**3GPP TSG-RAN WG4 Meeting #115R4-2508461**

**Malta, MT, 19 – 23 May, 2025**

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| *CR-Form-v12.3* |
| **CHANGE REQUEST** |
|  |
|  | 38.133 | **CR** |  | **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 NR mobility enhancements Phase 4 |
|  |  |
| ***Source to WG:*** | , China Telecom |
| ***Source to TSG:*** | R4 |
|  |  |
| ***Work item code:*** | NR\_Mob\_Ph4-Core |  | ***Date:*** | 2025-05-26 |
|  |  |  |  |  |
| ***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:*** | Draft big CR for RRM requirements of NR mobility enhancements Phase 4 in RAN4#115 |
|  |  |
| ***Summary of change:*** | The following endorsed CRs are consolidated in this big CR.R4-2508393 DraftCR for LTM L1 event-triggered reportingR4-2508394 DraftCR on event-triggered reporting for CSI-RS based L1 measurementR4-2508395 Draft CR on event-Triggered Reporting for Intra-Frequency L1 Measurements on Neighboring CellsR4-2508396 draft CR on CSI-RS based L1 measurement requirementR4-2508397 Draft CR to TS 38.133 on number of CSI-RS, number of cells and number of CSI-RS resourcesR4-2508445 DraftCR to 38.133 on LTM CSI-RS applicabilityR4-2506461 Draft CR on measurement reporting requirements for CSI-RS based LTMR4-2508399 Draft CR on introduction of CSI-RS L1-RSRP measurementR4-2508400 draftCR on measurement restriction for CSI-RS based L1-RSRPR4-2508401 Draft CR on scheduling availability of UE during CSI-RS based L1-RSRP measurementR4-2508405 DraftCR to 38.133 on conditional Intra-CU LTM |
|  |  |
| ***Consequences if not approved:*** | RRM requirements for NR mobility enhancements Phase 4 would still be missing. |
|  |  |
| ***Clauses affected:*** | 3.3, 6.3.x (new), 9.14.3.4 (new), 9.14.3.5 (new), 9.14a (new) |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **x** |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** | **x** |  |  Test specifications | TS38.533 |
| ***(show related CRs)*** |  | **x** |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

**<<Start of change>>**

## 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

CLTM Conditional L1/L2 triggered mobility

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 RSRP

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

LEO Low Earth Orbit

LMF Location Management Function

LPP LTE Positioning Protocol

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

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

**<<Unchanged sections omitted>>**

6.3.X Conditional L1/L2-Triggered Mobility

6.3.X.1 Introduction

The purpose of the conditional LTM cell switch is to switch PCell to a target cell based on configured CLTM execution condition.

The requirements in this clause are applicable to both intra-frequency and inter-frequency CLTM cell switch and subsequent CLTM cell switch.

The requirements in this clause are applicable only to SA, including the following scenarios:

PCell switch to a neighbouring CLTM candidate cell

- FR1 cell to FR1 cell

- FR1 cell to FR2 cell

- FR2 cell to FR2 cell

- FR2 cell to FR1 cell

PCell switch to a CLTM candidate cell that is a serving SCell in MCG

- FR1 cell to FR1 cell

- FR2 cell to FR2 cell

6.3.X.2 CLTM Cell Switch delay

Procedure delays for all procedures that can command a conditional LTM are specified in TS 38.331 [2].

When the UE receives a RRC message implying conditional LTM the UE shall start to transmit the first uplink transmission on the target cell fulfilling the configured CLTM condition within DCLTM seconds from the end of the last TTI containing the RRC message.

 DCLTM = TRRC + TEvent\_DU + Tmeasure + TCLTM-RRC-processing + TCLTM-interrupt

Where:

* TRRC is the RRC procedure delay defined in clause 12 in TS 38.331 [2].
* TEvent\_DU is the delay uncertainty which is the time from when the UE successfully decodes a conditional LTM configuration until a condition exists at the measurement reference point which will trigger the conditional LTM cell switch.
* Tmeasure is the time for the UE to measure and realize the condition for CLTM is fulfilled. Tmeasure equals to the measurements time stated in clause 6.3.X.2.1.
* TCLTM-RRC-processing is the time for ASN.1 decoding and validity/compliance check for the RRC configuration of the CLTM candidate cell indicated in the RRC command stated in clause 6.3.X.2.2.
* TCLTM-interrupt is the interruption time stated in clause 6.3.X.2.3.

6.3.X.2.1 Measurement time

The measurement delay is defined from the end of TEvent\_DU until UE starts conditional cell switch execution to a target cell.

1> If SSB based L1-RSRP measurement is used in the event, Tmeasure shall be no larger than the maximum of L1-RSRP measurement periods TL1-RSRP\_Measurement\_Period\_SSB of the serving cell and target cell.

2> serving cell measurement period TL1-RSRP\_Measurement\_Period\_SSB is defined in clause 9.5.4.1

2> if the target cell is an intra-frequency cell:

3>TL1-RSRP\_Measurement\_Period\_SSB = TL1-RSRP\_Measurement\_Period\_SSB\_intra defined in clause 9.14.5, if *deriveSSB-IndexFromCell* is enabled or UE has reported SSB index in L3 measurement report of the same cell, or

3>TL1-RSRP\_Measurement\_Period\_SSB = TL1-RSRP\_Measurement\_Period\_SSB\_intra + TSSB\_time\_index\_intra as defined in clause 9.14.5, otherwise.

2> if the target cell is an inter-frequency cell:

3>TL1-RSRP\_Measurement\_Period\_SSB = TL1-RSRP\_Measurement\_Period\_SSB\_inter defined in clause 9.15.5 or 9.15.6, if *deriveSSB-IndexFromCellInter-r17* is enabled or UE has reported SSB index in L3 measurement report of the same cell, or

3>TL1-RSRP\_Measurement\_Period\_SSB = TL1-RSRP\_Measurement\_Period\_SSB\_inter + TSSB\_time\_index\_inter as defined in clause 9.15.5 or 9.15.6.

1> If SSB based L3-RSRP measurement is used in the event and target cell is in FR1, Tmeasure in CHO stated in clause 6.1.4.2.2 is applicable.

1> If CSI-RS based L1-RSRP measurement is used in the event, for known cell, Tmeasure shall be no longer than TCSI-RS\_SFN\_intra defined in clause 9.10.2.5 plus CSI-RS based L1-RSRP measurement period defined in clause x.x.x.

Editor notes: further discuss the conditions for TCSI-RS\_SFN\_intra = 0. Further discuss whether to include unknown cell case. If included, add one more component of TPSS/SSS.

6.3.X.2.2 Conditional LTM RRC processing time

TCLTM-RRC-processing is the time for ASN.1 decoding and validity/compliance check for the RRC configuration of the CLTM target cell.

1> if the UE supports *ltm-FastProcessingConfig-r18* capability, and

2>if the number of LTM and CLTM candidate cell configurations does not exceed *maxNumberConfigs-r18* and

2>if the number of the configured serving cells and the cells in the LTM and CLTM configuration does not exceed *maxNumberStoredConfigCells-r18*

3> TCLTM-RRC-processing = 0

2> else:

3> if UE has received CLTM candidate cell TCI state activation command for the target cell at least THARQ + 13 ms before UE starts cell switch execution to the target cell, and/or

3> if UE has received PDCCH order for early RACH for the target cell at least NT,2+10 ms before UE starts cell switch execution to the target cell, where NT,2 is defined in section 8.1 of TS 38.213 [3], and

3> if the total number of LTM and CLTM candidate cells for which TCI state(s) were activated or PDCCH order was received before the UE starts cells witch execution to target cell does not exceed maxNumberConfigs-r18, and

3> if the total number of serving cells and the cells in the LTM and CLTM configuration for which TCI state(s) were activated and/or PDCCH order was received before the UE starts cell switch execution to the target cell does not exceed *maxNumberStoredConfigCells-r18*.

4> TCLTM-RRC-processing = 0

1> else:

2> TCLTM-RRC-processing = 10 ms.

6.3.X.2.3 Interruption time

The interruption time TCLTM-interrupt is the time between when the UE starts to execute cell switch towards the target cell until the time the UE transmits the first uplink transmission on the target cell, excluding TCLTM-RRC-processing.

TCLTM-interrupt = TLTM-processing + [Tfirst-RS + TRS-proc]+ TLTM-IU ms,

Where:

- TLTM-processing is the time for UE processing, consisting of applying the target cell parameters and L1/L2 change.

1> if the UE supports *ltm-FastUE-Processing-r18* capability,

2> the value of TLTM-processing equals to

3> *fr1-r18* for FR1 to FR1 LTM cell switch.

3> *fr2-r18 for* FR2 to FR2 LTM cell switch.

3> *fr1-AndFR2-r18* for FR1 to FR2 and FR2 to FR1 LTM cell switch.

1> else:

2> the value of TLTM-processing equals to

3> 20 ms for FR1 to FR1 and FR2 to FR2 LTM cell switch.

3> 40 ms for FR1 to FR2 and FR2 to FR1 LTM cell switch.

- Tfirst-RS is the time for fine time tracking and acquiring full timing information of the target cell [stated in clause 6.3.1.3].

- TRS-proc is the time for SSB processing [stated in clause 6.3.1.3].

- Editor notes: further discuss the conditions for Tfirst-RS = 0 and TRS-proc=0.

- TCLTM-IU is the interruption uncertainty during CLTM cell switch.

- For RACH-based CLTM cell switch, TCLTM-IU is the interruption uncertainty in acquiring the first available PRACH occasion in the new cell. TCLTM-IU can be up to the summation of SSB to PRACH occasion association period and 10 ms. SSB to PRACH occasion associated period is defined in the table 8.1-1 of TS 38.213 [3].

- For RACH-less CLTM cell switch, TCLTM-IU is the uncertainty on transmitting the first uplink transmission on the target cell.

6.3.X.3 Subsequent Conditional L1/L2-Triggered Mobility delay

When the UE sends a *RRCReconfigurationComplete* indicating completion of the previous CLTM cell switch the UE shall start to transmit the the first uplink transmission on the target cell fulfilling the configured CLTM condition within DSubsequent-CLTM seconds from the end of the last TTI containing *RRCReconfigurationComplete*.

DSubsequent-CLTM = TEvent\_DU + Tmeasure + TCLTM-RRC-processing + TCLTM-interrupt

Where:

- Tmeasure, TCLTM-RRC-processing and TCLTM-interrupt are defined in clause 6.3.X.2.

- TEvent\_DU is the delay uncertainty which is the time from when the UE successfully sends a *RRCReconfigurationComplete* message indicating completion of the previous CLTM cell switch until a condition exists at the measurement reference point which will trigger the subsequent conditional LTM cell switch.

**<<Unchanged sections omitted>>**

#### 9.14.3.4 Event Triggered Reporting

Reported L1-RSRP measurements contained in an event triggered L1-RSRP measurement report shall meet the requirements in clauses 10.1.19/10.1.19D for FR1 and 10.1.20/10.1.20A for FR2, respectively. This requirement applies for event triggered L1-RSRP reports sent on PUSCH using the MAC CE.

The UE shall not send any event triggered measurement reports if no reporting criteria is fulfilled.

The event triggered measurement reporting delay is defined as the time between an event that will trigger an event triggered measurement report and the point when the UE starts to transmit the first UL transmission to report the measurement results over the air interface. This measurement reporting delay excludes a delay which is caused by no UL resources being available for UE to send the measurement report on.

The event triggered measurement reporting delay shall be no larger than the maximum L1-RSRP measurement period of the cells corresponding to the event.

If serving cell is involved in event evaluation, L1-RSRP measurement period of serving cell refers to TL1-RSRP\_Measurement\_Period\_SSB as defined in 9.5, assuming TReport = 0 and TSSB is the periodicity of the serving cell SSB-Index configured for event triggered L1-RSRP measurement report, which is indicated by the *ssb-periodicityServingCell*

If neighbor cell is involved in event evaluation, L1-RSRP measurement period of neighbor cell refers to TL1-RSRP\_Measurement\_Period\_SSB\_intra for SSB based intra-frequency measurement, as defined in 9.14, assuming TReport = 0 and TSSB\_NBC is the periodicity of the neighbor cell SSB-Index configured for intra-frequency event-triggered L1-RSRP measurement report.

#### 9.14.3.5 Event-triggered Periodic Reporting

Reported L1-RSRP measurements contained in an event triggered L1-RSRP measurement report shall meet the requirements in clauses 10.1.19/10.1.19D for FR1 and 10.1.20/10.1.20A for FR2, respectively. This requirement applies for event triggered L1-RSRP reports sent on PUSCH using the MAC CE.

The first report in event triggered periodic measurement reporting shall meet the requirements specified in clause 9.14.3.4. For the subsequent reports in the event triggered periodic report, UE follows the [*reportInterval* and ReportAmount] as specified in TS 38.331.

**<<Unchanged sections omitted>>**

## 9.14a CSI-RS based Intra-frequency L1-RSRP measurements for neighbor cell

### 9.14a.1 Introduction

A measurement is defined as a CSI-RS based intra-frequency L1-RSRP measurement provided that:

- the SCS of the CSI-RS resource of LTM candidate cell(s) configured for L1 measurement is the same as the SCS of active DL BWP, and

- for SCS of 60KHz, the CP type of the CSI-RS resource of LTM candidate cell(s) configured for L1 measurement is the same as the CP type of active DL BWP, and

- at least 48 RBs of the CSI-RS resource of LTM candidate cell(s) configured for L1 measurement is included within the active DL BWP.

Otherwise, a measurement is defined as a CSI-RS based inter-frequency L1 measurement.

When configured by the network, the UE shall be able to perform CSI-RS based L1-RSRP measurements for neighbour cell, on the intra-frequency CSI-RS resources configured for L1-RSRP measurements.

The UE shall report the measurement quantity and send periodic, semi-persistent or aperiodic reports, according to the higher layer parameter [*reportConfigType*] of each reporting setting[*LTM-CSI-ReportConfig*].

### 9.14a.2 Requirements Applicability

The requirements in the clause 9.14a are applicable to FR1 and FR2-1 for LTM.

The requirements in clause 9.14a apply for CSI-RS L1-RSRP measurements for configured LTM candidate cell, provided the following conditions are met:

- The cell is known,

- The CSI-RS L1-RSRP measurement is configured as periodic CSI-RS or semi-persistent CSI-RS measurement, and

- at least 48 RBs of the CSI-RS configured for measurement is within the active BWP, and

- repetition is set to “OFF” [or not configured].

For CSI-RS based L1-RSRP measurement, the cell is considered as known if the following conditions are met:

- The UE has performed L3 measurement on the target cell during the last 5 seconds, and

- The SSB from the target cell configured for L3 measurement remains detectable according to the cell identification requirements in clause 9.2, and

- The CSI-RS from the target cell configured for L1 measurement remains measurable

Otherwise, the cell is unknown.

A CSI-RS resource configured for L1-RSRP for LTM candidate cell shall be considered measurable when for each relevant CSI-RS the following conditions are met:

- LTM CSI-RS L1-RSRP related side conditions given in clause [10.x.x] for FR1 and [10.x.x] for FR2-1 are met respectively, for a corresponding band.

### 9.14a.3 Measurement Reporting Requirements

The UE shall report the L1-RSRP value as a 7-bit value in the range -140, -44 dBm with 1 dB step size according to clauses 10.1.19D.2 for FR1 and 10.1.20A.2 for FR2 if *noOfReportedRS-PerCell-r18* and *noOfReportedCells-r18* are both configured to one. If *noOfReportedRS-PerCell-r18* and/or *noOfReportedCells-r18* are configured to be larger than one, the UE shall use differential L1-RSRP based reporting as defined in clause 10.1.19D.2 for FR1 and 10.1.20A.2 for FR2. The differential L1-RSRP is quantized to a 4-bit value with 2 dB step size. The mapping between the reported L1-RSRP value and the measured quantity is described in clause 10.1.6, where the reported differential value for unmeasured LTM L1-RSRP resources is DIFFRSRP\_15 in table 10.1.6.1.

#### 9.14a.3.1 Periodic Reporting

Reported L1-RSRP measurements contained in periodic L1-RSRP measurement reports shall meet the requirements in clauses 10.1.19D.2 for FR1 and 10.1.20A.2 for FR2, respectively. The UE shall transmit the periodic L1-RSRP reporting on PUCCH over the air interface according to the periodicity defined in clause 5.2.1.4 in TS 38.214 [26].

#### 9.14a.3.2 Semi-Persistent Reporting

Reported L1-RSRP measurements contained in a Semi-Persistent L1-RSRP measurement report shall meet the requirements in clauses 10.1.19D.2 for FR1 and 10.1.20A.2 for FR2, respectively. This requirement applies for semi-persistent L1-RSRP reports send on PUSCH or PUCCH.

The UE shall only send semi-persistent L1-RSRP measurement reports on PUSCH, if a DCI request has been received.

The UE shall only send semi-persistent L1-RSRP measurement reports on PUCCH, if an activation command [7] has been received.

The UE shall transmit the semi-persistent L1-RSRP reporting on PUSCH or PUCCH over the air interface according to the periodicity defined in clause 5.2.1.4 in TS 38.214 [26].

#### 9.14a.3.3 Aperiodic Reporting

Reported L1-RSRP measurements contained in aperiodic triggered, aperiodic triggered periodic and aperiodic triggered semi-persistent L1-RSRP reports shall meet the requirements in clauses 10.1.19D.2 for FR1 and 10.1.20A.2 for FR2, respectively.

The UE shall only send aperiodic L1-RSRP measurement report if a DCI trigger has been received.

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

#### 9.14a.3.x1 Event-triggered Periodic Reporting

Reported CSI-RS based L1-RSRP measurements contained in event-triggered periodic measurement reports shall meet the requirements in clauses 10.x1.y1.z1 for FR1 and 10.x2.y2.z2 for FR2.

The first report in event triggered periodic measurement reporting shall meet the requirements specified in clause 9.14a.3.x2.

#### 9.14a.3.x2 Event Triggered Reporting

Reported CSI-RS based L1-RSRP measurements contained in event triggered measurement reports shall meet the requirements in clauses clauses 10.x1.y1.z1 for FR1 and 10.x2.y2.z2 for FR2.

The UE shall not send any event triggered measurement reports as long as no reporting criteria is fulfilled.

The event triggered measurement reporting delay is defined as the time between an event that will trigger an event triggered measurement report and the point when the UE starts to transmit the first UL transmission to report the measurement results over the air interface. This measurement reporting delay excludes a delay which is caused by no UL resources being available for UE to send the measurement report on.

The event triggered measurement reporting delay shall be no larger than the maximum L1-RSRP measurement period of the cells corresponding to the event.

If serving cell is involved in event evaluation, L1-RSRP measurement period of serving cell refers to TL1-RSRP\_Measurement\_Period\_CSI-RS as defined in 9.5, assuming TReport = 0 and [TCSI-RS is the periodicity of the serving cell CSI-RS for event triggered L1-RSRP measurement report.]

If neighbor cell is involved in event evaluation, L1-RSRP measurement period of neighbor cell refers to [TL1-RSRP\_Measurement\_Period\_CSI\_intra] defined in [9.x], assuming TReport = 0, and TCSI-RS is the periodicity of the neighbor cell CSI-RS configured for intra-frequency event-triggered L1-RSRP measurement report.]

### 9.14a.4 Number of cells and number of CSI-RS resources

The number of cells and number of CSI-RS resources that UE shall be capable of performing L1-RSRP measurements on are reported by the capabilities [TBD].

### 9.14a.5 CSI-RS based L1-RSRP measurement requirements without measurement gaps

The requirements specified in this clause are only applicable when

- maximum RTD between cells are within CP.

[- *highSpeedMeasFlag-r16* is not configured, and

- *highSpeedMeasFlagFR2-r17* is not configured, and

- *highSpeedMeasCA-Scell-r17* is not configured.]

- At least 48 RBs of the CSI-RS configured for measurement is confined within the active BWP of the UE.

If a neighbor cell is known according to 9.14a.2, 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\_intra.

The value of TL1-RSRP\_Measurement\_Period\_CSI-RS\_intra is defined in table 9.14a.5-1 for FR1 and in table 9.14a.5-2 for FR2, where

- For periodic and semi-persistent CSI-RS resources in a resource set configured with higher layer parameter *repetition* set to OFF

- N=8 if UE is capable of *[skippingSSBbasedL1mesurement-R19] and* the CSI-RS resources shall be Type-D QCL’ed with the associated SSB for L3 measurement and the CSI-RS resource is configured with [TBD]; Otherwise,

- N=1 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.

- P value for CSI-RS resource to be measured is defined as

- Ntotal / Noutside\_MG in FR1

- Psharing factor \* Ntotal / Noutside\_MG in FR2 with Navailable = 0

- Ntotal / Navailable in FR2 with Navailable > 0

For a window W of duration max (TL1, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE measurement gaps and per-FR measurement gaps within the same FR as serving cell, and starting at the beginning of any CSI-RS resource occasion:

- Ntotal is the total number of CSI-RS resource occasions within the window, including those overlapped with measurement gap occasions or SMTC occasions within the window, and

- Noutside\_MG is the number of CSI-RS resource occasions that are not overlapped with any measurement gap occasion within the window W

- Navailable is the number of CSI-RS resource occasions that are not overlapped with any measurement gap occasion nor any SMTC occasion within the window W

- TL1 is periodicity of the target CSI-RS resource.

- Psharing factor = 1, if the CSI-RS configured for L1-RSRP measurement outside measurement gap is

- not overlapped with the SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol before each consecutive SSB symbols indicated by *SSB-ToMeasure* and 1 data symbol after each consecutive SSB symbols indicated by *SSB-ToMeasure*, given that *SSB-ToMeasure* is configured, where the *SSB-ToMeasure* is the union set of *SSB-ToMeasure* from all the configured measurement objects merged on the same serving carrier, and,

- not overlapped with the RSSI symbols indicated by *ss-RSSI-Measurement* and 1data symbol before each RSSI symbol indicated by *ss-RSSI-Measurement* and 1 data symbol after each RSSI symbol indicated by *ss-RSSI-Measurement*, given that *ss-RSSI-Measurement* is configured,

- Psharing factor = 3, otherwise.

If the high layer in TS 38.331 [2] signaling of *smtc2* is configured, TSMTCperiod corresponds to the value of higher layer parameter *smtc2*; Otherwise TSMTCperiod corresponds to the value of higher layer parameter *smtc1*. TSMTCperiod is the shortest SMTC period among all CCs in the same FR2 band, provided the SMTC offset of all CCs in FR2 have the same offset.

Longer measurement period would be expected if the combination of CSI-RS, SMTC occasion and measurement gap configurations does not meet previous conditions.

For either an FR1 or FR2 cell, longer measurement period would be expected during the period Tidentify\_CGI when the UE is requested to decode an NR CGI.

For either an FR1 or FR2 cell, longer L1 RSRP measurement period would be expected during the period Tidentify\_CGI,E-UTRAN when the UE is requested to decode an LTE CGI.

Table 9.14a.5-1: Intra-frequency L1-RSRP measurement period TL1-RSRP\_Measurement\_Period\_CSI-RS\_intra in FR1

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_CSI-RS (ms)  |
| non-DRX | max(TReport, ceil(P)\*TCSI-RS\_NBC) |
| DRX cycle ≤ 320 ms | max(TReport, ceil(K\*P)\*max(TDRX,TCSI-RS\_NBC)) |
| DRX cycle > 320 ms | ceil(P)\*TDRX |
| NOTE 1: TCSI-RS\_NBC is the periodicity of neighbor cell 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 = 1.5. |

Table 9.14a.5-2: Intra-frequency L1-RSRP measurement period TL1-RSRP\_Measurement\_Period\_CSI-RS\_intra in FR2

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_CSI-RS (ms)  |
| non-DRX | max(TReport, ceil(P\*[PL1\_sharing]\*N)\*TCSI-RS\_NBC) |
| DRX cycle ≤ 320 ms | max(TReport, ceil(1.5\*P\*[PL1\_sharing]\*N)\*max(TDRX,TCSI-RS\_NBC)) |
| DRX cycle > 320 ms | ceil(M\*P\*[PL1\_sharing]\*N)\*TDRX |
| NOTE 1: TCSI-RS\_NBC is the periodicity of neighbor cell CSI-RS configured for L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting.NOTE 2: the requirements are applicable provided that the CSI-RS resource configured for L1-RSRP measurement is transmitted with Density = 3. |

### 9.14a.6 Measurement restriction for CSI-RS based L1-RSRP measurement

Measurement restrictions described in the following clauses apply when UE is performing L1-RSRP measurement on neighbor cell(s) without measurement gap.

Unless explicitly stated, the CSI-RS to be measured for L1-RSRP measurement is transmitted from neighbor cell(s).

#### 9.14a.6.1 Measurement restriction for CSI-RS based L1-RSRP measurement

The SSB mentioned in this clause can be associated with either the serving cell PCI or a PCI different from serving cell PCI or intra-frequency neighbor cell(s) configured with L1-RSRP measurement or inter-frequency neighbor cell(s) configured with L1-RSRP measurement without gap.

[

For both FR1 and FR2, when the CSI-RS for L1-RSRP measurement is in the same OFDM symbol as SSB for RLM, BFD, CBD or L1-RSRP measurement, UE is not required to receive CSI-RS for L1-RSRP measurement in the PRBs that overlap with an SSB.

For FR1, when the SSB for RLM, BFD, CBD or L1-RSRP measurement is within the active BWP and has same SCS as the CSI-RS for L1-RSRP measurement, the UE shall be able to perform CSI-RS measurement without restrictions.

For FR1, when the SSB for RLM, BFD, CBD or L1-RSRP measurement is within the active BWP and has different SCS than CSI-RS for L1-RSRP measurement, the UE shall be able to perform CSI-RS measurement with restrictions according to its capabilities:

- If the UE supports *simultaneousRxDataSSB-DiffNumerology* the UE shall be able to perform CSI-RS measurement without restrictions.

- If the UE does not support *simultaneousRxDataSSB-DiffNumerology*, UE is required to measure one of but not both CSI-RS for L1-RSRP measurement and SSB. Longer measurement period for CSI-RS based L1-RSRP measurement is expected, and no requirements are defined.

For FR1, when the CSI-RS for L1-RSRP measurement is in the same OFDM symbol as another CSI-RS for RLM, BFD, CBD or L1-RSRP measurement, UE shall be able to measure the CSI-RS for L1-RSRP measurement without any restriction.

For FR2, when the CSI-RS for L1-RSRP measurement on one CC is in the same OFDM symbol as SSB for RLM, BFD or L1-RSRP measurement on the same CC or different CCs in the same band, or in the same symbol as SSB for CBD measurement on the same CC or different CCs in the same band when beam failure is detected, UE is required to measure one of but not both CSI-RS for L1-RSRP measurement and SSB. Longer measurement period for CSI-RS based L1-RSRP measurement is expected, and no requirements are defined.

For FR2, when the CSI-RS for L1-RSRP measurement on one CC is in the same OFDM symbol as another CSI-RS for RLM, BFD, CBD or L1-RSRP measurement on the same CC or different CCs in the same band,

- In the following cases, UE is required to measure one of but not both CSI-RS for L1-RSRP measurement and the other CSI-RS. Longer measurement period for CSI-RS based L1-RSRP measurement is expected, and no requirements are defined.

- The CSI-RS for L1-RSRP measurement or the other CSI-RS in a resource set configured with repetition ON, or

- The other CSI-RS is configured in q1 and beam failure is detected, or

- The two CSI-RS-es are not QCL-ed w.r.t. QCL-TypeD, or the QCL information is not known to UE,

- Otherwise, UE shall be able to measure the CSI-RS for L1-RSRP measurement without any restriction.

For UE incapable of *multiCellL1-measRTD-greaterThan-CP-r18* and for UE capable of *multiCellL1-measRTD-greaterThan-CP-r18*,

- For both FR1 and FR2, when the CSI-RS for L1-RSRP measurement fully or partially overlaps with the OFDM symbol as SSB from candidate LTM neighbor cell for intra-frequency L1-RSRP measurement or inter-frequency L1-RSRP measurement without gap, UE is not required to receive CSI-RS for L1-RSRP measurement in the PRBs that overlap with an SSB.

- For FR1, when the CSI-RS for L1-RSRP measurement fully or partially overlaps with the OFDM symbol as SSB from candidate LTM neighbor cell for intra-frequency L1-RSRP measurement or inter-frequency L1-RSRP measurement without gap, if CSI-RS and SSB have different SCS and UE does not support *simultaneousRxDataSSB-DiffNumerology*, UE is required to measure one of but not both CSI-RS for L1-RSRP measurement and SSB. Longer measurement period for CSI-RS based L1-RSRP is expected, and no requirements are defined.

- For FR2, when the CSI-RS for L1-RSRP measurement on one CC fully or partially overlaps with the OFDM symbol as SSB from candidate LTM neighbor cell for intra-frequency L1-RSRP measurement or inter-frequency L1-RSRP measurement without gap in the same band, UE is required to measure one of but not both CSI-RS for L1-RSRP measurement and SSB. Longer measurement period for CSI-RS based L1-RSRP is expected, and no requirements are defined.

For FR2-1, when the CSI-RS for L1-RSRP measurement on the one CC is in the same OFDM symbol as another CSI-RS for RLM, BFD or L1-RSRP measurement on the same CC, UE supporting *schedulingMeasurementRelaxation-r18* according to the conditions described in clause 3.6.19 shall be able to measure the CSI-RS for L1-RSRP measurement without restriction when the following conditions are met:

- Both CSI-RSs are not in any CSI-RS resource set with repetition ON, and

- One CSI-RS has same QCL source as either

- the active TCI state of a PDSCH scheduled in the same OFDM symbol or

- the QCL source based on the default QCL assumption to be applied in the same OFDM symbol according to 38.214 clause 5.1.5, and

- the other CSI-RS has same QCL source as either

- the active TCI state of a PDSCH scheduled in the same OFDM symbol or

- the QCL source based on the default QCL assumption to be applied in the same OFDM symbol according to 38.214 clause 5.1.5, and

- Resources of the active TCI states of the two PDSCHs, or QCL sources of the default QCL assumption, or the active TCI state of PDSCH and QCL source of the default QCL assumption have been reported as a resource group in Rel-17 group-based RSRP report.

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### 9.14a.7 Scheduling availability of UE during CSI-RS based L1-RSRP measurement

Scheduling availability restrictions described in the following clauses apply when UE is performing CSI-based L1-RSRP measurement on neighbor cell(s) without measurement gap.

Unless explicitly stated, the CSI-RS resource to be measured for L1-RSRP measurement is transmitted from neigbor cell(s).

#### 9.14a.7.1 Scheduling availability of UE performing L1-RSRP measurement with a same subcarrier spacing as PDSCH/PDCCH on FR1

There are no scheduling restrictions due to L1-RSRP measurement performed on CSI-RS as RS for L1-RSRP measurement with the same SCS as PDSCH/PDCCH in FR1.

#### 9.14a.7.2 Scheduling availability of UE performing L1-RSRP measurement on FR2

The following scheduling restriction applies due to L1-RSRP measurement.

- The UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/CSI-RS for tracking/CSI-RS for CQI on the concerned OFDM symbols, where the concern OFDM symbols are

- the same OFDM symbols corresponding to the CSI-RS resources configured for L1-RSRP measurement.

When intra-band carrier aggregation in FR2 is performed, the scheduling restrictions is performed apply to cell(s) in the band on the symbols that fully or partially overlap with restricted symbols.

When inter-band carrier aggregation in FR2 is performed, there are no scheduling restrictions on FR2 cells in the bands due to L1-RSRP measurement performed on FR2 cell(s) in different band(s), provided that UE is capable of independent beam management on this FR2 band pair. Additionally, there is no scheduling restriction if the UE is configured with different numerology between CSI-RS resources on one FR2 band and data on the other FR2 band provided the UE is configured for IBM operation for the band pair.

#### 9.14a.7.3 Scheduling availability of UE performing L1-RSRP measurement on FR1 or FR2 in case of FR1-FR2 inter-band CA

There are no scheduling restrictions on FR1 cell(s) due to CSI-RS based L1-RSRP measurement performed on FR2 cell(s).

There are no scheduling restrictions on FR2 cell(s) due to CSI-RS based L1-RSRP measurement performed on FR1 cell(s).

#### 9.14a.7.4 Scheduling availability of UE performing L1-RSRP measurement in TDD bands on FR1

When UE performs CSI-RS based L1-RSRP measurement on neighbor cell in a TDD band, the following restrictions apply due to L1-RSRP measurement

- The UE is not expected to transmit PUCCH/PUSCH/SRS on the concerned OFDM symbols and restricted symbols may partially or fully overlap with UL symbols, where the concern OFDM symbols are the same OFDM symbols corresponding to the CSI-RS resources configured for L1-RSRP measurement.

When TDD intra-band carrier aggregation is performed, the scheduling restrictions due to a given serving cell also apply to all other serving cells in the same band on the symbols that fully or partially overlap with the aforementioned restricted symbols.

**<<Unchanged sections omitted>>**

#### 9.15.3.4 Event Triggered Reporting

Reported L1-RSRP measurements contained in an event triggered L1-RSRP measurement report shall meet the requirements in clauses 10.1.19/10.1.19E for FR1 and 10.1.20/10.1.20B for FR2, respectively. This requirement applies for event triggered L1-RSRP reports sent on PUSCH using the MAC CE.

The UE shall not send any event triggered measurement reports if no reporting criteria is fulfilled.

The event triggered measurement reporting delay is defined as the time between an event that will trigger an event triggered measurement report and the point when the UE starts to transmit the first UL transmission to report measurement result over the air interfac. This measurement reporting delay excludes a delay which is caused by no UL resources being available for UE to send the measurement report on.

The event triggered measurement reporting delay shall be no larger than the maximum L1-RSRP measurement period of the cells corresponding to the event.

If serving cell is involved in event evaluation, L1-RSRP measurement period of the serving cell refers to TL1-RSRP\_Measurement\_Period\_SSB as defined in clause 9.5, where TReport = 0 and TSSB is the periodicity of the serving cell SSB-Index configured for event triggered L1-RSRP measurement report, which is indicated by the *ssb-periodicityServingCell*.

If an inter-frequency neighbor cell is involved in event evaluation, L1-RSRP measurement period of the neighbor cell refers to TL1-RSRP\_Measurement\_Period\_SSB\_inter as defined in clause 9.15, where TReport = 0 and TSSB\_NBC is the periodicity of the neighbor cell SSB-Index configured for inter-frequency event-triggered L1-RSRP measurement report.

#### 9.15.3.5 Event Triggered Periodic Reporting

Reported L1-RSRP measurements contained in an event triggered L1-RSRP measurement report shall meet the requirements in clauses 10.1.19/10.1.19E for FR1 and 10.1.20/10.1.20B for FR2, respectively. This requirement applies for event triggered L1-RSRP reports sent on PUSCH using the MAC CE.

The first report in event triggered periodic measurement reporting shall meet the requirements specified in clause 9.15.3.4. For the subsequent reports in the event triggered periodic report, UE follows the [*reportInterval* and ReportAmount] as specified in TS 38.331.

**<<End of change>>**