**3GPP TSG-RAN4 Meeting #109 *R4-2321641***

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| *CR-Form-v12.2* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
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|  | **38.133** | **CR** | **3952** | **rev** | **-** | **Current version:** | **18.3.0** |  |
|  | | | | | | | | |
| *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:*** |  | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | MediaTek Inc, Apple | | | | | | | | | |
| ***Source to TSG:*** | R4 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_Mob\_enh2-Core | | | | |  | ***Date:*** | | | 2023-11-21 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **B** |  | | | | | ***Release:*** | | | Rel-18 |
|  | *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 can be 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-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18) Rel-19 (Release 19)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | In Rel-18 FeMob enh, the mechanism of L1/L2 triggered mobility and requirement of enhanced CHO have been supported, the corresponding RRM requirement needs to be specified.  This document includes the endoresed draft CRs:  **Endorsed in 108bis**:   |  |  |  | | --- | --- | --- | | TDoc Endorsed CR | CR title | Source companies | | R4-2317314 | Draft CR on measurement restrictions for SSB and CSI-RS based beam failure detection for LTM requirements | CATT | | R4-2315322 | DraftCR on inter-f L1-RSRP measurement without gap | CMCC | | R4-2317319 | CR on CSSF for Inter-frequency L1-RSRP measurement within gap | Xiaomi | | R4-2317423 | Impact on CSSF of L3 measurement within gaps | Xiaomi | | R4-2317315 | draftCR on measurement restrictions for SSB and CSI-RS based candidate beam detection for LTM requirements | ZTE Corporation | | R4-2317320 | CR on measurement restriction for RLM due to intra-f L1-RSRP measurement on neighbor cell and Inter-f L1-RSRP measurement without gap | Huawei, HiSilicon | | R4-2317323 | DraftCR for LTM cell switch delay requirements | Nokia, Nokia Shanghai Bell | | R4-2317321 | Draft CR for measurement restriction on BFD and CBD due to LTM L1-RSRP measurement | OPPO | | R4-2317324 | draftCR on UL transmit timing requirements for R18 LTM | vivo | | R4-2317424 | Draft CR for requirements of inter-f L1-RSRP measurement with MG | Apple | | R4-2317316 | Draft CR for intra-frequency L1-RSRP measurement on 38.133 R18 LTM | MediaTek Inc, Ericsson | | R4-2317317 | Draft CR for impact on measurement restriction of L1-SINR due to LTM on 38.133 | MediaTek Inc. | | R4-2317358 | Draft CR on Enhanced CHO configurations | Apple | | R4-2317404 | Draft CR to TS 38.133 for CHO+CPC | Ericsson |   **Endorsed in 109**:   |  |  |  | | --- | --- | --- | | TDoc Endorsed CR | CR title | Source companies | | R4-2318320 | Draft CR on measurement restrictions for SSB and CSI-RS based BFD for LTM | CATT | | R4-2321373 | Draft CR for intra-frequency L1-RSRP measurement on 38.133 R18 LTM | MediaTek Inc, Ericsson | | R4-2321374 | Draft CR for R18 LTM on 38.133 | MediaTek Inc. | | R4-2321376 | Draft CR for requirements of inter-f L1-RSRP measurement with MG | Apple | | R4-2321377 | DraftCR on CSSF for Inter-frequency L1-RSRP measurement within gap | Xiaomi | | R4-2321378 | DraftCR on the Impact of CSSF for L3 measurement within gaps | Xiaomi | | R4-2321379 | DraftCR on inter-f L1-RSRP measurement without gap | CMCC | | R4-2319300 | draftCR on measurement restrictions for SSB and CSI-RS based candidate beam detection for LTM requirements | ZTE | | R4-2321381 | CR on measurement restriction for RLM due to intra-f L1-RSRP measurement on neighbor cell and Inter-f L1-RSRP measurement without gap | Huawei, HiSilicon | | R4-2319487 | Draft CR for measurement restriction on BFD and CBD due to LTM L1-RSRP measurement | OPPO | | R4-2321383 | Draft CR on LTM cell switch delay requirements | Nokia, Nokia Shanghai Bell | | R4-2321611 | draftCR on UL transmit timing requirements for R18 LTM | vivo | | R4-2319793 | draftCR on NR-DC with selective activation of cell groups via L3 enhancements | Nokia, Nokia Shanghai Bell | | R4-2321635 | draftCR for 38.133 on Improvement on SCell/SCG setup delay | Nokia, Nokia Shanghai Bell | | R4-2321396 | Draft CR to 38.133 for improvement for scg\_scell setup dealy enhancement | Ericsson | | R4-2321397 | Draft CR on CHO with CPC requirements | Nokia, Nokia Shanghai Bell | | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | |  |  |  | | --- | --- | --- | | Index of change | Clause impacted | Endorsed CRs in R4#108bis and RAN4#109 | | #1 | 3.3 | R4-2321374, #1 | | #2 | 4.x | R4-2321635  R4-2321396 | | #3 | 5.x | R4-2321635  R4-2321396 | | #4 | 6.1.x  6.1.y | R4-2317358, #1  R4-2317404  R4-2321397 | | #5 | 6.x | R4-2317323  R4-2321383, #1 | | #6 | 7.1 | R4-2317324  R4-2321611 | | #7 | 8.1.2.3 | R4-2317320, #1  R4-2321381, #1 | | #8 | 8.1.3.3 | R4-2317320, #2  R4-2321381, #2 | | #9 | 8.2.2 | R4-2321374, #2 | | #10 | 8.2.4 | R4-2321374, #3 | | #11 | 8.5.2.3 | R4-2317314, #1  R4-2318320,#1 | | #12 | 8.5.3.3 | R4-2317314, #2  R4-2318320,#2 | | #13 | 8.5.5.3 | R4-2317315, #1  R4-2319300, #1 | | #14 | 8.5.6.3 | R4-2317315, #2  R4-2319300, #2 | | #15 | 8.9C | R4-2319793 | | #16 | 8.11E | R4-2317358, #2 | | #17 | 8.18.2.3 | R4-2317321, #1  R4-2319487, #1 | | #18 | 8.18.5.3 | R4-2317321, #2  R4-2319487, #2 | | #19 | 8.x | R4-2321383, #2 | | #20 | 9.1.5.2 | R4-2317423  R4-2321378 | | #21 | 9.1.5.x (new) | R4-2317319  R4-2321377 | | #22 | 9.5.4.1 | R4-2321374, #4 | | #23 | 9.5.5.2 | R4-2321374, #5 | | #24 | 9.8.5 | R4-2317317  R4-2321374, #6 | | #25 | 9.x(new) | R4-2317316  R4-2321373 | | #26 | 9.y (new) | R4-2315322  R4-2317424  R4-2321376  R4-2321379 | | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | Corresponding RRM requirement would still be missing. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 3.3, 4.x (new), 5.x (new), 6.1.x (new), 6.1.y (new), 6.X (new), 7.1, 8.1.2.3, 8.1.3.3, 8.2.2, 8.2.4, 8.5.2.3, 8.5.3.3, 8.5.5.3, 8.5.6.3, 8.9C (new), 8.11E (new), 8.18.2.3, 8.18.5.3, 8.X (new), 9.1.5.2, 9.1.5.x (new), 9.5.4.1, 9.5.5.2, 9.8.5, 9.x (new), 9.y (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

BFD Beam Failure Detection

BFD-RS BFD Reference Signal

BLER Block Error Rate

BM-RS Beam Management Reference Signal

BWP Bandwidth Part

CA Carrier Aggregation

CBD Candidate Beam Detection

CBW Channel Bandwidth

CC Component Carrier

CCA Clear Channel Assessment

CG-SDT Configured Grant Small Data Transmisison

CLI Cross Link Interference

CMR Channel Measurement Resource

CORESET Control Resource Set

CP Cyclic Prefix

CSI Channel-State Information

CSI-RS CSI Reference Signal

CSI-RSRP CSI Reference Signal based Reference Signal Received Power

CSI-RSRQ CSI Reference Signal based Reference Signal Received Quality

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

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

DBT Discovery Burst Transmission

DC Dual Connectivity

DCI Downlink Control Information

DL Downlink

DL-AoD Downlink Angle-of-Departure

DL-TDOA Downlink Time Difference Of Arrival

DMRS Demodulation Reference Signal

DRX Discontinuous Reception

E-CID Enhanced Cell ID

E-UTRA Evolved UTRA

E-UTRAN Evolved UTRAN

EN-DC E-UTRA-NR Dual Connectivity

FDD Frequency Division Duplex

FR Frequency Range

GEO Geostationary Earth Orbit

HARQ Hybrid Automatic Repeat Request

HO Handover

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

IMR Interference Measurement Resource

L1-RSRP Layer 1 RSRP

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

LEO Low Earth Orbit

LMF Location Management Function

LPP LTE Positioning Protocol

LTM L1/L2 triggered mobilityMAC Medium Access Control

MCG Master Cell Group

MDT Minimization of Drive Tests

MG Measurement Gap

MGL Measurement Gap Length

MGRP Measurement Gap Repetition Period

MIB Master Information Block

ML Measurement Length

MN Master Node

MR-DC Multi-Radio Dual Connectivity

MUSIM Multi-Universal Subscriber Identity Module

NCSG Network Controlled Small Gap

NE-DC NR-E-UTRA Dual Connectivity

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

NR New Radio

NR-DC NR-NR Dual Connectivity

NTN Non-Terrestrial Network

OFDM Orthogonal Frequency Division Multiplexing

OFDMA Orthogonal Frequency Division Multiple Access

OTDOA Observed Time Difference Of Arrival

PBCH Physical Broadcast Channel

PCC Primary Component Carrier

PCell Primary Cell

PDCCH Physical Downlink Control Channel

PDSCH Physical Downlink Shared Channel

PLMN Public Land Mobile Network

PRACH Physical RACH

Pre-MG Pre-configured Measurement Gap

PRP PRS Received Power

PRS Positioning Reference Signal

PRS-RSRP Positioning Reference Signal based Reference Signal Received Power

PPW PRS Processing Window

PSBCH Physical Sidelink Broadcast Channel

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

PSCCH Physical Sidelink Control Channel

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

PSCell Primary SCell

PSS Primary Synchronization Signal

PSSCH Physical Sidelink Shared Channel

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

pTAG Primary Timing Advance Group

PUCCH Physical Uplink Control Channel

PUSCH Physical Uplink Shared Channel

QCL Quasi Co-Location

RACH Random Access Channel

RAT Radio Access Technology

RLM Radio Link Monitoring

RLM-RS Reference Signal for RLM

RMSI Remaining Minimum System Information

RRC Radio Resource Control

RRH Remote Radio Head

RRM Radio Resource Management

RSSI Received Signal Strength Indicator

RSRP Reference Signal Received Power

RSRQ Reference Signal Received Quality

RSTD Reference Signal Time Difference

RTT Round Trip Time

S-SSB Sidelink Synchronization Signal Block

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

SA Standalone operation mode

SAB Satellite access band

SAN Satellite Access Node

SCC Secondary Component Carrier

SCell Secondary Cell

SCG Secondary Cell Group

SCS Subcarrier Spacing

SCSSSB SSB subcarrier spacing

SDL Supplementary Downlink

SDT Small Data Transmission

SFN System Frame Number

SFTD SFN and Frame Timing DifferenceSI System Information

SIB System Information Block

SL-RSSI Sidelink Received Signal Strength Indicator

SLSS Sidelink Synchronization Signal

SMTC SSB-based Measurement Timing configuration

SpCell Special Cell

SRS Sounding Reference Signal

SRS-RSRP Sounding Reference Signal based Reference Signal Received Power

SS-RSRP Synchronization Signal based Reference Signal Received Power

SS-RSRQ Synchronization Signal based Reference Signal Received Quality

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

SSB Synchronization Signal Block

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

SSS Secondary Synchronization Signal

sTAG Secondary Timing Advance Group

SUL Supplementary Uplink

TA Timing Advance

TAG Timing Advance Group

TCI Transmission Configuration Indicator

TDD Time Division Duplex

TDOA Time Difference Of Arrival

TN Terrestrial Network

TRP Transmission-Reception Point

TTI Transmission Time Interval

UE User Equipment

UL Uplink

VIL Visible Interruption Length

VIRP Visible Interruption Repetition Period

VSAT Very Small Aperture Terminal

End of Change 1

Start of Change 2

4.x Measurement report for fast CA/DC setup

4.x.1 Introduction

A UE supporting [solution based on existing measurement] shall report the idle mode measurement results on the inter-frequency CA and DC candidate frequencies/cells indicated by higher layers and meet the requirement specified in this clause. The UE shall perform idle mode measurements provided that the serving cell support early measurement and is within the validity area. The idle mode measurement requirements apply to a configured carrier frequency and the serving cell are among the supported band combination of the UE.

A UE supporting [solution based on enhanced measurement], the UE may perform additional measurement starting from RRC connection setup/resume procedure. Measurement configuration for fast CA/DC setup is provided [for the carrier by higher layers]. The UE may perform additional measurement after paging reception for RRC setup/resume or after first RACH preamble transmission for RRC setup/resume.

4.x.2 Measurement Requirements

For a UE which supports *idleInactiveNR-MeasReport-r16* or *idleInactiveEUTRA-MeasReport-r16* the UE shall support the idle mode CA measurements on the serving cell, and carriers configured for idle mode CA/DC measurement and meet corresponding measurement requirements defined in clause 4.4.2.

[For a UE which supports [solution based on existing measurement] but not *idleInactiveNR-MeasReport-r16* or *idleInactiveEUTRA-MeasReport-r16* the UE shall support the idle mode CA measurements on the serving cell, and carriers configured for idle mode CA/DC measurement and meet corresponding measurement requirements defined in clause 4.2.2.The UE physical layer shall be capable of reporting SS-RSRP and SS-RSRQ measurements of the carriers configured to higher layers, with measurement accuracy as specified in clauses 10.1.4B and 10.1.5B and 10.1.9B and 10.1.10B, respectively]

4.x.3 Measurement Report Requirements

For a UE which supports [solution based on existing measurement] the UE is able to report valid measurement results upon RRC setup complete. The measurement results are considered valid if the following conditions are met:

* the measurements are performed within the last [X] seconds before msg1 transmission for RRC resume/setup request, where [X] is configured by [TBD], and
* the measurement results satisfy measurement accuracy requirement at the measurement instance.

Otherwise, the measurement results are considered invalid. The UE shall not report invalid measurement results. If network doesn’t provide configuration of [X], UE is not required to perform validity check but the measurement results satisfy measurement accuracy requirement at the measurement instance.

For a UE which supports [solution based on enhanced measurement], the UE is able to report idle mode CA/DC measurements when idle mode CA/DC measurement reporting is requested by the network. Measurements reported by UE supporting [solution based on enhanced measurement] shall meet the accuracy requirements defined in [10.x]. The UE shall follow the reporting configuration by the higher layers.

Editor’s note, the section may be further updated, if needed

End of Change 2

Start of Change 3

5.x Measurement report for fast CA/DC setup

5.x.1 Introduction

A UE supporting [solution based on existing measurement] shall perform the inactive mode measurement on the inter-frequency CA and DC candidate frequencies/cells indicated by higher layers and meet the requirement specified in this clause. The UE shall perform idle mode measurements provided that the serving cell support early measurement and is within the validity area. The idle mode measurement requirements apply to a configured carrier frequency and the serving cell are among the supported band combination of the UE.

A UE supporting [solution based on enhanced measurement], the UE may perform additional measurement starting from RRC connection setup/resume procedure. Measurement configuration for fast CA/DC setup is provided [for the carrier by higher layers]. The UE may perform additional measurement after paging reception for RRC setup/resume or after first RACH preamble transmission for RRC setup/resume.

5.x.2 Measurement Requirements

The requirements in clause 4.x.2 shall apply.

5.x.3 Measurement Report Requirements

The requirements in clause 4.x.3 shall apply.

End of Change 3

Start of Change 4

6.1.x NR Conditional Handover including target MCG and target SCG

6.1.x.1 Conditional handover including target MCG in FR1 and target SCG in FR1 in NR-DC

The requirements in this clause are applicable to conditional handover with target SCG from NR-DC to NR-DC. The requirements in this clause are only applicable to:

* FR1-FR1 NR-DC to FR1-FR1 NR-DC,
* FR1-FR2 NR-DC to FR1-FR1 NR-DC.

This clause defines requirements for the delay within which the UE shall be able to conditional handover from NR cell to NR cell and add NR PSCell in the meantime.

When the UE receives a RRC message implying conditional handover with PSCell,

- The UE shall be ready to start the transmission of the new uplink PRACH channel of the target PCell within DCHOwithPSCell\_PCell ms from the end of the last TTI containing the RRC command, and

- The UE shall be capable of transmitting PRACH preamble towards the target PSCell no later than DCHOwithPSCell\_PCell ms from the end of the last TTI containing the RRC command.

DCHOwithPSCell\_PCell = TRRC + TEvent\_DU + Tmeasure + Tinterrupt + TCHO\_execution

DCHOwithPSCell\_PCell is the PSCell change delay stated in clause 6.1.x.1.2

Where:

TRRC is the RRC procedure delay defined in clause 12 in TS 38.331 [2].

TEvent\_DU is the delay uncertainty which is the time from when the UE successfully decodes a conditional handover command until a condition exists at the measurement reference point which will trigger the conditional handover.

Tmeasure is the measurements time stated in clause 6.1.4.4.2.

TCHO\_execution is the conditional execution preparation time in clause 6.1.4.4.3.

Tinterrupt is the interruption time stated in clause 6.1.x.1.1.

6.1.x.1.1 CHO with PSCell – PCell Interruption time

The interruption time is the time between when the UE starts to execute the conditional handover to the target cell and the time the UE starts transmission of the new PRACH.

For intra-frequency or inter-frequency conditional conditional handover, the interruption time shall be less than Tinterrupt

Tinterrupt = TIU + Tprocessing + T∆ + Tmargin ms

Where:

- TIU, T∆ and Tmargin are the same as defined in clause 6.1.4.4.4

- Tprocessing is the SW processing time needed by UE, including RF warm up period.

For FR1-FR1 NR-DC to FR1-FR1 NR-DC, Tprocessing = 30 ms if SMTC of the target unknown PSCell is configured in *targetcellSMTC-SCG-r16* but not configured in *reconfigurationWithSync*. Otherwise, Tprocessing = 25 ms.

For FR1-FR2 NR-DC to FR1-FR1 NR-DC, Tprocessing = 50 ms if SMTC of the target unknown PSCell is configured in *targetcellSMTC-SCG-r16* but not configured in *reconfigurationWithSync*. Otherwise, Tprocessing = 45 ms.

In the interruption requirement a cell is known if it has been meeting the relevant cell identification requirement during the last 5 seconds otherwise it is unknown. Relevant cell identification requirements are described in Clause 9.2.5 for intra-frequency handover and Clause 9.3.4 for inter-frequency handover.

6.1.x.1.2 CHO with PSCell – PSCell change delay

The requirements in this section shall apply for PSCell change during conditional handover with PSCell from NR DC to NR-DC.

When conditional handover with PSCell from NR-DC to NR-DC is commanded, the PSCell change time shall be less than DCHOwithPSCell\_PSCell:

- DHOwithPSCell\_PSCell = TRRC + TEvent\_DU + Tmeasure + TCHO\_execution + Tprocessing + Tsearch\_PCell\_Conditional + Tsearch\_PSCell + T∆\_PSCell + TPSCell\_DU + 2 ms

Where:

- TRRC\_delay, TEvent\_DU, Tmeasure, TCHO\_execution are the same as defined in clause 6.1.x.1

- Tprocessing is the same as defined in 6.1.x.1.1 and TPSCell\_ DU are the same as defined in clause 8.9.2.

- Tsearch\_PCell\_Conditional is the time for obtaining the timing reference of target PCell. If SMTC of the target unknown PSCell is configured in *targetcellSMTC-SCG-r16* but not configured in *reconfigurationWithSync*, Tsearch\_PCell\_Conditional = TΔ + Tmargin, where TΔ and Tmargin are specified in clause 6.1.x.1.1 Otherwise, Tsearch\_PCell\_Conditional = 0 ms.

- T∆\_PSCell is time for fine time tracking and acquiring full timing information of the target cell. T∆\_PSCell = 1\*Trs ms for a known or unknown PSCell.

- TPSCell\_DU is the delay uncertainty in acquiring the first available PRACH occasion in the PSCell. TPSCell\_DU is up to the summation of SSB to PRACH occasion association period and 10 ms. SSB to PRACH occasion associated period is defined in Table 8.1-1 of TS 38.213 [3].

The Trs definition from clause 8.9.2 is modified as following for requirements in this section:

- Trs is the SMTC periodicity of the target NR cell if target PSCell is unknown and SMTC configuration of target unknown PSCell is present in either *targetcellSMTC-SCG-r16* or *reconfigurationWithSync*, otherwise Trs is the SMTC configured in the measObjectNR having the same SSB frequency and subcarrier spacing. If the measObjectNRs having the same SSB frequency and subcarrier spacing configured by MN and SN have different SMTC, Trs is the periodicity of one of the SMTC which is up to UE implementation. If the UE is not provided SMTC configuration or measurement object on this frequency, the requirement in this section is applied with Trs = 5 ms assuming the SSB transmission periodicity is 5 ms. There is no requirement if the SSB transmission periodicity is not 5 ms.

PSCell known and unknown condition is as defined in clause 8.9.2.

6.1.x.2 Conditional handover including target MCG in FR1 and target SCG in FR2 in NR-DC

The requirements in this clause are applicable to conditional handover with target SCG from NR-DC to NR-DC. The requirements in this clause are only applicable to:

* FR1-FR1 NR-DC to FR1-FR2 NR-DC,
* FR1-FR2 NR-DC to FR1-FR2 NR-DC.

This clause defines requirements for the delay within which the UE shall be able to handover from NR cell to NR cell and add NR PSCell in the meantime.

When the UE receives a RRC message implying conditional handover including target MCG in FR1 and target SCG in FR2,

- The UE shall be ready to start the transmission of the new uplink PRACH channel of the target PCell within DCHOwithPSCell\_PCell ms from the end of the last TTI containing the RRC command, and

- The UE shall be capable of transmitting PRACH preamble towards the target PSCell no later than DCHOwithPSCell\_PSCell ms from the end of the last TTI containing the RRC command.

Where:

- DCHOwithPSCell\_PCell equals the applicable RRC procedure delay defined in clause 12 in TS 38.331 [2] plus the interruption time stated in clause 6.1.x.2.1.

- DCHOwithPSCell\_PSCell is the PSCell change delay stated in clause 6.1.x.2.2.

6.1.x.2.1 CHO with PSCell – PCell handover delay

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

When the UE receives a RRC message implying conditional handover the UE shall be ready to start the transmission of the new uplink PRACH channel of the target PCell within DCHOwithPSCell\_PCell seconds from the end of the last TTI containing the RRC command.

DCHOwithPSCell\_PCell =TRRC + TEvent\_DU + Tmeasure + Tprocessing + TIU + T∆ + Tmargin + TCHO\_execution

Where:

TRRC is the RRC procedure delay defined in clause 12 in TS 38.331 [2].

TEvent\_DU is the delay uncertainty which is the time from when the UE successfully decodes a conditional handover command until a condition exists at the measurement reference point which will trigger the conditional handover.

Tmeasure is the measurements time stated in clause 6.1.4.2.2.

Tprocessing is the SW processing time needed by UE, including RF warm up period.

For FR1-FR1 NR-DC to FR1-FR2 NR-DC, Tprocessing = 50 ms if SMTC of the target unknown PSCell is configured in *targetcellSMTC-SCG-r16* but not configured in *reconfigurationWithSync*. Otherwise, Tprocessing = 45 ms.

For FR1-FR2 NR-DC to FR1-FR2 NR-DC, Tprocessing = 30 ms if SMTC of the target unknown PSCell is configured in *targetcellSMTC-SCG-r16* but not configured in *reconfigurationWithSync*. Otherwise, Tprocessing = 25 ms.

TIU is the interruption uncertainty in acquiring the first available PRACH occasion in the new cell stated in clause 6.1.4.2.4.

T∆ is time for fine time tracking and acquiring full timing information of the target cell stated in clause 6.1.4.2.4.

Tmargin is time for SSB post-processing stated in clause 6.1.4.2.4.

TCHO\_execution is the conditional execution preparation time in clause 6.1.4.2.3

6.1.x.2.2 CHO with PSCell – PSCell change delay

The requirements in this section shall apply for PSCell change during handover with PSCell from NR DC to NR-DC.

When handover with PSCell from NR-DC to NR-DC is commanded, the PSCell change time shall be less than DHOwithPSCell\_PSCell:

DCHOwithPSCell\_PSCell = TRRC + TEvent\_DU + Tmeasure + TCHO\_execution + Tprocessing + Tsearch\_PCell\_Conditional + Tsearch\_PSCell + T∆\_PSCell + TPSCell\_ DU + 2 ms

Where:

- TRRC\_delay TEvent\_DU Tmeasure TCHO\_execution are the same as defined in clause 6.1.x.2.1. Tsearch\_PSCell, T∆\_PSCell and TPSCell\_ DU are the same as defined in 6.1.5.4.2.

- Tprocessing is the SW processing time needed by UE, including RF warm up period. Tprocessing = 30 ms if SMTC of the target unknown PSCell is configured in *targetcellSMTC-SCG-r16* but not configured in *reconfigurationWithSync*. Otherwise, Tprocessing = 25 ms.

- Tsearch\_PCell \_Conditional is the time for obtaining the timing reference of target PCell. If SMTC of the target unknown PSCell is configured in *targetcellSMTC-SCG-r16* but not configured in *reconfigurationWithSync*, Tsearch\_PCell \_Conditional = TΔ + Tmargin, where TΔ and Tmargin are specified in clause 6.1.5.4.1. Otherwise, Tsearch\_PCell \_Conditional = 0 ms.

The Trs definition from clause 8.9.2 is modified as following for requirements in this section:

- Trs is the SMTC periodicity of the target NR cell if target PSCell is unknown and SMTC configuration of target unknown PSCell is present in either *targetcellSMTC-SCG-r16* or *reconfigurationWithSync*, otherwise Trs is the SMTC configured in the measObjectNR having the same SSB frequency and subcarrier spacing. If the measObjectNRs having the same SSB frequency and subcarrier spacing configured by MN and SN have different SMTC, Trs is the periodicity of one of the SMTC which is up to UE implementation. If the UE is not provided SMTC configuration or measurement object on this frequency, the requirement in this section is applied with Trs = 5 ms assuming the SSB transmission periodicity is 5 ms. There is no requirement if the SSB transmission periodicity is not 5 ms.

PSCell known and unknown condition is as defined in clause 8.9.2.

6.1.y NR Conditional Handover including target MCG and candidate SCG

6.1.y.1 Conditional handover including target MCG and candidate SCG for CPC in FR1 NR-DC

The purpose of NR Conditional handover including target MCG and candidate SCG for CPC is to change the NR PCell to another NR cell and change the PSCell along with PCell handover. The requirements in this clause are applicable to:

* FR1-FR1 NR-DC to FR1-FR1 NR-DC,
* FR1-FR2 NR-DC to FR1-FR1 NR-DC.

When the CHO execution condition is met but no CPC execution condition is met, and the UE has an available complementary CHO-only configuration, the UE executes CHO without CPC and the delay requirements for CHO defined in section 6.1.4 apply.

When the CHO execution condition is met but no CPC execution condition is met, and the UE has Rel-17 complementary CHO with SCG configuration, the UE executes Rel-17 CHO with SCG execution and the delay requirements for CHO with SCG defined in section 6.1.x apply.

When the UE receives a RRC message implying conditional handover including target MCG and candidate SCG for CPC,

- The UE shall be ready to start the transmission of the new uplink PRACH channel of the target PCell within DCHOwithCPC\_PCell ms from the end of the last TTI containing the RRC command, and

- The UE shall be capable of transmitting PRACH preamble towards the target PSCell no later than DCHOwithCPC\_PSCell ms from the end of the last TTI containing the RRC command.

Where:

- DCHOwithCPC\_PCell is the PCell conditional handover delay stated in clause 6.1.y.1.1.

- DCHOwithCPC\_PSCell is the PSCell conditional change delay stated in clause 6.1.y.1.2.

6.1.y.1.1 PCell conditional handover delay

DCHOwithCPC\_PCell = TRRC\_delay + TEvent\_DU + max (Tmeasure\_PCell, Tmeasure\_PSCell) + TUE\_preparation + Tprocessing + T∆\_PCell + TPCell\_DU + 2 ms

- TRRC\_delay is the RRC procedure delay defined in clause 12 in TS 38.331 [2] for processing the RRC command.

- TEvent\_DU in PCell and PSCell handover delay requirement is the delay uncertainty which is the time from when the UE successfully decodes the RRC command for CHO including target MCG and candidate SCG for CPC until conditions exist at the measurement reference point which will trigger the CHO and CPC.

- Tmeasure\_PCell is the measurements time stated in clause 6.1.y.1.1.1.

- Tmeasure\_PSCell is the measurements time stated in clause 6.1.y.1.2.1.

- TUE\_preparation is the UE preparation time for conditional handover with conditional PSCell change, and starts at simultaneous execution of PCell handover and PSCell change to a target PCell and a target PSCell respectively after UE realizes the conditions of conditional PCell handover and conditional PSCell change are met and identities of the target PCell and PSCell are determined. TUE\_preparation is up to 10ms.

- Tprocessing is the SW processing time needed by UE, including RF warm up period.

For FR1-FR1 NR-DC to FR1-FR1 NR-DC, Tprocessing = 25 ms.

For FR1-FR2 NR-DC to FR1-FR1 NR-DC, Tprocessing = 45 ms.

- T∆\_PCell is time for fine time tracking and acquiring full timing information of the target PCell. T∆\_PCell = 1\*Trs ms.

- Trs is the SMTC periodicity of the target cell if the UE has been provided with an SMTC configuration for the target cell in handover message, otherwise Trs is the SMTC configured in the measObjectNR having the same SSB frequency and subcarrier spacing. If the UE is not provided SMTC configuration or measurement object on this frequency, the requirement in this clause is applied with Trs = 5 ms assuming the SSB transmission periodicity is 5 ms. There is no requirement if the SSB transmission periodicity is not 5 ms.

- TPCell\_DU is the delay uncertainty in acquiring the first available PRACH occasion in the PCell. TPCell\_DU is up to the summation of SSB to PRACH occasion association period and 10 ms. SSB to PRACH occasion associated period is defined in Table 8.1-1 of TS 38.213 [3].

6.1.y.1.1.1 Measurement time

The measurement time delay for PCell is defined from the end of TEvent\_DU until UE realizes the condition of PCell handover is met and identity of new PCell is determined.

For intra-frequency PCell handover, the measurement time delay measured without Time To Trigger (TTT) and L3 filtering shall be less than Tidentify intra with index or Tidentify\_intra\_without\_index defined in clause 9.2.5.1 or clause 9.2.6.2.

For inter-frequency PCell handover, the measurement time delay measured without Time To Trigger (TTT) and L3 filtering shall be less than Tidentify\_inter\_without\_index or Tidentify\_inter\_with\_index defined in clause 9.3.4. When TTT or L3 filtering is used an additional delay can be expected.

A cell is detectable only if at least one SSB measured from the cell being configured remains detectable during the time period Tidentify\_intra\_without\_index or Tidentify\_intra\_with\_index for intra-frequency PCell handover or the time period Tidentify\_inter\_without\_index or Tidentify\_inter\_with\_index for inter-frequency PCell handover. If a cell, which has been detectable at least for the time period Tidentify\_intra\_without\_index or Tidentify\_intra\_with\_index for intra-frequency PCell handover or the time period Tidentify\_inter\_without\_index or Tidentify\_inter\_with\_index for inter-frequency PCell handover, becomes undetectable for a period and then the cell becomes detectable again and triggers a PCell handover, the measurement time delay shall be less than TSSB\_measurement\_period\_intra or TSSB\_measurement\_period\_inter provided the timing to that cell has not changed more than ± 3200/ Tc while the measurement gap has not been available and the L3 filter has not been used, where *µ* is the SCS configuration as defined in clause 4.2 of TS 38.211 [3]. When L3 filtering is used, an additional delay can be expected.

6.1.y.1.2 PSCell conditional change delay

DCHOwithCPC\_PSCell = TRRC\_delay + TEvent\_DU + max (Tmeasure\_PCell, Tmeasure\_PSCell) + TUE\_preparation + Tprocessing + T∆\_PSCell + TPSCell\_DU + 2 ms

- TRRC\_delay is the RRC procedure delay defined in clause 12 in TS 38.331 [2] for processing the RRC command.

- TEvent\_DU in PCell and PSCell handover delay requirement is the delay uncertainty which is the time from when the UE successfully decodes the RRC command for CHO including target MCG and candidate SCG for CPC until conditions exist at the measurement reference point which will trigger the CHO and CPC.

- Tmeasure\_PCell is the measurements time stated in clause 6.1.y.1.1.1.

- Tmeasure\_PSCell is the measurements time stated in clause 6.1.y.1.2.1.

- TUE\_preparation is the UE preparation time for conditional handover with conditional PSCell change, and starts at simultaneous execution of PCell handover and PSCell change to a target PCell and a target PSCell respectively after UE realizes the conditions of conditional PCell handover and conditional PSCell change are met and identities of the target PCell and PSCell are determined. TUE\_preparation is up to 10ms.

- Tprocessing is as specified in clause 6.1.y.1.1.

- T∆\_PSCell is time for fine time tracking and acquiring full timing information of the target PSCell. T∆\_PSCell = 1\*Trs ms.

- Trs is the SMTC periodicity of the target cell if the UE has been provided with an SMTC configuration for the target cell in PSCell addition message, otherwise Trs is the SMTC configured in the measObjectNR having the same SSB frequency and subcarrier spacing. If the UE is not provided SMTC configuration or measurement object on this frequency, the requirement in this clause is applied with Trs = 5 ms assuming the SSB transmission periodicity is 5 ms. There is no requirement if the SSB transmission periodicity is not 5 ms.

- TPSCell\_DU is the delay uncertainty in acquiring the first available PRACH occasion in the PSCell. TPSCell\_DU is up to the summation of SSB to PRACH occasion association period and 10 ms. SSB to PRACH occasion associated period is defined in Table 8.1-1 of TS 38.213 [3].

6.1.y.1.2.1 Measurement time

The measurement time delay for PSCell is defined from the end of TEvent\_DU until UE realizes the condition of PSCell change is met and identity of new PSCell is determined.

For intra-frequency PSCell change, the measurement time delay measured without Time To Trigger (TTT) and L3 filtering shall be less than Tidentify intra with index or Tidentify\_intra\_without\_index defined in clause 9.2.5.1 or clause 9.2.6.2.

For inter-frequency PSCell change, the measurement time delay measured without Time To Trigger (TTT) and L3 filtering shall be less than Tidentify\_inter\_without\_index or Tidentify\_inter\_with\_index defined in clause 9.3.4. When TTT or L3 filtering is used an additional delay can be expected.

A cell is detectable only if at least one SSB measured from the cell being configured remains detectable during the time period Tidentify\_intra\_without\_index or Tidentify\_intra\_with\_index for intra-frequency PCell handover or the time period Tidentify\_inter\_without\_index or Tidentify\_inter\_with\_index for inter-frequency PCell handover. If a cell, which has been detectable at least for the time period Tidentify\_intra\_without\_index or Tidentify\_intra\_with\_index for intra-frequency PCell handover or the time period Tidentify\_inter\_without\_index or Tidentify\_inter\_with\_index for inter-frequency PCell handover, becomes undetectable for a period and then the cell becomes detectable again and triggers a PCell handover, the measurement time delay shall be less than TSSB\_measurement\_period\_intra or TSSB\_measurement\_period\_inter provided the timing to that cell has not changed more than ± 3200/ Tc while the measurement gap has not been available and the L3 filter has not been used, where *µ* is the SCS configuration as defined in clause 4.2 of TS 38.211 [3]. When L3 filtering is used, an additional delay can be expected.

6.1.y.2 Conditional handover including target MCG in FR1 and Candidate SCG for CPC in FR2 in NR-DC

The requirements in this clause are applicable to conditional handover including target MCG in FR1 and candidate SCG for CPC in FR2 NR-DC. The requirements in this clause are applicable to:

* FR1-FR1 NR-DC to FR1-FR2 NR-DC,
* FR1-FR2 NR-DC to FR1-FR2 NR-DC.

Procedure delays for all procedures that can command a conditional handover including target MCG and candidate SCG for CPC are specified in TS 38.331 [2].

When the CHO execution condition is met but no CPC execution condition is met and the UE has an available complementary CHO-only configuration the UE executes CHO without CPC and the delay requirements for CHO defined in section 6.1.4 apply.

When the CHO execution condition is met but no CPC execution condition is met and the UE has Rel-17 complementary CHO with SCG configuration the UE executes Rel-17 CHO with SCG execution and the delay requirements for CHO with SCG defined in section 6.1.x apply.

When the UE receives a RRC message implying conditional handover including target MCG and candidate SCG for CPC

the UE shall be ready to start the transmission of the new uplink PRACH channel of the target PCell within DCHOwithCPC\_PCell ms from the end of the last TTI containing the RRC command and

the UE shall be capable of transimitting of the new uplink PRACH channel of the target PSCell within DCHOwithCPC\_PSCell ms from the end of the last TTI containing the RRC command.

Where:

- DCHOwithCPC\_PCell is the PCell conditional handover delay stated in clause 6.1.y.2.1.

- DCHOwithCPC\_PSCell is the PSCell conditional change delay stated in clause 6.1.y.2.2.

6.1.y.2.1 PCell handover delay

DCHOwithCPC\_PCell = TRRC\_delay + TEvent\_DU + max (Tmeasure\_PCell, Tmeasure\_PSCell) + TUE\_preparation + Tprocessing + T∆\_PCell + TPCell\_DU + 2 ms

- TRRC\_delay is the RRC procedure delay defined in clause 12 in TS 38.331 [2] for processing the RRC command.

- TEvent\_DU in PCell and PSCell handover delay requirement is the delay uncertainty which is the time from when the UE successfully decodes the RRC command for CHO including target MCG and candidate SCG for CPC until conditions exist at the measurement reference point which will trigger the CHO with CPC.

- Tmeasure\_PCell is the measurements time stated in clause 6.1.y.2.1.1

- Tmeasure\_PSCell is the measurements time stated in clause 6.1.y.2.2.1.

- TUE\_preparation is the UE preparation time for conditional handover with conditional PSCell change and starts at simultaneous execution of PCell handover and PSCell change to a target PCell and a target PSCell respectively after UE realizes the conditions of conditional PCell handover and conditional PSCell change are met and identities of the target PCell and PSCell are determined. TUE\_preparation is up to 10ms.

- Tprocessing is the SW processing time needed by UE, including RF warm up period.

For FR1-FR1 NR-DC to FR1-FR2 NR-DC, Tprocessing = 45 ms.

For FR1-FR2 NR-DC to FR1-FR2 NR-DC, Tprocessing = 25 ms

- T∆\_PCell is time for fine time tracking and acquiring full timing information of the target PCell. T∆\_PCell = 1\*Trs ms.

- Trs is the SMTC periodicity of the target cell if the UE has been provided with an SMTC configuration for the target cell in handover message, otherwise Trs is the SMTC configured in the measObjectNR having the same SSB frequency and subcarrier spacing. If the UE is not provided SMTC configuration or measurement object on this frequency, the requirement in this clause is applied with Trs = 5 ms assuming the SSB transmission periodicity is 5 ms. There is no requirement if the SSB transmission periodicity is not 5 ms.

- TPCell\_DU is the delay uncertainty in acquiring the first available PRACH occasion in the PCell. TPCell\_DU is up to the summation of SSB to PRACH occasion association period and 10 ms. SSB to PRACH occasion associated period is defined in Table 8.1-1 of TS 38.213 [3].

6.1.y.2.1.1 Measurement time

The measurement time delay for PCell is defined from the end of TEvent\_DU until UE realizes the condition of PCell handover is met and identity of new PCell is determined.

For intra-frequency PCell handover, the measurement time delay measured without Time To Trigger (TTT) and L3 filtering shall be less than Tidentify intra with index or Tidentify\_intra\_without\_index defined in clause 9.2.5.1 or clause 9.2.6.2.

For inter-frequency PCell handover, the measurement time delay measured without Time To Trigger (TTT) and L3 filtering shall be less than Tidentify\_inter\_without\_index or Tidentify\_inter\_with\_index defined in clause 9.3.4. When TTT or L3 filtering is used an additional delay can be expected.

A cell is detectable only if at least one SSB measured from the cell being configured remains detectable during the time period Tidentify\_intra\_without\_index or Tidentify\_intra\_with\_index for intra-frequency PCell handover or the time period Tidentify\_inter\_without\_index or Tidentify\_inter\_with\_index for inter-frequency PCell handover. If a cell, which has been detectable at least for the time period Tidentify\_intra\_without\_index or Tidentify\_intra\_with\_index for intra-frequency PCell handover or the time period Tidentify\_inter\_without\_index or Tidentify\_inter\_with\_index for inter-frequency PCell handover, becomes undetectable for a period and then the cell becomes detectable again and triggers a PCell handover, the measurement time delay shall be less than TSSB\_measurement\_period\_intra or TSSB\_measurement\_period\_inter provided the timing to that cell has not changed more than ± 3200/ Tc while the measurement gap has not been available and the L3 filter has not been used, where *µ* is the SCS configuration as defined in clause 4.2 of TS 38.211 [3]. When L3 filtering is used, an additional delay can be expected.

6.1.y.2.2 PSCell conditional change delay

DCHOwithCPC\_PSCell = TRRC\_delay + TEvent\_DU + max(Tmeasure\_PCell, Tmeasure\_PSCell) + TUE\_preparation + Tprocessing + T∆\_PSCell + TPSCell\_DU + 2 ms

- TRRC\_delay is the RRC procedure delay defined in clause 12 in TS 38.331 [2] for processing the RRC command.

- TEvent\_DU in PCell and PSCell handover delay requirement is the delay uncertainty which is the time from when the UE successfully decodes the RRC command for CHO including target MCG and candidate SCG for CPC until conditions exist at the measurement reference point which will trigger the CHO with CPC.

- Tmeasure\_PCell is the measurements time stated in clause 6.1.y.2.1.1.

- Tmeasure\_PSCell is the measurements time stated in clause 6.1.y.2.2.1.

- TUE\_preparation is the UE preparation time for conditional handover with conditional PSCell change and starts at simultaneous execution of PCell handover and PSCell change to a target PCell and a target PSCell respectively after UE realizes the conditions of conditional PCell handover and conditional PSCell change are met and identities of the target PCell and PSCell are determined. TUE\_preparation is up to 10ms.

- Tprocessing is as specified in clause 6.1.y.2.1.

- T∆\_PSCell is time for fine time tracking and acquiring full timing information of the target PSCell. T∆\_PSCell = 1\*Trs ms.

- Trs is the SMTC periodicity of the target cell if the UE has been provided with an SMTC configuration for the target cell in PSCell change message, otherwise Trs is the SMTC configured in the measObjectNR having the same SSB frequency and subcarrier spacing. If the UE is not provided SMTC configuration or measurement object on this frequency, the requirement in this clause is applied with Trs = 5 ms assuming the SSB transmission periodicity is 5 ms. There is no requirement if the SSB transmission periodicity is not 5 ms.

- TPSCell\_DU is the delay uncertainty in acquiring the first available PRACH occasion in the PSCell. TPSCell\_DU is up to the summation of SSB to PRACH occasion association period and 10 ms. SSB to PRACH occasion associated period is defined in Table 8.1-1 of TS 38.213 [3].

6.1.y.2.2.1 Measurement time

The measurement time delay for PSCell is defined from the end of TEvent\_DU until UE realizes the condition of PSCell change is met and identity of new PSCell is determined.

For intra-frequency PSCell change, the measurement time delay measured without Time To Trigger (TTT) and L3 filtering shall be less than Tidentify intra with index or Tidentify\_intra\_without\_index defined in clause 9.2.5.1 or clause 9.2.6.2.

For inter-frequency PSCell change, the measurement time delay measured without Time To Trigger (TTT) and L3 filtering shall be less than Tidentify\_inter\_without\_index or Tidentify\_inter\_with\_index defined in clause 9.3.4. When TTT or L3 filtering is used an additional delay can be expected.

A cell is detectable only if at least one SSB measured from the cell being configured remains detectable during the time period Tidentify\_intra\_without\_index or Tidentify\_intra\_with\_index for intra-frequency PCell handover or the time period Tidentify\_inter\_without\_index or Tidentify\_inter\_with\_index for inter-frequency PCell handover. If a cell, which has been detectable at least for the time period Tidentify\_intra\_without\_index or Tidentify\_intra\_with\_index for intra-frequency PCell handover or the time period Tidentify\_inter\_without\_index or Tidentify\_inter\_with\_index for inter-frequency PCell handover, becomes undetectable for a period and then the cell becomes detectable again and triggers a PCell handover, the measurement time delay shall be less than TSSB\_measurement\_period\_intra or TSSB\_measurement\_period\_inter provided the timing to that cell has not changed more than ± 3200/ Tc while the measurement gap has not been available and the L3 filter has not been used, where *µ* is the SCS configuration as defined in clause 4.2 of TS 38.211 [3]. When L3 filtering is used, an additional delay can be expected.

End of Change 4

Start of Change 5

6.X L1/L2-Triggered Mobility

6.X.1 PCell Cell Switch

6.X.1.1 Introduction

The purpose of LTM cell switch is to switch the PCell or PSCell to another cell. The requirements in this section are applicable to LTM PCell switch.

The requirements in this clause are applicable to SA and NR-DC, and to both intra-frequency and inter-frequency LTM cell switch.

The requirements in this clause are applicable to SA for the following scenarios:

PCell switch to a neighboring 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 serving SCell in MCG

- FR1 cell to FR1 cell

- FR2 cell to FR2 cell

The requirements in this clause are applicable to NR-DC for the following scenarios:

PCell switch to a neighboring cell

- FR1 cell to FR1 cell

PCell switch to a serving SCell in MCG

- FR1 cell to FR1 cell

6.X.1.2 LTM Cell Switch delay

LTM cell switch delay DLTM is the delay from the end of the last TTI containing the MAC-CE command for cell switch until the time the UE transmits the first UL message on the target cell.

When the target cell and the target joint UL/DL TCI state or separate UL and DL TCI states in the MAC-CE LTM cell switch command are known, the LTM cell switch delay is defined as:

DLTM = Tcmd + TLTM-interrupt

Where:

Tcmd equals to THARQ + 3ms, where THARQ is the timing between cell switch command and acknowledgement as specified in TS 38.213.

TLTM-interrupt is as stated in section 6.X.1.2.1.

The target cell in the LTM cell switch command is known if the following conditions are met:

* During the last 5 seconds before the reception of the cell switch command:
  + The UE has sent a valid L1 or L3 measurement report for the target cell, and
  + One of the SSBs measured from the NR target cell being configured remains detectable according to the cell identification conditions specified in clause 9.2 for intra-frequency cell and in clause 9.3 for inter-frequency cell,
* One of the SSBs measured from the target cell also remains detectable during the cell switch delay according to the cell identification conditions specified in clause 9.2 for intra-frequency cell and in clause 9.3 for inter-frequency cell.

Otherwise, the cell is unknown.

The target joint DL/UL TCI state or separate DL and UL TCI states in the LTM cell switch command are known if the following conditions are met:

* During the period from the last transmission of the RS resource used for the L1-RSRP measurement reporting for the target DL/UL TCI state to the completion of LTM cell switch, where the RS resource for L1-RSRP measurement is the RS in target DL/UL TCI state or QCLed to the target DL/UL TCI state
  + LTM cell switch command is received within 1280 ms upon the last transmission of the RS resource for beam reporting or measurement
  + The UE has sent at least 1 L1-RSRP report for the target DL/UL TCI state before the LTM cell switch command
  + The target DL/UL TCI state remains detectable during the LTM cell switching period
  + The SSB associated with the target DL/UL TCI state remain detectable during the cell switching period
    - * SNR of the TCI state ≥ -3dB

Otherwise, the target joint DL/UL TCI state or separate DL and UL TCI state is unknown.

6.X.1.3 Interruption time

The interruption time TLTM-interrupt is the time between the end of the last TTI containing the MAC-CE command for LTM cell switch until the time the UE transmits the first UL message on the target cell, excluding Tcmd stated in section 6.X.1.2.

TLTM-interrupt = TLTM-RRC-processing + TLTM-processing + Tfirst-RS + TRS-proc + TLTM-IU ms,

Where:

TLTM-RRC-processing is the time for early ASN.1 decoding and validity/compliance check for the RRC configuration of the LTM target cell indicated in the LTM cell switch command.

TLTM-RRC-processing = 0, if the the UE supporting capability [*earlyDecodingAndValidityCheck*] has performed early ASN.1 decoding and validity/compliance check of the complete LTM candidate cell configuration prior to the cell switch command for the LTM target cell indicated in the cell switch command.

*Editor’s note: FFS the conditions under which the UE with new capability can work with early ASN.1 decoding and validity/compliance check*

Otherwise TLTM-RRC-processing = 10 ms.

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

The value of TLTM-processing is 20 ms for FR1 to FR1 and FR2 to FR2 LTM cell switch.

The value of TLTM-processing is 40 ms for FR1 to FR2 and FR2 to FR1 LTM cell switch.

*Editor’s note: FFS whether a smaller value can be considered in some scenarios or under certain conditions, or whether to introduce a new UE capability to support smaller value of TLTM-processing.*

Tfirst-RS is the time for fine time tracking and acquiring full timing information of the target cell.

TRS-proc is the time for SSB processing.

Tfirst-RS = 0 and TRS-proc= 0 under the following conditions:

- The target TCI state indicated in the LTM cell switch command is in the LTM candidate cell active TCI state list or in the serving cell active TCI state list, and

- The time between receiving the MAC-CE activating the target TCI state and the LTM cell switch command is at least [THARQ + + TOk\*(Tfirst-SSB + TSSB-proc) / *NR slot length*, where THARQ, TOk, Tfirst-SSB and TSSB-proc are as stated in section 8.15.3], and

- L1-RSRP measurement period is not larger than 160 ms.

*Editor’s note: FFS other conditions.*

Otherwise,

Tfirst-RS is the time to the first SSB transmission on the target cell [after Tcmd].

*Editor’s note: FFS whether TRS transmission is also considered.*

TRS-proc = 2 ms.

TLTM-IU is the interruption uncertainty during LTM cell switch.

ForRACH-based LTM cell switch, TLTM-IU is the interruption uncertainty in acquiring the first available PRACH occasion in the new cell. TLTM-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].

ForRACH-less LTM cell switch, TLTM-IU\_is the uncertainty on transmitting the first uplink transmission on the target cell.

End of Change 5

Start of Change 6

## 7.1 UE transmit timing

### 7.1.1 Introduction

The UE shall have capability to follow the frame timing change of the reference cell in connected state or when transmiting PUSCH on CG resources for SDT in RRC\_Inactive. The uplink frame transmission takes place before the reception of the first detected path (in time) of the corresponding downlink frame from the reference cell. For serving cell(s) in pTAG, UE shall use the SpCell as the reference cell for deriving the UE transmit timing for cells in the pTAG. For serving cell(s) in sTAG, UE shall use any of the activated SCells as the reference cell for deriving the UE transmit timing for the cells in the sTAG. UE initial transmit timing accuracy and gradual timing adjustment requirements are defined in the following requirements.

In the requirements of clause 7.1.2, the term reference cell on a carrier frequency subject to CCA is not available at the UE refers to when at least one SSB is configured by gNB, but the first two successive candidate SSB positions for the same SSB index within the discovery burst transmission window are not available during at least one discovery burst transmission window, at the UE due to DL CCA failures at gNB during the last 1280 ms; otherwise the reference cell on the carrier frequency subject to CCA is considered as available at the UE.

[For UE supporting [RACH-based early TA acquisition] for LTM, and if the candidate cell is a neighbor cell,

* UE shall have capability to follow the frame timing of the reference cell. The PRACH transmission take place  before the reception of the first detected path (in time) of the corresponding downlink frame from the reference cell. For the neighbor cell to which PRACH is transmitted, UE shall use this neighbor cell as the reference cell for deriving transmit timing. UE initial transmit timing accuracy is defined in the following requirements.]

*Editor’s Note: The above requirements for RACH-based early TA acquisition can be revisited if any further agreements in other WG have impacts on the DL reference timing*

*Editor’s Note: FFS whether additional handling is needed when the candidate cell is a secondary serving cell.*

### 7.1.2 Requirements

The UE initial transmission timing error shall be less than or equal to ±Te where the timing error limit value Te is specified in Table 7.1.2-1. This requirement applies:

- when it is the first transmission in a DRX cycle for PUCCH, PUSCH and SRS, or it is the PRACH transmission, or it is the msgA transmission, or it is the first transmission sent on the PSCell for activating the deactivated SCG without RACH.

- when it is the transmission for PUSCH on CG resources for SDT in RRC\_Inactive.

- when it is the first transmission on target cell after UE receives LTM cell switch command.

*Editor’s Note: FFS the timing accuracy requirements for UE-based TA derivation.*

When the UL SCS is 120 kHz or smaller, the UE shall meet the Te requirement for an initial transmission provided that at least one SSB is available at the UE during the last 160 ms. When the UL SCS is 480 kHz the UE shall meet the Te requirement for an initial transmission provided that at least one SSB is available in the last 80 ms. When the UL SCS is 960 kHz the UE shall meet the Te requirement for an initial transmission provided that at least one SSB is available in the last 40 ms.

*Editor’s Note: For LTM, the impact to uplink timing accuracy requirements due to the SSB availability for PDCCH ordered RACH before cell switch is FFS.*

The reference point for the UE initial transmit timing control requirement shall be the downlink timing of the reference cell minus . The downlink timing is defined as the time when the first path (in time) of the corresponding downlink frame used by the UE to determine downlink timing is received from the reference cell at the UE antenna. *N*TA for PRACH is defined as 0.

 (in *Tc* units) for other channels is the difference between UE transmission timing and the downlink timing immediately after when the last timing advance in clause 7.3 was applied. *N*TA for other channels is not changed until next timing advance is received. The value ofdepends on the duplex mode of the cell in which the uplink transmission takes place and the frequency range (FR). is defined in Table 7.1.2-2.

Table 7.1.2-1: Te Timing Error Limit

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency Range | SCS of SSB signals (kHz) | SCS of uplink signals (kHz) | Te |
| 1 | 15 | 15 | 12\*64\*Tc |
|  |  | 30 | 10\*64\*Tc |
|  |  | 60 | 10\*64\*Tc |
|  | 30 | 15 | 8\*64\*Tc |
|  |  | 30 | 8\*64\*Tc |
|  |  | 60 | 7\*64\*Tc |
| 2-1 | 120 | 60 | 3.5\*64\*Tc |
|  |  | 120 | 3.5\*64\*Tc |
|  | 240 | 60 | 3\*64\*Tc |
|  |  | 120 | 3\*64\*Tc |
| 2-2 | 120 | 120 | 3.5\*64\*Tc |
|  |  | 480 | [1.58]\*64\*Tc |
|  | 480 | 120 | 2.86\*64\*Tc |
|  |  | 480 | [1.35]\*64\*Tc |
|  |  | 960 | [0.90]\*64\*Tc |
|  | 960 | 120 | 2.80\*64\*Tc |
|  |  | 480 | [1.13]\*64\*Tc |
|  |  | 960 | [0.86]\*64\*Tc |
| Note 1: Tc is the basic timing unit defined in TS 38.211 [6] | | | |

Table 7.1.2-2: The Value of 

|  |  |
| --- | --- |
| Frequency range and band of cell used for uplink transmission | (Unit: TC) |
| FR1 FDD or TDD band with neither E-UTRA–NR nor NB-IoT–NR coexistence case | 25600 (Note 1) |
| FR1 FDD band with E-UTRA–NR and/or NB-IoT–NR coexistence case | 0 (Note 1) |
| FR1 TDD band with E-UTRA–NR and/or NB-IoT–NR coexistence case | 39936 (Note 1) |
| FR2 | 13792 |
| Note 1: The UE identifies  based on the information n-TimingAdvanceOffset as specified in TS 38.331 [2]. If UE is not provided with the information n-TimingAdvanceOffset, the default value of  is set as 25600 for FR1 band. In case of multiple UL carriers in the same TAG, UE expects that the same value of n-TimingAdvanceOffset is provided for all the UL carriers according to clause 4.2 in TS 38.213 [3] and the value 39936 of  can also be provided for a FDD serving cell.  Note 2: Void | |

When it is not the first transmission in a DRX cycle or there is no DRX cycle, and when it is the transmission for PUCCH, PUSCH and SRS transmission, the UE shall be capable of changing the transmission timing according to the received downlink frame of the reference cell except when the timing advance in clause 7.3 is applied.

Table 7.1.2-3: void

If the UE uses a reference cell on a carrier frequency subject to CCA for deriving the UE transmit timing, then the UE shall meet all the transmit timing requirements defined in clause 7.1.2 provided that the reference cell is available at the UE. If the reference cell is not available at the UE on a carrier frequency subject to CCA, then the UE is allowed to transmit in the uplink provided that the UE meets all the transmit timing requirements defined in clause 7.1.2; otherwise the UE shall not transmit any uplink signal.

If a reference cell on a carrier frequency belonging to the PTAG, which is subject to CCA, is not available at the UE then the UE is allowed to use any of available activated SCell(s) at the UE in PTAG as a new reference cell. If the SCell used as reference cell is deactivated, or becomes not available, the UE is allowed to use another active serving cell in PTAG as new reference cell.

If a reference cell on a carrier frequency belonging to the STAG, which is subject to CCA is not available at the UE then the UE is allowed to use any of available activated SCell(s) at the UE in STAG as a new reference cell.

#### 7.1.2.1 Gradual timing adjustment

Requirements in this section shall apply regardless of whether the reference cell is on a carrier frequency subject to CCA or not.

When the transmission timing error between the UE and the reference timing exceeds ±Te then the UE is required to adjust its timing to within ±Te. The reference timing shall be  before the downlink timing of the reference cell. All adjustments made to the UE uplink timing shall follow these rules:

1) The maximum amount of the magnitude of the timing change in one adjustment shall be Tq.

2) The minimum aggregate adjustment rate shall be Tp per second.

3) The maximum aggregate adjustment rate shall be Tq per 200 ms for SCS of UL signals smaller or equal to 120 kHz and 100 ms for SCS of upling signals larger or equal to 480 kHz.

where the maximum autonomous time adjustment step Tq and the aggregate adjustment rate Tp are specified in Table 7.1.2.1-1.

Table 7.1.2.1-1: Tq Maximum Autonomous Time Adjustment Step and Tp Minimum Aggregate Adjustment rate

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency Range | SCS of uplink signals (kHz) | Tq | Tp |
| 1 | 15 | 5.5\*64\*Tc | 5.5\*64\*Tc |
|  | 30 | 5.5\*64\*Tc | 5.5\*64\*Tc |
|  | 60 | 5.5\*64\*Tc | 5.5\*64\*Tc |
| 2-1 | 60 | K\*64\*Tc | 2.5\*64\*Tc |
|  | 120 | K\*64\*Tc | 2.5\*64\*Tc |
| 2-2 | 120 | 2.5\*64\*Tc | 2.5\*64\*Tc |
|  | 480 | [0.8]\*64\*Tc | [0.8]\*64\*Tc |
|  | 960 | [0.8]\*64\*Tc | [0.8]\*64\*Tc |
| NOTE 1: Tc is the basic timing unit defined in TS 38.211 [6]  NOTE 2: When *highSpeedMeasFlagFR2-r17* is configured for UE supporting power class 6, K = 4.5; otherwise, K = 2.5. | | | |

#### 7.1.2.2 Void

Table 7.1.2.2-1: Void

#### 7.1.2.3 One shot large UL timing adjustment for FR2 Power Class 6 UE

When *highSpeedMeasFlagFR2-r17* is configured and *highSpeedLargeOneStepUL-TimingFR2-r17* is enabled for UE supporting FR2 power class 6 and [*largeOneStepUL-timingFR2-r17*] capability, the following requirements apply to the UE:

- If the absolute value , the requirement in clause 7.1.2.1 apply to the first UL transmission after a TCI state switch.

- Otherwise, the UE transmit timing immediately after TCI state switch shall be and clause 7.1.2.1 requirements don’t apply.

- The UE UL transmission timing error after the TCI state switching procedure shall be less than or equal to ±Te as specified in clause 7.1.2 if the new target TCI state is within active TCI state list, otherwise ±7\*64\*Tc, and the reference point is .

Above,

- (in units) is the DL timing defined as the time when UE receives downlink frame with new target TCI state.

- (in units) is the DL timing defined as the time when UE receives downlink frame with old source TCI state.

End of Change 6

Start of Change 7

#### 8.1.2.3 Measurement restrictions for SSB based RLM

The UE is required to be capable of measuring SSB for RLM without measurement gaps. The UE is required to perform the SSB measurements with measurement restrictions as described in the following scenarios.

For FR1, when the SSB for RLM is in the same OFDM symbol as CSI-RS for RLM, BFD, CBD or L1-RSRP measurement,

- If SSB and CSI-RS have same SCS, UE shall be able to measure the SSB for RLM without any restriction;

- If SSB and CSI-RS have different SCS,

- If UE supports *simultaneousRxDataSSB-DiffNumerology*, UE shall be able to measure the SSB for RLM without any restriction;

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

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

For FR2, when the SSB for RLM measurement on one CC is in the same or adjacent OFDM symbol as SSB from cell with additional PCI for BFD, CBD or L1-RSRP measurement on the same CC or different CCs in the same band, UE is required to measure one of but not both SSBs. Longer measurement period for SSB based RLM is expected, and no requirements are defined.

For FR2, for UE incapable of [*capability of measurement with RTD>CP*] and for UE capable of [*capability of measurement with RTD>CP*], when the SSB for RLM measurement on one CC is in the same or adjacent 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 SSBs. Longer measurement period for SSB based RLM is expected, and no requirements are defined.

For FR2, there is no measurement restriction allowed when the network configures mixed numerology between SSB for RLM measurement on one FR2 band and CSI-RS for RLM, BFD, CBD, L1-RSRP or L1-SINR measurement on the other FR2 band, provided that UE is capable of independent beam management on this FR2 band pair.

End of Change 7

Start of Change 8

#### 8.1.3.3 Measurement restrictions for CSI-RS based RLM

The SSB mentioned in this clause can be associated with either the serving cell PCI or a PCI different from serving cell PCI.

The UE is required to be capable of measuring CSI-RS for RLM without measurement gaps. The UE is required to perform the CSI-RS measurements with measurement restrictions as described in the following clauses.

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

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

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

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

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

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

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

For UE incapable of [*capability of measurement with RTD>CP*] and for UE capable of [*capability of measurement with RTD>CP*],

- For both FR1 and FR2, when the CSI-RS for RLM measurement is in the same or adjacent 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 RLM measurement in the PRBs that overlap with an SSB.

- For FR1, when the CSI-RS for RLM measurement is in the same or adjacent 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 RLM measurement and SSB. Longer measurement period for CSI-RS based RLM is expected, and no requirements are defined.

- For FR2, when the CSI-RS for RLM measurement on one CC is in the same or adjacent 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 RLM measurement and SSB. Longer measurement period for CSI-RS based RLM is expected, and no requirements are defined.

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

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

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

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

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

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

End of Change 8

Start of Change 9

8.2.2 SA: Interruptions with Standalone NR Carrier Aggregation

8.2.2.1 Introduction

This clause contains the requirements related to the interruptions on PCell and activated SCell if configured, when

up to 7 SCells are configured, de-configured, activated or deactivated, or

a supplementary UL carrier or an UL carrier is configured or de-configured, or

measurements on SCC with deactivated SCell in NR SCG, or

UL/DL BWP is switched on PCell or SCell, or

CGI reading of an NR neighbour cell with autonomous gaps, or

CGI reading of an E-UTRA neighbour cell with autonomous gaps.

UE-specific CBW is changed on PCell or SCell, or

NR SRS carrier based switching, or

NR SRS antenna port switching, or

UE dynamic Tx switches between two uplink carriers, or

SCell is activated based on aperiodic CSI-RS, or

PDCCH ordered RACH on target cell in LTM.

Note: interruptions at SCell addition/release, activation/deactivation and during measurements on SCC may not be required by all UEs.

The interruptions shall not interrupt RRC signalling or ACK/NACKs related to RRC reconfiguration procedure according to TS38.331 [2] for SCell addition/release or MAC control signalling according to TS37.340 [17] for SCell activation/deactivation command.

This clause additionally contains requirements related to interruptions at inter-frequency SFTD between PCell in FR1 and neighbour cell in FR2.

For a UE which does not support per-FR measurement gap, interruptions to the PCell and activated SCell may be caused by SCells on any frequency range. For a UE which supports per-FR gaps, interruptions to PCell and activated SCell may be caused by SCells on the same frequency range as the victim cell.

In addition to standalone NR carrier aggregation when no CCA is configured, the requirements in clause 8.2.2. and all subclauses of 8.2.2 apply when the UE is configured with

-A PCell not using CCA in downlink and one or more SCells using CCA in downlink or

-A PCell and one or more SCells using CCA in downlink

8.2.2.2 Requirements

< parts not changed are omitted>

##### 8.2.2.2.x Interruptions due to PDCCH ordered RACH on target LTM cell

When PRACH transmission is triggered by PDCCH order on target LTM cell,

- During RACH transmission, the UE is allowed an interruption on activated serving cell’s DL slot(s) overlapped with RACH occasion depending on UE capability [x].

- Before and after PRACH transmission, UE is allowed an interruption on any activated serving cell as follows:

- an interruption on any active serving cell:

- of up to the duration shown in table 8.2.2.2.x-1, if PRACH bandwidth is outside active UL BWP but within one of configured UL BWPs of any active serving cell, or

- of up to Yms as reported in [UE capability xx], if PRACH bandwidth is outside any of the configured UL BWPs of any active serving cell

Table 8.2.2.2.x-1: Interruption duration due to PDCCH ordered RACH on target LTM cell when PRACH bandwidth is outside active UL BWP but within one of configured UL BWPs of any active serving cell

|  |  |  |
| --- | --- | --- |
|  | NR Slot length (ms) of victim cell | Interruption length X (slots) |
| 0 | 1 | 2 |
| 1 | 0.5 | 2 |
| 2 | 0.25 | 4 |

End of Change 9

Start of Change 10

### 8.2.4 NR-DC: Interruptions

#### 8.2.4.1 Introduction

This clause contains the requirements related to the interruptions on PCell, PSCell and activated SCell if configured, when

up to 1 SCell in FR1 and up to 7 SCell(s) in FR2 are configured, deconfigured, activated or deactivated or,

a supplementary UL carrier or an UL carrier is configured or de-configured, or

measurements on SCC with deactivated SCell in NR SCG, or

measurements on the deactivated PSCell in NR SCG, or

UL/DL BWP is switched on PCell, PSCell or SCell,

UE-specific CBW is changed on PCell, PSCell or SCell, or

transitions between active and non-active during DRX, or

transitions from non-DRX to DRX, or

CGI reading of an NR neighbour cell with autonomous gaps, or

CGI reading of an E-UTRA neighbour cell with autonomous gaps.

NR SRS carrier based switching, or

NR SRS antenna port switching.

RLM/BFD Measurement on deactivatd NR PSCell, or

NR SCell is activated based on aperiodic CSI-RS, or

PDCCH ordered RACH on target cell in LTM.

Note: interruptions at SCell addition/release, activation/deactivation and during measurements on SCC may not be required by all UEs.

The interruptions shall not interrupt RRC signalling or ACK/NACKs related to RRC reconfiguration procedure [2] for SCell addition/release or MAC control signalling [17] for SCell activation/deactivation command.

The requirements shall apply for NR-DC with an NR PCell, PSCell or SCell.

For a UE which does not support per-FR measurement gap, interruptions to the PCell and activated SCell may be caused by SCells on any frequency range. For a UE which supports per-FR gaps, interruptions to PCell, PSCell and activated SCell may be caused by SCells on the same frequency range as the victim cell.

8.2.4.2 Requirements

< parts not changed are omitted>

##### 8.2.4.2.x Interruptions due to PDCCH ordered RACH on target LTM cell

When PRACH transmission is triggered by PDCCH order on target LTM cell,

- During RACH transmission, the UE is allowed an interruption on activated serving cell’s DL slot(s) overlapped with RACH occasion depending on UE capability [x].

- Before and after PRACH transmission, UE is allowed an interruption on any activated serving cell as follows:

- an interruption on any active serving cell:

- of up to the duration shown in table 8.2.4.2.x-1, if PRACH bandwidth is outside active UL BWP but within one of configured UL BWPs of any active serving cell, or

- of up to Yms as reported in [UE capability xx], if PRACH bandwidth is outside any of the configured UL BWPs

Table 8.2.4.2.x-1: Interruption duration due to PDCCH ordered RACH on target LTM cell when PRACH bandwidth is outside active UL BWP but within one of configured UL BWPs of any active serving cell

|  |  |  |
| --- | --- | --- |
|  | NR Slot length (ms) of victim cell | Interruption length X (slots) |
| 0 | 1 | 2 |
| 1 | 0.5 | 2 |
| 2 | 0.25 | 4 |
| 3 | 0.125 | 6 |

End of Change 10

Start of Change 11

#### 8.5.2.3 Measurement restriction for SSB based beam failure detection

The UE is required to be capable of measuring SSB for BFD without measurement gaps. The UE is required to perform the SSB measurements with measurement restrictions as described in the following scenarios.

For FR1, when the SSB for BFD measurement is in the same OFDM symbol as CSI-RS for RLM, BFD, CBD or L1-RSRP measurement,

- If SSB and CSI-RS have same SCS, UE shall be able to measure the SSB for BFD measurement without any restriction;

- If SSB and CSI-RS have different SCS,

- If UE supports *simultaneousRxDataSSB-DiffNumerology*, UE shall be able to measure the SSB for BFD measurement without any restriction;

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

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

For FR2, when the SSB for BFD measurement on one CC is in the same or adjacent OFDM symbol as SSB from cell with additional PCI for L1-RSRP measurement on the same CC or different CCs in the same band, UE is required to measure one of but not both SSBs. Longer measurement period for SSB based BFD is expected, and no requirements are defined.

For FR2, for UE incapable of [*capability of measurement with RTD>CP*] and for UE capable of [*capability of measurement with RTD>CP*], when the SSB for BFD measurement on one CC is in the same or adjacent 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 SSBs. Longer measurement period for SSB based BFD is expected, and no requirements are defined.

For FR2, if the network configures same or mixed numerology between SSB for BFD measurement on one FR2 band and CSI-RS for RLM, BFD, CBD, L1-RSRP or L1-SINR measurement on the other FR2 band, UE shall be able to perform the related SSB based measurements in one band without any measurement restrictions on the other band, provided that UE is capable of independent beam management on this FR2 band pair.

End of Change 11

Start of Change 12

#### 8.5.3.3 Measurement restrictions for CSI-RS beam failure detection

The SSB mentioned in this clause can be associated with either the serving cell PCI or a PCI different from serving cell PCI.

The UE is required to be capable of measuring CSI-RS for BFD without measurement gaps. The UE is required to perform the CSI-RS measurements with measurement restrictions as described in the following scenarios.

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

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

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

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

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

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

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

For UE incapable of [*capability of measurement with RTD>CP*] and for UE capable of [*capability of measurement with RTD>CP*],

- For both FR1 and FR2, when the CSI-RS for BFD measurement is in the same or adjacent 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 BFD measurement in the PRBs that overlap with an SSB.

- For FR1, when the CSI-RS for BFD measurement is in the same or adjacent 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 BFD measurement and SSB. Longer measurement period for CSI-RS based BFD is expected, and no requirements are defined.

- For FR2, when the CSI-RS for BFD measurement on one CC is in the same or adjacent 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 BFD measurement and SSB. Longer measurement period for CSI-RS based BFD is expected, and no requirements are defined.

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

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

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

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

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

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

End of Change 12

Start of Change 13

#### 8.5.5.3 Measurement restriction for SSB based candidate beam detection

For FR1, when the SSB for CBD measurement is in the same OFDM symbol as CSI-RS for RLM, BFD, CBD or L1-RSRP measurement,

- If SSB and CSI-RS have same SCS, UE shall be able to measure the SSB for CBD measurement without any restrictions;

- If SSB and CSI-RS have different SCS-es,

- If UE supports *simultaneousRxDataSSB-DiffNumerology*, UE shall be able to measure the SSB for CBD measurement without any restriction;

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

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

For FR2, when the SSB for CBD measurement on one CC is in the same OFDM symbol as SSB from cell with additional PCI for BFD or L1-RSRP measurement on the same CC or different CCs in the same band, UE is required to measure one of but not both SSBs. Longer measurement period for SSB based CBD measurement is expected, and no requirements are defined.

For FR2, for UE incapable of [*capability of measurement with RTD>CP*] and for UE capable of [*capability of measurement with RTD>CP*], when the SSB for CBD measurement on one CC is in the same or adjacent 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 SSBs. Longer measurement period for SSB based CBD measurement is expected, and no requirements are defined.

For FR2, if network configures same or mixed numerology between SSB for CBD measurement on one FR2 band and CSI-RS for RLM, BFD, CBD, L1-RSRP or L1-SINR measurement on the other FR2 band, UE shall be able to perform the related SSB based measurements in one band without any measurement restrictions in the other band, provided that UE is capable of independent beam management on this FR2 band pair.

End of Change 13

Start of Change 14

#### 8.5.6.3 Measurement restriction for CSI-RS based candidate beam detection

The SSB mentioned in this clause can be associated with either the serving cell PCI or a PCI different from serving cell PCI.

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

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

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

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

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

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

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

For UE incapable of [*capability of measurement with RTD>CP*] and for UE capable of [*capability of measurement with RTD>CP*],

- For both FR1 and FR2, when the CSI-RS for CBD measurement is in the same or adjacent 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 CBD measurement in the PRBs that overlap with an SSB.

- For FR1, when the CSI-RS for CBD measurement is in the same or adjacent 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 CBD measurement and SSB. Longer measurement period for CSI-RS based CBD is expected, and no requirements are defined.

- For FR2, when the CSI-RS for CBD measurement on one CC is in the same or adjacent 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 CBD measurement and SSB. Longer measurement period for CSI-RS based CBD is expected, and no requirements are defined.

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

End of Change 14

Start of Change 15

8.9C Subsequent Conditional PSCell Addition Delay

8.9C.1 Introduction

This clause defines requirements for the delay within which the UE shall be able to perform subsequent conditional PSCell addition in NR-DC. The requirements in this clause are applicable to NR-DC.

8.9C.2 Subsequent Conditional PSCell Addition Delay Requirement

The requirements in this clause shall apply for the UE configured with only PCell in FR1.

Upon receiving RRC Command containing MR-DCRelease configuration and sending an RRCReconfigurationComplete message confirming the release in subframe *n*, the UE shall be capable to transmit PRACH preamble towards PSCell no later than in subframe *n* + Tconfig\_PSCell\_Addition\_Conditional:

Where:

Tconfig\_PSCell\_Addition\_Conditional = TEvent\_DU + Tmeasure + TUE\_preparation + Tprocessing + T∆ + TPSCell\_ DU + 2 ms

TEvent\_DU is the delay uncertainty which is the time from when the UE successfully transmits an RRCReconfigurationComplete message confirming the release of SCG configuration until a condition exists at the measurement reference point which will trigger the conditional PSCell addition.

Tmeasure is the measurements time stated in clause 8.9A.2.1.

TUE\_preparation is the UE preparation time for conditional PSCell addition, and starts after UE realizes the condition of PSCell addition is met and identity of the PSCell is determined. TUE\_preparation is up to 10 ms.

Tprocessing is the SW processing time needed by UE, including RF warm up period. Tprocessing = 20 ms when PSCell is in FR1, and Tprocessing = 40 ms when PSCell is in FR2.

T∆ is time for fine time tracking and acquiring full timing information of the target cell. T∆ = 1\*Trs ms.

TPSCell\_ DU is the delay uncertainty in acquiring the first available PRACH occasion in the PSCell. TPSCell\_ DU is up to the summation of SSB to PRACH occasion association period and 10 ms. SSB to PRACH occasion associated period is defined in Table 8.1-1 of TS 38.213 [3].

Trs is the SMTC periodicity of the target cell if the UE has been provided with an SMTC configuration for the target cell in PSCell addition message, otherwise Trs is the SMTC configured in the measObjectNR having the same SSB frequency and subcarrier spacing. If the UE is not provided SMTC configuration or measurement object on this frequency, the requirement in this clause is applied with Trs = 5 ms assuming the SSB transmission periodicity is 5 ms. There is no requirement if the SSB transmission periodicity is not 5 ms.

The PCell interruption specified in clause 8.2 is allowed only after the UE starts to execute a conditional PSCell addition.

8.9C.2.1 Measurement time

The measurement time delay is defined from the end of TEvent\_DU until UE executes a PSCell addition and interruption time starts.

The measurement time delay measured without Time To Trigger (TTT) and L3 filtering shall be less than Tidentify\_inter\_with\_index defined in clause 9.3.4. When TTT or L3 filtering is used an additional delay can be expected.

A cell is detectable only if at least one SSB measured from the cell being configured remains detectable during the time period Tidentify\_inter\_with\_index for PSCell addition. If a cell, which has been detectable at least for the time period Tidentify\_inter\_with\_index for PSCell addition, becomes undetectable for a period and then the cell becomes detectable again and triggers a PSCell addition, the measurement time delay shall be less than TSSB\_measurement\_period\_inter provided the timing to that cell has not changed more than ± 3200/ Tc while the measurement gap has not been available and the L3 filter has not been used, where *µ* is the SCS configuration as defined in clause 4.2 of TS 38.211 [3]. When L3 filtering is used, an additional delay can be expected.

End of Change 15

Start of Change 16

8.11E Subsequent Conditional PSCell Change

8.11E.1 Introduction

This clause defines requirements for the delay within which the UE shall be able to perform subsequent conditional PSCell change in NR-DC. The requirements in this clause are applicable to NR-DC.

8.11E.2 Subsequent Conditoinal PSCell Change delay

The requirements in this clause shall apply for the UE configured with only PCell in FR1.

The UE shall be capable to transmit PRACH preamble towards the new target PSCell no later than in slot *n* + Tconfig\_PSCell\_Subsequent\_Change\_Conditional:

Where:

- Slot n is the time when UE transmits SN RRCReconfigurationcomplete message for the previous PSCell addition or change.

- Tconfig\_PSCell\_Subsequent\_Change\_Conditional = TEvent\_DU + Tmeasure + TUE\_preparation + Tprocessing + T∆ + TPSCell\_ DU + 2 ms

- TEvent\_DU is the delay uncertainty which is the time from when UE transmits SN RRCReconfigurationcomplete message for the previous PSCell addition or change until a condition exists at the measurement reference point which will trigger the subsequent conditional PSCell change.

- Tmeasure is the measurements time stated in clause 8.11E.2.1.

- TUE\_preparation is the UE preparation time for subsequent conditional PSCell change, and starts after UE realizes the condition of PSCell change is met and identity of new PSCell is determined. TUE\_preparation is up to 10ms.

- Tprocessing is the SW processing time needed by UE, including RF warm up period. Tprocessing = 20 ms when source and target cells are in the same FR, and Tprocessing = 40 ms when source and target cells are in different FRs.

- T∆ is time for fine time tracking and acquiring full timing information of the target cell. T∆ = 1\*Trs ms.

- Trs is the SMTC periodicity of the target cell if the UE has been provided with an SMTC configuration for the target cell in PSCell addition message, otherwise Trs is the SMTC configured in the measObjectNR having the same SSB frequency and subcarrier spacing. If the UE is not provided SMTC configuration or measurement object on this frequency, the requirement in this clause is applied with Trs = 5 ms assuming the SSB transmission periodicity is 5 ms. There is no requirement if the SSB transmission periodicity is not 5 ms.

- TPSCell\_ DU is the delay uncertainty in acquiring the first available PRACH occasion in the PSCell. TPSCell\_ DU is up to the summation of SSB to PRACH occasion association period and 10 ms. SSB to PRACH occasion associated period is defined in Table 8.1-1 of TS 38.213 [3].

The PCell interruption specified in clause 8.2 is allowed only after the UE starts to execute a subsequent conditional PSCell change.

8.11E.2.1 Measurement time

The measurement time delay is defined from the end of TEvent\_DU until UE executes a PSCell change to a target cell and interruption time starts.

For intra-frequency PSCell change, the measurement time delay measured without Time To Trigger (TTT) and L3 filtering shall be less than Tidentify intra with index or Tidentify\_intra\_without\_index defined in clause 9.2.5.1 or clause 9.2.6.2.

For inter-frequency PSCell change, the measurement time delay measured without Time To Trigger (TTT) and L3 filtering shall be less than Tidentify\_inter\_without\_index or Tidentify\_inter\_with\_index defined in clause 9.3.4. When TTT or L3 filtering is used an additional delay can be expected.

A cell is detectable only if at least one SSB measured from the cell being configured remains detectable during the time period Tidentify\_intra\_without\_index or Tidentify\_intra\_with\_index for intra-frequency PSCell change or the time period Tidentify\_inter\_without\_index or Tidentify\_inter\_with\_index for inter-frequency PSCell change. If a cell, which has been detectable at least for the time period Tidentify\_intra\_without\_index or Tidentify\_intra\_with\_index for intra-frequency PSCell change or the time period Tidentify\_inter\_without\_index or Tidentify\_inter\_with\_index for inter-frequency PSCell change, becomes undetectable for a period and then the cell becomes detectable again and triggers a PSCell change, the measurement time delay shall be less than TSSB\_measurement\_period\_intra or TSSB\_measurement\_period\_inter provided the timing to that cell has not changed more than ± 3200/ Tc while the measurement gap has not been available and the L3 filter has not been used, where *µ* is the SCS configuration as defined in clause 4.2 of TS 38.211 [3]. When L3 filtering is used, an additional delay can be expected.

End of Change 16

Start of Change 17

#### 8.18.2.3 Measurement restriction for SSB based beam failure detection

The UE is required to be capable of measuring SSB for BFD without measurement gaps. The UE is required to perform the SSB measurements with measurement restrictions as described in the following scenarios.

For FR1, when the SSB for BFD measurement is in the same OFDM symbol as CSI-RS for RLM, BFD, CBD or L1-RSRP measurement,

- If SSB and CSI-RS have same SCS, UE shall be able to measure the SSB for BFD measurement without any restriction;

- If SSB and CSI-RS have different SCS,

- If UE supports *simultaneousRxDataSSB-DiffNumerology*, UE shall be able to measure the SSB for BFD measurement without any restriction.

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

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

For FR2, when the SSB for BFD measurement on one CC is in the same or adjacent OFDM symbol as SSB with a different PCI for RLM, CBD or L1-RSRP measurement on the same CC or different CCs in the same band, UE is required to measure one of but not both SSBs with the two different PCIs. Longer measurement period for SSB based BFD is expected, and no requirements are defined.

For FR2, if the network configures same or mixed numerology between SSB for BFD measurement on one FR2 band and CSI-RS for RLM, BFD, CBD, L1-RSRP or L1-SINR measurement on the other FR2 band, UE shall be able to perform the related SSB based measurements in one band without any measurement restrictions on the other band, provided that UE is capable of independent beam management on this FR2 band pair.

For FR2, for UE incapable of [*capability of measurement with RTD>CP*] and for UE capable of [*capability of measurement with RTD>CP*], when the SSB for BFD measurement in sets or is in the same or adjacent OFDM symbol as SSB for intra-frequency L1-RSRP measurement or inter-frequency L1-RSRP measurement without gap on candidate LTM neighbour cell in the same band, UE is required to measure one of but not both SSBs. Longer measurement period for SSB based BFD is expected, and no requirements are defined.

End of Change 17

Start of Change 18

#### 8.18.5.3 Measurement restriction for SSB based candidate beam detection

For FR1, when the SSB for CBD measurement is in the same OFDM symbol as CSI-RS for RLM, BFD, CBD or L1-RSRP measurement,

- If SSB and CSI-RS have same SCS, UE shall be able to measure the SSB for CBD measurement without any restrictions.

- If SSB and CSI-RS have different SCS-es,

- If UE supports *simultaneousRxDataSSB-DiffNumerology*, UE shall be able to measure the SSB for CBD measurement without any restriction.

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

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

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

For FR2, if network configures same or mixed numerology between SSB for CBD measurement on one FR2 band and CSI-RS for RLM, BFD, CBD, L1-RSRP or L1-SINR measurement on the other FR2 band, UE shall be able to perform the related SSB based measurements in one band without any measurement restrictions in the other band, provided that UE is capable of independent beam management on this FR2 band pair.

For FR2, for UE incapable of [*capability of measurement with RTD>CP*] and for UE capable of [*capability of measurement with RTD>CP*], when the SSB for CBD measurement in sets or is in the same OFDM symbol as SSB for intra-frequency L1-RSRP measurement or inter-frequency L1-RSRP measurement without gap on candidate LTM neighbour cell on the same band, UE is required to measure one of but not both SSBs. Longer measurement period for SSB based CBD is expected, and no requirements are defined.

End of Change 18

Start of Change 19

8.X PSCell Cell Switch

8.X.1 Introduction

The purpose of LTM cell switch is to switch the PCell or PSCell to another cell. The requirements in this section are applicable to LTM PSCell switch.

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

The requirements in this clause are applicable to NR-DC for the following scenarios:

PSCell switch to a neighboring cell

- FR1 cell to FR1 cell

- FR1 cell to FR2 cell

- FR2 cell to FR2 cell

- FR2 cell to FR1 cell

PSCell switch to a serving SCell in SCG

- FR1 cell to FR1 cell

- FR2 cell to FR2 cell

8.X.2 LTM Cell Switch delay

LTM cell switch delay DLTM is the delay from the end of the last TTI containing the MAC-CE command for cell switch until the time the UE transmits the first UL message on the target cell.

When the target cell and the target joint UL/DL TCI state or separate UL and DL TCI states in the MAC-CE LTM cell switch command are known, the LTM cell switch delay is defined as:

DLTM = Tcmd + TLTM-interrupt

Where:

Tcmd is as stated in section 6.X.1.2.

TLTM-interrupt is as stated in section 8.X.1.3.

The definition of known LTM target cell and the definition of known target joint DL/UL TCI state or separate DL and UL TCI states are as stated in section 6.X.1.2.

8.X.3 Interruption time

The interruption time TLTM-interrupt is the time between the end of the last TTI containing the MAC-CE command for LTM cell switch until the time the UE transmits the first UL message on the target cell, excluding Tcmd stated in section 8.X.1.2.

TLTM-interrupt = TLTM-RRC-processing + TLTM-processing + Tfirst-RS + TRS-proc + TLTM-IU ms,

Where:

TLTM-RRC-processing, TLTM-processing, Tfirst-RS, TRS-proc and TLTM-IU are as stated in section 6.X.1.3.End of Change 19

Start of Change 20

9.1.5.2 Monitoring of multiple layers within gaps

For a UE supporting concurrent gaps and when concurrent gaps are configured the carrier-specific scaling factor CSSFwithin\_gap,i for a measurement object *i* derived in this chapter is applied to following measurement types for the associated measurement gap:

- SSB-based intra-frequency measurement object with no measurement gap in clause 9.2.5 and 9.2A.5, when

- all of the SMTC occasions of this intra-frequency measurement object are overlapped with the measurement gap or associated measurement gap in concurrent measurement gaps, or

- part of the SMTC occasions of this intra-frequency measurement object are overlapped with the associated measurement gap and all the SMTC occasions of this intra-frequency measurement object are overlapped with the union of all the measurement gaps.

- SSB-based intra-frequency measurement object with measurement gap in clause 9.2.6 and 9.2A.6.

- CSI-RS based inter-frequency measurement in clause 9.10.3, when CSI-RS resources for L3 measurement of this inter-frequency measurement object are overlapped by the measurement gap or the associated measurement gap in concurrent measurement gaps.

- CSI-RS based inter-frequency measurement in clause 9.10.3, when CSI-RS resources for L3 measurement of this inter-frequency measurement object are partially overlapped by the measurement gap or the associated measurement gap in concurrent measurement gaps.

- CSI-RS based intra-frequency measurement in clause 9.10.2, when all CSI-RS resources for L3 measurement of this intra-frequency measurement object are partially overlapped with the associated measurement gap and all CSI-RS resources for L3 measurement of this intra-frequency measurement object are overlapped with the union of the configured concurrent measurement gaps.

- SSB-based inter-frequency measurement object with measurement gap in clause 9.3.4.

- SSB-based inter-frequency measurement object without measurement gap for UE capable of *interFrequencyMeas-NoGap* in clause 9.3.9, when

- all of the SMTC occasions of this inter-frequency measurement object are overlapped with the measurement gap or associated measurement gap in concurrent measurement gaps, or

- part of the SMTC occasions of this inter-frequency measurement object are overlapped with the associated measurement gap and all the SMTC occasions of this inter-frequency measurement object are overlapped with the union of all the measurement gaps, or

- part of the SMTC occasions of this inter-frequency measurement object are overlapped by the measurement gap or associated measurement gap in concurrent measurement gaps and the flag *interFrequencyConfig-NoGap-r16* is not configured by the Network.

- NR PRS-based measurements for positioning in clause 9.9.

- E-UTRA Inter-RAT measurement object in clauses 9.4.2 and 9.4.3.

Otherwise, the carrier-specific scaling factor CSSFwithin\_gap,i for a measurement object *i* derived in this chapter is applied to following measurement types:

- SSB-based intra-frequency measurement object with no measurement gap in clause 9.2.5 and 9.2A.5, when all of the SMTC occasions of this intra-frequency measurement object are overlapped by the measurement gap.

- SSB-based intra-frequency measurement object with measurement gap in clause 9.2.6 and 9.2A.6.

- CSI-RS based inter-frequency measurement in clause 9.10.3, when CSI-RS resources for L3 measurement of this inter-frequency measurement object are overlapped by the measurement gap.

- CSI-RS based inter-frequency measurement in clause 9.10.3, when CSI-RS resources for L3 measurement of this inter-frequency measurement object are partially overlapped by the measurement gap.

- SSB-based inter-frequency measurement object with measurement gap in clause 9.3.4.

- SSB-based inter-frequency measurement object without measurement gap for UE capable of *interFrequencyMeas-NoGap* in clause 9.3.9, when

- all of the SMTC occasions of this inter-frequency measurement object are overlapped by the measurement gap, or

- part of the SMTC occasions of this inter-frequency measurement object are overlapped by the measurement gap, but the flag *interFrequencyConfig-NoGap-r16* is not configured by the Network.

- Intra-frequency RSSI/CO measurement with measurement gap in clause 9.2A.7.

- Intra-frequency RSSI/CO measurement with no measurement gap in clause 9.2A.7 when all of the RMTC occasions of this intra-frequency RSSI/CO measurement are overlapped by the measurement gap.

- Inter-frequency RSSI/CO measurement in clause 9.3A.8 and 9.3A.9.

- E-UTRA Inter-RAT measurement object in clauses 9.4.2 and 9.4.3.

- NR PRS-based measurements for positioning in clause 9.9.

- E-UTRA Inter-RAT RSTD and E-CID measurements in clauses 9.4.4 and 9.4.5.

- For a UE in E-UTRA-NR dual connectivity operation, NR SSB-based Inter-RAT measurement object configured by the E-UTRAN PCell (TS 36.133 [15] clause 8.17.4) on an NR serving carrier

- the SSB is not completely contained in the active BWP of the UE, or

- all of the SMTC occasions of this inter-RAT measurement object are overlapped by the measurement gap;

- NR SSB-based Inter-RAT measurement object configured by the E-UTRAN PCell (TS 36.133 [15] clause 8.17.4) on an NR non-serving carrier.

- E-UTRAN Inter-frequency measurement object configured by the E-UTRAN PCell (TS 36.133 [15] clause 8.17.3) and by the E-UTRAN PSCell (TS 36.133 [15] clause 8.19.3).

- E-UTRAN Inter-frequency RSTD measurement configured by the E-UTRAN PCell (TS 36.133 [15] clause 8.17.15).

- UTRA Inter-RAT measurement object configured by the E-UTRAN PCell (TS 36.133 [15] clauses 8.17.5 to 8.17.12).

- GSM Inter-RAT measurements configured by the E-UTRAN PCell (TS 36.133 [15] clauses 8.17.13 and 8.17.14).

- Note: The derivation of CSSFwithin\_gap,i additional considers the impact of SSB-based inter-frequency L1-RSRP measurement with measurement gap in clause 9.x.y.

The UE is expected to conduct the measurement of this measurement object *i* only within the measurement gap or the associated measurement gap if concurrent measurement gaps are configured. If UE is configured with concurrent measurement gaps and an association between measurement object i and certain measurement gap is provided, the requirements are defined assuming the UE shall conduct the measurement of this measurement object *i* within the associated measurement gap.

If the higher layer signaling in TS 38.331 [2] of *smtc2* is present and *smtc1* is fully overlapping with measurement gaps and *smtc2* is partially overlapping with measurement gaps, CSSFwithin\_gap,i and requirements derived from CSSFoutside\_gap,i are not specified.

Number of SSB layers should include SSB for mobility and that as associated SSB for CSI-RS mobility. the ssbfrequency is counted only once if the ssbfrequency for mobility and associated SSB are the same, or ssbfrequency and smtc in multiple MOs are the same.

Editor’s note: FFS how to add the layer corresponding to the associated SSB for a MO with only CSI-RS measurement configured.

##### 9.1.5.2.1 EN-DC mode: carrier-specific scaling factor for SSB, CSI-RS-based L3 measurements and RSSI and channel occupancy measurements performed within gaps

The scaling value CSSFwithin\_gap,i below has been derived without considering GSM inter-RAT carriers.

When one or more measurement objects are monitored within measurement gaps, the carrier specific scaling factor for a target measurement object with index *i* is designated as CSSFwithin\_gap,i and is derived as described in this clause.

For UE supporting per-FR gap, for each measurement object *i* that are measured based on effective MGRP as defined in clause 9.1.2, CSSFwithin\_gap,i used for derving the measurement requirements is defined as 2\*Nwith\_CSI-RS + NSSB\_only, where

- Nwith\_CSI-RS is the number of measurement objects with either both SSB and CSI-RS based L3 configured or only CSI-RS based L3 measurement configured in the same FR as measurement object *i*, and

- NSSB\_only is the number of measurement objects with only SSB based L3 measurement configured in the same FR as measurement object *i*.

For a UE in E-UTRA-NR dual connectivity operation, if a SSB-based measurement object configured by PSCell and an NR SSB-based inter-RAT measurement object configured by E-UTRAN PCell are on the same carrier, they shall be counted as one measurement object in Mtot,i,j, provided that they meet the measurement object merging conditions [in clause 9.1.3.2].

If measurement object *i* refers to an RSTD measurement with periodicity Tprs>160ms or with periodicity Tprs=160ms but *prs-MutingInfo-r9* is configured, CSSFwithin\_gap,i=1. Otherwise, the CSSFwithin\_gap,i for other measurement objects (including RSTD measurement with periodicity Tprs=160ms) participate in the gap competition are derived as below.

For each measurement gap *j* not used for an RSTD measurement with periodicity Tprs>160ms or with periodicity Tprs=160ms but *prs-MutingInfo-r9* is configured within an arbitrary 160ms period, count the total number of intra-frequency measurement objects and inter-frequency/inter-RAT measurement objects which are candidates to be measured within the gap *j*.

- An NR measurement object with SSB measurement configured is a candidate to be measured in a gap if its SMTC duration is fully covered by the MGL excluding RF switching time. For intra-frequency NR carriers, if the higher layer in TS 38.331 [2] signaling of *smtc2* is configured, the assumed periodicity of SMTC occasions corresponds to the value of higher layer parameter *smtc2*; otherwise the assumed periodicity of SMTC occasions corresponds to the value of higher layer parameter *smtc1*.

- An NR measurement object with CSI-RS measurement configured is a candidate to be measured in a gap if the window confining all CSI-RS resources are fully covered by the MGL excluding RF switching time. -

- An NR measurement object with RSSI and channel occupancy measurement is a candidate to be measurement in a gap if the RMTC duration is fully covered by MGL excluding RF switching time

- An inter-RAT UTRA measurement object configured by E-UTRA PCell [15] is a candidate to be measured in all measurement gaps.

- An inter-frequency E-UTRA measurement object configured by E-UTRA PCell [15] is a candidate to be measured in all measurement gaps.

- For UEs which support and are configured with per FR gaps, the counting is done on a per FR basis, and for UEs which are configured with per UE gaps the counting is done on a per UE basis.

- Mintra,i,j: Number of intra-frequency measurement objects, including both SSB, CSI-RS based and RSSI/CO measurement, which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise Mintra,i,j equals 0.

- Minter,i,j : Number of NR inter-frequency layers including both SSB and CSI-RS based NR inter-RAT frequency layer and RSSI/CO measurement, configured by E-UTRA PCell, EUTRA inter-frequency measurement objects configured by E-UTRA PCell, or UTRA inter-RAT measurement objects configured by E-UTRA PCell which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise Minter,i,j equals 0.

- A measurement object *i* in Mintra,i,j and in Minter,i,j is counted twice if the measurement object is configured with both RMTC and SMTC which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate

- Mtot,i,j = Mintra,i,j + Minter,i,j : Total number of intra-frequency, inter-frequency and inter-RAT frequency layers which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise Mtot,i,j equals 0.

For each measurement gap *j* used for an RSTD measurement with periodicity Tprs>160ms or with periodicity Tprs=160ms but *prs-MutingInfo-r9* is configured within an arbitrary 160ms period, Mintra,i,j = Minter,i,j = Mtot,i,j =0.

The carrier specific scaling factor CSSFwithin\_gap,i is given by:

If *measGapSharingScheme* is equal sharing, CSSFwithin\_gap,i= max(ceil(Ri×Mtot,i,j)), where *j*=0…(160/MGRP)-1

If *measGapSharingScheme* is not equal sharing and

- measurement object *i* is an intra-frequency measurement object, CSSFwithin\_gap,i is the maximum among

- ceil(Ri×Kintra×Mintra,i,j) in gaps where Minter,i,j≠0, where *j*=0…(160/MGRP)-1

- ceil(Ri×Mintra,i,j) in gaps where Minter,i,j=0, where *j*=0…(160/MGRP)-1

- measurement object *i* is an inter-frequency or inter-RAT measurement object, CSSFwithin\_gap,i is the maximum among

- ceil(Ri×Kinter×Minter,i,j) in gaps where Mintra,i,j ≠0, where *j*=0…(160/MGRP)-1

- ceil(Ri×Minter,i,j)in gaps where Mintra,i,j=0, where *j*=0…(160/MGRP)-1

Where Ri is the maximal ratio of the number of measurement gap where measurement object *i* is a candidate to be measured over the number of measurement gap where measurement object *i* is a candidate and not used for RSTD measurement with periodicity Tprs>160ms or with periodicity Tprs=160ms but *prs-MutingInfo-r9* is configured within an arbitrary 1280ms period.

##### 9.1.5.2.2 SA mode: carrier-specific scaling factor for SSB, CSI-RS-based L3 measurements and RSSI and channel occupancy measurements performed within gaps

When one or more measurement objectsare monitored within measurement gaps, the carrier specific scaling factor for a target measurement object with index *i* is designated as CSSFwithin\_gap,i and is derived as described in this clause.

For UE supporting per-FR gap, for each measurement object *i* that are measured based on effective MGRP as defined in clause 9.1.2, CSSFwithin\_gap,i used for derving the measurement requirements is defined as 2\*Nwith\_CSI-RS + NSSB\_only+ NL1\_SSB, where

- Nwith\_CSI-RS is the number of measurement objects with either both SSB and CSI-RS based L3 configured or only CSI-RS based L3 measurement configured in the same FR as measurement object *i*, and

- NSSB\_only is the number of measurement objects with only SSB based L3 measurement configured in the same FR as measurement object *i*, and

- NL1\_SSB is the number of SSB based inter-frequency L1-RSRP measurements configured in the same FR as measurement object *i.*

If a UE capable of concurrent gaps is configured with concurrent gaps, the carrier specific scaling factor is calculated separately for each gap pattern, [provided that the association between measurement objects and gap pattern is configured by network. Only the measurement objects associated to the same measurement gap pattern are counted when deriving CSSFwithin\_gap,i for a target measurement object with index *i*.]. In case of collision between concurrent measurement gaps, some measurement gap occasions may be dropped according to clause 9.1.8.3. The dropped gap occasions will not be used in deriving CSSFwithin\_gap,i.

If measurement object *i* refers to a long-periodicity measurement which is any of:

- an E-UTRA RSTD measurement with periodicity Tprs>160ms or with periodicity Tprs=160ms but *prs-MutingInfo-r9* is configured, or

- an NR measurement for positioning frequency layer i with Tavailable\_PRS,i >160ms, where Tavailable\_PRS,i is defined in clauses 9.9.2.5, 9.9.3.5 and 9.9.4.5 for RSTD, PRS-RSRP and UE Rx-Tx time difference measurements, respectively.

then CSSFwithin\_gap,i=1. Otherwise, the CSSFwithin\_gap,i for other measurement objects (including E-UTRA RSTD measurement with periodicity Tprs=160ms) participate in the gap competition and the CSSFwithin\_gap,i are derived as below.

Table 9.1.5.2.2-1: void

When multiple positioning frequency layers are configured,

- for each positioning frequency layer i, CSSFwithin\_gap,i is derived with the following steps assuming no other positioning frequency layer is configured.

- for each RRM frequency layer i, CSSFwithin\_gap,i is derived as follows:

- an intermediate CSSFwithin\_gap,i,k is derived with the following steps assuming only positioning frequency layer *k* is configured, and

- CSSFwithin\_gap,i= max(CSSFwithin\_gap,i,k), where *k*=0…K-1, and K is the number of configured positioning frequency layers.For each measurement gap *j* not used for a long-periodicity measurement defined above, count the total number of intra-frequency measurement objects and inter-frequency/inter-RAT measurement objects and inter-frequency L1-RSRP measurement layers and NR PRS measurements on all positioning frequency layers which are candidates to be measured within the gap *j*.

- An NR measurement object with SSB measurement configured is a candidate to be measured in a gap if its SMTC duration is fully covered by the MGL excluding RF switching time. For intra-frequency NR measurement objects, if the higher layer in TS 38.331 [2] signaling of *smtc2* is configured, the assumed periodicity of SMTC occasions corresponds to the value of higher layer parameter *smtc2*; otherwise the assumed periodicity of SMTC occasions corresponds to the value of higher layer parameter *smtc1*.

- An NR measurement object with CSI-RS measurement configured is a candidate to be measured in a gap if the window confining all CSI-RS resources are fully covered by the MGL excluding RF switching time.

- An NR measurement object with RSSI and channel occupancy measurement is a candidate to be measurement in a gap if the RMTC duration is fully covered by MGL excluding RF switching time

- An inter-frequency SFTD measurement object, if to be measured with measurement gaps, is a candidate to be measured in all measurement gaps.

- An NR PRS-based measurement is a candidate to be measured in a gap is TBD.

- A positioning frequency layer is counted as candidate for a MG occasion if at least one PRS resource on that positioning frequency layer is fully covered by the MGL excluding RF switching time.

- An inter-frequency L1-RSRP measurement layer is a candidate to be measured in a gap if all configured SSB resources on that frequency layer to be measured are fully covered by the MGL excluding RF switching time.

- For UEs which support and are configured with per FR gaps, the counting is done on a per FR basis, and for UEs which are configured with per UE gaps the counting is done on a per UE basis. For UEs which support and are configured with per FR gaps, the CSSF requirements do not apply when NR PRS measurement in one FR gap collides with SSB/CSI-RS/PRS measurements in the other FR gap in time domain.

- Mintra,i,j: Number of intra-frequency measurement objects, including both SSB, CSI-RS based and RSSI/CO measurements, which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise Mintra,i,j equals 0.

- Minter,i,j : Number of NR inter-frequency layers including both SSB and CSI-RS based, EUTRA inter-RAT and UTRA inter-RAT frequency layers, up to one positioning frequency layer, RSSI/CO measurements, inter-frequency L1-RSRP measurement layers, which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise Minter,i,j equals 0.

- In FR1, inter-frequency L1-RSRP measurement layer in Minter,i,j is not counted if the SSB resource instance configured for L1-RSRP measurement of an inter-frequency layer is overlapped with the measurement object of this inter-frequency layer which is candidate to be measured in gap *j*.

- In FR2, an inter-frequency L1-RSRP measurement layer in Minter,i,j contributes the number equal to the cell number for L1-RSRP measurement in this inter-frequency layer, which is candidate to be measured in gap *j*.

Editor Note: The current Minter,i,j assumes all cells in the same frequency layer have the same SSB periodicity. FFS whether and how to address the case of different periodicities.

- A measurement object *i* in Mintra,i,j and in Minter,i,j is counted twice if the measurement object is configured with both RMTC and SMTC which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate

- Mtot,i,j = Mintra,i,j + Minter,i,j : Total number of intra-frequency, inter-frequency and inter-RAT frequncy layers and up to one NR PRS measurement on any one positioning frequency layer, inter-frequency L1-RSRP measurement layers, which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise Mtot,i,j equals 0.

For each measurement gap *j* used for a long-periodicity measurement defined above, Mintra,i,j = Minter,i,j = Mtot,i,j =0. The carrier specific scaling factor CSSFwithin\_gap,i is given by:

If *measGapSharingScheme* is equal sharing, CSSFwithin\_gap,i= max(ceil(Ri×Mtot,i,j)), where *j*=0…(160/MGRP)-1

If *measGapSharingScheme* is not equal sharing and

- measurement object *i* is an intra-frequency measurement object, CSSFwithin\_gap,i is the maximum among

- ceil(Ri×Kintra×Mintra,i,j) in gaps where Minter,i,j≠0, where *j*=0…(160/MGRP)-1

- ceil(Ri×Mintra,i,j) in gaps where Minter,i,j=0, where *j*=0…(160/MGRP)-1

- measurement object *i* is an inter-frequency or inter-RAT measurement object or NR PRS measurement on any one positioning frequency layer, CSSFwithin\_gap,i is the maximum among

- ceil(Ri×Kinter×Minter,i,j) in gaps where Mintra,i,j ≠0, where *j*=0…(160/MGRP)-1

- ceil(Ri×Minter,i,j)in gaps where Mintra,i,j=0, where *j*=0…(160/MGRP)-1

Where Ri is the maximal ratio of the number of measurement gap where measurement object *i* is a candidate to be measured over the number of measurement gap where measurement object *i* is a candidate and not used for a long-periodicity measurement defined above.

CSSFwithin\_gap,k=1 during TDetect, E-UTRAN FDD specified in clause 9.4.4.1.2.2 and TDetect, E-UTRAN TDD specified in clause 9.4.4.2.2.2, where k is the carrier frequency where the UE is performing cell detection of the inter-RAT E-UTRA OTDOA assistance data reference cell when acquiring the subframe and slot timing of the cell according to clause 9.4.4. In this case, the UE cell identification and measurement periods derived based on CSSFwithin\_gap,i in clauses 9.2.5.1, 9.2.5.2, 9.2.6.2, 9.2.6.3, 9.3.4, 9.3.5, 9.4.2.2, 9.4.2.3 and 9.10.2 may be extended for measurement objects of which the cell identification and measurement periods are overlapped with TDetect, E-UTRAN FDD and TDetect, E-UTRAN TDD.

##### 9.1.5.2.3 NE-DC: carrier-specific scaling factor for SSB-based and CSI-RS based L3 measurements performed within gaps

When one or more measurement objects are monitored within measurement gaps, the carrier specific scaling factor for a target measurement object with index *i* is designated as CSSFwithin\_gap,i and is derived as described in this clause.

For UE supporting per-FR gap, for each measurement object *i* that are measured based on effective MGRP as defined in clause 9.1.2, CSSFwithin\_gap,i used for derving the measurement requirements is defined as 2\*Nwith\_CSI-RS + NSSB\_only, where

- Nwith\_CSI-RS is the number of measurement objects with either both SSB and CSI-RS based L3 configured or only CSI-RS based L3 measurement configured in the same FR as measurement object *i*, and

- NSSB\_only is the number of measurement objects with only SSB based L3 measurement configured in the same FR as measurement object *i*.

If measurement object *i* refers to a long-periodicty measurement which is any of:

- an E-UTRA RSTD measurement with periodicity Tprs>160ms or with periodicity Tprs=160ms but *prs-MutingInfo-r9* is configured, or

- an NR measurement for positioning frequency layer i with Tavailable\_PRS,i >160ms, where Tavailable\_PRS,i is defined in clauses 9.9.2.5, 9.9.3.5 ,9.9.4.5 and 9.9.6.5 for RSTD, PRS-RSRP ,UE Rx-Tx time difference and PRS-RSRPP measurements, respectively.

then CSSFwithin\_gap,i=1. Otherwise, the CSSFwithin\_gap,i for other measurement objects (including E-UTRA RSTD measurement with periodicity Tprs=160ms) participate in the gap competition are derived as below.

When multiple positioning frequency layers are configured,

- for each positioning frequency layer *i*, CSSFwithin\_gap,i is derived with the following steps assuming no other positioning frequency layer is configured.

- for each RRM frequency layer *i*, CSSFwithin\_gap,i is derived as follows:

- an intermediate CSSFwithin\_gap,i,k is derived with the following steps assuming only positioning frequency layer *k* is configured, and

- CSSFwithin\_gap,i= max(CSSFwithin\_gap,i,k), where *k*=0…K-1, and K is the number of configured positioning frequency layers.

For each measurement gap *j* not used for a long-periodicity measurement defined above, count the total number of intra-frequency measurement objects and inter-frequency/inter-RAT measurement objects and NR PRS measurements on all positioning frequency layers which are candidates to be measured within the gap *j*.

- An NR measurement object with SSB measurement configured is a candidate to be measured in a gap if its SMTC duration is fully covered by the MGL excluding RF switching time. For intra-frequency NR measurement objects, if the higher layer in TS 38.331 [2] signaling of *smtc2* is configured, the assumed periodicity of SMTC occasions corresponds to the value of higher layer parameter *smtc2*; otherwise the assumed periodicity of SMTC occasions corresponds to the value of higher layer parameter *smtc1*.

- An NR measurement object with CSI-RS measurement configured is a candidate to be measured in a gap if the window confining all CSI-RS resources are fully covered by the MGL excluding RF switching time.

- An inter-RAT measurement object is a candidate to be measured in all measurement gaps.

- An inter-frequency E-UTRA measurement object is a candidate to be measured in all measurement gaps.

- A positioning frequency layer is counted as candidate for a MG occasion if at least one PRS resource on that positioning frequency layer is fully covered by the MGL excluding RF switching time.

For UEs which support and are configured with per FR gaps, the counting is done on a per FR basis, and for UEs which are configured with per UE gaps the counting is done on a per UE basis. For UEs which support and are configured with per FR gaps, the CSSF requirements do not apply when NR PRS measurement in one FR gap collides with SSB/CSI-RS/PRS measurements in the other FR gap in time domain.

If the number of configured interfrequency and interRAT measuerement objects and NR PRS measurements on all positioning frequency layers is non-zero and the UE is configured with per UE gaps, or if the UE is configured with per FR gaps:

FR1 and FR2 intrafrequency measurement objects belong to group A

Interfrequency and interRAT measurement objects belong to group B

MgroupA,i,j: Sum of the number of FR1 intra-frequency measurement objects Mintra-FR1,i,j and the number of FR2 intra-frequency measurement objects Mintra-FR2,i,j , including both SSB and CSI-RS based, which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise MgroupA,i,j equals 0.

MgroupBi,j: Number of NR inter-frequency layers including both SSB and CSI-RS based, EUTRA inter-RAT and UTRA inter-RAT measurement objects, up to one positioning frequency layer, which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise MgroupB,i,j equals 0.

If the number of configured inter-frequency and inter-RAT measuerement objects and NR PRS measurements on all positioning frequency layers is zero and the UE is configured with per UE gaps:

FR1 intrafrequency measurement objects belong to group A

FR2 intrafrequency measurement objects belong to group B

MgroupA,i,j: The number of FR1 intrafrequency measurement objects Mintra-FR1,i,j , including both SSB and CSI-RS based, which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise MgroupA,i,j equals 0.

MgroupBi,j : The number of FR2 intrafrequency measurement objects Mintra-FR2,i,j , including both SSB and CSI-RS based, which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise MgroupB,i,j equals 0.

Mtot,i,j = MgroupA,i,j + MgroupB,i,j : Total number of group A and group B measurement objects which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise Mtot,i,j equals 0.

For each measurement gap *j* used for a long-periodicity measurement defined above, Mintra,i,j = Minter,i,j = Mtot,i,j =0. The carrier specific scaling factor CSSFwithin\_gap,i is given by:

If *measGapSharingScheme* is equal sharing, CSSFwithin\_gap,i= max(ceil(Ri×Mtot,i,j)), where *j*=0…(160/MGRP)-1

If *measGapSharingScheme* is not equal sharing and

- measurement object *i* is a group A measurement object, CSSFwithin\_gap,i is the maximum among

- ceil(Ri×Kintra×MgroupA,i,j) in gaps where MgroupB,i,j≠0, where *j*=0…(160/MGRP)-1

- ceil(Ri×MgroupA,i,j) in gaps where MgroupB,i,j=0, where *j*=0…(160/MGRP)-1

- measurement object *i* is an group B measurement object, CSSFwithin\_gap,i is the maximum among

- ceil(Ri×Kinter×MgroupBi,j) in gaps where MgroupA,i,j ≠0, where *j*=0…(160/MGRP)-1

- ceil(Ri×MgroupB,i,j)in gaps where MgroupA,i,j=0, where *j*=0…(160/MGRP)-1

Where Ri is the maximal ratio of the number of measurement gap where measurement object *i* is a candidate to be measured over the number of measurement gap where measurement object *i* is a candidate and not used for a long-periodicity measurement defined above.

##### 9.1.5.2.4 NR-DC: carrier-specific scaling factor for SSB-based and CSI-RS-based L3 measurements performed within gaps

When one or more measurement objects are monitored within measurement gaps, the carrier specific scaling factor for a target measurement object with index *i* is designated as CSSFwithin\_gap,i and is derived as described in this clause.

For UE supporting per-FR gap, for each measurement object *i* that are measured based on effective MGRP as defined in clause 9.1.2, CSSFwithin\_gap,i used for derving the measurement requirements is defined as 2\*Nwith\_CSI-RS + NSSB\_only+ NL1\_SSB, where

- Nwith\_CSI-RS is the number of measurement objects with either both SSB and CSI-RS based L3 configured or only CSI-RS based L3 measurement configured in the same FR as measurement object *i*, and

- NSSB\_only is the number of measurement objects with only SSB based L3 measurement and SSB based inter-frequency L1-RSRP measurement layers configured in the same FR as measurement object *i*.

- NL1\_SSB is the number of SSB based inter-frequency L1-RSRP measurements configured in the same FR as measurement object *i.*

If measurement object *i* refers to a long-periodicity measurement which is any of:

- an E-UTRA RSTD measurement with periodicity Tprs>160ms or with periodicity Tprs=160ms but *prs-MutingInfo-r9* is configured, or

- an NR measurement for positioning frequency layer i with Tavailable\_PRS,i >160ms, where Tavailable\_PRS,i is defined in clauses 9.9.2.5, 9.9.3.5 and 9.9.4.5 for RSTD, PRS-RSRP and UE Rx-Tx time difference measurements, respectively.

then CSSFwithin\_gap,i=1. Otherwise, the CSSFwithin\_gap,i for other measurement objects (including E-UTRA RSTD measurement with periodicity Tprs=160ms) participate in the gap competition and the CSSFwithin\_gap,i are derived as below.

When multiple positioning frequency layers are configured,

- for each positioning frequency layer *i*, CSSFwithin\_gap,i is derived with the following steps assuming no other positioning frequency layer is configured.

- for each RRM frequency layer *i*, CSSFwithin\_gap,i is derived as follows:

- an intermediate CSSFwithin\_gap,i,k is derived with the following steps assuming only positioning frequency layer *k* is configured, and

- CSSFwithin\_gap,i= max(CSSFwithin\_gap,i,k), where *k*=0…K-1, and K is the number of configured positioning frequency layers.

For each measurement gap *j* not used for an RSTD measurement with periodicity Tprs>160ms or with periodicity Tprs=160ms but *prs-MutingInfo-r9* is configured within an arbitrary 160ms period, count the total number of intra-frequency measurement objects and inter-frequency/inter-RAT measurement objects and NR PRS measurements on all positioning frequency layers and inter-frequency L1-RSRP measurement layers which are candidates to be measured within the gap *j*.

- An NR measurement object with SSB measurement configured is a candidate to be measured in a gap if its SMTC duration is fully covered by the MGL excluding RF switching time. For intra-frequency NR measurement objects, if the higher layer in TS 38.331 [2] signaling of *smtc2* is configured, the assumed periodicity of SMTC occasions corresponds to the value of higher layer parameter *smtc2*; otherwise the assumed periodicity of SMTC occasions corresponds to the value of higher layer parameter *smtc1*.

- An NR measurement object with CSI-RS measurement configured is a candidate to be measured in a gap if the window confining all CSI-RS resources are fully covered by the MGL excluding RF switching time.

- A positioning frequency layer is counted as candidate for a MG occasion if at least one PRS resource on that positioning frequency layer is fully covered by the MGL excluding RF switching time.

- An inter-frequency L1-RSRP measurement layer is a candidate to be measured in a gap if the window confining SSB resource is fully covered by the MGL excluding RF switching time.

For UEs which support and are configured with per FR gaps, the counting is done on a per FR basis, and for UEs which are configured with per UE gaps the counting is done on a per UE basis. For UEs which support and are configured with per FR gaps, the CSSF requirements do not apply when NR PRS measurement in one FR gap collides with SSB/CSI-RS/PRS measurements in the other FR gap in time domain.

If the number of configured interfrequency and interRAT measuerement objects and NR PRS measurements on all positioning frequency layers is non-zero and the UE is configured with per UE gaps, or if the UE is configured with per FR gaps:

FR1 and FR2 intrafrequency measurement objects belong to group A

Interfrequency and interRAT measurement objects and up to one NR PRS measurement on any one positioning frequency layer belong to group B

MgroupA,i,j: Sum of the number of FR1 intra-frequency measurement objects Mintra-FR1,i,j and the number of FR2 intra-frequency measurement objects Mintra-FR2,i,j , including both SSB and CSI-RS based, which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise MgroupA,i,j equals 0.

MgroupBi,j : Number of NR inter-frequency layers including both SSB and CSI-RS based, EUTRA inter-RAT and UTRA inter-RAT measurement objects and up to one positioning frequency layer, inter-frequency L1-RSRP measurement layers, which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise MgroupB,i,j equals 0.

- In FR1, inter-frequency L1-RSRP measurement layer *i* in Minter,i,j is not counted if the SSB resource instance configured for L1-RSRP measurement of an inter-frequency layer is overlapped with the measurement object of this inter-frequency layer which are candidates to be measured in gap *j*.

- In FR2, an inter-frequency L1-RSRP measurement layer *i* in Minter,i,j is contributed the number equal to the cell number for L1-RSRP measurement in this inter-frequency layer, which is candidate to be measured in gap *j*.

Editor Note: The currennt Minter,i,j assumes all cells in the same frequency layer have the same SSB periodicity. FFS whether and how to address the case of different periodicities. If the number of configured interfrequency and interRAT measuerement objects and NR PRS measurements on all positioning frequency layers is zero and the UE is configured with per UE gaps:

FR1 intrafrequency measurement objects belong to group A

FR2 intrafrequency measurement objects belong to group B

MgroupA,i,j: The number of FR1 intrafrequency measurement objects Mintra-FR1,i,j , including both SSB and CSI-RS based, which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise MgroupA,i,j equals 0.

MgroupBi,j : The number of FR2 intrafrequency measurement objects Mintra-FR2,i,j , including both SSB and CSI-RS based, which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise MgroupB,i,j equals 0.

Mtot,i,j = MgroupA,i,j + MgroupB,i,j : Total number of group A and group B measurement objects and inter-frequency L1-RSRP measurement layers which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise Mtot,i,j equals 0.

For each measurement gap *j* used for a long-periodicity measurement defined above, Mintra,i,j = Minter,i,j = Mtot,i,j =0. The carrier specific scaling factor CSSFwithin\_gap,i is given by:

If *measGapSharingScheme* is equal sharing, CSSFwithin\_gap,i= max(ceil(Ri×Mtot,i,j)), where *j*=0…(160/MGRP)-1

If *measGapSharingScheme* is not equal sharing and

- measurement object *i* is a group A measurement object, CSSFwithin\_gap,i is the maximum among

- ceil(Ri×Kintra×MgroupA,i,j) in gaps where MgroupB,i,j≠0, where *j*=0…(160/MGRP)-1

- ceil(Ri×MgroupA,i,j) in gaps where MgroupB,i,j=0, where *j*=0…(160/MGRP)-1

- measurement object *i* is an group B measurement object, CSSFwithin\_gap,i is the maximum among

- ceil(Ri×Kinter×MgroupBi,j) in gaps where MgroupA,i,j ≠0, where *j*=0…(160/MGRP)-1

- ceil(Ri×MgroupB,i,j)in gaps where MgroupA,i,j=0, where *j*=0…(160/MGRP)-1

Ri is the maximal ratio of the number of measurement gap where measurement object *i* is a candidate to be measured over the number of measurement gap where measurement object *i* is a candidate and not used for a long-periodicity measurement defined above.

< parts not changed are omitted>

End of Change 20

Start of Change 21

#### 9.1.5.x L1-RSRP measurements within measurement gap

The requirements in this clause apply for SSB-based L1-RSRP measurements within measurement gap for LTM in clause 9.x.y.

When SSB-based L1-RSRP measurements are configured on one or more frequecny layers within measurement gap, the carrier sepcific scaling factor for a target L1-RSRP measurement on a inter-frequency layer with index *i* is designated as CSSFwithin\_gap,i and is derived in this chapter, with the consideration of the impact from the following measurement types:

- SSB-based intra-frequency measurement object with no measurement gap in clause 9.2.5 and 9.2A.5, when all of the SMTC occasions of this intra-frequency measurement object are overlapped by the measurement gap.

- SSB-based intra-frequency measurement object with measurement gap in clause 9.2.6 and 9.2A.6.

- CSI-RS based inter-frequency measurement in clause 9.10.3, when CSI-RS resources for L3 measurement of this inter-frequency measurement object are overlapped by the measurement gap.

- CSI-RS based inter-frequency measurement in clause 9.10.3, when CSI-RS resources for L3 measurement of this inter-frequency measurement object are partially overlapped by the measurement gap.

- SSB-based inter-frequency measurement object with measurement gap in clause 9.3.4.

- SSB-based inter-frequency measurement object without measurement gap for UE capable of *interFrequencyMeas-NoGap* in clause 9.3.9, when

- all of the SMTC occasions of this inter-frequency measurement object are overlapped by the measurement gap, or

- part of the SMTC occasions of this inter-frequency measurement object are overlapped by the measurement gap, but the flag *interFrequencyConfig-NoGap-r16* is not configured by the Network.

- Intra-frequency RSSI/CO measurement with measurement gap in clause 9.2A.7.

- Intra-frequency RSSI/CO measurement with no measurement gap in clause 9.2A.7 when all of the RMTC occasions of this intra-frequency RSSI/CO measurement are overlapped by the measurement gap(s).

- Inter-frequency RSSI/CO measurement in clause 9.3A.8 and 9.3A.9.

- E-UTRA Inter-RAT measurement object in clauses 9.4.2 and 9.4.3.

- NR PRS-based measurements for positioning in clause 9.9.

- E-UTRA Inter-RAT RSTD and E-CID measurements in clauses 9.4.4 and 9.4.5.

- For a UE in E-UTRA-NR dual connectivity operation, NR SSB-based Inter-RAT measurement object configured by the E-UTRAN PCell (TS 36.133 [15] clause 8.17.4) on an NR serving carrier

- the SSB is not completely contained in the active BWP of the UE, or

- all of the SMTC occasions of this inter-RAT measurement object are overlapped by the measurement gap;

- NR SSB-based Inter-RAT measurement object configured by the E-UTRAN PCell (TS 36.133 [15] clause 8.17.4) on an NR non-serving carrier.

- E-UTRAN Inter-frequency measurement object configured by the E-UTRAN PCell (TS 36.133 [15] clause 8.17.3) and by the E-UTRAN PSCell (TS 36.133 [15] clause 8.19.3).

- E-UTRAN Inter-frequency RSTD measurement configured by the E-UTRAN PCell (TS 36.133 [15] clause 8.17.15).

- UTRA Inter-RAT measurement object configured by the E-UTRAN PCell (TS 36.133 [15] clauses 8.17.5 to 8.17.12).

- GSM Inter-RAT measurements configured by the E-UTRAN PCell (TS 36.133 [15] clauses 8.17.13 and 8.17.14).

- SSB-based inter-frequency L1-RSRP measurement with measurement gap in clause 9.x.y

The UE is expected to conduct the measurement of this inter-frequency L1-RSRP measurement layer *i* only within the measurement gap.

If the higher layer signaling in TS 38.331 [2] of *smtc2* is present and *smtc1* is fully overlapping with measurement gaps and *smtc2* is partially overlapping with measurement gaps, CSSFwithin\_gap,i and requirements derived from CSSFoutside\_gap,i are not specified.

In derivation of CSSFwithin\_gap,i , number of SSB layers should include SSB for mobility and that as associated SSB for CSI-RS mobility. the ssbfrequency is counted only once if the ssbfrequency for mobility and associated SSB are the same, or ssbfrequency and smtc in multiple MOs are the same.

##### 9.1.5.x.1 SA mode: carrier-specific scaling factor for L1-RSRP measurements performed within measurement gap

When one or more inter-frequency L1-RSRP measurement layers are monitored within measurement gaps, the carrier specific scaling factor for a target inter-frequency L1-RSRP measurement layer with index *i* is designated as CSSFwithin\_gap,i and is derived as described in this clause.

For UE supporting per-FR gap, for each inter-frequency L1-RSRP measurement layer *i* that are measured based on effective MGRP as defined in clause 9.1.2, CSSFwithin\_gap,i used for derving the measurement requirements is defined as 2\*Nwith\_CSI-RS + NSSB\_only + NL1\_SSB, where

- Nwith\_CSI-RS is the number of measurement objects with either both SSB and CSI-RS based L3 configured or only CSI-RS based L3 measurement configured in the same FR as, and

- NSSB\_only is the number of measurement objects with only SSB based L3 measurement, and

- NL1\_SSB is the number of SSB based inter-frequency L1-RSRP measurements configured in the same FR as measurement object *i.*When multiple positioning frequency layers are configured,

- for each SSB based inter-frequency L1-RSRP measurement i, CSSFwithin\_gap,i is derived as follows:

- an intermediate CSSFwithin\_gap,i,k is derived with the following steps assuming only positioning frequency layer *k* is configured, and

- CSSFwithin\_gap,i= max(CSSFwithin\_gap,i,k), where *k*=0…K-1, and K is the number of configured positioning frequency layers.

For each measurement gap *j* not used for a long-periodicity measurement defined above, count the total number of intra-frequency measurement objects and inter-frequency/inter-RAT measurement objects and NR PRS measurements on all positioning frequency layers and inter-frequency L1-RSRP measurement layers which are candidates to be measured within the gap *j*.

- An NR measurement object with SSB measurement configured is a candidate to be measured in a gap if its SMTC duration is fully covered by the MGL excluding RF switching time. For intra-frequency NR measurement objects, if the higher layer in TS 38.331 [2] signaling of *smtc2* is configured, the assumed periodicity of SMTC occasions corresponds to the value of higher layer parameter *smtc2*; otherwise the assumed periodicity of SMTC occasions corresponds to the value of higher layer parameter *smtc1*.

- An NR measurement object with CSI-RS measurement configured is a candidate to be measured in a gap if the window confining all CSI-RS resources are fully covered by the MGL excluding RF switching time.

- An NR measurement object with RSSI and channel occupancy measurement is a candidate to be measurement in a gap if the RMTC duration is fully covered by MGL excluding RF switching time

- An inter-frequency SFTD measurement object, if to be measured with measurement gaps, is a candidate to be measured in all measurement gaps.

- An NR PRS-based measurement is a candidate to be measured in a gap is TBD.

- A positioning frequency layer is counted as candidate for a MG occasion if at least one PRS resource on that positioning frequency layer is fully covered by the MGL excluding RF switching time.

- An inter-frequency L1-RSRP measurement layer is a candidate to be measured in a gap if all configured SSB resources on that frequency layer to be measured are fully covered by the MGL excluding RF switching time.

- For UEs which support and are configured with per FR gaps, the counting is done on a per FR basis, and for UEs which are configured with per UE gaps the counting is done on a per UE basis.

- Mintra,i,j: Number of intra-frequency measurement objects, including both SSB, CSI-RS based and RSSI/CO measurements, which are candidates to be measured in gap *j* where inter-frequency L1-RSRP measurement layer *i* is also a candidate. Otherwise Mintra,i,j equals 0.

- Minter,i,j : Number of NR inter-frequency layers including both SSB and CSI-RS based, EUTRA inter-RAT and UTRA inter-RAT frequency layers, up to one positioning frequency layer, RSSI/CO measurements, inter-frequency L1-RSRP measurement layers, which are candidates to be measured in gap *j* where the inter-frequency L1-RSRP measurement layer *i* is also a candidate. Otherwise Minter,i,j equals 0.

- In FR1, inter-frequency L1-RSRP measurement layer in Minter,i,j is not counted if the SSB resource instance configured for L1-RSRP measurement of an inter-frequency layer is overlapped with the measurement object of this inter-frequency layer which are candidates to be measured in gap *j*.

- In FR2, an inter-frequency L1-RSRP measurement layer in Minter,i,j is contributed the number equal to the cell number for L1-RSRP measurement in this inter-frequency layer, which is candidate to be measured in gap *j*.

Editor Note: The currennt Minter,i,j assumes all cells in the same frequency layer have the same SSB periodicity. FFS whether and how to address the case of different periodicities.

- A measurement object *i* in Mintra,i,j and in Minter,i,j is counted twice if the measurement object is configured with both RMTC and SMTC which are candidates to be measured in gap *j* where the inter-frequency L1-RSRP measurement layer *i* is also a candidate

- Mtot,i,j = Mintra,i,j + Minter,i,j : Total number of intra-frequency, inter-frequency and inter-RAT frequncy layers and up to one NR PRS measurement on any one positioning frequency layer, inter-frequency L1-RSRP measurement layers, which are candidates to be measured in gap *j* where the inter-frequency L1-RSRP measurement layer *i* is also a candidate. Otherwise Mtot,i,j equals 0.

For each measurement gap *j* used for a long-periodicity measurement defined above, Mintra,i,j = Minter,i,j = Mtot,i,j =0. The carrier specific scaling factor CSSFwithin\_gap,i is given by:

If *measGapSharingScheme* is equal sharing, CSSFwithin\_gap,i= max(ceil(Ri×Mtot,i,j)), where *j*=0…(160/MGRP)-1

[If *measGapSharingScheme* is not equal sharing and

- L1-RSRP measurement layer *i* is an SSB based inter-frequency L1-RSRP measurement layer, CSSFwithin\_gap,i is the maximum among

- ceil(Ri×Kinter×Minter,i,j) in gaps where Mintra,i,j ≠0, where *j*=0…(160/MGRP)-1

- ceil(Ri×Minter,i,j)in gaps where Mintra,i,j=0, where *j*=0…(160/MGRP)-1 ]

Where Ri is the maximal ratio of the number of measurement gap where inter-frequency L1-RSRP measurement layer *i* is a candidate to be measured over the number of measurement gap where inter-frequency L1-RSRP measurement layer *i* is a candidate and not used for a long-periodicity measurement defined above.

##### 9.1.5.x.2 NR-DC: carrier-specific scaling factor for L1-RSRP measurements performed within measurement gap

When one or more inter-frequency L1-RSRP measurement layers are monitored within measurement gaps, the carrier specific scaling factor for a target measurement object or a target inter-frequency L1-RSRP measurement layer with index *i* is designated as CSSFwithin\_gap,i and is derived as described in this clause.

For UE supporting per-FR gap, for each inter-frequency L1-RSRP measurement layer *i* that are measured based on effective MGRP as defined in clause 9.1.2, CSSFwithin\_gap,i used for derving the measurement requirements is defined as 2\*Nwith\_CSI-RS + NSSB\_only + NL1\_SSB, where

- Nwith\_CSI-RS is the number of measurement objects with either both SSB and CSI-RS based L3 configured or only CSI-RS based L3 measurement configured in the same FR as, and

- NSSB\_only is the number of measurement objects with only SSB based L3 measurement, and

- NL1\_SSB is the number of SSB based inter-frequency L1-RSRP measurements configured in the same FR as measurement object *i.*When multiple positioning frequency layers are configured,

- for each SSB based inter-frequency L1-RSRP measurement layer *i*, CSSFwithin\_gap,i is derived as follows:

- an intermediate CSSFwithin\_gap,i,k is derived with the following steps assuming only positioning frequency layer *k* is configured, and

- CSSFwithin\_gap,i= max(CSSFwithin\_gap,i,k), where *k*=0…K-1, and K is the number of configured positioning frequency layers.

For each measurement gap *j* not used for an RSTD measurement with periodicity Tprs>160ms or with periodicity Tprs=160ms but *prs-MutingInfo-r9* is configured within an arbitrary 160ms period, count the total number of intra-frequency measurement objects and inter-frequency/inter-RAT measurement objects and NR PRS measurements on all positioning frequency layers and inter-frequency L1-RSRP measurement layers which are candidates to be measured within the gap *j*.

- An NR measurement object with SSB measurement configured is a candidate to be measured in a gap if its SMTC duration is fully covered by the MGL excluding RF switching time. For intra-frequency NR measurement objects, if the higher layer in TS 38.331 [2] signaling of *smtc2* is configured, the assumed periodicity of SMTC occasions corresponds to the value of higher layer parameter *smtc2*; otherwise the assumed periodicity of SMTC occasions corresponds to the value of higher layer parameter *smtc1*.

- An NR measurement object with CSI-RS measurement configured is a candidate to be measured in a gap if the window confining all CSI-RS resources are fully covered by the MGL excluding RF switching time.

- A positioning frequency layer is counted as candidate for a MG occasion if at least one PRS resource on that positioning frequency layer is fully covered by the MGL excluding RF switching time.

- An inter-frequency L1-RSRP measurement layer is a candidate to be measured in a gap if all configured SSB resources on that frequency layer to be measured are fully covered by the MGL excluding RF switching time.

For UEs which support and are configured with per FR gaps, the counting is done on a per FR basis, and for UEs which are configured with per UE gaps the counting is done on a per UE basis.

If the number of configured interfrequency and interRAT measuerement objects and NR PRS measurements on all positioning frequency layers is non-zero and the UE is configured with per UE gaps, or if the UE is configured with per FR gaps:

FR1 and FR2 intrafrequency measurement objects belong to group A

Interfrequency and interRAT measurement objects and up to one NR PRS measurement on any one positioning frequency layer and [inter-frequency L1-RSRP measurement layers] belong to group B

MgroupA,i,j: Sum of the number of FR1 intra-frequency measurement objects Mintra-FR1,i,j and the number of FR2 intra-frequency measurement objects Mintra-FR2,i,j , including both SSB and CSI-RS based, which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise MgroupA,i,j equals 0.

MgroupBi,j : Number of NR inter-frequency layers including both SSB and CSI-RS based, EUTRA inter-RAT and UTRA inter-RAT measurement objects and up to one positioning frequency layer, inter-frequency L1-RSRP measurement layers, which are candidates to be measured in gap *j* where the inter-frequency L1-RSRP measurement layer *i* is also a candidate. Otherwise MgroupB,i,j equals 0.

- In FR1, inter-frequency L1-RSRP measurement layer in Minter,i,j is not counted if the SSB resource instance configured for L1-RSRP measurement of an inter-frequency layer is overlapped with the measurement object of this inter-frequency layer which are candidates to be measured in gap *j*.

- In FR2, an inter-frequency L1-RSRP measurement layer in Minter,i,j is contributed the number equal to the cell number for L1-RSRP measurement in this inter-frequency layer, which is candidate to be measured in gap *j*.

Editor Note: The currennt Minter,i,j assumes all cells in the same frequency layer have the same SSB periodicity. FFS whether and how to address the case of different periodicities.

Mtot,i,j = MgroupA,i,j + MgroupB,i,j : Total number of group A and group B measurement objects and inter-frequency L1-RSRP measurement layers which are candidates to be measured in gap *j* where the inter-frequency L1-RSRP measurement layer *i* is also a candidate. Otherwise Mtot,i,j equals 0.

For each measurement gap *j* used for a long-periodicity measurement defined above, Mintra,i,j = Minter,i,j = Mtot,i,j =0. The carrier specific scaling factor CSSFwithin\_gap,i is given by:

If *measGapSharingScheme* is equal sharing, CSSFwithin\_gap,i= max(ceil(Ri×Mtot,i,j)), where *j*=0…(160/MGRP)-1

[If *measGapSharingScheme* is not equal sharing and

- inter-frequency L1-RSRP measurement layer *i*, is an group B L1-RSRP measurement layer, CSSFwithin\_gap,i is the maximum among

- ceil(Ri×Kinter×MgroupBi,j) in gaps where MgroupA,i,j ≠0, where *j*=0…(160/MGRP)-1

- ceil(Ri×MgroupB,i,j)in gaps where MgroupA,i,j=0, where *j*=0…(160/MGRP)-1]

Ri is the maximal ratio of the number of measurement gap where inter-frequency L1-RSRP measurement layer *i*, is a candidate to be measured over the number of measurement gap where inter-frequency L1-RSRP measurement layer *i*, is a candidate and not used for a long-periodicity measurement defined above.

End of Change 21

Start of Change 22

#### 9.5.4.1 SSB based L1-RSRP Reporting

The UE shall be capable of performing L1-RSRP measurements based on the configured SSB resource for L1-RSRP computation, and the UE physical layer shall be capable of reporting L1-RSRP measured over the measurement period of TL1-RSRP\_Measurement\_Period\_SSB.

When there is no intra-frequency L1-RSRP measurement on LTM neighbor cell(s) to measure, the value of TL1-RSRP\_Measurement\_Period\_SSB is defined in Table 9.5.4.1-1 for FR1, the value of TL1-RSRP\_Measurement\_Period\_SSB is defined in Table 9.5.4.1-2 for FR2 when *highSpeedMeasFlagFR2-r17* is not configured, and defined in Table 9.5.4.1-3 for FR2 power class 6 UE when *highSpeedMeasFlagFR2-r17* is configured, where

- M=1 if higher layer parameter *timeRestrictionForChannelMeasurement* is configured, and M=3 otherwise

- N= 8 in Table 9.5.4.1-2.

For a UE supporting *concurrentMeasGap-r17* and when concurrent gaps are configured,

- P value for SSB resource to be measured is defined as

- Ntotal / Noutside\_MG in FR1

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

- Ntotal / Navailable in FR2 with Navailable > 0

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

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

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

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

- TL1 is periodicity of the target SSB.

Otherwise, for a UE not supporting *concurrentMeasGap-r17* or when concurrent gaps are not configured,

For FR1,

- P=, when in the monitored cell there are GAPs configured for intra-frequency, inter-frequency or inter-RAT measurements, which are overlapping with some but not all occasions of the SSB; and

- P=1 when in the monitored cell there are no GAPs overlapping with any occasion of the SSB.

For FR2,

P1=, when SSB is not overlapped with measurement gap and SSB is partially overlapped with SMTC occasion (TSSB < TSMTCperiod).

- P is PL1\_sharing\*Psharing factor, when SSB is not overlapped with measurement gap and SSB is fully overlapped with SMTC occasion (TSSB = TSMTCperiod).

- P1=, when SSB is partially overlapped with GAP and SSB is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with GAP and

- TSMTCperiod ≠ xRP or

- TSMTCperiod = xRP and TSSB < 0.5\*TSMTCperiod

- P is , when SSB is partially overlapped with GAP and SSB is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with GAP and TSMTCperiod = xRP and TSSB = 0.5\*TSMTCperiod

- P1=, when SSB is partially overlapped with GAP (TSSB < xRP) and SSB is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is partially or fully overlapped with GAP.

- P is , when SSB is partially overlapped with measurement gap and SSB is fully overlapped with SMTC occasion (TSSB = TSMTCperiod) and SMTC occasion is partially overlapped with GAP (TSMTCperiod < xRP)

-

- If SSB resource from the cell with different PCI is configured for L1-RSRP measurement, and P2 is valid accoding to 9.13.4.1, and any symbol of the SSBs from serving cell and cell with different PCI are overlapping or adjacent (in time domain)

- P = , if P1\*TSSB < P2\*TSSB\_CDP.

- P = P1, if P1\*TSSB > P2\*TSSB\_CDP.

- P = 2\*P1, if P1\*TSSB = P2\*TSSB\_CDP.

- Otherwise, P = P1

Where:

- TSSB = ssb-periodicityServingCell of the serving cell

- TSMTCperiod = the configured SMTC period

- TSSB\_CDP = SSB periodicity of the cell with PCI different from serving cell

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

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

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

- Psharing factor = 3, otherwise.

- PL1\_sharing = 2, if SSB resource from the cell with different PCI is configured for L1-RSRP measurement, and Psharing\_factor,CDP is used in 9.13.4.1, and any symbol of the SSBs from serving cell and cell with different PCI are overlapping or adjacent (in time domain). PL1\_sharing = 1, otherwise.

- TSSB = ssb-periodicityServingCell

- TSMTCperiod = the configured SMTC period

- If the UE is configured with Pre-MG, an SSB or an SMTC occasion is only considered to be overlapped by the Pre-MG if the Pre-MG is activated.

- When a measurement gap is configured and the measurement gap is not NCSG,

- an SSB or an SMTC occasion is considered to be overlapped with the GAP if it overlaps a measurement gap occasion, and

- xRP = MGRP

- Otherwise, when NCSG measurement gap is configured,

- an SSB or an SMTC occasion is considered to be overlapped with the GAP if

- it overlaps the VIL1 or VIL2 of NCSG, or

- it overlaps the ML of NCSG in FR2, and there exists a target carrier to be measured within NCSG that is intra-frequency carrier or inter-frequency carrier in the same band as the serving cell, or inter-frequency carrier in different band as the serving cell and UE does not support IBM between the target carrier and the serving cell,

- and

- xRP = VIRP

- When concurrent gaps are configured, an SSB or an SMTC occasion is not considered to be overlapped by a gap occasion if the gap occasion is dropped according to clause 9.1.8.

The value of TL1-RSRP\_Measurement\_Period\_SSB is defined in Table 9.5.4.1-4 for UE incapable of [*capability of measurement with RTD>CP*] in FR1, Table 9.5.4.1-5 for UE capable of [*capability of measurement with RTD>CP*] in FR1, Table 9.5.4.1-6 for UE incapable of [*capability of measurement with RTD>CP*] in FR2 and Table 9.5.4.1-7 for UE capable of [*capability of measurement with RTD>CP*] in FR2 when there is intra-frequency L1-RSRP measurement on neighbor cell(s) to measure, where

- M=1 if higher layer parameter *timeRestrictionForChannelMeasurement* is configured, and M=3 otherwise

- N= 8 in Table 9.5.4.1-6 and Table 9.5.4.1-7.

- P value for SSB resource to be measured is defined as

- Ntotal / Noutside\_MG in FR1

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

- Ntotal / Navailable in FR2 with Navailable > 0

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

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

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

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

- TL1 is periodicity of the target SSB.

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

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

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

- Psharing factor = 3, otherwise.

- PL1\_sharing is defined as

- When number of neighboring cells to be measured is 1

- PL1\_sharing = 2, if any symbol of the SSBs from serving cell and neighbor cell are overlapping or adjacent (in time domain)

- PL1\_sharing = 1, otherwise

- When number of neighboring cells to be measured is more than 1

- PL1\_sharing = 3.

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

Longer evaluation period would be expected if the combination of SSB, SMTC occasion and GAP configurations does not meet pervious conditions.

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

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

Table 9.5.4.1-1: Measurement period TL1-RSRP\_Measurement\_Period\_SSB for FR1

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_SSB (ms) |
| non-DRX | max(TReport, ceil(M\*P)\*TSSB) |
| DRX cycle ≤ 320ms | max(TReport, ceil(K \*M\*P)\*max(TDRX,TSSB)) |
| DRX cycle > 320ms | ceil(M\*P)\*TDRX |
| Note 1: TSSB = ssb-periodicityServingCell is the periodicity of the SSB-Index configured for L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting.  Note 2: K = 1 when TSSB ≤ 40 ms and *highSpeedMeasFlag-r16 or highSpeedMeasCA-Scell-r17* are configured; otherwise K = 1.5.  Note 3: When *highSpeedMeasFlag-r16* is configured, the requirements apply only to UE supporting either *measurementEnhancement-r16* or *intraNR-MeasurementEnhancement-r16. or measurementEnhancementCA-r17* | |

Table 9.5.4.1-2: Measurement period TL1-RSRP\_Measurement\_Period\_SSB for FR2

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_SSB (ms) |
| non-DRX | max(TReport, ceil(M\*P\*N)\*TSSB) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P\*N)\*max(TDRX,TSSB)) |
| DRX cycle > 320ms | ceil(1.5\*M\*P\*N)\*TDRX |
| Note: TSSB = ssb-periodicityServingCell is the periodicity of the SSB-Index configured for L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting. | |

Table 9.5.4.1-3: Measurement period TL1-RSRP\_Measurement\_Period\_SSB configured with *highSpeedMeasFlagFR2-r17* for FR2

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_SSB (ms) |
| non-DRX | max(TReport, ceil(M\*P\*N1Note2)\*TSSB) |
| DRX cycle ≤ 80ms | max(TReport, ceil(M\*P\*N1Note2\*M2)\*max(TDRX,TSSB)) |
| 80ms< DRX ≤ 320ms | max(TReport, ceil(1.5\*M\*P\*N)\*max(TDRX,TSSB)) |
| DRX cycle > 320ms | ceil(1.5\*M\*P\*N)\*TDRX |
| Note1: TSSB = ssb-periodicityServingCell is the periodicity of the SSB-Index configured for L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting.  Note 2: Scaling factor N1 = 2 when *highSpeedMeasFlagFR2-r17* = set1or scaling factor N1 = 6 when *highSpeedMeasFlagFR2-r17* = [set2], if UE is not supporting [*simultaneousReceptionFR2HST-r18*] or when *highSpeedDeploymentTypeFR2-r17* is not configured as bidirectional. Scaling factor N1 = [TBD] when *highSpeedMeasFlagFR2-r17* is configured to set1 or scaling factor N1 = [4] when *highSpeedMeasFlagFR2-r17* is configured to set2, if UE is supporting [*simultaneousReceptionFR2HST-r18*] and when *highSpeedDeploymentTypeFR2-r17* is configured as bidirectional.  Note 3: M2 = 1.5 if SMTC periodicity > 40 ms; otherwise M2 = 1 | |

Table 9.5.4.1-4: Measurement period TL1-RSRP\_Measurement\_Period\_SSB in FR1 for UE incapable of [*capability of measurement with RTD>CP*]

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_SSB\_intra (ms) |
| non-DRX | max(TReport, ceil(M\*P)\*TSSB) |
| DRX cycle ≤ 320ms | max(TReport, ceil(K \*M\*P)\*max(TDRX,TSSB)) |
| DRX cycle > 320ms | ceil(M\*P)\*TDRX |
| Note 1: TSSB = ssb-periodicityServingCell is the periodicity of the SSB-Index configured for L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting.  Note 2: K = 1.5.  Note 3: If the actual RTD of serving cell and neighbor cell is larger than CP, [accuracy degradation is allowed or no requirements]. | |

Table 9.5.4.1-5: Measurement period TL1-RSRP\_Measurement\_Period\_SSB in FR1 for UE capable of [*capability of measurement with RTD>CP*]

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_SSB\_intra (ms) |
| non-DRX | max(TReport, ceil(M\*P)\*TSSB) |
| DRX cycle ≤ 320ms | max(TReport, ceil(K \*M\*P)\*max(TDRX,TSSB)) |
| DRX cycle > 320ms | ceil(M\*P)\*TDRX |
| Note 1: TSSB = ssb-periodicityServingCell is the periodicity of the SSB-Index configured for L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting.  Note 2: K = 1.5. | |

*Editor notes: The requirements for multiple layers will be updated based on newly achieved agreements.*

Table 9.5.4.1-6: Measurement period TL1-RSRP\_Measurement\_Period\_SSB in FR2 for UE incapable of [*capability of measurement with RTD>CP*]

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_SSB\_intra (ms) |
| non-DRX | max(TReport, ceil(M\*P\*PL1\_sharing\*N)\*TSSB) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P\*PL1\_sharing \*N)\*max(TDRX,TSSB) ) |
| DRX cycle > 320ms | ceil(1.5\*M\*P\*PL1\_sharing\*N)\*TDRX |
| Note 1: TSSB = ssb-periodicityServingCell is the periodicity of the SSB-Index configured for L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting.  Note 2: No requirements if the actual RTD of serving cell and neighbor cell is larger than CP. | |

Table 9.5.4.1-7: Measurement period TL1-RSRP\_Measurement\_Period\_SSB in FR2 for UE capable of [*capability of measurement with RTD>CP*]

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_SSB\_intra (ms) |
| non-DRX | max(TReport, ceil(M\*P\*PL1\_sharing\*N)\*TSSB) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P\*PL1\_sharing\*N)\*max(TDRX,TSSB)) |
| DRX cycle > 320ms | ceil(1.5\*M\*P\*PL1\_sharing\*N)\*TDRX |
| Note 1: TSSB = ssb-periodicityServingCell is the periodicity of the SSB-Index configured for L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting. | |

End of Change 22

Start of Change 23

#### 9.5.5.2 Measurement restriction for CSI-RS based L1-RSRP

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.

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

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

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

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

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

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

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

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

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

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

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

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

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

End of Change 23

Start of Change 24

9.8.5 Measurement restriction for L1-SINR measurement

The UE is required to be capable of measuring L1-SINR without measurement gaps. The UE is required to perform the SSB and CSI-RS/CSI-IM measurements with measurement restrictions as described in the following clauses.

9.8.5.1 Measurement restriction if SSB configured for L1-SINR Measurement

For FR1, when the SSB configured as CMR for L1-SINR measurement is in the same OFDM symbol as CSI-RS for RLM, BFD, CBD, L1-RSRP or L1-SINR measurement,

- If SSB and CSI-RS have same SCS, UE shall be able to measure the SSB for L1-SINR measurement without any restriction;

- If SSB and CSI-RS have different SCS,

- If UE supports *simultaneousRxDataSSB-DiffNumerology*, UE shall be able to measure the SSB for L1-SINR measurement without any restriction;

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

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

For FR2, there is no measurement restriction allowed when the network configures mixed numerology between SSB configured as CMR for L1-SINR measurement on one FR2 band and CSI-RS for RLM, BFD, CBD, L1-RSRP or L1-SINR measurement on the other FR2 band, provided that UE is capable of independent beam management on this FR2 band pair.

For FR2, for UE incapable of [*capability of measurement with RTD>CP*] and for UE capable of [*capability of measurement with RTD>CP*], when the SSB configured as CMR for L1-SINR measurement on one CC is in the same or adjacent 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 SSB for L1-SINR measurement and SSB for L1-RSRP measurement on neighbor cell. Longer measurement period for SSB based L1-RSRP measurement is expected, and no requirements are defined.

9.8.5.2 Measurement restriction if CSI-RS configured for L1-SINR measurement

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

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

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

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

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

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

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

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

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

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

- The CSI-RS or the other CSI-RS is configured as dedicated IMR for L1-SINR computation with SSB as CMR, or

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

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

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

For UE incapable of [*capability of measurement with RTD>CP*] and for UE capable of [*capability of measurement with RTD>CP*],

- For both FR1 and FR2, when the CSI-RS configured for L1-SINR measurement is in the same or adjacent 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-SINR measurement in the PRBs that overlap with an SSB.

- For FR1, when the CSI-RS configured for L1-SINR measurement is in the same or adjacent 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-SINR measurement and SSB. Longer measurement period for CSI-RS based L1-SINR measurement is expected, and no requirements are defined.

- For FR2, when the CSI-RS configured for L1-SINR measurement on one CC is in the same or adjacent 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-SINR measurement and SSB. Longer measurement period for CSI-RS based L1-SINR measurement is expected, and no requirements are defined.

9.8.5.3 Measurement restriction if CSI-IM configured for L1-SINR measurement

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

For FR1, UE shall be able to measure the CSI-IM configured for L1-SINR measurement without any restriction.

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

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

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

- The CSI-RS in a resource set configured with repetition ON, or

- The CSI-IM or the CSI-RS is configured as dedicated IMR for L1-SINR computation with SSB as CMR, or

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

- The CMR for L1-SINR measurement and the CSI-RS are not QCL-ed w.r.t. QCL-TypeD, or the QCL information is not known to UE,

- Otherwise, UE shall be able to measure the CSI-IM configured for L1-SINR measurement without any restriction.

For UE incapable of [*capability of measurement with RTD>CP*] and for UE capable of [*capability of measurement with RTD>CP*],

- For both FR1 and FR2, when the CSI-IM configured for L1-SINR measurement is in the same or adjacent 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-IM for L1-SINR measurement in the PRBs that overlap with an SSB.

- For FR2, when the CSI-IM configured for L1-SINR measurement on one CC is in the same or adjacent 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-SINR measurement and SSB. Longer measurement period for CSI-IM based L1-SINR measurement is expected, and no requirements are defined.

End of Change 24

Start of Change 25

## 9.x Intra-frequency L1-RSRP measurements for neighbor cell

### 9.x.1 Introduction

A measurement is defined as a SSB based intra-frequency L1-RSRP measurement provided the centre frequency of the SSB of the serving cell indicated for L1-RSRP measurement and the centre frequency of the SSB of the neighbour cell are the same, and the subcarrier spacing of the two SSBs are also the same.

When configured with [*LTM-CSI-ResourceConfig-r18*] by the network, the UE shall be able to perform L1-RSRP measurements of configured measurement resources from a neighbor cell, with the measurement resources configured as SSBs of the neighbor cell.

[If the number of resources/cells, including the number of resources/cells configured for serving cell L1-RSRP measurement in 9.x exceeds the UE capability indicated by [x], UE behaviour is TBD.]

The UE shall report the measurement quantity and send periodic, semi-persistent or aperiodic reports, according to the higher layer parameter [*reportConfigType-r18*] of each reporting setting[*LTM-CSI-ReportConfig-r18*].

### 9.x.2 Requirements Applicability

The requirements in the clause 9.x are applicable to FR1 and FR2-1 for LTM.

The requirements in clause 9.x apply, provided for the SSB from the neighbor cell configured for intra-frequency L1-RSRP, the following conditions are met:

- The cell is known

- The SSB resources configured for L1-RSRP measurements are measurable.

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

- L1-RSRP related side conditions given in clause [10.1.19] for FR1 and [10.1.20] for FR2-1, respectively, for a corresponding band,

- SSB\_RP and SSB Ês/Iot according to Annex [B.2.4.1] for a corresponding band.

The cell is considered as known if the following conditions are met in this requirement:

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

- The SSB from the target cell configured for L1 measurement remains detectable according to the cell identification requirements specified in clause 9.2 and 9.3.

Otherwise, the cell is unknown.

### 9.x.3 Measurement Reporting Requirements

The UE shall report the L1-RSRP value as a 7-bit value in the range [-140, -44] dBm with 1dB step size according to clause [10.1.19] for FR1 and [10.1.20] for FR2 if [*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 [10.1.19] for FR1 and [10.1.20] for FR2. The differential L1-RSRP is quantized to a 4-bit value with 2dB step size. The mapping between the reported L1-RSRP value and the measured quantity is described in 10.1.6.

#### 9.x.3.1 Periodic Reporting

Reported L1-RSRP measurements contained in periodic L1-RSRP measurement reports shall meet the requirements in clause [10.1.19] for FR1 and [10.1.20] 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.x.3.2 Semi-Persistent Reporting

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

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

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

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

#### 9.x.3.3 Aperiodic Reporting

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

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

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

### 9.x.4 Number of cells and number of SSB

For each intra-frequency layer, the UE shall be capable of performing L1-RSRP measurements for at least [[TBD] cells/SSBs based on UE capability]

### 9.x.5 L1-RSRP measurement requirements without measurement gaps

#### 9.x.5.1 SSB based L1-RSRP Reporting

The requirements specified in this clause are only applicable when

- *highSpeedMeasFlag-r16* is not configured, and

- *highSpeedMeasFlagFR2-r17* is not configured, and

- highSpeedMeasCA-Scell-r17 is not configured.

- The SSB from the neighbor cell completely contained in the active BWP of the UE

If a neighbor cell is known according 9.x.2, the UE shall be capable of performing L1-RSRP measurements based on the configured SSB resource for L1-RSRP computation, and the UE physical layer shall be capable of reporting L1-RSRP measured over the measurement period of TL1-RSRP\_Measurement\_Period\_SSB\_intra if *deriveSSB-IndexFromCell* is enabled or UE has reported SSB index in L3 measurement report of the same cell. Otherwise, UE physical layer shall be capable of reporting L1-RSRP measured over the measurement period of TL1-RSRP\_Measurement\_Period\_SSB\_intra+TSSB\_time\_index\_intra, where TSSB\_time\_index\_intra is the time period used to acquire the index of the SSB being measured given in Table 9.2.5.1-3.

The value of TL1-RSRP\_Measurement\_Period\_SSB\_intra is defined for FR1 in Table 9.x.5.1-1 for UE incapable of [*capability of measurement with RTD>CP*] and in Table 9.x.5.1-2 for UE capable of [*capability of measurement with RTD>CP*]. The value of TL1-RSRP\_Measurement\_Period\_SSB\_intra is defined for FR2 in Table 9.x.5.1-3 for UE incapable of [*capability of measurement with RTD>CP*] and in Table 9.x.5.1-4 for UE capable of [*capability of measurement with RTD>CP*], where

- M=1 if higher layer parameter *timeRestrictionForChannelMeasurement* is configured, and M=3 otherwise

- N= 8.

- P value for SSB resource to be measured is defined as

- Ntotal / Noutside\_MG in FR1

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

- Ntotal / Navailable in FR2 with Navailable > 0

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

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

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

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

- TL1 is periodicity of the target SSB.

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

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

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

- Psharing factor = [3], otherwise.

- PL1\_sharing is defined as

- When number of neighboring cells to be measured is 1

- PL1\_sharing = 2, if any symbol of the SSBs from serving cell and neighbor cell are overlapping or adjacent (in time domain)

- PL1\_sharing = 1, otherwise

- When number of neighboring cells to be measured is more than 1

- When TCI state of neighbor cells are not in the active TCI state list

- PL1\_sharing = 3\*NNeighbor\_Cell, where NNeighbor\_Cell is the number of neighbor cells to measure on intra-frequency and inter-frequency without gap

- Otherwise

- PL1\_sharing = 3\*NNeighbor\_Cell\_in\_list, where NNeighbor\_Cell\_in\_list is the number of neigbour cells (including intra-frequency neighbor cells and inter-frequency without gap neighbor cells) whose TCI state(s) are in the active TCI state list.

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 SSB, SMTC occasion and measurement gap configurations does not meet pervious 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.x.5.1-1: Intra-frequency L1-RSRP measurement period TL1-RSRP\_Measurement\_Period\_SSB\_intra in FR1 for UE incapable of [*capability of measurement with RTD>CP*]

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_SSB\_intra (ms) |
| non-DRX | max(TReport, ceil(M\*P)\*TSSB\_NBC) |
| DRX cycle ≤ 320ms | max(TReport, ceil(K \*M\*P)\*max(TDRX,TSSB\_NBC)) |
| DRX cycle > 320ms | ceil(M\*P)\*TDRX |
| Note 1: TSSB\_NBC is the periodicity of the neighbor cell SSB-Index configured for intra-frequency L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting.  Note 2: K = 1.5.  Note 3: No requirements if the actual RTD of serving cell and neighbor cell is larger than CP. | |

Table 9.x.5.1-2: Intra-frequency L1-RSRP measurement period TL1-RSRP\_Measurement\_Period\_SSB\_intra in FR1 for UE capable of [*capability of measurement with RTD>CP*]

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_SSB\_intra (ms) |
| non-DRX | max(TReport, ceil(M\*P)\*TSSB\_NBC\*NLayer) |
| DRX cycle ≤ 320ms | max(TReport, ceil(K \*M\*P)\*max(TDRX,TSSB\_NBC) \*NLayer) |
| DRX cycle > 320ms | ceil(M\*P)\*TDRX\*NLayer |
| Note 1: TSSB\_NBC is the periodicity of the neighbor cell SSB-Index configured for intra-frequency L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting. [NLayer = the number of intra-frequency layers configured for L1-RSRP measurement with [*LTM-CSI-ResourceConfig-r18*] + the number of inter-frequency layers without measurement gaps which are configured for L1-RSRP measurement with [*LTM-CSI-ResourceConfig-r18*]] .  Note 2: K = 1.5. | |

Table 9.x.5.1-3: Intra-frequency L1-RSRP measurement period TIntra\_ L1-RSRP\_Measurement\_Period\_SSB in FR2 for UE incapable of [*capability of measurement with RTD>CP*]

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_SSB\_intra (ms) |
| non-DRX | max(TReport, ceil(M\*P\*PL1\_sharing\*N)\*TSSB\_NBC) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P\*PL1\_sharing \*N)\*max(TDRX,TSSB\_NBC) ) |
| DRX cycle > 320ms | ceil(1.5\*M\*P\*PL1\_sharing\*N)\*TDRX |
| Note 1: TSSB\_NBC is the periodicity of the neighbor cell SSB-Index configured for intra-frequency L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting.  Note 2: No requirements, if the actual RTD of serving cell and neighbor cell is larger than CP no requirements.  Note3: When the number of neighbor cells **t**o be measured on intra-frequency and inter-frequency without gap is more than 1 and TCI state(s) of one of these neighbor cells is in the active TCI state, no requirements for other intra-frequency neighbor cells except the one whose TCI state(s) is in the active TCI state. | |

Table 9.x.5.1-4: Intra-frequency L1-RSRP measurement period TL1-RSRP\_Measurement\_Period\_SSB\_intra in FR2 for UE capable of [*capability of measurement with RTD>CP*]

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_SSB\_intra (ms) |
| non-DRX | max(TReport, ceil(M\*P\*PL1\_sharing\*N)\*TSSB\_NBC) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P\*PL1\_sharing\*N)\*max(TDRX,TSSB\_NBC)) |
| DRX cycle > 320ms | ceil(1.5\*M\*P\*PL1\_sharing\*N)\*TDRX |
| Note 1: TSSB\_NBC is the periodicity of the neighbor cell SSB-Index configured for intra-frequency L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting.  Note 2: When the number of neighbor cells **t**o be measured on intra-frequency and inter-frequency without gap is more than 1 and TCI state(s) of one of these neighbor cells is in the active TCI state, no requirements for other intra-frequency neighbor cells except the one whose TCI state(s) is in the active TCI state. | |

### 9.x.6 Measurement restriction for 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 SSB to be measured for L1-RSRP measurement is transmitted from neighbor cell(s).

#### 9.x.6.1 Measurement restriction for SSB based L1-RSRP

For FR1,

when the SSB for L1-RSRP measurement is in the same OFDM symbol as SSB transmitted from serving cell(s) for RLM, BFD, CBD or L1-RSRP measurement,

- UE shall be able to measure the SSB for L1-RSRP measurement without any restriction;

when the SSB for L1-RSRP measurement is in the same OFDM symbol as CSI-RS transmitted from serving cell(s) for RLM, BFD, CBD or L1-RSRP measurement,

- If SSB and CSI-RS have same SCS, UE shall be able to measure the SSB for L1-RSRP measurement without any restriction;

- If SSB and CSI-RS have different SCS,

- If UE supports *simultaneousRxDataSSB-DiffNumerology*, UE shall be able to measure the SSB for L1-RSRP measurement without any restriction;

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

For FR2, for UE incapable of [*capability of measurement with RTD>CP*] and for UE capable of [*capability of measurement with RTD>CP*],

when the SSB for L1-RSRP measurement on one CC is in the same or adjacent OFDM symbol as SSB transmitted from serving cell(s) for RLM, BFD, or CBD measurement on the same CC or different CCs in the same band, UE is required to measure one of but not both SSBs. Longer measurement period for SSB based RLM is expected, and no requirements are defined.

when the SSB for L1-RSRP measurement on one CC is in the same or adjacent OFDM symbol as CSI-RS transmitted from serving cell(s) for RLM, BFD, or CBD measurement on the same CC or different CCs in the same band, UE is required to measure one of but not both SSB for L1-RSRP measurement and CSI-RS. Longer measurement period for SSB based L1-RSRP measurement is expected, and no requirements are defined.

For FR2, if the network configures same or mixed numerology between SSB for L1-RSRP measurement on one FR2 band and CSI-RS for RLM, BFD, CBD, L1-RSRP or L1-SINR measurement on the other FR2 band, UE shall be able to perform the related SSB based measurements in one band without any measurement restrictions in the other band, provided that UE is capable of independent beam management on this FR2 band pair.

### 9.x.7 Scheduling availability of UE during L1-RSRP measurement

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

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

#### 9.x.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 SSB as RS for L1-RSRP measurement with the same SCS as PDSCH/PDCCH in FR1.

#### 9.x.7.2 Scheduling availability of UE performing L1-RSRP measurement with a different subcarrier spacing than PDSCH/PDCCH on FR1

For UEs which support *simultaneousRxDataSSB-DiffNumerology* [14] there are no restrictions on scheduling availability due to L1-RSRP measurement based on SSB as RS for L1-RSRP measurement. For UEs which do not support *simultaneousRxDataSSB-DiffNumerology* [14] the following restrictions apply due to L1-RSRP measurement based on SSB configured for L1-RSRP measurement.

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

- the same and 1 OFDM symbol before or after the OFDM symbols corresponding to the SSB indexes configured for L1-RSRP measurement, if UE supports [*capability of measurement with RTD>CP*],

- the same OFDM symbols corresponding to the SSB indexes configured for L1-RSRP measurement, if UE does not support [*capability of measurement with RTD>CP*],

When intra-band carrier aggregation in FR1 is configured, the scheduling restrictions apply to cell(s) in the same band on the symbols that fully or partially overlap with restricted symbols. When inter-band carrier aggregation within FR1 is configured, there are no scheduling restrictions on FR1 cells configured in other bands than the bands in which the cell where L1-RSRP measurement is performed.

#### 9.x.7.3 Scheduling availability of UE performing L1-RSRP measurement on FR2

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

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

- the same and 1 OFDM symbol before or after the OFDM symbols corresponding to the SSB indexes configured for L1-RSRP measurement, if UE supports [*capability of measurement with RTD>CP*],

- the same OFDM symbols corresponding to the SSB indexes configured for L1-RSRP measurement, if UE does not support [*capability of measurement with RTD>CP*],

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

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

If following conditions are met,

- UE has been notified about system information update through paging,

- The gap between UE’s reception of PDCCH that UE monitors in the Type 2-PDCCH CSS set and that notifies system information update, and the PDCCH that UE monitors in the Type0-PDCCH CSS set, is greater than 2 slots,

For the SSB and CORESET for RMSI scheduling multiplexing patterns 3, UE is expected to receive the PDCCH that UE monitors in the Type0-PDCCH CSS set, and the corresponding PDSCH, on SSB symbols to be measured for L1-RSRP measurement; and

For the SSB and CORESET for RMSI scheduling multiplexing patterns 2, UE is expected to receive PDSCH that corresponds to the PDCCH that UE monitors in the Type0-PDCCH CSS set, on SSB symbols to be measured for L1-RSRP measurement.

#### 9.x.7.4 Scheduling availability of UE performing L1-RSRP measurement on FR1 or FR2 in case of FR1-FR2 inter-band CA

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

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

#### 9.x.7.5 Scheduling availability of UE performing L1-RSRP measurement in TDD bands on FR1

When UE performs 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 and 1 OFDM symbol before or after the OFDM symbols corresponding to the SSB indexes configured for L1-RSRP measurement, if UE supports [*capability of measurement with RTD>CP*],

- the same OFDM symbols corresponding to the SSB indexes configured for L1-RSRP measurement, if UE does not support [*capability of measurement with RTD>CP*].

End of Change 25

Start of Change 26

## 9.y NR inter-frequency L1 measurement

### 9.y.1 Introduction

A L1-RSRP measurement is defined as an inter-frequency L1-RSRP measurement provided it is not defined as an intra- frequency L1-RSRP measurement according to clause [9.x].

When measurement gaps are provided, the UE shall be able to perform inter-frequency L1-RSRP measurements of SSBs from inter-frequency neighbor cells.

The UE shall be able to measure all SSB resources within the CSI-Resource*Config* settings configured for L1-RSRP measurement on inter-frequency neighbor cells with measurement gaps. If the number of resources exceeds the UE capability indicated by [TBD], it is up to UE implementation on how to choose resources to measure.

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

### 9.y.2 Requirements Applicability

The requirements in clause 9.y apply if the following conditions are met:

- The SSB configured for inter-frequency L1-RSRP measurement is on the same carrier frequency of SSB configured for RRM measurement in one of the measurement objects configured in the measObjectNR.

- The inter-frequency neighbor cell is known.

- The SSB resources configured for inter-frequency L1-RSRP measurements are measurable.

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

- L1-RSRP related side conditions given in [clauses 10.1.19.1 and 10.1.20.1 for FR1 and FR2], respectively, for a corresponding band,

- SSB\_RP and SSB Ês/Iot according to [Annex B.2.4.1] for a corresponding band.

The inter-frequency neighbor cell is considered as known if the following conditions are met in this requirement:

- During the last 5 seconds before the reception of the cell switch command:

- the UE has sent a valid L1 or L3 measurement report for the target cell and

- One of the SSBs measured from the NR target cell being configured remains detectable according to the cell identification conditions specified in clause 9.2 for intra-frequency cell and in clause 9.3 for inter-frequency cell,

- One of the SSBs measured from the target cell also remains detectable during the cell switch delay according to the cell identification conditions specified in clause 9.2 for intra-frequency cell and in clause 9.3 for inter-frequency cell.

Otherwise, the cell is unknown.

### 9.y.3 Measurement Reporting Requirements

The UE shall send L1-RSRP reports for report configurations configured for the inter-frequency L1 measurement on neighbor cell.

The UE shall report the L1-RSRP value as a 7-bit value in the range [-140, -44] dBm with 1dB step size according to clause 10.1.6. If *nrofReportedRS* is configured to be larger than one, or if *groupBasedBeamReporting-r17* is enabled, the UE shall use differential L1-RSRP based reporting as defined in clause 10.1.6. The differential L1-RSRP is quantized to a 4-bit value with 2dB step size. The mapping between the reported L1-RSRP value and the measured quantity is described in 10.1.6.

In EN-DC and NE-DC operation, when the UE is configured to perform E-UTRA SRS carrier-based switching an additional delay can be expected in FR1 if the UE is capable of per-FR gap, or an additional delay can be expected in both FR1 and FR2 if the UE is not capable of per-FR gap.

#### 9.y.3.1 Periodic Reporting

Reported L1-RSRP measurements contained in periodic L1-RSRP measurement reports shall meet the requirements in clauses 10.1.19 for FR1 and 10.1.20 for FR2, respectively.

The UE shall 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.y.3.2 Semi-Persistent Reporting

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

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

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

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

#### 9.y.3.3 Aperiodic Reporting

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

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

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

### 9.y.4 Number of cells and number of SSB

For inter-frequency layer, during each layer 1 measurement period, the UE shall be capable of performing L1-RSRP measurements for at least [[TBD] cells/SSBs based on UE capability].

### 9.y.5 inter-frequency L1-RSRP with MG

#### 9.y.5.1 Inter-frequency SSB based L1-RSRP Reporting

The requirements specified in this clause are only applicable when

- *highSpeedMeasFlag-r16* is not configured, and

- *highSpeedMeasFlagFR2-r17* is not configured, and

- highSpeedMeasCA-Scell-r17 is not configured, and

- [Concurrent gaps are not configured, and]

- SSBs of the neighbor cell configured for inter-frequency L1-RSRP measurement are fully or partially overlapped with measurement gaps.

If an inter-frequency neighbor cell is known according to [9.y.2], the UE shall be capable of performing L1-RSRP measurements based on the configured SSB resource for L1-RSRP computation, and the UE physical layer shall be capable of reporting L1-RSRP measured over the measurement period of TL1-RSRP\_Measurement\_Period\_SSB\_Inter if *deriveSSB-IndexFromCellInter-r17* is enabled on target frequency layers or UE is indicated to report SSB based RRM measurement result with the associated SSB index (*reportQuantityRsIndexes* or *maxNrofRSIndexesToReport* is not configured) of the same cell. Otherwise, UE physical layer shall be capable of reporting L1-RSRP measured over the measurement period of TL1-RSRP\_Measurement\_Period\_SSB\_inter+TSSB\_time\_index\_inter, where TSSB\_time\_index\_inter is the time period used to acquire the index of the SSB being measured given in Table 9.3.4.

The value of TL1-RSRP\_Measurement\_Period\_SSB\_Inter is defined in Table 9.y.5.1-1 for FR1. The value of TL1-RSRP\_Measurement\_Period\_SSB\_Inter is defined in Table 9.y.5.1-2 for FR2, where

- M=[1 or 2] if higher layer parameter *timeRestrictionForChannelMeasurement* is configured, and M=[3 or 4] otherwise

- N= 8.

- CSSFinter: it is a carrier specific scaling factor and is determined according to [CSSFwithin\_gap] in clause 9.1.5.x for L1-RSRP measurement conducted within measurement gaps.

Table 9.y.5.1-1: Inter-frequency L1-RSRP measurement period TL1-RSRP\_Measurement\_Period\_SSB\_Inter for known cells in FR1

|  |  |
| --- | --- |
| **Condition** | **TL1-RSRP\_Measurement\_Period\_SSB\_Inter** |
| No DRX | Max(Treport, Ceil(M \* Kgap) × Max(MGRP, SSB period)) × CSSFinter |
| DRX cycle ≤ 320ms | Max(Treport, Ceil(M × 1.5 \* Kgap) × Max(MGRP, SSB period, DRX cycle)) × CSSFinter |
| DRX cycle > 320ms | Ceil(M \* Kgap) × DRX cycle × CSSFinter |
| The definition of Kgap is the same as L3 measurement which is a scaling factor for a SSB frequency layer to be measured within an associated measurement gap pattern. | |

Table 9.y.5.1-2: Inter-frequency L1-RSRP measurement period TL1-RSRP\_Measurement\_Period\_SSB\_Inter for known cells in FR2

|  |  |
| --- | --- |
| **Condition** | **TL1-RSRP\_Measurement\_Period\_SSB\_Inter** |
| No DRX | Max(Treport, Ceil(Kgap × M\*N)× Max(MGRP, SSB period)) × CSSFinter |
| DRX cycle ≤ 320ms | Max(Treport, Ceil(1.5 \* Kgap × M\*N) × Max(MGRP, SSB period, DRX cycle)) × CSSFinter |
| DRX cycle > 320ms | Ceil(Kgap × M\*N) × DRX cycle × CSSFinter |
| The definition of Kgap is the same as L3 measurement which is a scaling factor for a SSB frequency layer to be measured within an associated measurement gap pattern. | |

### 9.y.6 Inter frequency L1-RSRP measurement without measurement gaps

#### 9.y.6.1 Inter frequency L1-RSRP measurement requirements

##### 9.y.6.1.1 Inter-frequency SSB based L1-RSRP measurement

When configured by the network and the inter-frequency cell’s SSB is completely contained in the DL active BWP, the UE shall be able to perform L1-RSRP measurements based on the configured SSB resource for L1-RSRP computation, and the UE physical layer shall be capable of reporting L1-RSRP measured over the measurement period of TL1-RSRP\_Measurement\_Period\_SSB\_inter\_withoutGap.

[If a neighbor cell is known according 9.x.2, the UE shall be capable of performing L1-RSRP measurements based on the configured SSB resource for L1-RSRP computation, and the UE physical layer shall be capable of reporting L1-RSRP measured over the measurement period of TL1-RSRP\_Measurement\_Period\_SSB\_inter\_withoutGap if *deriveSSB-IndexFromCellInter-r17* is enabled or UE has reported SSB index in L3 measurement report of the same cell. [Otherwise, UE physical layer shall be capable of reporting L1-RSRP measured over the measurement period of TL1-RSRP\_Measurement\_Period\_SSB\_inter\_withoutGap+TSSB\_time\_index\_inter, where TSSB\_time\_index\_inter is the time period used to acquire the index of the SSB being measured given in Table 9.3.9.1-3 for FR1 and in Table 9.3.9.1-4 for FR2].

The value of TL1-RSRP\_Measurement\_Period\_SSB\_inter\_withoutGap is defined for FR1 in Table 9.y.6.1.1-1. The value of TL1-RSRP\_Measurement\_Period\_SSB\_inter\_withoutGap is defined for FR2 in Table 9.y.6.1.1-2, where

- [M=1 if higher layer parameter *timeRestrictionForChannelMeasurement* is configured, and M=3 otherwise]

- N= 8.

- [P value for SSB resource to be measured is defined as

- Ntotal / Noutside\_MG in FR1

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

- Ntotal / Navailable in FR2 with Navailable > 0

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

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

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

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

- TL1 is periodicity of the target SSB.

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

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

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

- Psharing factor = 3, otherwise.

- PL1\_sharing is defined as

- When number of neighboring cells to be measured is 1

- PL1\_sharing = 2, if any symbol of the SSBs from serving cell and neighbor cell are overlapping or adjacent (in time domain)

- PL1\_sharing = 1, otherwise

- When number of neighboring cells to be measured is more than 1

- When TCI state of all the intra-frequency neighbor cells are not in the active TCI state list

- PL1\_sharing = 3\*NNeighbor\_Cell, where NNeighbor\_Cell is the number of neighbor cells to measure on intra-frequency and inter-frequency without gap

- Otherwise

- PL1\_sharing = 3, if the neighbor cell’s TCI state is in the active TCI state list

Note: The above principle and requirements apply when the NW Network is supposed to activate only one TCI state(s) from only one neighbor cell.

FFS: when TCI states are activated on neighbor cells in multiple bands

If the high layer in TS 38.331 [2] signaling of *smtc2* is configured, for cells indicated in the *pci-List* parameter in *smtc2*, TSMTCperiod corresponds to the value of higher layer parameter *smtc2*; Otherwise TSMTCperiod corresponds to the value of higher layer parameter *smtc1*.

Longer measurement period would be expected if the combination of SSB, 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.y.6.1.1-1: Measurement delay for inter frequency L1-RSRP measurement without measurement gaps in FR1

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_SSB\_inter\_withoutGap (ms) |
| non-DRX | max(TReport, ceil(M\*P)\*TSSB\_NBC\*NLayer) |
| DRX cycle ≤ 320ms | max(TReport, ceil(K \*M\*P)\*max(TDRX,TSSB\_NBC)\*NLayer) |
| DRX cycle > 320ms | ceil(M\*P)\*TDRX\*NLayer |
| Note 1: TSSB\_NBC is the periodicity of the neighbor cell SSB-Index configured for intra-frequency L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting. [NLayer = the number of inter-frequency layers which are configured for L1-RSRP measurement with [*LTM-CSI-ResourceConfig-r18*] and measured without measurement gaps + the number of intra-frequency layers configured for L1-RSRP measurement with [*LTM-CSI-ResourceConfig-r18*]].  Note 2: K = 1.5.  Note 3: If the actual RTD of serving cell and neighbor cell is larger than CP, for UE incapable of [*capability of measurement with RTD>CP*], [accuracy degradation is allowed or no requirements]. | |

Editor note: FFS whether to add a new table on measurement delay for UE incapable of [*capability of measurement with RTD>CP*]

Table 9.y.6.1.1-2: Measurement delay for inter frequency L1-RSRP measurement without measurement gaps in FR2

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_SSB\_inter\_withoutGap (ms) |
| non-DRX | max(TReport, ceil(M\*P\*PL1\_sharing\*N)\*TSSB\_NBC) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P\*PL1\_sharing \*N)\*max(TDRX,TSSB\_NBC) ) |
| DRX cycle > 320ms | ceil(1.5\*M\*P\*PL1\_sharing\*N)\*TDRX |
| Note 1: TSSB\_NBC is the periodicity of the neighbor cell SSB-Index configured for intra-frequency L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting.  Note 2: If the actual RTD of serving cell and neighbor cell is larger than CP, for UE incapable of [*capability of measurement with RTD>CP*],[accuracy degradation is allowed or no requirements].  Note3: When the number of neighbor cells **t**o be measured on intra-frequency and inter-frequency without gap is more than 1 and TCI state(s) of one of the neighbor cells is in the active TCI state, no requirements for other intra-frequency and inter-frequency without gap neighbor cells except the one whose TCI state(s) is in the active TCI state. | |

Editor note: FFS whether to add a new table on measurement delay for UE incapable of [*capability of measurement with RTD>CP*]

*Editor’s Note: The section may be further updated based any newly achieved agreements.*

#### 9.y.6.2 Measurement restriction for inter frequency 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 SSB to be measured for L1-RSRP measurement is transmitted from neigbor cell(s).

*Editor’s Note: The section may be further updated based any newly achieved agreements.*

##### 9.y.6.2.1 Measurement restriction for SSB based L1-RSRP

[For FR1,

when the SSB for L1-RSRP measurement overlaps with the concerned OFDM symbols, where the concern OFDM symbols are

- the same and 1 OFDM symbol before or after the OFDM symbol of SSB transmitted from serving cell(s) for RLM, BFD, CBD or L1-RSRP measurement, if UE support [*capability of measurement with RTD>CP*],

- the same OFDM symbol of SSB transmitted from serving cell(s) for RLM, BFD, CBD or L1-RSRP measurement, if UE does not support [*capability of measurement with RTD>CP*],

- UE shall be able to measure the SSB for L1-RSRP measurement without any restriction;

when the SSB for L1-RSRP measurement overlapps with the concerned OFDM symbols, where the concern OFDM symbols are

- the same and 1 OFDM symbol before or after the OFDM symbol of CSI-RS transmitted from serving cell(s) for RLM, BFD, CBD or L1-RSRP measurement, if UE supports [*capability of measurement with RTD>CP*],

- the same OFDM symbol of SSB transmitted from serving cell(s) for RLM, BFD, CBD or L1-RSRP measurement, if UE does not support [*capability of measurement with RTD>CP*],

- If SSB and CSI-RS have same SCS, UE shall be able to measure the SSB for L1-RSRP measurement without any restriction;

- If SSB and CSI-RS have different SCS,

- If UE supports *simultaneousRxDataSSB-DiffNumerology*, UE shall be able to measure the SSB for L1-RSRP measurement without any restriction;

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

For FR2,

when the SSB for L1-RSRP measurement on one CC overlapps with the concerned OFDM symbols, where the concern OFDM symbols are

- the same and/or 1 OFDM symbol before or after OFDM symbol of SSB transmitted from serving cell(s) for RLM, BFD, or CBD measurement on the same CC or different CCs in the same band, if UE supports [*capability of measurement with RTD>CP*],

- the same OFDM symbol as SSB transmitted from serving cell(s) for RLM, BFD, or CBD measurement on the same CC or different CCs in the same band, if UE does not support [*capability of measurement with RTD>CP*],

UE is required to measure one of but not both the SSBs. Longer measurement period for SSB based L1-RSRP measurement is expected, and no requirements are defined.

when the SSB for L1-RSRP measurement on one CC overlapps with the concerned OFDM symbols, where the concern OFDM symbols are

- the same and/or 1 OFDM symbol before or after OFDM symbol of CSI-RS transmitted from serving cell(s) for RLM, BFD, or CBD measurement on the same CC or different CCs in the same band, if UE supports [*capability of measurement with RTD>CP*],

- the same OFDM symbol as CSI-RS transmitted from serving cell(s) for RLM, BFD, or CBD measurement on the same CC or different CCs in the same band, if UE does not support [*capability of measurement with RTD>CP*],

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

For FR2, if the network configures same or mixed numerology between SSB for L1-RSRP measurement on one FR2 band and CSI-RS for RLM, BFD, CBD, L1-RSRP or L1-SINR measurement on the other FR2 band, UE shall be able to perform the related SSB based measurements in one band without any measurement restrictions in the other band, provided that UE is capable of independent beam management on this FR2 band pair.]

#### 9.y.6.3 Scheduling availability of UE during inter-frequency L1-RSRP measurements

Scheduling availability restrictions described in the following clauses apply when UE is performing L1-RSRP measurement on inter-frequency cell(s), and UE is receiving PDCCH/PDSCH from serving cell.

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

##### 9.y.6.3.1 Scheduling availability of UE performing L1-RSRP measurement with a same subcarrier spacing as PDSCH/PDCCH on FR1

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

##### 9.y.6.3.2 Scheduling availability of UE performing L1-RSRP measurement with a different subcarrier spacing than PDSCH/PDCCH on FR1

For UEs which support *simultaneousRxDataSSB-DiffNumerology* [14] there are no restrictions on scheduling availability due to L1-RSRP measurement based on SSB as RS for L1-RSRP measurement. For UEs which do not support *simultaneousRxDataSSB-DiffNumerology* [14] the following restrictions apply due to L1-RSRP measurement based on SSB configured for L1-RSRP measurement.

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

- the same and 1 OFDM symbol before or after the OFDM symbols corresponding to the SSB indexes configured for L1-RSRP measurement, if UE supports [*capability of measurement with RTD>CP*],

- the same OFDM symbols corresponding to the SSB indexes configured for L1-RSRP measurement, if UE does not support [*capability of measurement with RTD>CP*],

When intra-band carrier aggregation in FR1 is configured, the scheduling restrictions apply to cell(s) in the same band on the symbols that fully or partially overlap with restricted symbols. When inter-band carrier aggregation within FR1 is configured, there are no scheduling restrictions on FR1 cells configured in other bands than the bands in which the cell where L1-RSRP measurement is performed is configured.

##### 9.y.6.3.3 Scheduling availability of UE performing L1-RSRP measurement on FR2

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

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

- the same and 1 OFDM symbol before or after the OFDM symbols corresponding to the SSB indexes configured for L1-RSRP measurement, if UE supports [*capability of measurement with RTD>CP*],

- the same OFDM symbols corresponding to the SSB indexes configured for L1-RSRP measurement, if UE does not support [*capability of measurement with RTD>CP*],

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

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

If following conditions are met,

- UE has been notified about system information update through paging,

- The gap between UE’s reception of PDCCH that UE monitors in the Type 2-PDCCH CSS set and that notifies system information update, and the PDCCH that UE monitors in the Type0-PDCCH CSS set, is greater than 2 slots,

For the SSB and CORESET for RMSI scheduling multiplexing patterns 3, UE is expected to receive the PDCCH that UE monitors in the Type0-PDCCH CSS set, and the corresponding PDSCH, on SSB symbols to be measured for L1-RSRP measurement; and

For the SSB and CORESET for RMSI scheduling multiplexing patterns 2, UE is expected to receive PDSCH that corresponds to the PDCCH that UE monitors in the Type0-PDCCH CSS set, on SSB symbols to be measured for L1-RSRP measurement.

##### 9.y.6.3.4 Scheduling availability of UE performing L1-RSRP measurement on FR1 or FR2 in case of FR1-FR2 inter-band CA

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

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

##### 9.y.6.3.5 Scheduling availability of UE performing L1-RSRP measurement in TDD bands on FR1

When UE performs 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 and 1 OFDM symbol before or after the OFDM symbols corresponding to the SSB indexes configured for L1-RSRP measurement, if UE supports [*capability of measurement with RTD>CP*],

- the same OFDM symbols corresponding to the SSB indexes configured for L1-RSRP measurement, if UE does not support [*capability of measurement with RTD>CP*]

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