**3GPP TSG-RAN4 Meeting #115 *R4-2508459***

**Malta, MT, 19 – 23 May, 2025**

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| *CR-Form-v12.3* |
| **CHANGE REQUEST** |
|  |
|  | **38.133** | **CR** | xxxx | **rev** | - | **Current version:** | **19.0.0** |  |
|  |
| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* |
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| ***Proposed change affects:*** | UICC apps |  | ME | **x** | Radio Access Network |  | Core Network |  |

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|  |
| ***Title:***  | Draft big CR for RRM requirements of Sub-band full duplex |
|  |  |
| ***Source to WG:*** | Huawei, HiSilicon |
| ***Source to TSG:*** | R4 |
|  |  |
| ***Work item code:*** | NR\_duplex\_evo-Core |  | ***Date:*** | 2025-05-27 |
|  |  |  |  |  |
| ***Category:*** | B |  | ***Release:*** | Rel-19 |
|  | *Use one of the following categories:****F*** *(correction)****A*** *(mirror corresponding to a change in an earlier release)****B*** *(addition of feature),* ***C*** *(functional modification of feature)****D*** *(editorial modification)*Detailed explanations of the above categories canbe found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | *Use one of the following releases:Rel-8 (Release 8)Rel-9 (Release 9)Rel-10 (Release 10)Rel-11 (Release 11)…Rel-17 (Release 17)Rel-18 (Release 18)Rel-19 (Release 19) Rel-20 (Release 20)* |
|  |  |
| ***Reason for change:*** | This draft big CR includes the following draftCRs endorsed at RAN4#115 meeting for defining RRM core requirements for SBFD.

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| --- | --- | --- |
| **Tdoc** | **Title** | **Source company** |
| R4-2508293 | Draft CR on general for SBFD | vivo |
| R4-2508295 | draftCR on L1 CLI measurement | Nokia, Nokia Shanghai Bell |
| R4-2508297 | DraftCR on measurement period for L1-SRS-RSRP measurement | CMCC |
| R4-2508299 | Draft CR on scheduling applicability of R19 SBFD | ZTE Corporation, Sanechips |
| R4-2508294 | Draft CR on general L1-CLI-RSSI measurements | Samsung |
| R4-2508296 | Draft CR for L1-SRS-RSRP measurement period | LG Electronics Inc. |
| R4-2508298 | draft CR on scheduling restriction due to L1-CLI-RSSI measurement for SBFD | Ericsson |
| R4-2508305 | draftCR on CSI-RS based RLM evaluation period requirements with SBFD | Qualcomm Incorporated |
| R4-2508306 | DraftCR to update CSI-RS based BFD evaluation period due to impact of SBFD operation | CATT |
| R4-2508302 | Draft CR on CSI-RS based CBD evaluation period requirements with SBFD | China Telecom |
| R4-2508300 | draftCR on requirements of CSI-RS based L1-RSRP Reporting with SBFD | OPPO |
| R4-2508303 | draftCR on L1-SINR measurement requirements with SBFD | Huawei, HiSilicon |
| R4-2508304 | Draft CR on clarification of L3 CSI-RS measurement requirement for SBFD | MediaTek inc. |
| R4-2508301 | CR on Measurement gap and Active BWP switch delay for SBFD | Apple |

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| ***Summary of change:*** | Introduce RRM core requirements for SBFD. |
|  |  |
| ***Consequences if not approved:*** | RRM core requirements for SBFD are missing. |
|  |  |
| ***Clauses affected:*** | 3.3, 3.6x (new), 8.1.3.2, 8.5.3.2, 8.5.6.2, 9.5.4.2, 9.8.4.1, 9.8.4.2, 9.8.4.3, 9.10.1, 9.x (new) |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **x** |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** |  | **x** |  Test specifications | TS/TR ... CR ...  |
| ***(show related CRs)*** |  | **x** |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

<Start of Change 1>

## 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

ATG Air to Ground

AWGN Additive White Gaussian Nouse

BFD Beam Failure Detection

BFD-RS BFD Reference Signal

BLER Block Error Rate

BM-RS Beam Management Reference Signal

BW Bandwidth

BWP Bandwidth Part

CA Carrier Aggregation

CBD Candidate Beam Detection

CBW Channel Bandwidth

CC Component Carrier

CCA Clear Channel Assessment

CCE Control Channel Element

CG-SDT Configured Grant Small Data Transmission

CHO Conditional Handover

CLI Cross Link Interference

CMR Channel Measurement Resource

CN Core Network

CORESET Control Resource Set

CP Cyclic Prefix

CPC Conditional PSCell Change

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

DAPS Dual Active Protocol Stack

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

DPC Delta Power Class

DRX Discontinuous Reception

E-CID Enhanced Cell ID

eDRX Extended DRX

E-UTRA Evolved UTRA

E-UTRAN Evolved UTRAN

EMR Early measurement reporting

EMW Effective measurement window

EMWRP Effective measurement window repetition period

EN-DC E-UTRA-NR Dual Connectivity

FDD Frequency Division Duplex

FH Frequency Hopping

FR Frequency Range

GEO Geostationary Earth Orbit

GNSS Global Navigation Satellite System

GSO Geosynchronous Orbit

HARQ Hybrid Automatic Repeat Request

HO Handover

HST High Speed Train

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

IMR Interference Measurement Resource

kHz Kilo Hertz

L1-RSRP Layer 1 RSRPL1 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

LTM L1/L2 triggered mobility

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

MHz Mega Hertz

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

NGSO Non-Geosynchronous Orbit

NR New Radio

NR-DC NR-NR Dual Connectivity

NTN Non-Terrestrial Network

OCNG OFDMA Channel Noise Generator

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

PCI Physical Cell Identity

PDCCH Physical Downlink Control Channel

PDSCH Physical Downlink Shared Channel

PLMN Public Land Mobile Network

PRACH Physical RACH

Pre-MG Pre-configured Measurement Gap

ProSe Proximity-based Service

PRB Physical Resource Block

PRP PRS Received Power

PRS Positioning Reference Signal

PRS-RSRP Positioning Reference Signal based Reference Signal Received Power

PPW PRS Processing Window

PPWL PRS Processing Window Length

PPWRP PRS Processing Window Repetition Period

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

PTW Paging Time Window

PUCCH Physical Uplink Control Channel

PUSCH Physical Uplink Shared Channel

QCL Quasi Co-Location

RACH Random Access Channel

RAN Radio Access Network

RAT Radio Access Technology

RF Radio Frequency

RLM Radio Link Monitoring

RLM-RS Reference Signal for RLM

RMC Reference Measurement Channel

RMSI Remaining Minimum System Information

RRC Radio Resource Control

RRH Remote Radio Head

RRM Radio Resource Management

RRT RF Retuning Time

RS Reference Signal

RSCP Reference Signal Carrier Phase

RSCPD Reference Signal Carrier Phase Difference

RSSI Received Signal Strength Indicator

RSRP Reference Signal Received Power

RSRPP Reference Signal Received Path Power

RSRQ Reference Signal Received Quality

RSTD Reference Signal Time Difference

RTD Receive Timing Difference

RTOA Relative Time Of Arrival

RTT Round Trip Time

S-SSB Sidelink Synchronization Signal Block

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 or radiated interface boundary.

SA Standalone operation mode

SAB Satellite access band

SAN Satellite Access Node

SBFD Subband non-overlapping Full Duplex

SCC Secondary Component Carrier

SCCH Sidelink Control Channel

SCell Secondary Cell

SCG Secondary Cell Group

SCH Synchronization Channel

SCS Subcarrier Spacing

SCSSSB SSB subcarrier spacing

SDL Supplementary Downlink

SDT Small Data Transmission

SFN System Frame Number

SFTD SFN and Frame Timing Difference

SI System Information

SIB System Information Block

SL Sidelink

SL AoA Sidelink AoA

SL PRS-RSRP Sidelink PRS-based RSRP

SL PRS-RSRPP Sidelink PRS-based RSRPP

SL RSTD Sidelink RSTD

SL RTOA Sidelink RTOA

SL Rx-Tx Sidelink Receive-Transmit time difference

SL-PRP SL-PRS Received Power

SL-PRS Sidelink PRS

SL-RSSI Sidelink Received Signal Strength Indicator

SLPP Sidelink Positioning Protocol

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

TDCP Time Domain Channel Properties

TDD Time Division Duplex

TDOA Time Difference Of Arrival

TE Test Equipment

TN Terrestrial Network

TRP Transmission-Reception Point

TRS Tracking Reference Signal

TTI Transmission Time Interval

U2N UE-to-Network

U2U UE-to-UE

UE User Equipment

UL Uplink

V2X Vehicle-to-Everything service

VIL Visible Interruption Length

VIRP Visible Interruption Repetition Period

VSAT Very Small Aperture Terminal

<End of Change 1>

<Start of Change 2>

3.6.x Applicability of requirements for SBFD

If UE supports [SBFD capability] and [SBFD configuration] is configured by network, in all applicable requirements hereafter the term “UL slot” includes UL slot or SBFD slot in which UE performs transmission, and the term “DL slot” includes DL slot or SBFD slot in which UE performs reception[/measurement].

<End of Change 2>

<Start of Change 3>

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 period becomes worse than the threshold Qout\_CSI-RS within TEvaluate\_out\_CSI-RS 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.

For the value of L1Out and L1In,

1> If the UE does not support [SBFD capability] or [SBFD configuration] is not configured by the network,

2> L1Out = 0;

2> L1In = 0;

1> Else if the UE supports [SBFD capability] and [SBFD configuration] is configured by the network,

2> If DRX is not configured,

3> L1Out is the number of occasions of the CSI-RS resource for RLM that are overlapping with dynamic UL transmission on SBFD symbols during TEvaluate\_Out\_CSI-RS;

3> L1In is the number of occasions of the CSI-RS resource for RLM that are overlapping with dynamic UL transmission on SBFD symbols during TEvaluate\_In\_CSI-RS, when DRX is not configured

2> If DRX is configured,

3> L1Out is the number of DRX cycles in which at least one occasion of the CSI-RS resource for RLM is overlapping with dynamic UL transmission on SBFD symbols during TEvaluate\_Out\_CSI-RS;

3> L1In is the number of DRX cycles in which at least one occasion of the CSI-RS resource for RLM is overlapping with dynamic UL transmission on SBFD symbols during TEvaluate\_In\_CSI-RS;

If the UE supports [SBFD capability] and [SBFD configuration] is configured by the network, the requirements in this clause apply provided that all the occasions of the CSI-RS resource are in the same type (i.e., SBFD or non-SBFD) of symbols.

For a UE supporting *concurrentMeasGapsPreMG-r18* and when concurrent measurement gap(s) with Pre-MG(s) are configured, or a UE supporting *concurrentMeasGapsNCSG-r18* and when concurrent measurement gap(s) with NCSG(s) are configured, or a UE supporting *concurrentMeasGap-r17* or *musim-GapPreference-r17* or both *concurrentMeasGap-r17* and *musim-GapPreference-r17,* and when concurrent measurement gaps or periodic MUSIM gaps or both concurrent GAPs and periodic MUSIM gaps are are configured,

- an RLM-RS resource occasion is not considered to be overlapped by a gap occasion if the gap occasion is dropped according to clauses 9.1.8 and 9.1.10,

- 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, xRP\_max), where xRP\_max is the maximum xRP across all configured per-UE measurement gaps or periodic MUSIM gap(s) or NCSGs and per-FR measurement gaps or NCSGs, and, in case of Pre-MG, all activated 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 W, including those overlapped with GAP occasions, MUSIM 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 non-dropped GAP occasion nor non-dropped MUSIM gap occasion within the window W, and

- Navailable is the number of RLM-RS resource occasions that are not overlapped with any non-dropped GAP occasion, nor non-dropped MUSIM gap occasion, nor any SMTC occasion within the window W, and

- an RLM-RS resource occasion is considered to be overlapped with the MUSIM gap if it overlaps a MUSIM gap occasion, and

- TL1 is periodicity of the target RLM-RS.

- xRP = MGRP when configured GAP is activated Pre-MG or MG, and xRP = VIRP when configured GAP is NCSG.

Otherwise, for a UE neither supporting *concurrentMeasGap-r17* nor *concurrentMeasGapsPreMG-r18* nor *concurrentMeasGapsNCSG-r18* nor supporting *musim-GapPreference-r17* or when neither of the above configurations applies, i.e. concurrent measurement gaps, concurrent measurement gap(s) with Pre-MG(s), concurrent measurement gap(s) with NCSG(s), and periodic MUSIM gaps,

For FR1,

- $P=\frac{1}{1-\frac{T\_{CSI-RS}}{xRP}}$, 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.

- $P=\frac{1}{1-\frac{T\_{CSI-RS}}{xRP}}$, when the RLM-RS resource is partially overlapped with GAP and the RLM-RS resource is not overlapped with SMTC occasion (TCSI-RS < xRP)

- $P=\frac{1}{1-\frac{T\_{CSI-RS}}{T\_{SMTCperiod}}}$, 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).

- $P=\frac{1}{1-\frac{T\_{CSI-RS}}{xRP} - \frac{T\_{CSI-RS}}{T\_{SMTCperiod}}}$, 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

- $P=\frac{P\_{sharing factor}}{1-\frac{T\_{CSI-RS}}{xRP}}$, 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 and TCSI-RS = 0.5 × TSMTCperiod

- $P=\frac{1}{1-\frac{T\_{CSI-RS}}{Min(xRP, T\_{SMTCperiod})}}$, 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

- $P=\frac{P\_{sharing factor}}{1-\frac{T\_{CSI-RS}}{xRP}}$, when the RLM-RS resource is partially overlapped with GAP and the RLM-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 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 higher layer in TS 38.331 [2] signalling 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 GAP is configured only and the GAP is not NCSG,

- an RLM-RS resource or an SMTC occasion is considered to be overlapped with the GAP if it overlaps a GAP occasion, and

- xRP = MGRP

- Otherwise, when NCSG 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 only, 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 or concurrent measurement gap(s) with Pre-MG(s) or concurrent measurement gap(s) with NCSG(s) are configured , an RLM-RS resource or an SMTC occasion is not considered to be overlapped by a GAP occasion if the GAP occasion is dropped according to clause 9.1.8, clause 9.1.12, clause 9.1.13, respectively.

If the higher layer in TS 38.331 [2] signalling 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.

When the configured aperiodic MUSIM gap is overlapping with RLM-RS resource occasion, longer evaluation period would be expected.

When UE is configured with MUSIM gap(s), and if RLM-RS resource occasions are fully overlapped with MUSIM gap(s) or the union of MUSIM gap(s) and GAPs, no requirement applies for CSI-RS based RLM.

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.

If the UE supports [SBFD capability] and [SBFD configuration] is configured by the network, the requirements in this clause apply provided that 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 in at least one DL subband.

**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+ L1Out)×P)×TCSI-RS) | Max(100, Ceil((Min+ L1In)×P) × TCSI-RS) |
| DRX ≤ 320 ms | Max(200, Ceil(1.5×(Mout+ L1Out)×P)× Max(TDRX, TCSI-RS)) | Max(100, Ceil(1.5×(Min+ L1In)×P)× Max(TDRX, TCSI-RS)) |
| DRX > 320 ms | Ceil((Mout+ L1Out)×P) × TDRX | Ceil((Min+ L1In)×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, 10 ms, 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+ L1Out)×P×N)×TCSI-RS) | Max(100, Ceil((Min+ L1In)×P×N) × TCSI-RS) |
| DRX ≤ 320 ms | Max(200, Ceil(1.5×(Mout+ L1Out)×P×N)× Max(TDRX, TCSI-RS)) | Max(100, Ceil(1.5×(Min+ L1In)×P×N)× Max(TDRX, TCSI-RS)) |
| DRX > 320 ms | Ceil((Mout+ L1Out)×P×N) × TDRX | Ceil((Min+ L1In)×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 ≤ 320 ms | Ceil(1.5 ×Mout×P) × Max(TDRX, measCyclePSCell) | Ceil(1.5 ×Min×P) × Max(TDRX, measCyclePSCell) |
| DRX > 320 ms | 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 ≤ 320 ms | Ceil(1.5 × Mout×P×N) × Max(TDRX, measCyclePSCell) | Ceil(1.5 × Min×P×N) × Max(TDRX, measCyclePSCell) |
| DRX > 320 ms | 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. |

<End of Change 3>

<Start of Change 4>

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 $\bar{q}\_{0}$ estimated over the last TEvaluate\_BFD\_CSI-RS period becomes worse than the threshold Qout\_LR\_CSI-RS within TEvaluate\_BFD\_CSI-RS 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.

- For a UE supporting *concurrentMeasGapsPreMG-r18* and when concurrent measurement gap(s) with Pre-MG(s) are configured, or a UE supporting *concurrentMeasGapsNCSG-r18* and when concurrent measurement gap(s) with NCSG(s) are configured, or a UE supporting *concurrentMeasGap-r17* or *[musim-GapPreference-r17]* or both *concurrentMeasGap-r17* and *musim-GapPreference-r17,* and when concurrent gaps or periodic MUSIM gaps or both concurrent GAPs and periodic MUSIM gaps are configured,

- an CSI-RS resource occasion for beam failure detection is not considered to be overlapped by a gap occasion if the gap occasion is dropped according to clause 9.1.8 and 9.1.10,

- 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, xRP\_max), where xRP\_max is the maximum xRP across all configured per-UE measurement gaps or MUSIM gap(s) or NCSGs and per-FR measurement gaps or NCSGs, and, in case of Pre-MG, all activated 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 W, including those overlapped with GAP occasions, MUSIM gap occasions or SMTC occasions within the window W, and

- Noutside\_MG is the number of BFD-RS resource occasions that are not overlapped with any non-dropped GAP occasion nor non-dropped MUSIM gap occasion within the window W, and

- Navailable is the number of BFD-RS resource occasions that are not overlapped with any non-dropped GAP occasion nor non-dropped MUSIM gap occasion nor any SMTC occasion within the window W, and

- an CSI-RS resource occasion for beam failure detection is considered to be overlapped with the MUSIM gap if it overlaps a MUSIM gap occasion, and

 TL1 is periodicity of the target BFD-RS.

- xRP = MGRP when configured GAP is activated Pre-MG or MG, and xRP = VIRP when configured GAP is NCSG.

Otherwise, for a UE neither supporting *concurrentMeasGap-r17* nor *concurrentMeasGapsPreMG-r18* nor *concurrentMeasGapsNCSG-r18* nor supporting *musim-GapPreference-r17* or when neither of the above configurations applies, i.e. concurrent measurement gaps, concurrent measurement gap(s) with Pre-MG(s) and concurrent measurement gap(s) with NCSG(s), and periodic MUSIM gaps,For FR1,

For FR1,

- $P=\frac{1}{1-\frac{T\_{CSI-RS}}{xRP}}$, 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.

- $P=\frac{1}{1-\frac{T\_{CSI-RS}}{xRP}}$, when the BFD-RS resource is partially overlapped with GAP and the BFD-RS resource is not overlapped with SMTC occasion (TCSI-RS < xRP)

- $P=\frac{1}{1-\frac{T\_{CSI-RS}}{T\_{SMTCperiod}}}$, 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).

- $P=\frac{1}{1-\frac{T\_{CSI-RS}}{xRP} - \frac{T\_{CSI-RS}}{T\_{SMTCperiod}}}$, 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 = xRP and TCSI-RS < 0.5 × TSMTCperiod

- $P=\frac{P\_{sharing factor}}{1-\frac{T\_{CSI-RS}}{xRP}}$, 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

- $P=\frac{1}{1-\frac{T\_{CSI-RS}}{Min(xRP, T\_{SMTCperiod})}}$, 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.

- $P=\frac{P\_{sharing factor}}{1-\frac{T\_{CSI-RS}}{xRP}}$, when the BFD-RS resource is partially overlapped with 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 higher layer in TS 38.331 [2] signalling 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 GAP is configured only and the GAP is not NCSG,

- a BFD-RS resource or an SMTC occasion is considered to be overlapped with the GAP if it overlaps a GAP occasion, and

- xRP = MGRP

- Otherwise, when NCSG GAP only 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 only, 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 or concurrent measurement gap(s) with Pre-MG(s) or concurrent measurement gap(s) with NCSG(s) are configured, a BFD-RS resource or an SMTC occasion is not considered to be overlapped by a GAP occasion if the GAP occasion is dropped according to clause 9.1.8, clause 9.1.12, clause 9.1.13, respectively.

NOTE: The overlap between CSI-RS for BFD and SMTC means that CSI-RS for BFD is within the SMTC window duration.

For the value of L1,

1> If the UE does not support [SBFD capability] or [SBFD configuration] is not configured by the network

2> L1=0;

1> Else if the UE supports [SBFD capability] and [SBFD configuration] is configured by the network

2> If DRX is not configured,

3> L1 is the number of occasions of the configured BFD-RS resource that are overlapping with the dynamic UL transmission on SBFD symbols during TEvaluate\_BFD\_CSI-RS;

2> Else if DRX is configured,

3> L1 is the number of DRX cycles in which at least one occasion of the BFD-RS resource is overlapping with the dynamic UL transmission on SBFD symbols during TEvaluate\_BFD\_CSI-RS.

If the UE supports [SBFD capability] and [SBFD configuration] is configured by the network, the requirements in this clause apply provided that all occasions of the BFD-RS resource are in the same type of symbols.

Longer evaluation period would be expected if the combination of the BFD-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.

When the configured aperiodic MUSIM gap is overlapping with CSI-RS resource occasion for beam failure detection, longer evaluation period would be expected.

When UE is configured with MUSIM gap(s), and if CSI-RS resource occasions for beam failure detection are fully overlapped with MUSIM gap(s), or the union of MUSIM gap(s) and GAPs, no requirement applies for CSI-RS based beam failure detection.

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.

Note: If UE supports [SBFD capability] and [SBFD configuration] is configured by the network, the requirements in this clause apply provided that CSI-RS resource(s) in set  used for BFD is transmitted with Density = 3 and over the bandwidth ≥ 24 PRBs in at least one DL subband.

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+L1) × P × PBFD) × TCSI-RS) |
| DRX cycle ≤ 320 ms | Max(50, Ceil(1.5 × (MBFD+L1) × P × PBFD) × Max(TDRX, TCSI-RS)) |
| DRX cycle > 320 ms | Ceil((MBFD+L1) × 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+L1) × P × N × PBFD) × TCSI-RS) |
| DRX cycle ≤ 320 ms | Max(50, Ceil(1.5 × (MBFD+L1) × P × N × PBFD) × Max(TDRX, TCSI-RS)) |
| DRX cycle > 320 ms | Ceil((MBFD+L1) × 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 ≤ 320 ms | Ceil(1.5 × MBFD × P × PBFD) × Max(TDRX, measCyclePscell) |
| DRX cycle > 320 ms | 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 ≤ 320 ms | Ceil(1.5 × MBFD × P × N × PBFD) × Max(TDRX, measCyclePscell) |
| DRX cycle > 320 ms | 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.  |

<End of Change 4>

<Start of Change 5>

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 $\bar{q}\_{1}$ estimated over the last TEvaluate\_CBD\_CSI-RS period becomes better than the threshold Qin\_LR within TEvaluate\_CBD\_CSI-RS period provided CSI-RS Ês/Iot is according to annex 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 ≤ 320 ms.

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, where

- N = 2, 4 or 6 for serving cell in FR2-1 if the UE supports *fastBeamSweepingMultiRx-r18* according to the conditions in clause 3.6.19

- N=8 for other cases in FR2-1, and

- N=12 for FR2-2.

For the value of L1,

1> If the UE does not support [SBFD capability] or [SBFD configuration] is not configured by the network,

2> L1=0;

1> Else if the UE supports [SBFD capability] and [SBFD configuration] is configured by the network,

2> If DRX is not configured,

3> L1 is the number of occasions of the CSI-RS resource for candidate beam detection that are overlapping with dynamic UL transmission on SBFD symbols during TEvaluate\_CBD\_CSI-RS;

2> If DRX is configured,

3> L1 is the number of DRX cycles in which at least one occasion of the CSI-RS resource for candidate beam detection is overlapping with dynamic UL transmission on SBFD symbols during TEvaluate\_CBD\_CSI-RS.

If the UE supports [SBFD capability] and [SBFD configuration] is configured by the network, the requirements in this clause apply provided that all the occasions of the CSI-RS resource are in the same type of symbols.

For a UE supporting *concurrentMeasGapsPreMG-r18* and when concurrent measurement gap(s) with Pre-MG(s) are configured, or a UE supporting *concurrentMeasGapsNCSG-r18* and when concurrent measurement gap(s) with NCSG(s) are configured, or a UE supporting *concurrentMeasGap-r17* or *musim-GapPreference-r17* or both *concurrentMeasGap-r17* and *musim-GapPreference-r17* and when concurrent gaps or periodic MUSIM gaps or both concurrent GAPs and periodic MUSIM gaps are configured,

- an CSI-RS resource occasion for candidate beam detection is not considered to be overlapped by a gap occasion if the gap occasion is dropped according to clause 9.1.8 and 9.1.10,

- 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, xRP\_max), where xRP\_max is the maximum xRP across all configured per-UE measurement gaps or periodic MUSIM gap(s) or NCSGs and per-FR measurement gaps or NCSGs, and, in case of Pre-MG, all activated 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 W, including those overlapped with GAP occasions, MUSIM gap occasions or SMTC occasions within the window W, and

- Noutside\_MG is the number of CBD-RS resource occasions that are not overlapped with any non-dropped GAP occasion nor non-dropped MUSIM gap occasion within the window W, and

- Navailable is the number of CBD-RS resource occasions that are not overlapped with any non-dropped GAP occasion nor non-dropped MUSIM gap occasion nor any SMTC occasion within the window W, and

- an CSI-RS resource occasion for candidate beam detection is considered to be overlapped with the MUSIM gap if it overlaps a MUSIM gap occasion, and

- TL1 is periodicity of the target CBD-RS, and

- xRP = MGRP when configured GAP is activated Pre-MG or MG, and xRP = VIRP when configured GAP is NCSG.

Otherwise, for a UE neither supporting *concurrentMeasGap-r17* nor *concurrentMeasGapsPreMG-r18* nor *concurrentMeasGapsNCSG-r18* nor supporting *musim-GapPreference-r17* or when neither of the above configurations applies, i.e. concurrent measurement gaps, concurrent measurement gap(s) with Pre-MG(s), concurrent measurement gap(s) with NCSG(s), and periodic MUSIM gaps,

For FR1,

- $P=\frac{1}{1-\frac{T\_{CSI-RS}}{xRP}}$, 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.

- $P=\frac{1}{1-\frac{T\_{CSI-RS}}{xRP}}$ when candidate beam detection RS is partially overlapped with GAP and candidate beam detection RS is not overlapped with SMTC occasion (TCSI-RS < xRP)

- $P=\frac{1}{1-\frac{T\_{CSI-RS}}{T\_{SMTCperiod}}}$, 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).

- $P=\frac{1}{1-\frac{T\_{CSI-RS}}{xRP} - \frac{T\_{CSI-RS}}{T\_{SMTCperiod}}}$,, 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

- $P=\frac{P\_{sharing factor}}{1-\frac{T\_{CSI-RS}}{xRP}}$, 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

- $P=\frac{1}{1-\frac{T\_{CSI-RS}}{Min(xRP, T\_{SMTCperiod})}}$, 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

- $P=\frac{3}{1-\frac{T\_{CSI-RS}}{xRP}}$,, 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 higher layer in TS 38.331 [2] signalling 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 GAP is configured only and the GAP is not NCSG,

- a CBD-RS resource or an SMTC occasion is considered to be overlapped with the GAP if it overlaps the GAP occasion, and

- xRP = MGRP

- Otherwise, when NCSG GAP only 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

- If the UE is configured with Pre-MG only, an CBD-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 or concurrent measurement gap(s) with Pre-MG(s) or concurrent measurement gap(s) with NCSG(s) are configured, a CBD-RS resource or an SMTC occasion is not considered to be overlapped by a GAP occasion if the GAP occasion is dropped according to clause 9.1.8, clause 9.1.12, clause 9.1.13, respectively.

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 GAP configurations does not meet previous 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.

When the configured aperiodic MUSIM gap is overlapping with CSI-RS resource occasion for candidate beam detection, longer evaluation period would be expected.

When UE is configured with MUSIM gap(s), and if CSI-RS resource occasions for candidate beam detection are fully overlapped with MUSIM gap(s), or the union of MUSIM gap(s) and GAPs, no requirement applies for CSI-RS based candidate beam detection.

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 $\bar{q}\_{1}$ is transmitted with Density = 3 and over the bandwidth ≥ 24 PRBs.

If the UE supports [SBFD capability] and [SBFD configuration] is configured by the network, the requirements in this clause apply provided that CSI-RS resource configured in the set $\bar{q}\_{1}$ is transmitted with Density = 3 and over the bandwidth ≥ 24 PRBs in at least one DL subband.

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 $\bar{q}\_{1}$ 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 $\bar{q}\_{1}$ configured for PSCell in NR-DC

- PCBD = 2 if UE is configured for candidate beam detection on SCell, 1 otherwise.

- For each CSI-RS resource in the set $\bar{q}\_{1}$ 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 candidate beam 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 ≤ 320 ms | Max(25, Ceil((MCBD+L1) × P × PCBD) × TCSI-RS) |
| DRX cycle > 320 ms | Ceil((MCBD+L1) × 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 ≤ 320 ms | Max(25, Ceil((MCBD+L1) × P × N × PCBD) × TCSI-RS) |
| DRX cycle > 320 ms | Ceil((MCBD+L1) × P × N × PCBD) × TDRX |
| Note: TCSI-RS is the periodicity of CSI-RS resource in the set $\bar{q}\_{1}$. TDRX is the DRX cycle length. |

<End of Change 5>

<Start of Change 6>

9.5.4.2 CSI-RS based L1-RSRP Reporting

When *groupBasedBeamReporting-r17* is not configured, 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.

When *groupBasedBeamReporting-r17* is configured, the UE shall be capable of performing L1-RSRP measurements based on the two configured CSI-RS resource sets for L1-RSRP, and the UE physical layer shall be capable of reporting group-based 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) for table 9.5.4.2-2, 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 clauses 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 the value of L1,

1> If UE does not support [SBFD capability] or [SBFD configuration] is not configured by the network

2> L1=0

1> else (if UE supports [SBFD capability] and [SBFD configuration] is configured by the network)

2> if higher layer parameter *timeRestrictionForChannelMeasurement* is configured

3> L1=0

2> else (if higher layer parameter *timeRestrictionForChannelMeasurement* is not configured)

3> if UE is configured to report L1-RSRP for SBFD symbols

4> When DRX is not configured, L1 is the number of occasions of the CSI-RS resource that are overlapping with dynamic UL transmission [or with non-SBFD symbols] during TL1-RSRP\_Measurement\_Period\_CSI-RS

4> When DRX is configured, L1 is the number of DRX cycles in which at least one occasion of the CSI-RS resource is overlapping with dynamic UL transmission [or with non-SBFD symbols] during TL1-RSRP\_Measurement\_Period\_CSI-RS

3> if UE is configured to report L1-RSRP for non-SBFD symbols

4> When DRX is not configured, L1 is the number of occasions of the CSI-RS resource that are overlapping with SBFD symbols during TL1-RSRP\_Measurement\_Period\_CSI-RS, when DRX is not configured

4> When DRX is configured, L1 is the number of DRX cycles in which at least one occasion of the CSI-RS resource is overlapping with SBFD symbols during TL1-RSRP\_Measurement\_Period\_CSI-RS

For a UE supporting [*support for Case 1 requirements*] and when concurrent measurement gap(s) with Pre-MG(s) are configured, or a UE supporting [*support for Case 2 requirements*] and when concurrent measurement gap(s) with NCSG measurement gap(s) are configured, or a UE supporting *concurrentMeasGap-r17* or *musim-GapPreference-r17* or both concurrent measurement gap and *musim-GapPreference-r17* and when concurrent gaps or periodic MUSIM gaps or both concurrent gaps and periodic MUSIM 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 clauses 9.1.8 and 9.1.10,

- 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, xRP\_max), where xRP\_max is the maximum xRP across all configured per-UE measurement gaps or NCSGs, MUSIM gap(s)and per-FR measurement gaps or NCSGs, and, in case of Pre-MG, all activated 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 W, including those overlapped with measurement gap occasions, MUSIM gap occasions or SMTC occasions within the window W, and

- Noutside\_MG is the number of CSI-RS resource occasions that are not overlapped with any non-dropped GAP occasions nor non-dropped MUSIM gap occasion within the window W, and

- Navailable is the number of CSI-RS resource occasions that are not overlapped with any non-dropped GAP occasions, non-dropped MUSIM gap occasion nor any SMTC occasion within the window W.

- a CSI-RS or an SMTC occasion is considered to be overlapped with the MUSIM gap if it overlaps a MUSIM gap occasion.

- xRP = MGRP when configured GAP is activated Pre-MG or MG, and xRP = VIRP when configured GAP is NCSG.

TL1 is periodicity of the target CSI-RS.

Otherwise, for a UE neither supporting *concurrentMeasGap-r17* nor *[support for Case 1 requirements]* nor *[support for Case 2 requirements]* or when neither of the above configurations applies, i.e. concurrent measurement gaps, concurrent measurement gap(s) with Pre-MG(s) and concurrent measurement gap(s) with NCSG measurement gap(s), and UE does not support *musim-GapPreference-r17* or when no MUSIM gaps are configured.

For FR1,

- P=$\frac{1}{1-\frac{T\_{CSI-RS}}{xRP}}$, 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=$\frac{1}{1-\frac{T\_{CSI-RS}}{xRP}}$, when CSI-RS is partially overlapped with GAP and CSI-RS is not overlapped with SMTC occasion (TCSI-RS < xRP)

- P=$\frac{1}{1-\frac{T\_{CSI-RS}}{T\_{SMTCperiod}}}$, 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=$ \frac{1}{1-\frac{T\_{CSI-RS}}{xRP}-\frac{T\_{CSI-RS}}{T\_{SMTCperiod}}}$, 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=$\frac{3}{1-\frac{T\_{CSI-RS}}{xRP}}$, 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 and TCSI-RS = 0.5\*TSMTCperiod

- P=$ \frac{1}{1-\frac{T\_{CSI-RS}}{min⁡(T\_{SMTCperiod},xRP)}}$, 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=$\frac{P\_{sharing factor}}{1-\frac{T\_{CSI-RS}}{xRP}}$, 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

- 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

- 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.

- Otherwise, when NCSG measurement gap only 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 UE is configured with aperiodic MUSIM gap and the aperiodic MUSIM gap is overlapping with CSI-RS resource occasion for L1-RSRP, longer evaluation period would be expected.

When UE is configured with MUSIM gap(s), and CSI-RS resource occasions for L1-RSRP are fully overlapped with MUSIM gap(s) or fully overlapped with the union of MUSIM gap(s) and GAPs, no requirement applies for the CSI-RS based L1-RSRP measurement.

**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+L1)\*P)\*TCSI-RS) |
| DRX cycle ≤ 320 ms | max(TReport, ceil(K \*(M+L1)\*P)\*max(TDRX,TCSI-RS)) |
| DRX cycle > 320 ms | ceil((M+L1)\*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+L1)\*P\*N)\*TCSI-RS) |
| DRX cycle ≤ 320 ms | max(TReport, ceil(1.5\*(M+L1)\*P\*N)\*max(TDRX,TCSI-RS)) |
| DRX cycle > 320 ms | ceil((M+L1)\*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 9.5.4.2-2A: Void**

<End of Change 6>

<Start of Change 7>

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 clauses 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.

For the value of L1,

1> If UE does not support [SBFD capability] or [SBFD configuration] is not configured by the network

2> L1=0

1> else (if UE supports [SBFD capability] and [SBFD configuration] is configured by the network)

2> if higher layer parameter *timeRestrictionForChannelMeasurement* is configured

3> L1=0

2> else (if higher layer parameter *timeRestrictionForChannelMeasurement* is not configured)

3> if UE is configured to report L1-SINR for SBFD symbols

4> When DRX is not configured, L1 is the number of occasions of the CSI-RS resource as CMR that are overlapping with dynamic UL transmission [or with non-SBFD symbols] during TL1-SINR\_Measurement\_Period\_CSI-RS\_CMR\_Only

4> When DRX is configured, L1 is the number of DRX cycles in which at least one occasion of the CSI-RS resource as CMR is overlapping with dynamic UL transmission [or with non-SBFD symbols] during TL1-SINR\_Measurement\_Period\_CSI-RS\_CMR\_Only

3> if UE is configured to report L1-SINR for non-SBFD symbols

4> [When DRX is not configured, L1 is the number of occasions of the CSI-RS resource as CMR that are overlapping with SBFD symbols during TL1-SINR\_Measurement\_Period\_CSI-RS\_CMR\_Only

4> When DRX is configured, L1 is the number of DRX cycles in which at least one occasion of the CSI-RS resource as CMR is overlapping with SBFD symbols during TL1-SINR\_Measurement\_Period\_CSI-RS\_CMR\_Only]

For a UE supporting [*support for Case 1 requirements*] and when concurrent measurement gap(s) with Pre-MG(s) are configured, or a UE supporting [*support for Case 2 requirements*] and when concurrent GAP(s) with NCSG(s) are configured, or a UE supporting *concurrentMeasGap-r17* or *musim-GapPreference-r17* or both concurrent measurement gap and *musim-GapPreference-r17* and when concurrent GAPs or periodic MUSIM gaps or both concurrent gaps and periodic MUSIM 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 and 9.1.10,

- 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, xRP\_max), where xRP\_max is the maximum xRP across all configured per-UE GAPs or periodic MUSIM gap(s) and per-FR GAPs, and, in case of Pre-MG, all activated 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 GAP occasions, MUSIM 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 non-dropped GAP occasion nor non-dropped MUSIM gap occasion within the window W, and

- Navailable is the number of CSI-RS resource occasions that are not overlapped with any non-dropped GAP occasion, non-dropped MUSIM gap occasion nor any SMTC occasion within the window W.

- a CSI-RS or an SMTC occasion is considered to be overlapped with the MUSIM gap if it overlaps a MUSIM gap occasion.

- TL1 is periodicity of the target CSI-RS.

- xRP = MGRP when configured GAP is activated Pre-MG or MG, and xRP = VIRP when configured GAP is NCSG.

Otherwise, for a UE neither supporting *concurrentMeasGap-r17* nor *[support for Case 1 requirements]* nor *[support for Case 2 requirements]* or when neither of the above configurations applies, i.e. concurrent measurement gaps, concurrent measurement gap(s) with Pre-MG(s) and concurrent GAP(s) with NCSG(s) and UE does not support *musim-GapPreference-r17* or when no MUSIM gaps are configured,

For the value of P in FR1,

- P=$\frac{1}{1-\frac{T\_{CSI-RS}}{xRP}}$, when in the monitored cell there are GAP 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=$\frac{1}{1-\frac{T\_{CSI-RS}}{xRP}}$, when CSI-RS is partially overlapped with GAP and CSI-RS is not overlapped with SMTC occasion (TCSI-RS < xRP)

- P=$\frac{1}{1-\frac{T\_{CSI-RS}}{T\_{SMTCperiod}}}$, 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 GAP and CSI-RS is fully overlapped with SMTC occasion (TCSI-RS = TSMTCperiod).

- P=$ \frac{1}{1-\frac{T\_{CSI-RS}}{xRP}-\frac{T\_{CSI-RS}}{T\_{SMTCperiod}}}$, 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=$\frac{P\_{sharing factor}}{1-\frac{T\_{CSI-RS}}{xRP}}$, 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 and TCSI-RS = 0.5\*TSMTCperiod

- P=$ \frac{1}{1-\frac{T\_{CSI-RS}}{min⁡(T\_{SMTCperiod},xRP)}}$, 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=$\frac{P\_{sharing factor}}{1-\frac{T\_{CSI-RS}}{xRP}}$, 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-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

- 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

- 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.

- Otherwise, when NCSG measurement gap only 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

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.

When UE is configured with aperiodic MUSIM gap and the aperiodic MUSIM gap is overlapping with CSI-RS resource occasion for L1-SINR, longer evaluation period would be expected.

When UE is configured with MUSIM gap(s), and CSI-RS resource occasions for L1-SINR are fully overlapped with MUSIM gap(s) or fully overlapped with the union of MUSIM gap(s) and GAPs, no requirement applies for the CSI-RS based L1-SINR measurement.

Longer evaluation period would be expected if the combination of CSI-RS, SMTC occasion and GAP configurations does not meet previous 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+L1)\*P)\*TCSI-RS) |
| DRX cycle ≤ 320 ms | max(TReport, ceil(1.5\*(M+L1)\*P)\*max(TDRX,TCSI-RS)) |
| DRX cycle > 320 ms | ceil((M+L1)\*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+L1)\*P\*N)\*TCSI-RS) |
| DRX cycle ≤ 320 ms | max(TReport, ceil(1.5\*(M+L1)\*P\*N)\*max(TDRX,TCSI-RS)) |
| DRX cycle > 320 ms | ceil((M+L1)\*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 = 2, 4 or 6 in FR2-1 for UE supporting *fastBeamSweepingMultiRx-r1*8, according to the conditions described in clause 3.6.19,

- N = 8 otherwise.

For the value of L1,

1> If UE does not support [SBFD capability] or [SBFD configuration] is not configured by the network

2> L1=0

1> else (if UE supports [SBFD capability] and [SBFD configuration] is configured by the network)

2> if higher layer parameter *timeRestrictionForChannelMeasurement* is configured

3> L1=0

2> else (if higher layer parameter *timeRestrictionForChannelMeasurement* is not configured)

3> if UE is configured to report L1-SINR for SBFD symbols

4> When DRX is not configured, L1 is the number of occasions of the CSI-RS/CSI-IM resource as IMR that are overlapping with dynamic UL transmission [or with non-SBFD symbols] during TL1-SINR\_Measurement\_Period\_SSB\_CMR\_IMR

4> When DRX is configured, L1 is the number of DRX cycles in which at least one occasion of the CSI-RS/CSI-IM resource as IMR is overlapping with dynamic UL transmission [or with non-SBFD symbols] during TL1-SINR\_Measurement\_Period\_SSB\_CMR\_IMR

3> if UE is configured to report L1-SINR for non-SBFD symbols

4> [When DRX is not configured, L1 is the number of occasions of the CSI-RS/CSI-IM resource as IMR that are overlapping with non-SBFD symbols, during TL1-SINR\_Measurement\_Period\_SSB\_CMR\_IMR

4> When DRX is configured, L1 is the number of DRX cycles in which at least one occasion of the CSI-RS/CSI-IM resource as IMR is overlapping with non-SBFD symbols, during TL1-SINR\_Measurement\_Period\_SSB\_CMR\_IMR]

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 previous 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+L1)\*P)\*TSSB) |
| DRX cycle ≤ 320 ms | max(TReport, ceil(1.5\*(M+L1)\*P)\*max(TDRX,TSSB)) |
| DRX cycle > 320 ms | ceil((M+L1)\*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+L1)\*P\*N)\*TSSB) |
| DRX cycle ≤ 320 ms | max(TReport, ceil(1.5\*(M+L1)\*P\*N)\*max(TDRX,TSSB)) |
| DRX cycle > 320 ms | ceil(1.5\*(M+L1)\*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 FR2-1**

|  |  |
| --- | --- |
| **Configuration** | **TL1-SINR\_Measurement\_Period\_SSB\_CMR\_IMR (ms)**  |
| non-DRX | max(TReport, ceil((M+L1)\*P\*N1Note 3)\*TSSB) |
| DRX cycle ≤ 80 ms | max(TReport, ceil((M+L1)\*P\*N1Note 3\*M2)\*max(TDRX,TSSB)) |
| 80 ms< DRX cycle ≤ 320 ms | max(TReport, ceil(1.5\*(M+L1)\*P\*N)\*max(TDRX,TSSB)) |
| DRX cycle > 320 ms | ceil(1.5\*(M+L1)\*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.

For the value of L1,

1> If UE does not support [SBFD capability] or [SBFD configuration] is not configured by the network

2> L1=0

1> else (if UE supports [SBFD capability] and [SBFD configuration] is configured by the network)

2> if higher layer parameter *timeRestrictionForChannelMeasurement* is configured

3> L1=0

2> else (if higher layer parameter *timeRestrictionForChannelMeasurement* is not configured)

3> if UE is configured to report L1-SINR for SBFD symbols

4> When DRX is not configured, L1 is the maximum between number of occasions of the CSI-RS resource as CMR that are overlapping with dynamic UL transmission [or with non-SBFD symbols] and number of occasions of the CSI-RS/CSI-IM resource as IMR that are overlapping with dynamic UL transmission [or with non-SBFD symbols], during TL1-SINR\_Measurement\_Period\_CSI-RS\_CMR\_IMR

4> When DRX is configured, L1 is the number of DRX cycles in which at least one occasion of the CSI-RS resource as CMR or at least one occasion of the CSI-RS/CSI-IM resource as IMR is overlapping with dynamic UL transmission [or with non-SBFD symbols], during TL1-SINR\_Measurement\_Period\_CSI-RS\_CMR\_IMR

3> if UE is configured to report L1-SINR for non-SBFD symbols

4> [When DRX is not configured, L1 is the maximum between number of occasions of the CSI-RS resource as CMR that are overlapping with non-SBFD symbols and number of occasions of the CSI-RS/CSI-IM resource as IMR that are overlapping with non-SBFD symbols, during TL1-SINR\_Measurement\_Period\_CSI-RS\_CMR\_IMR

4> When DRX is configured, L1 is the number of DRX cycles in which at least one occasion of the CSI-RS resource as CMR or at least one occasion of the CSI-RS/CSI-IM resource as IMR is overlapping with non-SBFD symbols, during TL1-SINR\_Measurement\_Period\_CSI-RS\_CMR\_IMR]

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 previous 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+L1)\*P)\*TCSI-RS) |
| DRX cycle ≤ 320 ms | max(TReport, ceil(1.5\*(M+L1)\*P)\*max(TDRX,TCSI-RS)) |
| DRX cycle > 320 ms | ceil((M+L1)\*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+L1)\*P\*N)\*TCSI-RS) |
| DRX cycle ≤ 320 ms | max(TReport, ceil(1.5\*(M+L1)\*P\*N)\*max(TDRX,TCSI-RS)) |
| DRX cycle > 320 ms | ceil((M+L1)\*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. |

<End of Change 7>

<Start of Change 8>

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

- For a UE capable of supporting [SBFD-R19],

- Measurement requirements are applicable provided that all CSI-RS resources configured for measurement are available in one DL subband of SBFD symbols and/or on non-SBFD DL symbols of the cell transmitting the CSI-RS.

The measurement reporting delay can be longer for the measurement reporting requirements in this clause when IDC autonomous denial is configured.

<End of Change 8>

<Start of Change 9>

9.x L1 Cross Link Interference measurements

9.x.1 Introduction

The UE capable of performing L1 CLI measurements shall be able to measure L1-SRS-RSRP and L1-CLI-RSSI which are defined in TS 38.215 [4] within active DL BWP. The measurements requirements in this clause apply for [TDD mode only].

L1 CLI measurements are only applicable for RRC\_CONNECTED intra-frequency:

- when L1-SRS-RSRP measurement resource is configured within active DL BWP

- when L1-CLI-RSSI measurement resource is configured within active DL BWP

The measurements shall be performed for a serving cell, including PCell, PSCell, [or SCell], on the resources configured for L1-SRS-RSRP and L1-CLI-RSSI measurements within the active BWP.

For performing CLI measurements in FR2, UE can optionally be configured with CLI measurement resources containing an explicit indication of a TCI state providing a TypeD QCL source [26, TS 38.214]. If the TCI state is not configured, 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.

The measurement reporting delay can be longer for the measurement reporting requirements in this clause when IDC autonomous denial is configured.

9.x.2 L1-SRS-RSRP measurements

9.x.2.1 Introduction

When configured by the network, the UE shall be able to perform L1-SRS-RSRP measurements on the [*SRS-RSRP-MeasurementResourceSet*] configured in a *CSI-ResourceConfig*.

When the UE measures L1-SRS-RSRP, 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.

9.x.2.2 Requirements applicability

The requirements in clause 9.x.2 apply, provided:

- SRS resources configured for L1-SRS-RSRP measurements are measurable.

An SRS resource configured for L1-SRS-RSRP shall be considered measurable when for each relevant SRS the following conditions are met:

- L1-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.x.2.3 Measurement Reporting Requirements

The UE shall send L1-SRS-RSRP reports only for report configurations configured for the active DL BWP,

The UE shall report the L1-SRS-RSRP value as a 7-bit value in the range [-140, -44] dBm with 1 dB step size according to clause 10.1.X for FR1 and 10.1.Y for FR2 if *nrofReportedCLIMeasureResources* is configured to one. If *nrofReportedCLIMeasureResources* is configured to be larger than one, the UE shall use differential L1-SRS-RSRP based reporting as defined in clause 10.1.X for FR1 and 10.1.Y for FR2. The differential L1-SRS-RSRP is quantized to a 4-bit value with 2 dB step size. The mapping between the reported L1-SRS-RSRP value and the measured quantity is described in clause 10.1.X.

##### 9.x.2.3.1 Aperiodic Reporting

Reported L1-SRS-RSRP measurements contained in aperiodic triggered[, aperiodic triggered periodic and aperiodic triggered semi-persistent] L1-SRS-RSRP reports shall meet the requirements in clauses [10.1.X] for FR1 and [10.1.Y] for FR2, respectively.

The UE shall only send aperiodic L1-SRS-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-SRS-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.x.2.4 Measurement capability

The UE shall be capable of performing L1-SRS-RSRP measurements on the SRS resources configured for measurement, provided [TBD].

9.x.2.5 L1-SRS-RSRP measurement period

The UE shall be capable of performing L1-SRS-RSRP measurement based on the configured SRS resource. For periodic and semi-persistent SRS resource, the UE shall be capable of reporting L1-SRS-RSRP measured over measurement period of TL1\_SRS\_RSRP\_measurement\_period for FR1 and FR2.

**Table 9.x.2.5‑1 Measurement period TL1\_SRS\_RSRP\_measurement\_period**

|  |  |
| --- | --- |
| **Configuration** | **TL1\_SRS\_measurement\_period (ms)** |
| No DRX | Max(TReport, M X TSRS) |
| DRX cycle ≤ 320 ms | Max(TReport, Ceil(1.5 X M) X max(TSRS, TDRX)) |
| DRX cycle > 320 ms |  M X TDRX |
| NOTE 1: TSRS is SRS measurement periodicity configured *SRS-PeriodicityAndOffset*, and TDRX is the DRX cycle length. TReport is configured periodicity for reporting.NOTE 2: M=1 if higher layer parameter *timeRestrictionForChannelMeasurement* is configured, and M=3 otherwise. |

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 TL1\_SRS\_RSRP\_measurement\_period.

*[Editor notes: measurement restriction for the case that measurement resources for L1-SRS-RSRP and L1-CLI-RSSI are partially or fully overlapping will be added later if consensus reached]*

9.x.2.6 Scheduling availability of UE during L1-CLI measurements

Scheduling availability when the UE is performing L1-CLI measurements which are L1-SRS-RSRP and L1-CLI-RSSI are described in the following clause.

##### 9.x.2.6.1 Scheduling availability of UE performing L1-SRS-RSRP measurement on FR1

The following scheduling restriction applies due to L1-SRS-RSRP measurements.

- The UE is not expected to transmit PUCCH/PUSCH/SRS on OFDM symbols on which the UE performs L1-SRS-RSRP measurements, and on 1 data symbol before the OFDM symbol(s) used for L1-SRS-RSRP measurements for 15 kHz and 30 kHz subcarrier spacing.

- For the UE which does not support [*SRS-RSRP-FDM\_DL]*, the UE is not expected to receive PDCCH/PDSCH/CSI-RS for tracking/CSI-RS for CQI on OFDM symbol(s) on which the UE performs L1-SRS-RSRP measurements, and on 1 data symbol before the OFDM symbol(s) used for L1-SRS-RSRP 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 L1-SRS-RSRP measurement, and on 2 data symbols before the OFDM symbol(s) used for L1-SRS-RSRP measurements for 60 kHz subcarrier spacing.

- For the UE which does not support [*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 L1-SRS-RSRP measurement, and on 2 data symbols before the OFDM symbol(s) used for L1-SRS-RSRP 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 to all serving cells in the same band on the symbols that fully or partially overlap with restricted symbols.

When intra-band non-contiguous carrier aggregation is configured for a UE indicating *intraBandNR-CA-non-collocated-r18* and if *nonCollocatedTypeNR-CA-r18* is not provided, there are no scheduling restrictions on FR1 serving cell(s) to be measured and configured on the non-contiguous CC(s) in the same band. Otherwise, the scheduling restrictions on serving cell where CLI measurements are performed apply to all serving cells in the same band on the symbols that fully or partially overlap with restricted symbols if *nonCollocatedTypeNR-CA-r18* is provided.]

##### 9.x.2.6.2 Scheduling availability of UE performing L1-SRS-RSRP measurement on FR2

The following scheduling restriction applies due to L1-SRS-RSRP measurements.

- The UE is not expected to transmit PUCCH/PUSCH/SRS on OFDM symbols on which the UE performs L1-SRS-RSRP measurements, and on 1 data symbol before the OFDM symbol(s) used for L1-SRS-RSRP measurements for 60 kHz subcarrier spacing.

- For the UE which does not support *[SRS-RSRP-FDM\_DL]*, the UE is not expected to receive PDCCH/PDSCH/CSI-RS for tracking/CSI-RS for CQI on the OFDM symbols on which the UE performs L1-SRS-RSRP measurements, and on 1 data symbol before the OFDM symbol(s) used for L1-SRS-RSRP measurements for 60 kHz subcarrier spacing.

- For the UE which supports *[SRS-RSRP-FDM\_DL]* but the SRS resources are not TypeD QCL-ed with PDCCH/PDSCH, 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 L1-SRS-RSRP measurements, and on 1 data symbol before the OFDM symbol(s) used for L1-SRS-RSRP measurements for 60 kHz subcarrier spacing.

- The UE is not expected to transmit PUCCH/PUSCH/SRS on OFDM symbols on which the UE performs L1-SRS-RSRP measurements, and on 2 data symbols before the OFDM symbol(s) used for L1-SRS-RSRP measurements for 120 kHz subcarrier spacing.

- For the UE which does not support *[SRS-RSRP-FDM\_DL]*, the UE is not expected to receive PDCCH/PDSCH/CSI-RS for tracking/CSI-RS for CQI on the OFDM symbol(s) on which the UE performs L1-SRS-RSRP measurements, and on 2 data symbols before the OFDM symbol(s) used for L1-SRS-RSRP measurements for 120 kHz subcarrier spacing.

- For the UE which supports *[SRS-RSRP-FDM\_DL]* but the SRS resources are not TypeD QCL-ed with PDCCH/PDSCH, the UE is not expected to receive PDCCH/PDSCH/CSI-RS for tracking/CSI-RS for CQI on the OFDM symbols on which the UE performs L1-SRS-RSRP measurements, and on 2 data symbols before the OFDM symbol(s) used for SRS-RSRP measurements for 120 kHz subcarrier spacing.

[When TDD intra-band carrier aggregation is configured, the scheduling restrictions on serving cell where L1-SRS-RSRP measurements are performed apply on all serving cells in the same band on the symbols that fully or partially overlap with restricted symbols.]

9.x.3 L1-CLI-RSSI measurements

9.x.3.1 Introduction

When configured by the network, the UE shall be able to perform L1-CLI-RSSI measurement of configured [*CLI-RSSI-MeasurementResourceSet]*, and:

* UE measures L1-CLI-RSSI within DL subband, if one L1-CLI-RSSI measurement resource is configured within a DL subband or one L1-CLI-RSSI measurement resource is configured across two DL subbands,
* UE measures L1-CLI-RSSI within UL subband.

When the UE measures L1-CLI-RSSI, the downlink reference timing in the serving cell shall be applied.

9.x.3.2 Requirements applicability

The requirements in clause 9.x.3 apply, provided:

- The measurement resources configured for L1-CLI-RSSI measurements are measurable.

A measurement resource configured for L1-CLI-RSSI shall be considered measurable when for each relevant L1-CLI-RSSI resource the following conditions are met:

- L1-CLI-RSSI related side conditions given in clauses 10.X.X.X for FR1 and FR2 for a corresponding band.

9.x.3.3 Measurement Reporting Requirements

The UE shall send L1-CLI-RSSI reports only for report configurations for periodical and aperiodic report when *[cli-RSSI]* is configured.

The UE shall report the L1-CLI-RSSI value as a 7-bit value in the range [-100, -25] dBm with 1 dB step size according to clause 10.X.X.X if *nrofReportedCLIMeasureResources* is configured to one. If *nrofReportedCLIMeasureResources* is configured to be larger than one, the UE shall use differential L1-CLI-RSSI based reporting as defined in clause 10.X.X.X. The differential L1-CLI-RSSI is quantized to a 4-bit value with 2 dB step size. The mapping between the reported L1-CLI-RSSI value and the measured quantity is described in clause 10.X.X.X.

9.x.3.3.1 Periodic Reporting

Reported L1-CLI-RSSI measurements contained in periodically triggered measurement reports shall meet the requirements in clause 10.X.X.X.

The UE shall transmit the periodic L1-CLI-RSSI reporting on PUCCH over the air interface according to the periodicity defined in clause 5.2.1.4 in TS 38.214 [26].

9.x.3.3.2 Aperiodic Reporting

Reported L1-CLI-RSSI measurements contained in aperiodically triggered L1-CLI-RSSI measurement reports shall meet the requirements in clauses 10.X.X.X.

The UE shall only send aperiodic L1-CLI-RSSI measurement reports, if a DCI trigger has been received.

After the UE receives CSI request in DCI, the UE shall transmit the aperiodic L1-CLI-RSSI reporting on PUSCH over the air interface at the time specified according to clause 6.1.2.1 in TS 38.214 [26].

9.x.3.4 Measurement capability

The UE shall be capable of performing L1-CLI-RSSI measurement based on the configured resource, provided that the maximum number of L1-CLI-RSSI measurement resources for the UE does not exceed [TBD].

9.x.3.5 L1-CLI-RSSI measurement period

The UE capable of [*performing L1 CLI measurement*] shall perform L1-CLI-RSSI measurement based on the configured L1-CLI-RSSI measurement resource, and the UE shall be capable of reporting L1-CLI-RSSI measured over measurement period of TL1-CLI\_RSSI\_measurement\_period for FR1 and FR2 when periodic and semi-persistent L1-CLI-RSSI measurement resoureces are configured.

**Table 9.x.3.5‑1 Measurement period TL1-CLI\_RSSI\_measurement\_period**

|  |  |
| --- | --- |
| **Configuration** | **TL1-CLI\_RSSI measurement\_period (ms)** |
| No DRX | Max(TReport, TCLI-RSSI) |
| DRX cycle ≤ 320ms | Max(TReport, Ceil(1.5) X max(TCLI-RSSI, TDRX)) |
| DRX cycle > 320ms |  TDRX |
| Note: TCLI-RSSI is L1-CLI-RSSI measurement periodicity configured *[RSSI-PeriodicityAndOffset-R19]*, and TDRX is the DRX cycle length. TReport is configured periodicity for reporting. |

For FR2, if the configured L1-CLI-RSSI measurement resources 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 TL1-CLI\_RSSI\_measurement\_period.

[*Editor notes: For FR1, FFS*]

[*Editor notes: measurement restriction for the case that measurement resources for L1-SRS-RSRP and L1-CLI-RSSI are partially or fully overlapping could be added or refer to L1-SRS-RSRP measurement period clause later if consensus reached*]

9.x.3.6 Scheduling availability of UE during L1-CLI-RSSI measurements

Scheduling availability restrictions when the UE is performing L1-CLI-RSSI are described in the following clause.

##### 9.X.3.6.1 Scheduling availability of UE performing L1-CLI-RSSI measurement on FR1

The following scheduling restriction applies due to the L1-CLI-RSSI measurement:

* The UE is not expected to transmit PUCCH/PUSCH/SRS on OFDM symbols on which the UE performs L1-CLI-RSSI measurements.

[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.

When intra-band non-contiguous carrier aggregation is configured for a UE indicating *intraBandNR-CA-non-collocated-r18* and if *nonCollocatedTypeNR-CA-r18* is not provided, there are no scheduling restrictions on FR1 serving cell(s) to be measured and configured on the non-contiguous CC(s) in the same band. Otherwise, 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 if *nonCollocatedTypeNR-CA-r18* is provided.]

##### 9.X.3.6.2 Scheduling availability of UE performing L1-CLI-RSSI measurement on FR2

The following scheduling restriction applies due to the L1-CLI-RSSI measurement:

* The UE is not expected to transmit PUCCH/PUSCH/SRS on OFDM symbols on which the UE performs L1-CLI-RSSI measurements.
* 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 L1-CLI-RSSI measurements when RSSI resources are not TypeD QCL-ed with PDCCH/PDSCH/CSI-RS.

[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.]

<End of Change 9>