timing Error Limit

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency Range of sidelink | SCS of SSB signals ( kHz) | SCS of sidelink signals (kHz) | Te |
| FR1 | 15 | 15 | 14\*64\*Tc |
|  |  | 30 | 12\*64\*Tc |
|  |  | 60 | 12\*64\*Tc |
|  | 30 | 15 | 10\*64\*Tc |
|  |  | 30 | 10\*64\*Tc |
|  |  | 60 | 9\*64\*Tc |
| Note 1: Tc is the basic timing unit defined in TS 38.211 [6]. | | | |

### 12.2.4 E-URTAN Cell as synchronization reference source

The requirements in this subclause are applicable when the reference timing used for sidelink transmissions is an E-UTRAN serving cell on a non-V2X sidelink carrier.

The sidelink transmissions takes place  before the reception of the first detected path (in time) of the corresponding E-UTRAN downlink frame from the reference cell, where  = 0 and=0.

The transmission timing error for sidelink transmissions shall be less than or equal to ±Te where the timing error limit value Te is defined in Table 12.2.4-1.

Table 12.2.4-1: Te Timing Error Limit

|  |  |  |
| --- | --- | --- |
| Frequency Range of sidelink | E-UTRAN downlink bandwidth (MHz) | Te\_ |
| FR1 | ≥3 | 14\*64\*Tc |
| Note 1: Tc is the basic timing unit defined in TS 38.211 [6]. | | |

### 12.2.5 SyncRef UE as synchronization reference source

The requirements in this subclause are applicable when the reference timing used for deriving sidelink transmission is from SyncRef UE transmitting sidelink synchronization signals.

The sidelink transmissions takes place  before the reception of the first detected path (in time) of the corresponding timing reference frame from the SyncRef UE, where  = 0 and=0.

The transmission timing error for sidelink transmissions shall be less than or equal to ±Te where the timing error limit value Te is defined in Table 12.2.5-1.

Table 12.2.5-1: Te Timing Error Limit

|  |  |  |
| --- | --- | --- |
| Frequency Range of sidelink | SCS of sidelink signals (kHz) | Te |
| FR1 | 15 | 12\*64\*Tc |
|  | 30 | 8\*64\*Tc |
|  | 60 | 5\*64\*Tc |
| Note 1: Tc is the basic timing unit defined in TS 38.211 [6]. | | |

## 12.3 Initiation/Cease of SLSS Transmissions

### 12.3.1 Introduction

The requirements in this subclause are applicable to the UE capable of V2X sidelink communication when:

- GNSS is used as the synchronization reference source;

- NR Cell is used as the synchronization reference source;

- EUTRAN Cell is used as the synchronization reference source;

- SyncRef UE is used as the synchronization reference source.

#### 12.3.1.1 Initiation/Cease of SLSS transmissions with NR cell as synchronization reference source

The requirements apply when the NR Cell is used as synchronization reference source and when the UE is

- out of coverage on the V2X NR sidelink carrier and in-coverage with a serving cell on a NR non-V2X sidelink carrier, or

- in coverage with a serving cell on a NR V2X sidelink carrier,

and when the conditions for SLSS transmissions specified in TS 38.331[2] are met; *networkControlledSyncTx* is not configured; and *syncTxThreshIC* is included in *SystemInformationBlockType12*. The UE shall be capable of measuring the RSRP of the cell used as synchronization reference source to evaluate to initiate/cease SLSS transmissions within Tevaluate,SLSS

where,

- Tevaluate,SLSS is as specified in Table 12.3.1.1-1 when UE performs SSB based measurements without measurement gaps.

- Tevaluate,SLSS is as specified in Table 12.3.1.1-2 when UE performs SSB based measurements with measurement gaps.

Table 12.3.1.1-1: Tevaluate,SLSS for measurements without measurement gaps when NR cell is used as synchronization reference source (FR1)

|  |  |
| --- | --- |
| DRX cycle in NR cell | Tevaluate,SLSS |
| No DRX | max(400ms, ceil( 2 x 5 x Kp) x SMTC period)Note 1 |
| DRX cycle≤ 320ms | max(400ms, ceil(1.5 x 2 x 5 x Kp) x max(SMTC period, DRX cycle)) |
| DRX cycle>320ms | ceil( 7 x Kp ) x DRX cycle |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified | |

Table 12.3.1.1-2: Tevaluate,SLSS for measurements with measurement gaps when NR cell is used as synchronization reference source (FR1)

|  |  |
| --- | --- |
| DRX cycle in NR cell | Tevaluate,SLSS |
| No DRX | max(400ms, 2 x 5 x max(MGRP, SMTC period)) x CSSFintra |
| DRX cycle≤ 320ms | max(400ms, ceil(2 x 1.5x 5) x max(MGRP, SMTC period,DRX cycle))x CSSFintra |
| DRX cycle>320ms | 7 x max(MGRP, DRX cycle) x CSSFintra |

If higher layer filtering is configured, an additional delay in evaluation to initiate/cease SLSS transmissions can be expected.

For the NR cell as synchronization reference source:

- SS-RSRP related side conditions given in clauses 10.1.2 for FR1, respectively, for a corresponding Band,

- SS-RSRQ related side conditions given in clauses 10.1.7 for FR1, respectively, for a corresponding Band,

- SS-SINR related side conditions given in clauses 10.1.12 for FR1, respectively, for a corresponding Band,

- SSB\_RP and SSB Ês/Iot according to Annex B.2.2 for a corresponding Band.

#### 12.3.1.2 Initiation/Cease of SLSS transmissions with EUTRAN cell as synchronization reference source

The requirements apply when the EUTRAN Cell is used as synchronization reference source and when the UE is

- out of coverage on the V2X NR sidelink carrier and in-coverage with a serving cell on a LTE non-V2X sidelink carrier,

and when the conditions for SLSS transmissions specified in TS 36.331[16] are met; *networkControlledSyncTx* is not configured; and *syncTxThreshIC* is included in *SystemInformationBlockType28*. The UE shall be capable of measuring the RSRP of the cell used as synchronization reference source to evaluate to initiate/cease SLSS transmissions within Tevaluate,SLSS

where,

- Tevaluate,SLSS = 0.4 seconds when UE is not configured with DRX.

- Tevaluate,SLSS = as specified in Table 12.3.1.2-1 when UE is configured with DRX.

Table 12.3.1.2-1: Tevaluate,SLSS when EUTRAN cell is used as synchronization reference source

|  |  |
| --- | --- |
| DRX cycle length in EUTRAN cell[s] | Tevaluate,SLSS  [s] (number of DRX cycles) |
| ≤0.04 | 0.4 (Note 1) |
| 0.04<DRX-cycle≤2.56 | Note 2 (6) |
| Note1: Number of DRX cycles depends upon the DRX cycle in use  Note2: Time depends upon the DRX cycles in use | |

If higher layer filtering is configured, an additional delay in evaluation to initiate/cease SLSS transmissions can be expected.

For the cell as synchronization reference source:

- RSRP related side conditions given in TS 36.133[15] Clauses 9.1.2.1 and 9.1.2.2 and RSRQ related side conditions given in TS 36.133[15] Clause 9.1.5.1 for a corresponding Band are fulfilled,

- SCH\_RP and SCH Ês/Iot according to TS 36.133[15] Annex B.2.1 for a corresponding Band are fulfilled.

#### 12.3.1.3 Initiation/Cease of SLSS transmissions with GNSS as synchronization reference source

The requirements apply when GNSS is used as synchronization reference source and when the UE is

- out of coverage on the V2X sidelink carrier and in-coverage with a serving cell on a non-V2X sidelink carrier, or

- in coverage with a serving cell on a NR V2X sidelink carrier,

and when the conditions for SLSS transmissions specified in TS 38.331[2] are met; *networkControlledSyncTx* is not configured; and *syncTxThreshIC* is included in *SystemInformationBlockType12* in a NR cell.

When the conditions for SLSS transmissions specified in TS 36.331[16] are met; *networkControlledSyncTx* is not configured; and *syncTxThreshIC* is included in *SystemInformationBlockType28* in a EUTRAN cell.

The requirements in Clause 12.3.1.1 shall apply if the serving cell is a NR cell.

The requirements in Clause 12.3.1.2 shall apply if the serving cell is a EUTRAN cell.

#### 12.3.1.4 Initiation/Cease of SLSS transmissions with SyncRef UE as synchronization reference source

The requirements apply when SyncRef UE is used as synchronization reference source and when the UE is

- in any cell selection state, or

- out of coverage on the V2X sidelink carrier and is associated with a serving cell on a non-V2X sidelink carrier, or

- in coverage with a serving cell on a NR V2X sidelink carrier,

and when the conditions for SLSS transmissions specified in TS 38.331[2] are met and when SyncRef UE is used as synchronization reference source and if *syncTxThreshOoC* is included in the preconfigured V2X parameters.

The UE shall be capable of measuring the PSBCH-RSRP of the selected SyncRef UE used as synchronization reference source and evaluate it to initiate/cease SLSS transmissions within Tevaluate,SLSS, as shown in Table 12.3.1.4-1.

Table 12.3.1.4-1: Tevaluate,SLSS when SyncRef UE is used as synchronization reference source

|  |  |
| --- | --- |
| SL-DRX cycleNote 1 [ms] | Tevaluate,SLSS [ms] |
| No SL-DRX | 4 x S-SSB periods |
| SL-DRX cycle ≤ 160ms | 4 x S-SSB periods |
| SL-DRX cycle > 160ms | 4 x SL-DRX cycle |
| Note 1: If multiple SL-DRX cycles are configured for SL UE, the SL-DRX cycle in the requirement is the shortest one. When the shortest SL-DRX cycle UE used changes, the requirements do not apply to the time of transition. | |

If higher layer filtering for PSBCH-RSRP measurements is pre-configured, an additional delay in evaluation to initiate/cease SLSS transmissions can be expected.

For the selected SyncRef UE as defined in TS 38.331 [2] used to derive transmission timing for V2X sidelink communication:

- PSBCH-RSRP related side conditions given in Clause 12.4 for a corresponding Band are fulfilled,

- V2X S-SSB\_RP and S-SSB Ês/Iot according to Annex B. 4 for a corresponding Band are fulfilled.

## 12.4 Selection / Reselection of V2X Synchronization Reference Source

The requirements defined in this clause do not apply to the UEs that do not support transmission and reception of SLSS.

A SyncRef UE is considered to be detectable when

- PSBCH-RSRP related side conditions given in Clause 10 are fulfilled for a corresponding Band,

- S-SSB\_RP and S-SSB Ês/Iot according to Annex B.4.3 for a corresponding Band are fulfilled.

When GNSS synchronization reference source is configured as the highest priority and

- UE is synchronized to GNSS directly,

- UE shall not drop any V2X SLSS and data transmission for the purpose of selection/reselection to the SyncRef UE.

- UE is synchronized to a SyncRef UE that is synchronized to GNSS directly or in-directly,

- UE shall not drop any V2X data transmission for the purpose of selection/reselection to the SyncRef UE. The UE shall be able to identify newly detectable intra-frequency SyncRef UE within Tdetect,SyncRef UE\_V2X seconds if the SyncRef UE meets the selection / reselection criterion defined in TS 38.331[2]. Tdetect,SyncRef UE\_V2X is defined as 1.6 seconds at S-SSB Ês/Iot ≥ 0 dB, provided that the UE is allowed to drop a maximum of 30% of its SLSS transmissions during Tdetect,SyncRef UE\_V2X for the purpose of selection / reselection to the SyncRef UE.

- in other case

- When UE is in non-SL-DRX

- The UE shall be able to identify newly detectable intra-frequency SyncRef UE within Tdetect,SyncRef UE\_V2X seconds if the SyncRef UE meets the selection / reselection criterion defined in TS 38.331[2]. Tdetect,SyncRef UE\_V2X is defined as 8 seconds at S-SSB Ês/Iot ≥ 0 dB, provided that the UE is allowed to drop a maximum of 6 % of its V2X data and SLSS transmissions during Tdetect,SyncRef UE\_V2X for the purpose of selection / reselection to the SyncRef UE.

- UE is allowed to drop up to 2 slots of its V2X data reception per PSBCH monitoring occasion and overall drop rate shall not exceed 0.3% of its V2X data reception during Tdetect,SyncRef UE\_V2X for the purpose of selection / reselection to the SyncRef UE.

- When UE is in SL-DRX

- UE shall be able to identify newly detectable intra-frequency SyncRef UE within Tdetect,SyncRef UE\_V2X seconds if the SyncRef UE meets the selection / reselection criterion defined in TS 38.331[2]. Tdetect,SyncRef UE\_V2X is defined as 8 seconds at S-SSB Ês/Iot ≥ 0 dB, provided that the V2X UE is allowed to drop a maximum of 6 % of its V2X data and SLSS transmissions for the purpose of selection / reselection to the SyncRef UE.

- UE is allowed to drop up to 2 slots of its V2X data reception per PSBCH monitoring occasion and UE is allowed to drop at most an aggregated window of 24ms of its V2X data reception during Tdetect,SyncRef UE\_V2X for the purpose of selection / reselection to the SyncRef UE.

- The UE is allowed to extend Tdetect,SyncRef UE\_V2X to max(4 x 50 SL-DRX cycle length, 8s) when the following conditions are satisfied over an evaluation period Tevaluate,SLSS in clause 12.3.1.1 if an NR cell is used as synchronization reference source, or Tevaluate,SLSS in clause 12.3.1.2 if an EUTRA cell is used as synchronization reference source, or Tevaluate,SLSS in clause 12.3.1.4 if an SLSS is used as synchronization reference source. If multiple SL-DRX cycles are configured, the SL-DRX cycle length is the longest one.

- SS-RSRP is larger than *syncTxThreshOoC*.

When serving cell/PCell synchronization reference source is configured as the highest priority,

- When UE is in non-SL-DRX

- UE shall be able to identify newly detectable intra-frequency SyncRef UE within Tdetect,SyncRef UE\_V2X seconds if the SyncRef UE meets the selection / reselection criterion defined in TS 38.331[2]. Tdetect,SyncRef UE\_V2X is defined as 8 seconds at SCH Es/Iot ≥ 0 dB, provided that the V2X UE is allowed to drop a maximum of 6 % of its V2X data and SLSS transmissions for the purpose of selection / reselection to the SyncRef UE.

- UE is allowed to drop up to 2 slots of its V2X data reception per PSBCH monitoring occasion and overall drop rate shall not exceed 0.3% of its V2X data reception during Tdetect,SyncRef UE\_V2X for the purpose of selection / reselection to the SyncRef UE.

- When UE is in SL-DRX

- The UE shall be able to identify newly detectable intra-frequency SyncRef UE within Tdetect,SyncRef UE\_V2X seconds if the SyncRef UE meets the selection / reselection criterion defined in TS 38.331[2]. Tdetect,SyncRef UE\_V2X is defined as 8 seconds at SCH Es/Iot ≥ 0 dB, provided that the UE is allowed to drop its V2X data and SLSS transmissions at most in an aggregated window of 480ms during Tdetect,SyncRef UE\_V2X for the purpose of selection / reselection to the SyncRef UE.

- UE is allowed to drop up to 2 slots of its V2X data reception per PSBCH monitoring occasion and UE is allowed to drop at most an aggregated window of 24ms of its V2X data reception during Tdetect,SyncRef UE\_V2X for the purpose of selection / reselection to the SyncRef UE.

- The UE is allowed to extend Tdetect,SyncRef UE\_V2X to max(4 x 50 SL-DRX cycle length, 8s) when the following conditions are satisfied over an evaluation period Tevaluate,SLSS in clause 12.3.1.1 if an NR cell is used as synchronization reference source, or Tevaluate,SLSS in clause 12.3.1.2 if an EUTRA cell is used as synchronization reference source, or Tevaluate,SLSS in clause 12.3.1.4 if an SLSS is used as synchronization reference source. If multiple SL-DRX cycles are configured, the SL-DRX cycle length is the longest one.

- SS-RSRP is larger than *syncTxThreshOoC*.

UE shall be capable of performing PSBCH-RSRP measurements for 3 identified intra-frequency SyncRef UE with the measurement period of Tmeasure,PSBCH-RSRP in Table 12.4-1. It is assumed that the SyncRef UE do not drop or delay any SLSS transmission within the measurement period. Otherwise, the measurement period may be extended.

Table 12.4-1: PSBCH-RSRP measurement period for intra-frequency SyncRef UE

|  |  |
| --- | --- |
| SL-DRX cycleNote 1 [ms] | Tmeasure,PSBCH-RSRP [ms] |
| No SL-DRX | 320 |
| SL-DRX cycle ≤ 160ms | 320 |
| SL-DRX cycle > 160ms | 2 x SL-DRX cycle |
| Note 1: If multiple SL-DRX cycles are configured, the SL-DRX cycle is the shortest one. | |

When UE is synchronized to GNSS directly, before selection / reselection of the new synchronization reference source UE shall evaluate the GNSS synchronization source reliability for at least 20 seconds before changing the synchronization reference from GNSS to another synchronization reference source. UE shall be always synchronized to GNSS directly during the evaluation of GNSS synchronization source reliability.

## 12.5 L1 SL-RSRP measurements

### 12.5.1 Introduction

This clause contains the measurement requirements related to resource reselection and resource pre-emption of the UE capable of V2X sidelink communication.

### 12.5.2 SL-RSRP measurements

The UE physical layer shall be capable of performing the L1 SL-RSRP measurements on the carrier operating V2X sidelink communication for determining the subset of resources to be excluded in PSSCH resource selection in sidelink transmission mode 2. The L1 SL-RSRP measurement period corresponds to one slot and the measurement shall meet the L1 SL-RSRP measurement accuracy requirement in Clause 10. After resource (re-)selection procedure, re-evaluation is performed on the reserved resources by L1 SL-RSRP measurements before transmission of SCI with reservation when the conditions specified in TS 38.214[26] are satisfied.

When the pre-emption mechanism is enabled for the resource pool that UE is monitoring and selecting resource from, after UE selects from the resource not excluded based on L1 SL-RSRP measurement procedure, the UE shall be capable of triggering reselection of already signalled resource(s) as a resource reservation when the conditions specified in TS38.214[26] are satisfied.

When partial sensing mechanism is enabled for the resource pool that UE is monitoring and selecting resource from, the UE shall be capable of performing the L1 SL-RSRP measurements on the sensing periods specified in TS38.214[26]. When SL-DRX is enabled, the UE shall be capable of performing the L1 SL-RSRP measurements and select resource during SL-DRX active time as specified in TS38.214[26].

## 12.6 Congestion Control measurements

The UE shall be capable of estimating the channel busy ratio for one or more transmission pools indicated by higher layers in TS 38.331[2], based on SL-RSSI measurements provided by the physical layer.

When no sidelink transmissions occur, the UE physical layer shall perform a single-shot SL-RSSI measurement for each sub-channel included in all the slots configured as transmission pools.

The SL-RSSI measurement performed according to this clause shall meet the SL-RSSI measurement accuracy requirements defined in Clause 10.

The UE shall perform channel busy ratio (CBR) measurement based on SL-RSSI measurements as described in TS 38.215 [4].

## 12.7 Interruption

### 12.7.1 Interruptions to WAN due to V2X Sidelink Communication

This clause contains the requirements related to the interruptions on the PCell/serving cell due to V2X sidelink communication.

A UE capable of V2X sidelink communication may indicate its interest (initiation or termination) in V2X sidelink communication to the connected gNodeB using IE *SidelinkUEInformationNR* in TS38.331[2].

The UE is allowed an interruption of up to the duration shown in table 12.7.1-1 on the PCell/serving cell during the RRC reconfiguration procedure that includes the V2X sidelink communication configuration message *SL-ConfigDedicatedNR* in TS 38.331[2] (setup and release). This interruption is for both uplink and downlink of the PCell/serving cell.

Table 12.7.1-1: Interruption length at V2X RRC reconfiguration

|  |  |  |
| --- | --- | --- |
|  | NR Slot length (ms) | Interruption length  (number of slots) |
| 0 | 1 | 2 |
| 1 | 0.5 | 3 |
| 2 | 0.25 | 5 |
| 3 | 0.125 | 9 |

### 12.7.2 V2X Sidelink Communication Dropping due to synchronization source change

This clause contains the requirements related to the interruptions on the V2X sidelink communication due to synchronization source change.

For NR V2X UE not supporting gNB/eNB as synchronization reference source, UE is allowed to drop LTE and NR V2X SL transmission or reception for up to 1ms when synchronization source is changed, where the drop of  LTE V2X SL transmission or reception applies only to in-device coexistence scenario in TS38.213 [3]:

- From GNSS

- to syncRef UE that is synchronized to GNSS directly/in-directly

- to syncRef UE that has the lowest priority

- From syncRef UE that is synchronized to GNSS directly/in-directly

- to GNSS

- to syncRef UE that has the lowest priority

- From syncRef UE that has the lowest priority

- to GNSS

- to syncRef UE that is synchronized to GNSS directly/in-directly

- to syncRef UE that has the lowest priority

For NR V2X UE supporting gNB/eNB as synchronization reference source, UE is allowed to drop LTE and NR V2X SL transmission or reception for up to 1ms when synchronization source is changed, where the drop of  LTE V2X SL transmission or reception applies only to in-device coexistence scenario in TS38.213 [3]:

- From GNSS

- to syncRef UE that is synchronized to GNSS directly/in-directly

- to gNB/eNB

- to syncRef UE that is synchronized to gNB/eNB directly

- to syncRef UE that is synchronized to gNB/eNB in-directly

- to syncRef UE that has the lowest priority

- From syncRef UE that is synchronized to GNSS directly/in-directly

- to GNSS

- to gNB/eNB

- to syncRef UE that is synchronized to gNB/eNB directly

- to syncRef UE that is synchronized to gNB/eNB in-directly

- to syncRef UE that has the lowest priority

- From gNB or eNB

- to GNSS

- to syncRef UE that is synchronized to GNSS directly/in-directly

- to eNB or gNB

- to syncRef UE that is synchronized to gNB or eNB directly

- to syncRef UE that is synchronized to gNB or eNB in-directly

- to syncRef UE that has the lowest priority

- From syncRef UE that is synchronized to gNB/eNB directly

- to GNSS

- to syncRef UE that is synchronized to GNSS directly/in-directly

- to gNB/eNB

- to syncRef UE that is synchronized to gNB/eNB directly

- to syncRef UE that is synchronized to gNB/eNB in-directly

- to syncRef UE that has the lowest priority

- From syncRef UE that is synchronized to gNB/eNB in-directly

- to GNSS

- to syncRef UE that is synchronized to GNSS directly/in-directly

- to gNB/eNB

- to syncRef UE that is synchronized to gNB/eNB directly

- to syncRef UE that is synchronized to gNB/eNB in-directly

- to syncRef UE that has the lowest priority

- From syncRef UE that has the lowest priority

- to GNSS

- to syncRef UE that is synchronized to GNSS directly

- to syncRef UE that is synchronized to GNSS in-directly

- to gNB/eNB

- to syncRef UE that is synchronized to gNB/eNB directly

- to syncRef UE that is synchronized to gNB/eNB in-directly

- to syncRef UE that has the lowest priority

UE is allowed to interruption any V2X sidelink signals including PSSCH, PSCCH, PSBCH, PSFCH and SLSS signals.

### 12.7.3 Interruptions to WAN due to switching between E-UTRA V2X Sidelink and NR V2X Sidelink

This sub-clause contains the requirements related to the interruptions on the PCell/serving cell due to switching between E-UTRA V2X sidelink and NR V2X sidelink transmissions on a dedicated carrier. It is applicable for UE capable of both NR V2X sidelink and E-UTRA V2X sidelink transmissions in TDM-ed manner.

When a UE capable of switching between E-UTRA V2X sidelink and NR V2X sidelink, the UE is allowed an interruption of up to the duration shown in table 12.7.3-1 on the PCell/serving cell during the E-UTRA V2X sidelink and NR V2X sidelink switch.

This interruption is for both uplink and downlink of the PCell/serving cell.

Table 12.7.3-1: Interruption length due to switching between E-UTRA V2X and NR V2X

|  |  |  |
| --- | --- | --- |
|  | Slot length (ms) | Interruption length (number of slots) |
| 0 | 1 | 2 |
| 1 | 0.5 | 2 |
| 2 | 0.25 | 2 |
| 3 | 0.125 | 3 |

### 12.7.4 Interruptions to WAN at transitions between active and non-active during SL-DRX

Interruption on PCell/serving cell if configured due to V2X transitions between active and non-active during SL-DRX are allowed with up to 1% probability of missed ACK/NACK when the configured SL-DRX cycle is less than 640 ms, and 0.625% probability of missed ACK/NACK is allowed when the configured SL-DRX cycle is 640 ms or longer. When multiple SL-DRX cycles are configured, the shortest SL-DRX cycle is applied. Each interruption shall not exceed X slot as defined in table 12.7.4-1.

Table 12.7.4-1: Interruption length X at transition between active and non-active during SL-DRX

|  |  |  |  |
| --- | --- | --- | --- |
|  | NR Slot | Interruption length X (slots) | |
|  | length (ms) | Sync | Async |
| 0 | 1 | 1 | 2 |
| 1 | 0.5 | 1 | 2 |
| 2 | 0.25 | 3 | |

For SL-DRX active to inactive state transition, when the UE is in non-DRX or DRX on WAN and V2X is in sidelink resource allocation mode 2, the interruptions in this clause shall not apply when one of the following conditions is met:

- While receiving paging,

- While receiving system information.

In addition, for SL-DRX active to inactive state transition, when the UE is in non-DRX or DRX on WAN and V2X is in sidelink resource allocation mode 2 and SL DRX cycle is less than 320 ms, the interruptions in this clause shall not apply when one of the following conditions is met:

- T310 timer is running for RLF on PCell

- performing candidate beam detection on PCell/serving cell as specfied in section 8.5.5. and 8.5.6

### 12.7.5 Interruptions to V2X sidelink at transitions between active and non-active during DRX

Interruption on V2X sidelink if configured due to PCell transitions between active and non-active during DRX are allowed with up to 1% probability of missed ACK/NACK when the configured DRX cycle is less than 640 ms, and 0.625% probability of missed ACK/NACK is allowed when the configured DRX cycle is 640 ms or longer. It is only applied when HARQ process on V2X sidelink is supported. Each interruption shall not exceed X slot as defined in table 12.7.5-1.

Table 12.7.5-1: Interruption length X at transition between active and non-active during DRX

|  |  |  |  |
| --- | --- | --- | --- |
|  | NR V2X Slot | Interruption length X (slots) | |
|  | length (ms) | Sync | Async |
| 0 | 1 | 1 | 2 |
| 1 | 0.5 | 1 | 2 |
| 2 | 0.25 | 3 | |

### 12.7.6 Interruptions to V2X sidelink due to Active BWP switching Requirement

This clause contains the requirements related to the interruptions on the V2X sidelink due to BWP switch in FDM based intra-band concurrent V2X operation.

The requirements in clause 8.2.2.2.5 shall apply. The interrupted X slot is defined in Table 12.7.6-1.

Table 12.7.6-1: Interruption length X

|  |  |  |
| --- | --- | --- |
|  | NR V2X Slot | Interruption length X (slots) |
|  | length (ms) |  |
| 0 | 1 | 1 |
| 1 | 0.5 | 1 |
| 2 | 0.25 | 3 |

Note: No sidelink communication happens during BWP switching delay period for TDM based intra-band concurrent operation.

### 12.7.7 Interruptions to WAN due to SyncRef UE detection and/or Sensing during SL DRX off duration

This sub-clause contains the requirements related to the interruptions on the PCell/serving cell due to SyncRef UE detection and/or Sensing during SL DRX off duration.

The requirements in clause 12.7.4 shall apply.

### 12.7.8 Interruptions at NR sidelink discovery configuration

This clause contains the requirements related to the interruptions on the PCell/serving cell due to NR sidelink discovery.

A UE capable of NR sidelink discovery may indicate its interest (initiation or termination) in NR sidelink discovery to the connected gNodeB using IE *SidelinkUEInformationNR* in TS38.331[2].

The UE is allowed an interruption of up to the duration shown in Table 12.7.8-1 on the PCell/serving cell during the RRC reconfiguration procedure that includes the NR sidelink discovery configuration message *sl-DiscConfig* in TS 38.331[2] (setup and release). This interruption is for both uplink and downlink of the PCell/serving cell.

12.7.8-1: Interruption length at NR sidelink discovery configuration

|  |  |  |
| --- | --- | --- |
|  | NR Slot length (ms) | Interruption length  (number of slots) |
| 0 | 1 | 2 |
| 1 | 0.5 | 3 |
| 2 | 0.25 | 5 |
| 3 | 0.125 | 9 |

## 12.8 Reliability of GNSS signal

This clause contains requirements regarding reliability of GNSS signal for the UE capable of V2X sidelink communication under the following additional condition:

- The UE is configured or pre-configured with parameters for enabling the UE to acquire the GNSS synchronization.

If UE considers GNSS is a reliable synchronization reference, the UE shall meet timing accuracy requirement as specified in 12.2 and frequency accuracy requirement as specified in 6.4E of TS38.101-1[18]. Otherwise, the UE shall be capable to select another synchronization reference source.

## 12.9 Scheduling availability

### 12.9.1 Scheduling availability of UE switching between E-UTRA sidelink and NR sidelink

This clause contains the restrictions on the scheduling availability for V2X sidelink due to switching between E-UTRA V2X sidelink and NR V2X sidelink transmission on a dedicated carrier. For the NR V2X sidelink, the assumed number of configured symbols in a slot is 14.

When switch from E-UTRA V2X sidelink to NR V2X sidelink occurs in NR slot ‘n’,

* UE is not expected to transmit or receive on NR V2X sidelink on the slot ‘n’.

When switch from NR V2X sidelink to E-UTRA V2X sidelink occurs in NR slot ‘n-1’,

* UE is not expected to transmit or receive on NR V2X sidelink on the slot ‘n-1’.

When switch from NR V2X sidelink to E-UTRA V2X sidelink occurs in E-UTRA subframe ‘n’,

* UE is not expected to transmit or receive on E-UTRA V2X sidelink on the subframe ‘n’.

When switch from E-UTRA V2X sidelink to NR V2X sidelink occurs in E-UTRA subframe ‘n-1’,

* UE is not expected to transmit or receive E-UTRA on V2X sidelink on the subframe ‘n-1’.

### 12.9.2 Scheduling availability of UE switching between Uu uplink and V2X sidelink

This clause contains the restrictions on the scheduling availability for V2X sidelink due to switching between Uu uplink and V2X sidelink. For NR V2X sidelink, the assumed number of configured symbols in a slot is 14.

When switch from Uu uplink slot to V2X sidelink slot occurs in sidelink slot ‘n’,

- UE is not expected to transmit or receive on V2X sidelink on the sidelink slot ‘n’.

When switch from V2X sidelink slot to Uu uplink slot occurs in sidelink slot ‘n-1’,

- UE is not expected to transmit or receive on V2X sidelink on the sidelink slot ‘n-1’.

When switch from V2X sidelink slot to Uu uplink slot occurs in Uu slot ‘n’,

- UE is not expected to transmit uplink or receive downlink on the Uu slot ‘n’.

When switch from Uu uplink slot to V2X sidelink slot occurs in Uu slot ‘n-1’,

- UE is not expected to transmit uplink or receive downlink on the Uu slot ‘n-1’.

- UE is not expected to transmit uplink or receive downlink on the Uu slot ‘n-1’.

## 12.10 Selection / Reselection of relay UE

### 12.10.1 Introduction

This section contains the requirements related to selection and reselection of relay UE.

The requirements apply for the selection and reselection of candidate relay UEs that are transmitting relay discovery signals within the resource pool as configured for the remote UE.

### 12.10.2 Selection / Reselection of relay UE

For a remote UE configured by upper layer for relay operation, the remote UE shall search for candidate relay UEs for selection and/or reselection every discovery period which is determined by resource reservation period or SPS transmission periodicity configured by network.

If the remote UE has a selected sidelink relay UE, then the remote UE shall measure the SD-RSRP or SL-RSRP of the selected relay once in every four discovery periods and evaluate if it meets the relay selection criterion as defined in TS 38.331[2] (clause 5.8.15.3).

The remote UE shall measure SD-RSRP or SL-RSRP of the candidate relay UEs every Tmeasure, SL\_Relay\_Intra for relay UEs that are detected and measured according to the measurement rules.

For intra-frequency relay UEs that are detected, but that has not been selected or reselected to, the remote UE shall be capable of evaluating that the intra-frequency relay UE has met selection or reselection criterion defined in TS 38.331[2] (clause 5.8.15.3) within Tevaluate, SL\_Relay\_Intra as specified in table 12.10.2-1.

The minimum requirements are required to meet when the selected and candidate relay UEs are transmitting relay discovery message every discovery period.

Table 12.10.2-1: Tmeasure, SL\_Relay\_Intra and Tevaluate, SL\_Relay\_Intra

|  |  |  |
| --- | --- | --- |
| Discovery Period [s] | Tmeasure,SL\_Relay\_Intra [s] (number of discovery periods) | Tevaluate, SL\_Relay\_Intra [s] (number of discovery periods) |
| 0.04≤Discovery period≤10.24 | Note 1 (4) | Note 1 (16) |
| Note 1: Time depends upon the discovery period which is resource reservation period (in mode 2) or SPS transmission periodicity (in mode 1).  Note 2: SL-RSRP or SD-RSRP can be derived from PSCCH-DMRS and/or PSSCH-DMRS. | | |

# 13 Measurement Performance Requirements for NR gNB

## 13.1 UL-RTOA

### 13.1.1 Report mapping

The reporting range of UL Relative Time of Arrival (UL-RTOA), as defined in Clause 5.2.2 of TS 38.215 [4], is defined from -985024Tc to +985024×Tc. The reporting resolution is uniform across the reporting range and is defined as T = Tc\*2k where k is selected by gNB from the set {0, 1, 2, 3, 4, 5}.

Tc is defined in TS 38.211 [6].

LMF provides a recommended resolution parameter, *timingReportingGranularityFactor* [35]. gNB selects parameter k based on *timingReportingGranularityFactor* [35] and informs the LMF.

The mapping of measured quantity for each reporting resolution (k) is defined in Table 13.1.1-1 to Table 13.1.1-6.

Table 13.1.1-1: UL-RTOA measurement report mapping for reporting resolution of Tc (k=0)

|  |  |  |
| --- | --- | --- |
| Reported Value | Measured Quantity Value | Unit |
| UL\_RTOA\_0000 | -985024 > UL\_RTOA | Tc |
| UL\_RTOA\_0001 | -985024 ≤ UL\_RTOA < -985023 | Tc |
| UL\_RTOA\_0002 | -985023 ≤ UL\_RTOA < -985022 | Tc |
| … | … | … |
| UL\_RTOA\_985023 | -2 ≤ UL\_RTOA < -1 | Tc |
| UL\_RTOA\_985024 | -1 ≤ UL\_RTOA ≤ 0 | Tc |
| UL\_RTOA\_985025 | 0 < UL\_RTOA ≤ 1 | Tc |
| UL\_RTOA\_985026 | 1 < UL\_RTOA ≤ 2 | Tc |
| UL\_RTOA\_985027 | 2 < UL\_RTOA ≤ 3 | Tc |
| … | … | … |
| UL\_RTOA\_1970048 | 985023 < UL\_RTOA ≤ 985024 | Tc |
| UL\_RTOA\_1970049 | 985024 < UL\_RTOA | Tc |

Table 13.1.1-2: UL-RTOA measurement report mapping for reporting resolution of 2Tc (k=1)

|  |  |  |
| --- | --- | --- |
| Reported Value | Measured Quantity Value | Unit |
| UL\_RTOA\_0000 | -985024 > UL\_RTOA | Tc |
| UL\_RTOA\_0001 | -985024 ≤ UL\_RTOA < -985022 | Tc |
| UL\_RTOA\_0002 | -985022 ≤ UL\_RTOA < -985020 | Tc |
| … | … | … |
| UL\_RTOA\_492511 | -4 ≤ UL\_RTOA < -2 | Tc |
| UL\_RTOA\_492512 | -2 ≤ UL\_RTOA ≤ 0 | Tc |
| UL\_RTOA\_492513 | 0 < UL\_RTOA ≤ 2 | Tc |
| UL\_RTOA\_492514 | 2 < UL\_RTOA ≤ 4 | Tc |
| UL\_RTOA\_492515 | 4 < UL\_RTOA ≤ 6 | Tc |
| … | … | … |
| UL\_RTOA\_985024 | 985022 < UL\_RTOA ≤ 985024 | Tc |
| UL\_RTOA\_985025 | 985024 < UL\_RTOA | Tc |

Table 13.1.1-3: UL-RTOA measurement report mapping for reporting resolution of 4Tc (k=2)

|  |  |  |
| --- | --- | --- |
| Reported Value | Measured Quantity Value | Unit |
| UL\_RTOA\_0000 | -985024 > UL\_RTOA | Tc |
| UL\_RTOA\_0001 | -985024 ≤ UL\_RTOA < -985020 | Tc |
| UL\_RTOA\_0002 | -985020 ≤ UL\_RTOA < -985018 | Tc |
| … | … | … |
| UL\_RTOA\_246255 | -8 ≤ UL\_RTOA < -4 | Tc |
| UL\_RTOA\_246256 | -4 ≤ UL\_RTOA ≤ 0 | Tc |
| UL\_RTOA\_246257 | 0 < UL\_RTOA ≤ 4 | Tc |
| UL\_RTOA\_246258 | 4 < UL\_RTOA ≤ 8 | Tc |
| UL\_RTOA\_246259 | 8 < UL\_RTOA ≤ 12 | Tc |
| … | … | … |
| UL\_RTOA\_492512 | 985020 < UL\_RTOA ≤ 985024 | Tc |
| UL\_RTOA\_492513 | 985024 < UL\_RTOA | Tc |

Table 13.1.1-4: UL-RTOA measurement report mapping for reporting resolution of 8Tc (k=3)

|  |  |  |
| --- | --- | --- |
| Reported Value | Measured Quantity Value | Unit |
| UL\_RTOA\_0000 | -985024 > UL\_RTOA | Tc |
| UL\_RTOA\_0001 | -985024 ≤ UL\_RTOA < -985016 | Tc |
| UL\_RTOA\_0002 | -985016 ≤ UL\_RTOA < -985008 | Tc |
| … | … | … |
| UL\_RTOA\_123127 | -16 ≤ UL\_RTOA < -8 | Tc |
| UL\_RTOA\_123128 | -8 ≤ UL\_RTOA ≤ 0 | Tc |
| UL\_RTOA\_123129 | 0 < UL\_RTOA ≤ 8 | Tc |
| UL\_RTOA\_123130 | 8 < UL\_RTOA ≤ 16 | Tc |
| UL\_RTOA\_123131 | 16 < UL\_RTOA ≤ 24 | Tc |
| … | … | … |
| UL\_RTOA\_246256 | 985016 < UL\_RTOA ≤ 985024 | Tc |
| UL\_RTOA\_246257 | 985024 < UL\_RTOA | Tc |

Table 13.1.1-5: UL-RTOA measurement report mapping for reporting resolution of 16Tc (k=4)

|  |  |  |
| --- | --- | --- |
| Reported Value | Measured Quantity Value | Unit |
| UL\_RTOA\_0000 | -985024 > UL\_RTOA | Tc |
| UL\_RTOA\_0001 | -985024 ≤ UL\_RTOA < -985008 | Tc |
| UL\_RTOA\_0002 | -985008 ≤ UL\_RTOA < -984992 | Tc |
| … | … | … |
| UL\_RTOA\_61563 | -32 ≤ UL\_RTOA < -16 | Tc |
| UL\_RTOA\_61564 | -16 ≤ UL\_RTOA ≤ 0 | Tc |
| UL\_RTOA\_61565 | 0 < UL\_RTOA ≤ 16 | Tc |
| UL\_RTOA\_61566 | 16 < UL\_RTOA ≤ 32 | Tc |
| UL\_RTOA\_61567 | 32 < UL\_RTOA ≤ 48 | Tc |
| … | … | … |
| UL\_RTOA\_123128 | 985008 < UL\_RTOA ≤ 985024 | Tc |
| UL\_RTOA\_123129 | 985024 < UL\_RTOA | Tc |

Table 13.1.1-5: UL-RTOA measurement report mapping for reporting resolution of 32Tc (k=5)

|  |  |  |
| --- | --- | --- |
| Reported Value | Measured Quantity Value | Unit |
| UL\_RTOA\_0000 | -985024 > UL\_RTOA | Tc |
| UL\_RTOA\_0001 | -985024 ≤ UL\_RTOA < -984992 | Tc |
| UL\_RTOA\_0002 | -984992 ≤ UL\_RTOA < -984960 | Tc |
| … | … | … |
| UL\_RTOA\_30781 | -64 ≤ UL\_RTOA < -32 | Tc |
| UL\_RTOA\_30782 | -32 ≤ UL\_RTOA ≤ 0 | Tc |
| UL\_RTOA\_30783 | 0 < UL\_RTOA ≤ 32 | Tc |
| UL\_RTOA\_30784 | 32 < UL\_RTOA ≤ 64 | Tc |
| UL\_RTOA\_30785 | 64 < UL\_RTOA ≤ 96 | Tc |
| … | … | … |
| UL\_RTOA\_61564 | 984992 < UL\_RTOA ≤ 985024 | Tc |
| UL\_RTOA\_61565 | 985024 < UL\_RTOA | Tc |

## 13.2 gNB Rx-Tx time difference

### 13.2.1 Report mapping

The reporting range of gNB Rx-Tx time difference, as defined in Clause 5.2.3 of TS 38.215 [4], is defined from -985024Tc to +985024×Tc. The reporting resolution is uniform across the reporting range and is defined as T = Tc\*2k where k is selected by gNB from the set {0, 1, 2, 3, 4, 5}.

Tc is defined in TS 38.211 [6].

LMF provides a recommended resolution parameter, *timingReportingGranularityFactor* [35]. gNB selects parameter k based on *timingReportingGranularityFactor* [35] and informs the LMF.

The mapping of measured quantity for each reporting resolution (k) is defined in Table 13.2.1-1 to Table 13.2.1-6.

Table 13.2.1-1: gNB Rx-Tx time difference measurement report mapping for reporting resolution of Tc (k=0)

|  |  |  |
| --- | --- | --- |
| Reported Value | Measured Quantity Value | Unit |
| RX-TX\_0000 | -985024 > RX-TX | Tc |
| RX-TX\_0001 | -985024 ≤ RX-TX < -985023 | Tc |
| RX-TX\_0002 | -985023 ≤ RX-TX < -985022 | Tc |
| … | … | … |
| RX-TX\_985023 | -2 ≤ RX-TX < -1 | Tc |
| RX-TX\_985024 | -1 ≤ RX-TX ≤ 0 | Tc |
| RX-TX\_985025 | 0 < RX-TX ≤ 1 | Tc |
| RX-TX\_985026 | 1 < RX-TX ≤ 2 | Tc |
| RX-TX\_985027 | 2 < RX-TX ≤ 3 | Tc |
| … | … | … |
| RX-TX\_1970048 | 985023 < RX-TX ≤ 985024 | Tc |
| RX-TX\_1970049 | 985024 < RX-TX | Tc |

Table 13.2.1-2: gNB Rx-Tx time difference measurement report mapping for reporting resolution of 2Tc (k=1)

|  |  |  |
| --- | --- | --- |
| Reported Value | Measured Quantity Value | Unit |
| RX-TX\_0000 | -985024 > RX-TX | Tc |
| RX-TX\_0001 | -985024 ≤ RX-TX < -985022 | Tc |
| RX-TX\_0002 | -985022 ≤ RX-TX < -985020 | Tc |
| … | … | … |
| RX-TX\_492511 | -4 ≤ RX-TX < -2 | Tc |
| RX-TX\_492512 | -2 ≤ RX-TX ≤ 0 | Tc |
| RX-TX\_492513 | 0 < RX-TX ≤ 2 | Tc |
| RX-TX\_492514 | 2 < RX-TX ≤ 4 | Tc |
| RX-TX\_492515 | 4 < RX-TX ≤ 6 | Tc |
| … | … | … |
| RX-TX\_985024 | 985022 < RX-TX ≤ 985024 | Tc |
| RX-TX\_985025 | 985024 < RX-TX | Tc |

Table 13.2.1-3: gNB Rx-Tx time difference measurement report mapping for reporting resolution of 4Tc (k=2)

|  |  |  |
| --- | --- | --- |
| Reported Value | Measured Quantity Value | Unit |
| RX-TX\_0000 | -985024 > RX-TX | Tc |
| RX-TX\_0001 | -985024 ≤ RX-TX < -985020 | Tc |
| RX-TX\_0002 | -985020 ≤ RX-TX < -985018 | Tc |
| … | … | … |
| RX-TX\_246255 | -8 ≤ RX-TX < -4 | Tc |
| RX-TX\_246256 | -4 ≤ RX-TX ≤ 0 | Tc |
| RX-TX\_246257 | 0 < RX-TX ≤ 4 | Tc |
| RX-TX\_246258 | 4 < RX-TX ≤ 8 | Tc |
| RX-TX\_246259 | 8 < RX-TX ≤ 12 | Tc |
| … | … | … |
| RX-TX\_492512 | 985020 < RX-TX ≤ 985024 | Tc |
| RX-TX\_492513 | 985024 < RX-TX | Tc |

Table 13.2.1-4: gNB Rx-Tx time difference measurement report mapping for reporting resolution of 8Tc (k=3)

|  |  |  |
| --- | --- | --- |
| Reported Value | Measured Quantity Value | Unit |
| RX-TX\_0000 | -985024 > RX-TX | Tc |
| RX-TX\_0001 | -985024 ≤ RX-TX < -985016 | Tc |
| RX-TX\_0002 | -985016 ≤ RX-TX < -985008 | Tc |
| … | … | … |
| RX-TX\_123127 | -16 ≤ RX-TX < -8 | Tc |
| RX-TX\_123128 | -8 ≤ RX-TX ≤ 0 | Tc |
| RX-TX\_123129 | 0 < RX-TX ≤ 8 | Tc |
| RX-TX\_123130 | 8 < RX-TX ≤ 16 | Tc |
| RX-TX\_123131 | 16 < RX-TX ≤ 24 | Tc |
| … | … | … |
| RX-TX\_246256 | 985016 < RX-TX ≤ 985024 | Tc |
| RX-TX\_246257 | 985024 < RX-TX | Tc |

Table 13.2.1-5: gNB Rx-Tx time difference measurement report mapping for reporting resolution of 16Tc (k=4)

|  |  |  |
| --- | --- | --- |
| Reported Value | Measured Quantity Value | Unit |
| RX-TX\_0000 | -985024 > RX-TX | Tc |
| RX-TX\_0001 | -985024 ≤ RX-TX < -985008 | Tc |
| RX-TX\_0002 | -985008 ≤ RX-TX < -984992 | Tc |
| … | … | … |
| RX-TX\_61563 | -32 ≤ RX-TX < -16 | Tc |
| RX-TX\_61564 | -16 ≤ RX-TX ≤ 0 | Tc |
| RX-TX\_61565 | 0 < RX-TX ≤ 16 | Tc |
| RX-TX\_61566 | 16 < RX-TX ≤ 32 | Tc |
| RX-TX\_61567 | 32 < RX-TX ≤ 48 | Tc |
| … | … | … |
| RX-TX\_123128 | 985008 < RX-TX ≤ 985024 | Tc |
| RX-TX\_123129 | 985024 < RX-TX | Tc |

Table 13.2.1-5: gNB Rx-Tx time difference measurement report mapping for reporting resolution of 32Tc (k=5)

|  |  |  |
| --- | --- | --- |
| Reported Value | Measured Quantity Value | Unit |
| RX-TX\_0000 | -985024 > RX-TX | Tc |
| RX-TX\_0001 | -985024 ≤ RX-TX < -984992 | Tc |
| RX-TX\_0002 | -984992 ≤ RX-TX < -984960 | Tc |
| … | … | … |
| RX-TX\_30781 | -64 ≤ RX-TX < -32 | Tc |
| RX-TX\_30782 | -32 ≤ RX-TX ≤ 0 | Tc |
| RX-TX\_30783 | 0 < RX-TX ≤ 32 | Tc |
| RX-TX\_30784 | 32 < RX-TX ≤ 64 | Tc |
| RX-TX\_30785 | 64 < RX-TX ≤ 96 | Tc |
| … | … | … |
| RX-TX\_61564 | 984992 < RX-TX ≤ 985024 | Tc |
| RX-TX\_61565 | 985024 < RX-TX | Tc |

### 13.2.2 Measurement Accuracy Requirements

#### 13.2.2.1 Introduction

This clause defines accuracy requirements for gNB Rx-Tx time difference measurement in FR1 and FR2. The requirements are applicable for gNB supporting gNB Rx-Tx time difference measurement. The gNB, which declares the support for gNB Rx-Tx time difference measurement also declares that it meets gNB Rx-Tx time difference accuracy requirements at least for one side condition Ês/Iot ≥ +3 dB or Ês/Iot ≥ -13 dB.

13.2.2.2 Requirements

The accuracy requirements for gNB Rx-Tx time difference measurement shall be within ±(X+Y) Tc under the following conditions:

- AWGN propagation conditions.

- The measured signals are in the directions covered by RoAoA of OTA reference sensitivity requirements for gNB type 1-O and 2-O BS

where

- X is defined in Table 13.2.2.2-1 for gNB types 1-C, 1-H and 1-O and in Table 13.2.2.2-2 for gNB type 2-O.

- Y is declared by manufacturer and can be different for different gNB types 1-C, 1-H, 1-O and 2-O.

Note: The measurement accuracy requirements in Table 13.2.2.2-1 and Table 13.2.2.2-2 are defined under an assumption that gNB is not mandated to perform receive beam sweeping.

Table 13.2.2.2-1: gNB Rx-Tx time difference absolute accuracy in FR1 for gNB type 1-C, 1-H and 1-O

|  |  |  |  |
| --- | --- | --- | --- |
| Accuracy | SRS Ês/Iot | SCS | SRS bandwidth range |
| Unit: Tc | Unit: dB | Unit: kHz | Unit: RB |
| 123 | ≥ -13 | 15 | 44 ≤ BW ≤ 84 |
| 48 | 88 ≤ BW ≤ 168 |
| 17 | 176 ≤ BW |
| 122 | ≥ +3 | 24 ≤ BW ≤ 40 |
| 62 | 44 ≤ BW ≤ 84 |
| 32 | 88 ≤ BW ≤ 168 |
| 16 | 176 ≤ BW |
| 42 | ≥ -13 | 30 | 48 ≤ BW ≤ 84 |
| 24 | 88 ≤ BW ≤ 168 |
| 8 | 176 ≤ BW |
| 32 | ≥ +3 | 48 ≤ BW ≤ 84 |
| 17 | 88 ≤ BW ≤ 168 |
| 9 | 176 ≤ BW |
| 21 | ≥ -13 | 60 | 48 ≤ BW ≤ 84 |
| 12 | 88 ≤ BW |
| 16 | ≥ +3 | 48 ≤ BW ≤ 84 |
| 9 | 88 ≤ BW |

Table 13.2.2.2-2: gNB Rx-Tx time difference absolute accuracy in FR2 for gNB type 2-O

|  |  |  |  |
| --- | --- | --- | --- |
| Accuracy | SRS Ês/Iot | SCS | SRS bandwidth range |
| Unit: Tc | Unit: dB | Unit: kHz | Unit: RB |
| 9 | ≥ -13 | 60 | 132 ≤ BW ≤ 168 |
| 8 | 176 ≤ BW |
| 9 | ≥ +3 | 132 ≤ BW ≤ 168 |
| 8 | 176 ≤ BW |
| 22 | ≥ -13 | 120 | 32 ≤ BW ≤ 40 |
| 15 | 44 ≤ BW ≤ 84 |
| 8 | 88 ≤ BW |
| 16 | ≥ +3 | 32 ≤ BW ≤ 40 |
| 9 | 44 ≤ BW ≤ 84 |
| 8 | 88 ≤ BW |

## 13.3 UL SRS RSRP measurement

### 13.3.1 Report mapping

The reporting range of UL SRS RSRP, as defined in clause 5.2.5 of 38.215 [4], is defined from -156dBm to -31dBm with resolution 1dB.

The mapping of measured quantity is defined in Table 13.3.1-1. The range in the signalling may be larger than the guaranteed accuracy range.

Table 13.3.1-1: UL SRS RSRP report mapping

|  |  |  |
| --- | --- | --- |
| Reported value | Measured quantity value | Unit |
| SRS\_RSRP\_0 | SRS-RSRP<-156 | dBm |
| SRS\_RSRP\_1 | -156≤SRS-RSRP<-155 | dBm |
| SRS\_RSRP\_2 | -155≤SRS-RSRP<-154 | dBm |
| SRS\_RSRP\_3 | -154≤SRS-RSRP<-153 | dBm |
| SRS\_RSRP\_4 | -153≤SRS-RSRP<-152 | dBm |
| SRS\_RSRP\_5 | -152≤SRS-RSRP<-151 | dBm |
| SRS\_RSRP\_6 | -151≤SRS-RSRP<-150 | dBm |
| SRS\_RSRP\_7 | -150≤SRS-RSRP<-149 | dBm |
| SRS\_RSRP\_8 | -149≤SRS-RSRP<-148 | dBm |
| SRS\_RSRP\_9 | -148≤SRS-RSRP<-147 | dBm |
| SRS\_RSRP\_10 | -147≤SRS-RSRP<-146 | dBm |
| SRS\_RSRP\_11 | -146≤SRS-RSRP<-145 | dBm |
| SRS\_RSRP\_12 | -145≤SRS-RSRP<-144 | dBm |
| SRS\_RSRP\_13 | -144≤SRS-RSRP<-143 | dBm |
| SRS\_RSRP\_14 | -143≤SRS-RSRP<-142 | dBm |
| SRS\_RSRP\_15 | -142≤SRS-RSRP<-141 | dBm |
| SRS\_RSRP\_16 | -141≤SRS-RSRP<-140 | dBm |
| SRS\_RSRP\_17 | -140≤SRS-RSRP<-139 | dBm |
| SRS\_RSRP\_18 | -139≤SRS-RSRP<-138 | dBm |
| … | … | … |
| SRS\_RSRP\_111 | -46≤SRS-RSRP<-45 | dBm |
| SRS\_RSRP\_112 | -45≤SRS-RSRP<-44 | dBm |
| SRS\_RSRP\_113 | -44≤SRS-RSRP<-43 | dBm |
| SRS\_RSRP\_114 | -43≤SRS-RSRP<-42 | dBm |
| SRS\_RSRP\_115 | -42≤SRS-RSRP<-41 | dBm |
| SRS\_RSRP\_116 | -41≤SRS-RSRP<-40 | dBm |
| SRS\_RSRP\_117 | -40≤SRS-RSRP<-39 | dBm |
| SRS\_RSRP\_118 | -39≤SRS-RSRP<-38 | dBm |
| SRS\_RSRP\_119 | -38≤SRS-RSRP<-37 | dBm |
| SRS\_RSRP\_120 | -37≤SRS-RSRP<-36 | dBm |
| SRS\_RSRP\_121 | -36≤SRS-RSRP<-35 | dBm |
| SRS\_RSRP\_122 | -35≤SRS-RSRP<-34 | dBm |
| SRS\_RSRP\_123 | -34≤SRS-RSRP<-33 | dBm |
| SRS\_RSRP\_124 | -33≤SRS-RSRP<-32 | dBm |
| SRS\_RSRP\_125 | -32≤SRS-RSRP<-31 | dBm |
| SRS\_RSRP\_126 | -31≤SRS-RSRP | dBm |

### 13.3.2 Measurement accuracy requirements

#### 13.3.2.1 Introduction

This clause defines accuracy requirements for SRS-RSRP measurement in FR1 and FR2. The requirements are applicable for gNB supporting SRS-RSRP measurement. The gNB, which declares the support for SRS-RSRP measurement also declares that it meets SRS-RSRP accuracy requirements at least for one side condition Ês/Iot ≥ +3 dB or Ês/Iot ≥ -13 dB.

#### 13.3.2.2 Requirements

The accuracy requirements in Table 13.3.2.2-1, Table 13.3.2.2-2 and Table 13.3.2.2-3 are valid under the following conditions:

- AWGN propagation conditions.

- The measured signals are in the directions covered by RoAoA of OTA reference sensitivity requirements for gNB type 1-O and 2-O BS

Note: The measurement accuracy requirements in Table 13.3.2.2-1, Table 13.3.2.2-2 and Table 13.3.2.2-3 are defined under an assumption that gNB is not mandated to perform receive beam sweeping.

Table 13.3.2.2-1 gNB SRS-RSRP absolute accuracy requirements in FR1 for gNB type 1-C

|  |  |  |
| --- | --- | --- |
| Accuracy | Conditions | |
| SRS Ês/Iot | SRS bandwidth range |
|
| dB | dB | RB |
| ±4 | Ês/Iot ≥ +3 | 24 ≤ BW < 48 |
| ±4 | 48 ≤ BW < 132 |
| ±4 | 132 ≤ BW |
| ±6.5 | Ês/Iot ≥ -13 | 48 ≤ BW < 132 |
| ±5.5 | 132 ≤ BW |

Table 13.3.2.2-2 gNB SRS-RSRP absolute accuracy requirements in FR1 for gNB type 1-H and 1-O

|  |  |  |
| --- | --- | --- |
| Accuracy | Conditions | |
| SRS Ês/Iot | SRS bandwidth range |
|
| dB | dB | RB |
| ±5.5 | Ês/Iot ≥ +3 | 24 ≤ BW < 48 |
| ±5.5 | 48 ≤ BW < 132 |
| ±5.5 | 132 ≤ BW |
| ±8 | Ês/Iot ≥ -13 | 48 ≤ BW < 132 |
| ±7 | 132 ≤ BW |

Table 13.3.2.2-3 gNB SRS-RSRP absolute accuracy requirements in FR2 for gNB type 2-O

|  |  |  |
| --- | --- | --- |
| Accuracy | Conditions | |
| SRS Ês/Iot | SRS bandwidth range |
|
| dB | dB | RB |
| ±5.5 | Ês/Iot ≥ +3 | 32 ≤ BW < 64 |
| ±5.5 | 64 ≤ BW < 132 |
| ±5.5 | 132 ≤ BW |
| ±8 | Ês/Iot ≥ -13 | 64 ≤ BW < 132 |
| ±7 | 132 ≤ BW |

### 13.4 AoA/ZoA

### 13.4.1 Report mapping

The reporting range of UL Angle of Arrival, as defined in Clause 5.2.4 of TS 38.215 [4], is defined from -180 degree to +180 degree for azimuth angle (AoA). The reporting resolution is 0.1 degree.

The reporting range of UL Angle of Arrival, as defined in Clause 5.2.4 of TS 38.215 [4], is defined from 0 degree to +180 degree for vertical angle (ZoA). The reporting resolution is 0.1 degree.

The mapping of AoA measured quantity is defined in Table 13.4.1-1. The mapping of ZoA measured quantity is defined in Table 13.4.1-2.

Table 13.4.1-1: AoA measurement report mapping

|  |  |  |
| --- | --- | --- |
| Reported value | Measured quantity value (AoA) | Unit |
| AoA\_0 | -180 ≤ AoA < -179.9 | degree |
| AoA\_1 | -179.9 ≤ AoA < -179.8 | degree |
| AoA\_2 | -179.8 ≤ AoA < -179.7 | degree |
| … | … | … |
| AoA\_1798 | -0.2 ≤ AoA ≤ -0.1 | degree |
| AoA\_1799 | -0.1 ≤ AoA < 0 | degree |
| AoA\_1800 | 0 ≤ AoA < 0.1 | degree |
| AoA\_1801 | 0.1 ≤ AoA < 0.2 | degree |
| AoA\_1802 | 0.2 ≤ AoA < 0.3 | degree |
| … | … | … |
| AoA\_3598 | 179.8 ≤ AoA < 179.9 | degree |
| AoA\_3599 | 179.9 ≤ AoA < 180 | degree |

Table 13.4.1-2: ZoA measurement report mapping

|  |  |  |
| --- | --- | --- |
| Reported value | Measured quantity value (ZoA) | Unit |
| ZoA\_0 | 0 ≤ ZoA < 0.1 | degree |
| ZoA \_1 | 0.1 ≤ ZoA < 0.2 | degree |
| ZoA \_2 | 0.2 ≤ ZoA < 0.3 | degree |
| … | … | … |
| ZoA \_1798 | 179.8 ≤ ZoA < 179.9 | degree |
| ZoA \_1799 | 179.9 ≤ ZoA < 180 | degree |

## 13.5 Timing advance (TADV)

### 13.5.1 Report mapping

The reporting range of TADV, as defined in Clause 5.2.7 of TS 38.215 [4], is defined from 0 to 3150848 Tc with 128 Tc resolution for timing advance less or equal to 262144 Tc, and 512 Tc for timing advance greater than 262144 Tc.

Tc is defined in TS 38.211 [6].

The mapping of measured quantity is defined in Table 13.X.1-1.

Table 13.5.1-1: TADV measurement report mapping

|  |  |  |
| --- | --- | --- |
| **Reported value** | **Measured quantity value** | **Unit** |
| TIME\_ADVANCE\_00 | TADV < 128 | Tc |
| TIME\_ADVANCE\_01 | 128 ≤ TADV < 256 | Tc |
| TIME\_ADVANCE\_02 | 256 ≤ TADV < 384 | Tc |
| … | … | … |
| TIME\_ADVANCE\_2046 | 261888 ≤ TADV < 262016 | Tc |
| TIME\_ADVANCE\_2047 | 262016 ≤ TADV < 262144 | Tc |
| TIME\_ADVANCE\_2048 | 262144 ≤ TADV < 262656 | Tc |
| TIME\_ADVANCE\_2049 | 262656 ≤ TADV < 263168 | Tc |
| … | … | … |
| TIME\_ADVANCE\_7688 | 3149824 ≤ TADV < 3150336 | Tc |
| TIME\_ADVANCE\_7689 | 3150336 ≤ TADV < 3150848 | Tc |
| TIME\_ADVANCE\_7690 | 3150848 ≤ TADV | Tc |

NOTE: For report mapping, the TADV equal to (gNB Rx – Tx time difference) + NTA\_offset, where NTA\_offset is based on the information *n-TimingAdvanceOffset* as specified in TS 38.331 [2].

## 13.6 UL SRS RSRPP measurement

### 13.6.1 Report mapping

The reporting range of UL SRS RSRPP, as defined in clause 5.2.5 of 38.215 [4], is defined from -156dBm to -31dBm with resolution 1dB.

The mapping of measured quantity is defined in Table 13.6.1-1. The range in the signalling may be larger than the guaranteed accuracy range.

Table 13.6.1-1: UL SRS RSRPP report mapping

|  |  |  |
| --- | --- | --- |
| Reported value | Measured quantity value | Unit |
| SRS\_RSRPP\_0 | SRS-RSRPP<-156 | dBm |
| SRS\_RSRPP\_1 | -156≤SRS-RSRPP<-155 | dBm |
| SRS\_RSRPP\_2 | -155≤SRS-RSRPP<-154 | dBm |
| SRS\_RSRPP\_3 | -154≤SRS-RSRPP<-153 | dBm |
| SRS\_RSRPP\_4 | -153≤SRS-RSRPP<-152 | dBm |
| SRS\_RSRPP\_5 | -152≤SRS-RSRPP<-151 | dBm |
| SRS\_RSRPP\_6 | -151≤SRS-RSRPP<-150 | dBm |
| SRS\_RSRPP\_7 | -150≤SRS-RSRPP<-149 | dBm |
| SRS\_RSRPP\_8 | -149≤SRS-RSRPP<-148 | dBm |
| SRS\_RSRPP\_9 | -148≤SRS-RSRPP<-147 | dBm |
| SRS\_RSRPP\_10 | -147≤SRS-RSRPP<-146 | dBm |
| SRS\_RSRPP\_11 | -146≤SRS-RSRPP<-145 | dBm |
| SRS\_RSRPP\_12 | -145≤SRS-RSRPP<-144 | dBm |
| SRS\_RSRPP\_13 | -144≤SRS-RSRPP<-143 | dBm |
| SRS\_RSRPP\_14 | -143≤SRS-RSRPP<-142 | dBm |
| SRS\_RSRPP\_15 | -142≤SRS-RSRPP<-141 | dBm |
| SRS\_RSRPP\_16 | -141≤SRS-RSRPP<-140 | dBm |
| SRS\_RSRPP\_17 | -140≤SRS-RSRPP<-139 | dBm |
| SRS\_RSRPP\_18 | -139≤SRS-RSRPP<-138 | dBm |
| … | … | … |
| SRS\_RSRPP\_111 | -46≤SRS-RSRPP<-45 | dBm |
| SRS\_RSRPP\_112 | -45≤SRS-RSRPP<-44 | dBm |
| SRS\_RSRPP\_113 | -44≤SRS-RSRPP<-43 | dBm |
| SRS\_RSRPP\_114 | -43≤SRS-RSRPP<-42 | dBm |
| SRS\_RSRPP\_115 | -42≤SRS-RSRPP<-41 | dBm |
| SRS\_RSRPP\_116 | -41≤SRS-RSRPP<-40 | dBm |
| SRS\_RSRPP\_117 | -40≤SRS-RSRPP<-39 | dBm |
| SRS\_RSRPP\_118 | -39≤SRS-RSRPP<-38 | dBm |
| SRS\_RSRPP\_119 | -38≤SRS-RSRPP<-37 | dBm |
| SRS\_RSRPP\_120 | -37≤SRS-RSRPP<-36 | dBm |
| SRS\_RSRPP\_121 | -36≤SRS-RSRPP<-35 | dBm |
| SRS\_RSRPP\_122 | -35≤SRS-RSRPP<-34 | dBm |
| SRS\_RSRPP\_123 | -34≤SRS-RSRPP<-33 | dBm |
| SRS\_RSRPP\_124 | -33≤SRS-RSRPP<-32 | dBm |
| SRS\_RSRPP\_125 | -32≤SRS-RSRPP<-31 | dBm |
| SRS\_RSRPP\_126 | -31≤SRS-RSRPP | dBm |

## 13.7 gNB Rx-Tx time difference measurements for RTT-based PDC

### 13.7.1 Report mapping

The reporting range of gNB Rx-Tx time difference, as defined in Clause 5.2.3 of TS 38.215 [4], is defined from -985024Tc to +985024×Tc. The reporting resolution is uniform across the reporting range and is defined as Tc\*32.

Tc is defined in TS 38.211 [6].

The mapping of measured quantity is defined in Table 13.7.1-1.

Table 13.7.1-1: gNB Rx-Tx time difference measurement report mapping

|  |  |  |
| --- | --- | --- |
| Reported Value | Measured Quantity Value | Unit |
| RX-TX\_0000 | -985024 > RX-TX | Tc |
| RX-TX\_0001 | -985024 ≤ RX-TX < -984992 | Tc |
| RX-TX\_0002 | -984992 ≤ RX-TX < -984960 | Tc |
| … | … | … |
| RX-TX\_30781 | -64 ≤ RX-TX < -32 | Tc |
| RX-TX\_30782 | -32 ≤ RX-TX ≤ 0 | Tc |
| RX-TX\_30783 | 0 < RX-TX ≤ 32 | Tc |
| RX-TX\_30784 | 32 < RX-TX ≤ 64 | Tc |
| RX-TX\_30785 | 64 < RX-TX ≤ 96 | Tc |
| … | … | … |
| RX-TX\_61564 | 984992 < RX-TX ≤ 985024 | Tc |
| RX-TX\_61565 | 985024 < RX-TX | Tc |

### 13.7.2 Measurement Accuracy Requirements

#### 13.7.2.1 Introduction

This clause defines accuracy requirements for gNB Rx-Tx time difference measurement in FR1 and FR2. The requirements are applicable for gNB supporting gNB Rx-Tx time difference measurement for RTT-based PDC.

#### 13.7.2.2 Requirements

The accuracy requirements for gNB Rx-Tx time difference measurement for RTT-based PDC shall be within ±(X+Y) Tc under the following conditions:

- AWGN propagation conditions.

- The measured signals are in the directions covered by RoAoA of OTA reference sensitivity requirements for gNB type 1-O and 2-O BS

where

- X is defined in Table 13.7.2.2-1 for gNB types 1-C, 1-H and 1-O and in Table 13.7.2.2-2 for gNB type 2-O.

- Y is declared by manufacturer and can be different for different gNB types 1-C, 1-H, 1-O and 2-O.

Note: The measurement accuracy requirements in Table 13.7.2.2-1 and Table 13.7.2.2-2 are defined under an assumption that gNB is not mandated to perform receive beam sweeping.

Table 13.7.2.2-1: gNB Rx-Tx time difference absolute accuracy in FR1 for gNB type 1-C, 1-H and 1-O

|  |  |  |  |
| --- | --- | --- | --- |
| Accuracy | SRS Ês/Iot | SCS | SRS bandwidth range |
| Unit: Tc | Unit: dB | Unit: kHz | Unit: RB |
| 122 | ≥ +3 | 15 | 24 ≤ BW ≤ 40 |
| 62 | 44 ≤ BW ≤ 84 |
| 32 | 88 ≤ BW ≤ 168 |
| 16 | 176 ≤ BW |
| 32 | 30 | 48 ≤ BW ≤ 84 |
| 17 | 88 ≤ BW ≤ 168 |
| 9 | 176 ≤ BW |
| 16 | 60 | 48 ≤ BW ≤ 84 |
| 9 | 88 ≤ BW |

Table 13.7.2.2-2: gNB Rx-Tx time difference absolute accuracy in FR2 for gNB type 2-O

|  |  |  |  |
| --- | --- | --- | --- |
| Accuracy | SRS Ês/Iot | SCS | SRS bandwidth range |
| Unit: Tc | Unit: dB | Unit: kHz | Unit: RB |
| 9 | ≥ +3 | 60 | 132 ≤ BW ≤ 168 |
| 8 | 176 ≤ BW |
| 16 | 120 | 32 ≤ BW ≤ 40 |
| 9 | 44 ≤ BW ≤ 84 |
| 8 | 88 ≤ BW |