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

**, US, November 13 – 17, 2023**

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| *CR-Form-v12.2* |
| **CHANGE REQUEST** |
|  |
|  | **38.133** | **CR** | **3784** | **rev** | **-** | **Current version:** | **18.3.0** |  |
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| *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:***  | Big CR to specify RRM requirements on enhanced NR support for Rel-18 FR2 HST |
|  |  |
| ***Source to WG:*** | Samsung |
| ***Source to TSG:*** | R4 |
|  |  |
| ***Work item code:*** | NR\_HST\_FR2\_enh-Core |  | ***Date:*** | 2023-11-20 |
|  |  |  |  |  |
| ***Category:*** | ***F*** |  | ***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 canbe found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | *Use one of the following releases:Rel-8 (Release 8)Rel-9 (Release 9)Rel-10 (Release 10)Rel-11 (Release 11)…Rel-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)Rel-19 (Release 19)* |
|  |  |
| ***Reason for change:*** | 1. Some RRM requirements for NR HST FR2 specified in the current Spec. TS 38.133 need to be updated based on the agreements achieved in RAN4 #108-bis meeting, the corresponding agreements can be found in R4-2317392.
2. The big CR R4-2313541 agreed in RAN4 #108 meeting need to be updated by capturing the RRM requirements defined in draft CRs endorsed in RAN4 #109 meeting.
3. RRM requirements for NR HST FR2 are introduced into TS 38.133 from draft CRs endorsed in RAN4 #109 meeting.
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|  |  |
| ***Summary of change:*** | RRM requirements for NR HST FR2 endorsed in the following draft CRs are added to TS 38.1331. R4-2318866, draftCR with updated N1 for HST requirements of SSB based BFD
2. R4-2319963, CR on L1-RSRP requirements for R18 FR2 HST
3. R4-2320990, CR on RLM requirements for R18 FR2 HST
4. R4-2321419, Maintenance CR on MRTD requirements for HST FR2 multi-panel Rx UE-s
5. R4-2321422, Update on SCell activation for R18 FR2 HST CA
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|  |  |
| ***Consequences if not approved:*** | The RRM requirements specified in the current Spec. TS 38.133 are not applicable to Rel-18 NR FR2 HST  |
|  |  |
| ***Clauses affected:*** | 7.6.7, 8.1.2.2, 8.3.2, 8.5.5.2, 9.5.4.1 |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **X** |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** | **X** |  |  Test specifications | TS/TR 38.533  |
| ***(show related CRs)*** |  | **X** |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** | 1st version. |

==========================Start of change 1 =============================

## 7.6 Maximum Receive Timing Difference

### 7.6.7 Minimum Requirements for PC6 UE in FR2

In HST FR2 scenario, when *highSpeedMeasFlagFR2-r17* is configured and *highSpeedDeploymentTypeFR2-r17* is configured as bidirectional for a PC6 UE supporting [*simultaneousReceptionFR2HST-r18*]*,* the UE shall be capable of handling a maximum receive timing difference specified as in the below table 7.6.7-1. The specified timing difference is between the subframe boundaries of the signals on the same CC which UE receives using two different Rx chains simultaneously.

Table 7.6.7-1: Maximum receive timing difference requirement for PC6 UE supporting [*simultaneousReceptionFR2HST-r18*]

|  |  |  |
| --- | --- | --- |
| Frequency Range | Subcarrier spacing (kHz) | Maximum receive timing difference (µs)  |
| FR2 | 120 | 8 |

==========================End of change 1 =============================

==========================Start of change 2 =============================

## 8.1 Radio Link Monitoring

### 8.1.2 Requirements for SSB based radio link monitoring

#### 8.1.2.2 Minimum requirement

UE shall be able to evaluate whether the downlink radio link quality on the configured RLM-RS resource estimated over the last TEvaluate\_out\_SSB [ms] period becomes worse than the threshold Qout\_SSB within TEvaluate\_out\_SSB [ms] evaluation period.

UE shall be able to evaluate whether the downlink radio link quality on the configured RLM-RS resource estimated over the last TEvaluate\_in\_SSB [ms] period becomes better than the threshold Qin\_SSB within TEvaluate\_in\_SSB [ms] evaluation period.

TEvaluate\_out\_SSB and TEvaluate\_in\_SSB are defined in Table 8.1.2.2-1 for FR1.

TEvaluate\_out\_SSB and TEvaluate\_in\_SSB are defined in Table 8.1.2.2-2 for FR2 with scaling factor N=8 for FR2-1 and N=12 for FR2-2, for FR2 power classes other than power class 6 or for FR2 power class 6 when *highSpeedMeasFlagFR2-r17* is not configured.

TEvaluate\_out\_SSB and TEvaluate\_in\_SSB are defined in Table 8.1.2.2-3 for FR2 power class 6 UE configured with *highSpeedMeasFlagFR2-r17*.

TEvaluate\_out\_SSB and TEvaluate\_in\_SSB are defined in Table 8.1.2.2-4 for FR1 (deactivated PSCell).

TEvaluate\_out\_SSB and TEvaluate\_in\_SSB are defined in Table 8.1.2.2-5 for FR2 (deactivated PSCell) with scaling factor N=8 for FR2-1 and N=12 for FR2-2.

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

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

- Ntotal / Noutside\_MG in FR1

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

- Ntotal / Navailable in FR2 with Navailable > 0

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

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

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

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

- TL1 is periodicity of the target RLM-RS.

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

For FR1,

- $P=\frac{1}{1-\frac{T\_{SSB}}{xRP}}$, when in the monitored cell there are GAPs configured for intra-frequency, inter-frequency or inter-RAT measurements, and these GAPs are overlapping with some but not all occasions of the SSB; and

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

For FR2

- $P=\frac{1}{1-\frac{T\_{SSB}}{T\_{SMTCperiod}}}$, when RLM-RS resource is not overlapped with GAP and the RLM-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod).

- P is Psharing factor, when the RLM-RS resource is not overlapped with GAP and RLM-RS resource is fully overlapped with SMTC occasion (TSSB = TSMTCperiod).

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

- TSMTCperiod ≠ xRP or

- TSMTCperiod = xRP and TSSB < 0.5\*TSMTCperiod

- $P=\frac{P\_{sharing factor}}{1-\frac{T\_{SSB}}{xRP}}$, when the RLM-RS is partially overlapped with GAP and the RLM-RS is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with GAP and TSMTCperiod = xRP and TSSB = 0.5 × TSMTCperiod

- $P=\frac{1}{1-\frac{T\_{SSB}}{Min(xRP, T\_{SMTCperiod})}}$, when the RLM-RS resource is partially overlapped with GAP and the RLM-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is partially or fully overlapped with GAP

- $P=\frac{P\_{sharing factor}}{1-\frac{T\_{SSB}}{xRP}}$, when the RLM-RS resource is partially overlapped with GAP and the RLM-RS resource is fully overlapped with SMTC occasion (TSSB = TSMTCperiod) and SMTC occasion is partially overlapped with GAP (TSMTCperiod < xRP)

where,

- Psharing factor = 1, if the RLM-RS resource outside gap is

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

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

- Psharing factor = 3, otherwise.

- If the high layer in TS 38.331 [2] signaling of *smtc2*is present, TSMTCperiod follows *smtc2*; Otherwise TSMTCperiod follows *smtc1.* TSMTCperiod is the shortest SMTC period among all CCs in the same FR2 band, provided the SMTC offset of all CCs in FR2 have the same offset.

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

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

- xRP = MGRP

- Otherwise, when NCSG measurement gap is configured,

- an RLM-RS resource or an SMTC occasion is considered to be overlapped with the GAP if

- it overlaps the VIL1 or VIL2 of NCSG, or

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

- and

- xRP = VIRP

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

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

If the high layer in TS 38.331 [2] signaling of *smtc2*is present, TSMTCperiod follows *smtc2*; Otherwise TSMTCperiod follows *smtc1.*

Longer evaluation period would be expected if the combination of RLM-RS resource, SMTC occasion and GAP configurations does not meet previous conditions.

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

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

Table 8.1.2.2-1: Evaluation period TEvaluate\_out\_SSB and TEvaluate\_in\_SSB for FR1

|  |  |  |
| --- | --- | --- |
| Configuration | TEvaluate\_out\_SSB (ms)  | TEvaluate\_in\_SSB (ms)  |
| no DRX | Max(200, Ceil(10 × P) × TSSB) | Max(100, Ceil(5 × P) × TSSB) |
| DRX cycle≤320ms | Max(200, Ceil(15 × P) × Max(TDRX,TSSB)) | Max(100, Ceil(7.5 × P) × Max(TDRX,TSSB)) |
| DRX cycle>320ms | Ceil(10 × P) × TDRX | Ceil(5 × P) × TDRX |
| NOTE: TSSB is the periodicity of the SSB configured for RLM. TDRX is the DRX cycle length. |

Table 8.1.2.2-2: Evaluation period TEvaluate\_out\_SSB and TEvaluate\_in\_SSB for FR2

|  |  |  |
| --- | --- | --- |
| Configuration | TEvaluate\_out\_SSB (ms)  | TEvaluate\_in\_SSB (ms)  |
| no DRX | Max(200, Ceil(10 × P × N) × TSSB) | Max(100, Ceil(5 × P × N) × TSSB) |
| DRX cycle≤320ms | Max(200, Ceil(15 × P × N) × Max(TDRX,TSSB)) | Max(100, Ceil(7.5 × P × N) × Max(TDRX,TSSB)) |
| DRX cycle>320ms | Ceil(10 × P × N) × TDRX | Ceil(5 × P × N) × TDRX |
| NOTE: TSSB is the periodicity of the SSB configured for RLM. TDRX is the DRX cycle length. |

Table 8.1.2.2-3: Evaluation period TEvaluate\_out\_SSB and TEvaluate\_in\_SSB for FR2 power class 6 UE configured with *highSpeedMeasFlagFR2-r17*

|  |  |  |
| --- | --- | --- |
| Configuration | TEvaluate\_out\_SSB (ms)  | TEvaluate\_in\_SSB (ms)  |
| no DRX | Max(200, Ceil(10 × P × N Note2) × TSSB) | Max(100, Ceil(5 × P × N Note2) × TSSB) |
| DRX cycle≤80ms | Max(200, Ceil(15 × P × N Note2) × Max(TDRX,TSSB)) | Max(100, Ceil(7.5 × P × N Note2) × Max(TDRX,TSSB)) |
| NOTE 1: TSSB is the periodicity of the SSB configured for RLM. TDRX is the DRX cycle length.NOTE 2: For a UE not supporting [*simultaneousReceptionFR2HST-r18*] or when *highSpeedDeploymentTypeFR2-r17* is not configured as *bi-directional*, scaling factor N=2 when *highSpeedMeasFlagFR2-r17* is configured to set1 and scaling factor N=6 when *highSpeedMeasFlagFR2-r17* is configured to set2. For a UE supporting [*simultaneousReceptionFR2HST-r18*] and when *highSpeedDeploymentTypeFR2-r17* is configured as *bidirectional*, scaling factor N=1.5 when *highSpeedMeasFlagFR2-r17* is configured to set1 and scaling factor N=4 when *highSpeedMeasFlagFR2-r17* is configured to set2 |

Table 8.1.2.2-4: Evaluation period TEvaluate\_out\_SSB and TEvaluate\_in\_SSB for FR1(deactivated PSCell)

|  |  |  |
| --- | --- | --- |
| Configuration | TEvaluate\_out\_SSB (ms)  | TEvaluate\_in\_SSB (ms)  |
| no DRX | Ceil(10 × P) × measCyclePSCell | Ceil(5 × P) × measCyclePSCell |
| DRX cycle≤ 320ms | Ceil(15 × P) × Max(TDRX, measCyclePSCell) | Ceil(7.5 × P) × Max(TDRX, measCyclePSCell) |
| DRX cycle> 320ms | Ceil(10 × P) × Max(TDRX, measCyclePSCell) | Ceil(5 × P) × Max(TDRX, measCyclePSCell) |
| NOTE: TDRX is the DRX cycle length of SCG. measCyclePSCell is the measurement cycle length of the deactivated PSCell. |

Table 8.1.2.2-5: Evaluation period TEvaluate\_out\_SSB and TEvaluate\_in\_SSB for FR2(deactivated PSCell)

|  |  |  |
| --- | --- | --- |
| Configuration | TEvaluate\_out\_SSB (ms)  | TEvaluate\_in\_SSB (ms)  |
| no DRX | Ceil(10 × P× N) × measCyclePSCell | Ceil(5 × P× N) × measCyclePSCell |
| DRX cycle≤ 320 ms | Ceil(15 × P× N) × Max(TDRX, measCyclePSCell) | Ceil(7.5 × P× N) × Max(TDRX, measCyclePSCell) |
| DRX cycle> 320 ms | Ceil(10 × P× N) × Max(TDRX, measCyclePSCell) | Ceil(5 × P× N) × Max(TDRX, measCyclePSCell) |
| NOTE: TDRX is the DRX cycle length of SCG. measCyclePSCell is the measurement cycle length of the deactivated PSCell. |

==========================End of change 2 =============================

==========================Start of change 3 =============================

## 8.3 SCell Activation and Deactivation Delay

### 8.3.1 Introduction

This clause defines requirements for the delay within which the UE shall be able to activate a deactivated SCell and deactivate an activated SCell in EN-DC, or in standalone NR carrier aggregation, or in NE-DC, or in NR-DC.

The requirements shall apply for EN-DC, standalone NR carrier aggregation, NE-DC, and NR-DC.

### 8.3.2 SCell Activation Delay Requirement for Deactivated SCell

The requirements in this clause shall apply for the UE configured with one downlink SCell in EN-DC, or in standalone NR carrier aggregation or in NE-DC or in NR-DC and when one SCell is being activated.

The delay within which the UE shall be able to activate the deactivated SCell depends upon the specified conditions.

Upon receiving SCell activation command in slot *n*, the UE shall be capable to transmit valid CSI report and apply actions related to the activation command for the SCell being activated no later than in slot $n+\frac{T\_{HARQ}+T\_{activation\\_time}+T\_{CSI\\_Reporting}}{NR slot length}$ , where:

 THARQ (in ms) is the timing between DL data transmission and acknowledgement as specified in TS 38.213 [3]

 Tactivation\_time is the SCell activation delay in millisecond.

 If the SCell is known and belongs to FR1, Tactivation\_time is:

- TFirstSSB+ 5ms, if the measurement period of the SCell being activated is equal to or smaller than 2400ms.

- TFirstSSB\_MAX + Trs + 5ms, if the measurement period of the SCell being activated is larger than 2400ms.

 If the SCell is unknown and belongs to FR1, and if one of the following conditions is met

- ‘ssb-PositionInBurst’ indicates only one SSB is being actually transmitted, or

- ‘ssb-PositionInBurst’ indicates multiple SSBs and TCI indication is provided in same MAC PDU with SCell activation,

provided that the side condition Ês/Iot ≥ -2dB is fulfilled, Tactivation\_time is:

- TFirstSSB\_MAX + TSMTC\_MAX + Trs + 5ms, if the following conditions are met,

- the SCell is contiguous to an active serving cell in the same band, and

- its *ssb-PositionInBurst* is same as the one of contiguous FR1 active serving cell, and

- its SMTC offset is same as the one of contiguous FR1 active serving cell, and

- its RTD with contiguous FR1 active serving cell is smaller than or equal to 260ns with respect to the to-be-activated SCell’s SSB numerology, and its reception power difference with contiguous FR1 active serving cell is smaller than or equal to 6dB;

- TFirstSSB\_MAX + TSMTC\_MAX + 2\*Trs + 5ms, otherwise.

otherwise, provided that the side condition Ês/Iot ≥ -2dB is fulfilled, Tactivation\_time is:

- 6ms + TFirstSSB\_MAX + TSMTC\_MAX + Trs + TL1-RSRP,measure + TL1-RSRP,report + THARQ + max(Tuncertainty\_MAC + TFineTiming + 2ms, Tuncertainty\_SP), if semi-persistent CSI-RS is used for CSI reporting,

- 3ms + TFirstSSB\_MAX + TSMTC\_MAX + Trs + TL1-RSRP,measure + TL1-RSRP,report + max(THARQ + Tuncertainty\_MAC + 5ms + TFineTiming, Tuncertainty\_RRC + TRRC\_delay), if periodic CSI-RS is used for CSI reporting.

- However, when the following conditions are fulfilled, no activation requirement will be applied for this unknown SCell:

- the SCell is contiguous to an active serving cell in the same band, and

- A single SSB is used in the unknown SCell; or multiple SSBs are used in the SCell and TCI state indication for PDCCH is provided by the same MAC PDU used for SCell activation; and

- its *ssb-PositionInBurst* is same as the one of contiguous FR1 active serving cell, and

- its SMTC offset is same as the one of contiguous FR1 active serving cell

- its RTD with contiguous FR1 active serving cell is larger than 260ns with respect to the to-be-activated SCell’s SSB numerology, or its reception power difference with contiguous FR1 active serving cell is larger than 6dB;

 If the SCell being activated belongs to FR1 and if there is at least one active serving cell contiguous to the SCell on that FR1 band, if the UE is not provided with SSB configuration (*absoluteFrequencySSB*) nor SMTC configuration for the target SCell, Tactivation\_time is 3 ms for UE supporting *scellWithoutSSB*, provided

- The RTD between the target SCell and the contiguous active serving cell is within within ±260ns, and

- The difference of the reception power with the contiguous active serving cell is <= 6dB, and

- The RS(s) of SCell being activated is (are) QCL-TypeA with TRS(s) of the SCell being activated, and the TRS(s) of the SCell being activated is (are) further QCL-TypeC with SSB(s) of any active serving cell that is contiguous to the SCell being activated on that FR1 band.

 If the SCell being activated belongs to FR2 and if there is at least one active serving cell on that FR2 band, then Tactivation\_time is TFirstSSB+ 5ms provided:

- The UE is provided with SMTC for the target SCell, and

- The SSBs in the serving cell(s) and the SSBs in the SCell fulfil the condition defined in clause 3.6.3, and

- The parameter ssb-PositionsInBurst is same for the serving cell(s) and the Scell, and

- SSB is in the same half-frame on the SCell and the contiguous FR2 active serving cell.

 If the SCell being activated belongs to FR2 and if there is at least one active serving cell on that FR2 band, if the UE supporting *scellWithoutSSB* is not provided with any SMTC for the target SCell, Tactivation\_time is 3 ms, provided

- the RS (s) of SCell being activated is (are) QCL-TypeD with RS (s) of one active serving cell on that FR2 band.

 If the SCell being activated belongs to FR2 and if there is at least one active serving cell on that FR2 band, if the FR2 power class 6 UE supporting [*Enhanced FR2 HST RRM requirements for intra-band CA and inter-frequency measurements in connected mode*] is configured with *highSpeedMeasFlagFR2-r17*, Tactivation\_time is 3 ms , provided

- the RS (s) of SCell being activated is (are) QCL-TypeD with RS (s) of one active serving cell on that FR2 band.

*Editor Notes: FFS additional condition/capability is needed.*

 If the SCell being activated belongs to FR2 and if there is no active serving cell on that FR2 band provided that PCell or PSCell is in FR1 or in FR2:

 If the target SCell is known to UE and semi-persistent CSI-RS is used for CSI reporting, then Tactivation\_time is:

- 3ms + max(Tuncertainty\_MAC + TFineTiming + 2ms, Tuncertainty\_SP), where Tuncertainty\_MAC=0 and Tuncertainty\_SP=0 if UE receives the SCell activation command, semi-persistent CSI-RS activation command and TCI state activation command at the same time.

 If the target SCell is known to UE and periodic CSI-RS is used for CSI reporting, then Tactivation\_time is:

- max(Tuncertainty\_MAC + 5ms + TFineTiming, Tuncertainty\_RRC + TRRC\_delay-THARQ), where Tuncertainty\_MAC=0 if UE receives the SCell activation command and TCI state activation commands at the same time.

 If the PCell/PSCell and the target SCell are configured as FR1-FR2-1 CA or if the PCell/PSCell and the target SCell are in a FR2-1 band pair with independent beam management, and the target SCell is unknown to UE and semi-persistent CSI-RS is used for CSI reporting, provided that the side condition Ês/Iot ≥ -2dB is fulfilled, then Tactivation\_time is:

- 6ms + TFirstSSB\_MAX + 15\*TSMTC\_MAX + 8\*Trs + TL1-RSRP, measure + TL1-RSRP, report + THARQ + max(Tuncertainty\_MAC + TFineTiming + 2ms, Tuncertainty\_SP).

 If the PCell/PSCell and the target SCell are configured as FR1-FR2-2 CA or if the PCell/PSCell and the target SCell are in a FR2-2 band pair with independent beam management, and the target SCell is unknown to UE and semi-persistent CSI-RS is used for CSI reporting, provided that the side condition Ês/Iot ≥ -2dB is fulfilled, then Tactivation\_time is:

- 6ms + TFirstSSB\_MAX + 23\*TSMTC\_MAX + 12\*Trs + TL1-RSRP, measure + TL1-RSRP, report + THARQ + max(Tuncertainty\_MAC + TFineTiming + 2ms, Tuncertainty\_SP).

 If the PCell/PSCell and the target SCell are configured as FR1-FR2-1 CA or if the PCell/PSCell and the target SCell are in a FR2-1 band pair with independent beam management, and the target SCell is unknown to UE and periodic CSI-RS is used for CSI reporting, provided that the side condition Ês/Iot ≥ -2dB is fulfilled, then Tactivation\_time is:

- 3ms + TFirstSSB\_MAX + 15\*TSMTC\_MAX + 8\*Trs + TL1-RSRP, measure + TL1-RSRP, report + max {(THARQ + Tuncertainty\_MAC + 5ms + TFineTiming), (Tuncertainty\_RRC + TRRC\_delay)}.

 If the PCell/PSCell and the target SCell are configured as FR1-FR2-2 CA or if the PCell/PSCell and the target SCell are in a FR2-2 band pair with independent beam management, and the target SCell is unknown to UE and periodic CSI-RS is used for CSI reporting, provided that the side condition Ês/Iot ≥ -2dB is fulfilled, then Tactivation\_time is:

- 3ms + TFirstSSB\_MAX + 23\*TSMTC\_MAX + 12\*Trs + TL1-RSRP, measure + TL1-RSRP, report + max {(THARQ + Tuncertainty\_MAC + 5ms + TFineTiming), (Tuncertainty\_RRC + TRRC\_delay)}.

where,

 TSMTC\_MAX:

- In FR1, in case of intra-band contiguous SCell activation or in case of intra-band non-contiguous SCell activation for UE not capable of [*intraBandNRCA-NonCollocated-r18*], TSMTC\_MAX is the longer SMTC periodicity between active serving cells and SCell being activated provided the cell specific reference signals from the active serving cells and the SCells being activated or released are available in the same slot; in case of intra-band non-contiguous SCell activation for UE capable of [*intraBandNRCA-NonCollocated-r18*] or in case of inter-band SCell activation, TSMTC\_MAX is the SMTC periodicity of SCell being activated.

- In FR2, in case of intra-band SCell activation, TSMTC\_MAX is the longer SMTC periodicity between active serving cells and SCell being activated provided that in Rel-15 only support FR2 intra-band CA; in case of FR2 inter-band SCell activation, TSMTC\_MAX is the SMTC periodicity of SCell being activated.

- TSMTC\_MAX is bounded to a minimum value of 10ms.

 Trs is the SMTC periodicity of the SCell being activated if the UE has been provided with an SMTC configuration for the SCell in SCell addition message, otherwise Trs is the SMTC configured in the measObjectNR having the same SSB frequency and subcarrier spacing. If the measObjectNRs having the same SSB frequency and subcarrier spacing configured by MN and SN have different SMTC, Trs is the periodicity of one of the SMTC which is up to UE implementation. If the UE is not provided SMTC configuration or measurement object on this frequency, the requirement which involves Trs is applied with Trs = 5ms assuming the SSB transmission periodicity is 5ms. There are no requirements if the SSB transmission periodicity is not 5ms

TFirstSSB: is the time to the end of the first complete SSB burst indicated by the SMTC, or within 5ms if SMTC is not configured, after slot n + $\frac{T\_{HARQ}+3ms}{NR slot length}$.

TFirstSSB\_MAX: Is the time to the end of the first complete SSB burst indicated by the SMTC, or within 5ms if SMTC is not configured, after slot n + $\frac{T\_{HARQ}+3ms}{NR slot length}$, further fulfilling:

- In FR1, in case of intra-band contiguous SCell activation or in case of intra-band non-contiguous SCell activation for UE not capable of [*intraBandNRCA-NonCollocated-r18*], the occasion when all active serving cells and SCells being activated or released are transmitting SSB bursts in the same slot; in case of intra-band non-contiguous SCell activation for UE capable of [*intraBandNRCA-NonCollocated-r18*] or in case of inter-band SCell activation, the first occasion when the SCell being activated is transmitting SSB burst.

- In FR2, the occasion when all active serving cells and SCells being activated or released are transmitting SSB bursts in the same slot.

 TFineTiming is the time period between UE finish processing the last activation command for PDCCH TCI, PDSCH TCI (when applicable) and the timing of first complete available SSB corresponding to the TCI state.

 TL1-RSRP, measure is L1-RSRP measurement delay TL1-RSRP\_Measurement\_Period\_SSB msor TL1-RSRP\_Measurement\_Period\_CSI-RS based on applicability as defined in clause 9.5 assuming M=1 and TReport=0.

 TL1-RSRP, report is delay of acquiring CSI reporting resources.

 Tuncertainty\_MAC is the time period between reception of the last activation command for PDCCH TCI, PDSCH TCI (when applicable) relative to

- SCell activation command for known case;

- First valid L1-RSRP reporting for unknown case.

 Tuncertainty\_RRC is the time period between reception of the RRC configuration message for TCI of periodic CSI-RS for CQI reporting (when applicable) relative to

- SCell activation command for known case;

- First valid L1-RSRP reporting for unknown case.

 Tuncertainty\_SP is the time period between reception of the activation command for semi-persistent CSI-RS resource set for CQI reporting relative to

- SCell activation command for known case;

- First valid L1-RSRP reporting for unknown case.

 TRRC\_delay is the RRC procedure delay as specified in TS38.331 [2].

 Longer delays for RRM measurement requirements, and in case of FR2 also SSB based RLM/BFD/CBD/L1-RSRP measurement requirements, can be expected during the cell detection time for unknown SCell activation.

 When *absoluteFrequencySSB* is not configured in *DownlinkConfigCommon* for target SCell but SMTC for target SCell is configured, no requirement would be applied.

 TCSI\_reporting is the delay (in ms) including uncertainty in acquiring the first available downlink CSI reference resource, UE processing time for CSI reporting and uncertainty in acquiring the first available CSI reporting resources as specified in TS 38.331 [2].

SCell in FR1 is known if it has been meeting the following conditions:

- During the period equal to max(5\*measCycleSCell,  5\*DRX cycles) for FR1 before the reception of the SCell activation command:

- the UE has sent a valid measurement report for the SCell being activated and

- the SSB measured remains detectable according to the cell identification conditions specified in clause 9.2 and 9.3.

- the SSB measured during the period equal to max(5\*measCycleSCell, 5\*DRX cycles) also remains detectable during the SCell activation delay according to the cell identification conditions specified in clause 9.2 and 9.3.

Otherwise SCell in FR1 is unknown.

For the first SCell activation in FR2 bands, the SCell is known if it has been meeting the following conditions:

- During the period equal to 4s for UE supporting power class 1/5 and 3s for UE supporting power class 2/3/4 before UE receives the last activation command for PDCCH TCI, PDSCH TCI (when applicable) and semi-persistent CSI-RS for CQI reporting (when applicable):

- the UE has sent a valid L3-RSRP measurement report with SSB index, and

- SCell activation command is received after L3-RSRP reporting and no later than the time when UE receives MAC-CE command for TCI activation

- During the period from L3-RSRP reporting to the valid CQI reporting, the reported SSBs with indexes remain detectable according to the cell identification conditions specified in clauses 9.2 and 9.3, and the TCI state is selected based on one of the latest reported SSB indexes.

Otherwise, the first SCell in FR2 band is unknown. The requirement for unknown SCell applies provided that the activation commands for PDCCH TCI, PDSCH TCI (when applicable), semi-persistent CSI-RS for CQI reporting (when applicable), and configuration message for TCI of periodic CSI-RS for CQI reporting (when applicable) are based on the latest valid L1-RSRP reporting.

If the UE has been provided with higher layer in TS 38.331 [2] signaling of *smtc2*prior to the activation command, TSMTC\_Scell follows *smtc1* or *smtc2* according to the physical cell ID of the target cell being activated. TSMTC\_MAX follows *smtc1* or *smtc2* according to the physical cell IDs of the target cells being activated and the active serving cells.

In addition to CSI reporting defined above, UE shall also apply other actions related to the activation command specified in TS 38.331 [2] for a SCell at the first opportunities for the corresponding actions once the SCell is activated.

The starting point of an interruption window on spCell or any activated SCell, as specified in clause 8.2, shall not occur before slot n+1+$\frac{T\_{HARQ}}{NR slot length}$ and not occur after slot slot n+1+$\frac{T\_{HARQ}+3ms+T\_{X}}{NR slot length}$, where NR slot length is with respect to the numerology used in the SCell being activated, and TX is:

- 0, if Tactivation\_time is 3ms;

- TFirstSSB, for any scenario where Tactivation\_time includes TFirstSSB;

- TFirstSSB\_MAX, for any scenario where Tactivation\_time includes TFirstSSB\_MAX;

- Tuncertainty\_MAC +TFineTiming, for any scenario where Tactivation\_time includes only TFineTiming and no TFirstSSB\_MAX.

The length of the interruption window may be different for different victim cells, and depends on the applicable scenario and on the frequency band relation between the aggressor cell and the victim cell.

The requirements in this clause and requriements on interruption due to SCell activation in clause 8.2 apply provided that the SSB of the to-be-activated SCell is within the first active DL BWP of the Scell.

Starting from the slot specified in clause 4.3 of TS 38.213 [3] (timing for secondary Cell activation/deactivation) and until the UE has completed the SCell activation, the UE shall report out of range if the UE has available uplink resources to report CQI for the SCell.

Starting from the slot specified in clause 4.3 of TS 38.213 [3] (timing for secondary Cell activation/deactivation) and until the UE has completed a first L1-RSRP measurement, the UE shall report lowest valid L1 SS-RSRP range if the UE has available uplink resources to report L1-RSRP for the SCell.

==========================End of change 3 =============================

==========================Start of change 4 =============================

## 8.5 Link Recovery Procedures

### 8.5.5 Requirements for SSB based candidate beam detection

#### 8.5.5.2 Minimum requirement

UE shall be able to evaluate whether the downlink radio link quality on the configured SSB resource in set  estimated over the last TEvaluate\_BFD\_SSB ms period becomes worse than the threshold Qout\_LR\_SSB within TEvaluate\_BFD\_SSB ms period.

The value of TEvaluate\_BFD\_SSB is defined in Table 8.5.2.2-1 or Table 8.5.2.2-4 (deactivated PSCell) for FR1.

The value of TEvaluate\_BFD\_SSB is defined in Table 8.5.2.2-2 or Table 8.5.2.2-5 (deactivated PSCell) for FR2 with scaling factor N=8 for FR2-1 and N=12 for FR2-2, for FR2 power classes other than power class 6 or for FR2 power class 6 when *highSpeedMeasFlagFR2-r17* is not configured.

The value of TEvaluate\_BFD\_SSB is defined in Table 8.5.2.2-3 for FR2 power class 6 UE configured with *highSpeedMeasFlagFR2-r17*.

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

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

- Ntotal / Noutside\_MG in FR1

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

- Ntotal / Navailable in FR2 with Navailable > 0

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

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

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

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

- TL1 is periodicity of the target BFD-RS.

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

For FR1,

- $P=\frac{1}{1-\frac{T\_{SSB}}{xRP}}$, when in the monitored cell there are GAPs configured for intra-frequency, inter-frequency or inter-RAT measurements, which are overlapping with some but not all occasions of the SSB.

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

For FR2

- $P=\frac{1}{1-\frac{T\_{SSB}}{T\_{SMTCperiod}}}$, when BFD-RS resource is not overlapped with GAPs and the BFD-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod).

- P = Psharing factor, when the BFD-RS resource is not overlapped with GAP and the BFD-RS resource is fully overlapped with SMTC occasion (TSSB = TSMTCperiod).

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

- TSMTCperiod ≠ xRP or

- TSMTCperiod = xRP and TSSB < 0.5\*TSMTCperiod

- $P=\frac{P\_{sharing factor}}{1-\frac{T\_{SSB}}{xRP}}$, when the BFD-RS resource is partially overlapped with GAP and the BFD-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with GAP and TSMTCperiod = xRP and TSSB = 0.5\*TSMTCperiod

- $P=\frac{1}{1-\frac{T\_{SSB}}{Min(xRP, T\_{SMTCperiod})}}$, when the BFD-RS resource is partially overlapped with GAP (TSSB <xRP) and the BFD-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is partially or fully overlapped with GAP.

- $P=\frac{P\_{sharing factor}}{1-\frac{T\_{SSB}}{xRP}}$, when the BFD-RS resource is partially overlapped with GAP and the BFD-RS resource is fully overlapped with SMTC occasion (TSSB = TSMTCperiod) and SMTC occasion is partially overlapped with GAP (TSMTCperiod < xRP)

where,

- Psharing factor = 1, if the BFD-RS resource outside gap is

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

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

- Psharing factor = 3, otherwise.

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

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

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

- xRP = MGRP

- Otherwise, when NCSG measurement gap is configured,

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

- it overlaps the VIL1 or VIL2 of NCSG, or

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

- and

- xRP = VIRP

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

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

Longer evaluation period would be expected if the combination of BFD-RS resource, SMTC occasion and GAP configurations does not meet pervious conditionsFor either an FR1 or FR2 serving cell, longer evaluation period would be expected during the period Tidentify\_CGI when the UE is requested to decode an NR CGI.

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

**Table 8.5.2.2-1: Evaluation period TEvaluate\_BFD\_SSB for FR1**

|  |  |
| --- | --- |
| **Configuration** | **TEvaluate\_BFD\_SSB (ms)**  |
| no DRX | Max(50, Ceil(5 × P) × TSSB) |
| DRX cycle ≤ 320ms | Max(50, Ceil(7.5 × P) × Max(TDRX,TSSB)) |
| DRX cycle > 320ms | Ceil(5 × P) × TDRX |
| Note: TSSB is the periodicity of SSB in the set . TDRX is the DRX cycle length. |

**Table 8.5.2.2-2: Evaluation period TEvaluate\_BFD\_SSB for FR2**

|  |  |
| --- | --- |
| **Configuration** | **TEvaluate\_BFD\_SSB (ms)**  |
| no DRX | Max(50, Ceil(5 × P × N) × TSSB) |
| DRX cycle ≤ 320ms | Max(50, Ceil(7.5 × P × N) × Max(TDRX,TSSB)) |
| DRX cycle > 320ms | Ceil(5 × P × N) × TDRX |
| Note: TSSB is the periodicity of SSB in the set . TDRX is the DRX cycle length. |

**Table 8.5.2.2-3: Evaluation period TEvaluate\_BFD\_SSB for FR2 power class 6 UE configured with *highSpeedMeasFlagFR2-r17***

|  |  |
| --- | --- |
| **Configuration** | **TEvaluate\_BFD\_SSB (ms)**  |
| no DRX | Max(50, Ceil(5 × P × N Note2) × TSSB) |
| DRX cycle ≤ 80ms | Max(50, Ceil(7.5 × P × N Note2) × Max(TDRX,TSSB)) |
| Note 1: TSSB is the periodicity of SSB in the set . TDRX is the DRX cycle length.Note 2: scaling factor N=2 when *highSpeedMeasFlagFR2-r17* is configured to set1 or scaling factor N=6 when *highSpeedMeasFlagFR2-r17* is configured to set2, if UE is not supporting [*simultaneousReceptionFR2HST-r18*] or when *highSpeedDeploymentTypeFR2-r17* is not configured as bidirectional; Scaling factor N=1.5 when *highSpeedMeasFlagFR2-r17* is configured to set1 or scaling factor N=4 when *highSpeedMeasFlagFR2-r17* is configured to set2, if UE is supporting [*simultaneousReceptionFR2HST-r18*] and when *highSpeedDeploymentTypeFR2-r17* is configured as bidirectional. |

**Table 8.5.2.2-4: Evaluation period TEvaluate\_BFD\_SSB for deactivated PSCell in FR1**

|  |  |
| --- | --- |
| **Configuration** | **TEvaluate\_BFD\_SSB (ms)**  |
| no DRX | Ceil(5 × P) × measCyclePscell |
| DRX cycle ≤ 320ms | Ceil(7.5 × P) × Max(measCyclePscell, TDRX) |
| DRX cycle > 320ms | Ceil(5 × P) × Max(measCyclePscell, TDRX) |
| Note: DRX cycle is the configured DRX cycle of the PSCell. measCyclePSCell is the measurement cycle length of the deactivated PSCell.  |

**Table 8.5.2.2-5: Evaluation period TEvaluate\_BFD\_SSB for deactivated PSCell in FR2**

|  |  |
| --- | --- |
| **Configuration** | **TEvaluate\_BFD\_SSB (ms)**  |
| no DRX | Ceil(5 × P × N) × measCyclePscell |
| DRX cycle ≤ 320ms | Ceil(7.5 × P × N) × Max(measCyclePscell, TDRX) |
| DRX cycle > 320ms | Ceil(5 × P × N) × Max(measCyclePscell, TDRX) |
| Note: DRX cycle is the configured DRX cycle of the PSCell. measCyclePSCell is the measurement cycle length of the deactivated PSCell.  |

==========================End of change 4 =============================

==========================Start of change 5 =============================

## 9.5 L1-RSRP measurements for Reporting

### 9.5.4 L1-RSRP measurement requirements

#### 9.5.4.1 SSB based L1-RSRP Reporting

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

The value of TL1-RSRP\_Measurement\_Period\_SSB is defined in Table 9.5.4.1-1 for FR1. The value of TL1-RSRP\_Measurement\_Period\_SSB is defined in Table 9.5.4.1-2 for FR2 when *highSpeedMeasFlagFR2-r17* is not configured, and defined in Table 9.5.4.1-3 for FR2 power class 6 UE when *highSpeedMeasFlagFR2-r17* is configured, where

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

- N= 8 in Table 9.5.4.1-2.

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=$\frac{1}{1-\frac{T\_{SSB}}{xRP}}$, when in the monitored cell there are GAPs configured for intra-frequency, inter-frequency or inter-RAT measurements, which are overlapping with some but not all occasions of the SSB; and

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

For FR2,

 P1=$ \frac{1}{1-\frac{T\_{SSB}}{T\_{SMTCperiod}}}$, 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=$\frac{1}{1-\frac{T\_{SSB}}{xRP}-\frac{T\_{SSB}}{T\_{SMTCperiod}}}$, 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 $\frac{P\_{sharing factor}}{1-\frac{T\_{SSB}}{xRP}}$, 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=$ \frac{1}{1-\frac{T\_{SSB}}{min(T\_{SMTCperiod},xRP)}}$, 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 $ P\_{L1\\_sharing}\*\frac{P\_{sharing factor}}{1-\frac{T\_{SSB}}{xRP}}$, 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 = $\frac{P\_{1}}{1-\frac{P\_{1}\*T\_{SSB}}{P\_{2}\*T\_{SSB\\_CDP}}}$ , 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.

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* = set1 or scaling factor N1 = 6 when *highSpeedMeasFlagFR2-r17* = [set2], if UE does not support [*simultaneousReceptionFR2HST-r18*] or when *highSpeedDeploymentTypeFR2-r17* is not configured as bidirectional. Scaling factor N1 = 1.5 when *highSpeedMeasFlagFR2-r17* is configured to set1 or scaling factor N1 = 4 when *highSpeedMeasFlagFR2-r17* is configured to set2, if UE supports [*simultaneousReceptionFR2HST-r18*] and when *highSpeedDeploymentTypeFR2-r17* is configured as bidirectional.Note 3: M2 = 1.5 if SMTC periodicity > 40 ms; otherwise M2 = 1 |

==========================End of change 5 =============================