**3GPP TSG-RAN4 Meeting # 116bis *R4-2514044***

**Prague, Czech Republic, Oct 13th – 17th, 2025**

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| *CR-Form-v12.3* |
| **CHANGE REQUEST** |
|  |
|  | **38.133** | **CR** | **draftCR** | **rev** | **1** | **Current version:** | **19.2.0** |  |
|  |
| *For* ***[HE](http://www.3gpp.org/3G_Specs/CRs.htm%22%20%5Cl%20%22_blank)******[LP](http://www.3gpp.org/3G_Specs/CRs.htm%22%20%5Cl%20%22_blank)*** *on using this form: comprehensive instructions can be found at <http://www.3gpp.org/Change-Requests>.* |
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| ***Proposed change affects:*** | UICC apps |  | ME | **x** | Radio Access Network |  | Core Network |  |

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|  |
| ***Title:***  | Draft CR on R19 LB CA via switching |
|  |  |
| ***Source to WG:*** | ZTE Corporation, Sanechips |
| ***Source to TSG:*** | R4 |
|  |  |
| ***Work item code:*** | NR\_LBCA\_Sw-Core |  | ***Date:*** | 2025-10-01 |
|  |  |  |  |  |
| ***Category:*** | F |  | ***Release:*** | Rel-19 |
|  | *Use one of the following categories:****F*** *(correction)****A*** *(mirror corresponding to a change in an earlier release)****B*** *(addition of feature),* ***C*** *(functional modification of feature)****D*** *(editorial modification)*Detailed explanations of the above categories canbe found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | *Use one of the following releases:Rel-8 (Release 8)Rel-9 (Release 9)Rel-10 (Release 10)Rel-11 (Release 11)…Rel-17 (Release 17)Rel-18 (Release 18)Rel-19 (Release 19) Rel-20 (Release 20)* |
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| ***Reason for change:*** | Change 1:In the RLM/BFD measurement, the available RS occasions for PCell measurement should be the RS occasions neither overlapped with SDL ON duration nor overlapped with the switching gap. In other word, the available RS occasions for PCell measurement contains the RS occasions overlapped with FDD PCell ON duration. The case of “not overlapped with the switching gap” is missing. So we revised as the second solution. Similar revision for the available RS occasions for SCell measurement.Change 2: The IE should be unified as LowBandCA-via-Switching-r19. |
|  |  |
| ***Summary of change:*** | Change 1: The available RS occasions for PCell measurement should be the RS occasions neither overlapped with SDL ON duration nor overlapped with the switching gap. In other word, the available RS occasions for PCell measurement contains the RS occasions overlapped with FDD PCell ON duration. The case of “not overlapped with the switching gap” is missing. So we revised as the second solution. Similar revision for the available RS occasions for SCell measurement.Change 2: The IE should be unified as LowBandCA-via-Switching-r19. |
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| ***Consequences if not approved:*** | The requirements LB CA are not accurate |
|  |  |
| ***Clauses affected:*** | 8.1.2.2, 8.1.3.2, 8.5.2.2, 8.5.3.2, 8.5.5.2, 8.5.6.2 |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **X** |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** | **X** |  |  Test specifications | TS 38.533 |
| ***(show related CRs)*** |  | **X** |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

# <Start of Change #1>

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 period becomes worse than the threshold Qout\_SSB within TEvaluate\_out\_SSB 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 period becomes better than the threshold Qin\_SSB within TEvaluate\_in\_SSB 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, where

- N=2, 4, or 6 for FR2-1 for UE supporting *fastBeamSweepingMultiRx-r18* according to the conditions in clause 3.6.19, and

- N=8 for other cases in 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 LowBandCA-via-Switching-r19, or for a UE supporting *concurrentMeasGapsPreMG-r18* and when concurrent measurement gap(s) with Pre-MG(s) are configured, or a UE supporting *concurrentMeasGapsNCSG-r18* and when concurrent measurement gap(s) with NCSG(s) are configured, or a UE supporting *concurrentMeasGap-r17* or *musim-GapPreference-r17* or both *concurrentMeasGap-r17* and *musim-GapPreference-r17*, and when concurrent measurement gaps or periodic MUSIM gaps or both concurrent GAPs and periodic MUSIM gaps are configured,

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

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

- Ntotal / Noutside\_MG in FR1

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

- Ntotal / Navailable in FR2 with Navailable > 0

- For a window W of duration max(TL1, xRP\_max, switching pattern periodicity), where xRP\_max is the maximum xRP across all configured per-UE measurement gaps or periodic MUSIM gap(s) or NCSGs and per-FR measurement gaps or NCSGs, and, in case of Pre-MG, all activated per-UE measurement gaps and per-FR measurement gaps, within the same FR as serving cell, and starting at the beginning of any RLM-RS resource occasion:

- Ntotal is the total number of RLM-RS resource occasions within the window W, including those overlapped with GAP occasions, MUSIM gap occasions or SMTC occasions within the window W. For UEs supporting LowBandCA-via-Switching-r19, Ntotal also includes RLM-RS occasions that overlap with the SDL ON duration within the window, as defined by the configured switching pattern, and

- Noutside\_MG is the number of RLM-RS resource occasions that are not overlapped with any non-dropped GAP occasion nor non-dropped MUSIM gap occasion, or number of RLM-RS resource occasions that are overlapped with PCell ON duration corresponding to the LB CA switching pattern within the window W, and

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

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

- TL1 is periodicity of the target RLM-RS.

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

- for UEs that support LB CA via switching, switching pattern periodicity is the periodicity of the RRC configured semi-static switching pattern; otherwise, it is not applicable.

- RLM requirement in this clause is not applied when Noutside\_MG = 0.

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

For FR1,

- $P=\frac{1}{1−\frac{T\_{SSB}}{xRP}}$, 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 higher layer in TS 38.331 [2] signalling of *smtc2*is present, TSMTCperiod follows *smtc2*; Otherwise TSMTCperiod follows *smtc1.* TSMTCperiod is the shortest SMTC period among all CCs in the same FR2 band, provided the SMTC offset of all CCs in FR2 have the same offset.

- When a GAP is configured only and the GAP is not NCSG,

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

- xRP = MGRP

- Otherwise, when NCSG is configured,

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

- it overlaps the VIL1 or VIL2 of NCSG, or

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

- and

- xRP = VIRP

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

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

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

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

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

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

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

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

**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≤320 ms | Max(200, Ceil(15 × P) × Max(TDRX,TSSB)) | Max(100, Ceil(7.5 × P) × Max(TDRX,TSSB)) |
| DRX cycle>320 ms | 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≤320 ms | Max(200, Ceil(15 × P × N) × Max(TDRX,TSSB)) | Max(100, Ceil(7.5 × P × N) × Max(TDRX,TSSB)) |
| DRX cycle>320 ms | 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≤80 ms | 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 *simultaneousReceptionTwoQCL-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 *simultaneousReceptionTwoQCL-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≤ 320 ms | Ceil(15 × P) × Max(TDRX, measCyclePSCell) | Ceil(7.5 × P) × Max(TDRX, measCyclePSCell) |
| DRX cycle> 320 ms | 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 #1>

# <Start of Change #2>

8.1.3.2 Minimum requirement

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

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

- TEvaluate\_out\_CSI-RS and TEvaluate\_in\_CSI-RS are defined in table 8.1.3.2-1 for FR1.

- TEvaluate\_out\_CSI-RS and TEvaluate\_in\_CSI-RS are defined in table 8.1.3.2-2 for FR2 with scaling factor N=1.

- TEvaluate\_out\_CSI-RS and TEvaluate\_in\_CSI-RS are defined in table 8.1.3.2-3 for FR1 (deactivated PSCell).

- TEvaluate\_out\_CSI-RS and TEvaluate\_in\_CSI-RS are defined in table 8.1.3.2-4 for FR2 (deactivated PSCell) with scaling factor N=1.

The requirements of TEvaluate\_out\_CSI-RS and TEvaluate\_in\_CSI-RS apply provided that the CSI-RS for RLM is not in a resource set configured with repetition ON. The requirements do not apply when the CSI-RS resource in the active TCI state of CORESET is the same CSI-RS resource for RLM and the TCI state information of the CSI-RS resource is not given, wherein the TCI state information means QCL Type-D to SSB for L1-RSRP or CSI-RS with repetition ON.

For a UE supporting LowBandCA-via-Switching-r19, or for a UE supporting *concurrentMeasGapsPreMG-r18* and when concurrent measurement gap(s) with Pre-MG(s) are configured, or a UE supporting *concurrentMeasGapsNCSG-r18* and when concurrent measurement gap(s) with NCSG(s) are configured, or a UE supporting *concurrentMeasGap-r17* or *musim-GapPreference-r17* or both *concurrentMeasGap-r17* and *musim-GapPreference-r17,* and when concurrent measurement gaps or periodic MUSIM gaps or both concurrent GAPs and periodic MUSIM gaps are are configured,

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

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

- Ntotal / Noutside\_MG in FR1

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

- Ntotal / Navailable in FR2 with Navailable > 0

- For a window W of duration max(TL1, xRP\_max, switching pattern periodicity), where xRP\_max is the maximum xRP across all configured per-UE measurement gaps or periodic MUSIM gap(s) or NCSGs and per-FR measurement gaps or NCSGs, and, in case of Pre-MG, all activated per-UE measurement gaps and per-FR measurement gaps, within the same FR as serving cell, and starting at the beginning of any RLM-RS resource occasion:

- Ntotal is the total number of RLM-RS resource occasions within the window W, including those overlapped with GAP occasions, MUSIM gap occasions or SMTC occasions within the window W. For UEs supporting LowBandCA-via-Switching-r19, Ntotal also includes RLM-RS occasions that overlap with the SDL ON duration within the window, as defined by the configured switching pattern, and

- Noutside\_MG is the number of RLM-RS resource occasions that are not overlapped with any non-dropped GAP occasion nor non-dropped MUSIM gap occasion, or number of RLM-RS resource occasions that are overlapped with PCell ON duration corresponding to the LB CA switching pattern within the window W, and

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

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

- TL1 is periodicity of the target RLM-RS.

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

- for UEs that support LB CA via switching, switching pattern periodicity is the periodicity of the RRC configured semi-static switching pattern; otherwise, it is not applicable.

- RLM requirement in this clause is not applied when Noutside\_MG = 0.

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

For FR1,

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

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

For FR2,

- P=1, when the RLM-RS resource is not overlapped with measurement gap and also not overlapped with SMTC occasion.

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

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

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

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

- TSMTCperiod ≠ xRP or

- TSMTCperiod = xRP and TCSI-RS < 0.5 × TSMTCperiod

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

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

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

where,

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

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

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

- Psharing factor = 3, otherwise.

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

- When a GAP is configured only and the GAP is not NCSG,

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

- xRP = MGRP

- Otherwise, when NCSG is configured,

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

- it overlaps the VIL1 or VIL2 of NCSG, or

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

- and

- xRP = VIRP

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

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

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

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

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

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

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

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

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

The values of Mout and Min used in table 8.1.3.2-1, table 8.1.3.2-2, table 8.1.3.2-3 and table 8.1.3.2-4 are defined as:

- Mout = 20 and Min = 10, if the CSI-RS resource configured for RLM is transmitted with higher layer CSI-RS parameter *density* [6, clause 7.4.1] set to 3 and over the bandwidth ≥ 24 PRBs.

**Table 8.1.3.2-1: Evaluation period TEvaluate\_out\_CSI-RS and TEvaluate\_in\_CSI-RS for FR1**

|  |  |  |
| --- | --- | --- |
| **Configuration** | **TEvaluate\_out\_CSI-RS (ms)**  | **TEvaluate\_in\_CSI-RS (ms)**  |
| no DRX | Max(200, Ceil(Mout×P)×TCSI-RS) | Max(100, Ceil(Min×P) × TCSI-RS) |
| DRX ≤ 320 ms | Max(200, Ceil(1.5×Mout×P)× Max(TDRX, TCSI-RS)) | Max(100, Ceil(1.5×Min×P)× Max(TDRX, TCSI-RS)) |
| DRX > 320 ms | Ceil(Mout×P) × TDRX | Ceil(Min×P) × TDRX |
| NOTE: TCSI-RS is the periodicity of the CSI-RS resource configured for RLM. The requirements in this table apply for TCSI-RS equal to 5 ms, 10 ms, 20 ms or 40 ms. TDRX is the DRX cycle length. |

**Table 8.1.3.2-2: Evaluation period TEvaluate\_out\_CSI-RS and TEvaluate\_in\_CSI-RS for FR2**

|  |  |  |
| --- | --- | --- |
| **Configuration** | **TEvaluate\_out\_CSI-RS (ms)**  | **TEvaluate\_in\_CSI-RS (ms)**  |
| no DRX | Max(200, Ceil(Mout×P×N)×TCSI-RS) | Max(100, Ceil(Min×P×N) × TCSI-RS) |
| DRX ≤ 320 ms | Max(200, Ceil(1.5×Mout×P×N)× Max(TDRX, TCSI-RS)) | Max(100, Ceil(1.5×Min×P×N)× Max(TDRX, TCSI-RS)) |
| DRX > 320 ms | Ceil(Mout×P×N) × TDRX | Ceil(Min×P×N) × TDRX |
| NOTE: TCSI-RS is the periodicity of the CSI-RS resource configured for RLM. The requirements in this table apply for TCSI-RS equal to 5 ms, 10 ms, 20 ms or 40 ms. TDRX is the DRX cycle length. |

**Table 8.1.3.2-3: Evaluation period TEvaluate\_out\_CSI-RS and TEvaluate\_in\_CSI-RS for FR1 (deactivated PSCell)**

|  |  |  |
| --- | --- | --- |
| **Configuration** | **TEvaluate\_out\_CSI-RS (ms)**  | **TEvaluate\_in\_CSI-RS (ms)**  |
| no DRX | Ceil(Mout×P) × measCyclePSCell | Ceil(Min×P) × measCyclePSCell |
| DRX ≤ 320 ms | Ceil(1.5 ×Mout×P) × Max(TDRX, measCyclePSCell) | Ceil(1.5 ×Min×P) × Max(TDRX, measCyclePSCell) |
| DRX > 320 ms | Ceil(Mout×P) × Max(TDRX, measCyclePSCell) | Ceil(Min×P) × Max(TDRX, measCyclePSCell) |
| NOTE: TDRX is the DRX cycle length of SCG. measCyclePSCell is the measurement cycle length of the deactivated PSCell. |

**Table 8.1.3.2-4: Evaluation period TEvaluate\_out\_CSI-RS and TEvaluate\_in\_CSI-RS for FR2 (deactivated PSCell)**

|  |  |  |
| --- | --- | --- |
| **Configuration** | **TEvaluate\_out\_CSI-RS (ms)**  | **TEvaluate\_in\_CSI-RS (ms)**  |
| no DRX | Ceil(Mout×P×N) × measCyclePSCell | Ceil(Min×P×N) × measCyclePSCell |
| DRX ≤ 320 ms | Ceil(1.5 × Mout×P×N) × Max(TDRX, measCyclePSCell) | Ceil(1.5 × Min×P×N) × Max(TDRX, measCyclePSCell) |
| DRX > 320 ms | Ceil(Mout×P×N) × Max(TDRX, measCyclePSCell) | Ceil(Min×P×N) × Max(TDRX, measCyclePSCell) |
| NOTE: TDRX is the DRX cycle length of SCG. measCyclePSCell is the measurement cycle length of the deactivated PSCell. |

# <End of Change #2>

# <Start of Change #3>

#### 8.5.2.2 Minimum requirement

UE shall be able to evaluate whether the downlink radio link quality on the configured SSB resource in set $\bar{q}\_{0}$ estimated over the last TEvaluate\_BFD\_SSB period becomes worse than the threshold Qout\_LR\_SSB within TEvaluate\_BFD\_SSB 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, where

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

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

- N=12 for FR2-2,

for 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 8.5.2.2-5 (deactivated PSCell) for FR2 with scaling factor N=8 for FR2-1 and N=12 for FR2-2, for FR2 power classes other than power class 6 or for FR2 class 6 when *highSpeedMeasFlagFR2-r17* is not configured.

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

For a UE supporting LowBandCA-via-Switching-r19, or for a UE supporting [*support for Case 1 requirements*] and when concurrent measurement gap(s) with Pre-MG(s) are configured, or a UE supporting [*support for Case 2 requirements*] and when concurrent measurement gap(s) with NCSG(s) are configured, or a UE supporting *concurrentMeasGap-r17* or *[musim-GapPreference-r17]* or both *concurrentMeasGap-r17* and *[musim-GapPreference-r17],* and when concurrent gaps or periodic MUSIM gaps or both concurrent GAPs and periodic MUSIM gaps are configured,

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

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

- Ntotal / Noutside\_MG in FR1

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

- Ntotal / Navailable in FR2 with Navailable> 0

- For a window W of duration max(TL1, xRP\_max, switching pattern periodicity), where xRP\_max is the maximum xRP across all configured per-UE measurement gaps or periodic MUSIM gap(s) or NCSGs and per-FR measurement gaps or NCSGs, and, in case of Pre-MG, all activated per-UE measurement gaps and per-FR measurement gaps, within the same FR as serving cell, and starting at the beginning of any BFD-RS resource occasion:

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

For UEs supporting LB CA via switching and configured with low band CA via switching:

- for the BFD monitoring on PCell, Ntotal also includes SSB resource occasions that overlap with the SDL ON duration within the window,

- for the BFD monitoring on SCell, Ntotal also includes SSB resource occasions that overlap with the PCell ON duration within the window, as defined by the configured switching pattern, and

- Noutside\_MG is the number of BFD-RS resource occasions within the window W,

- that are not overlapped with any non-dropped GAP occasion nor non-dropped MUSIM gap occasion, and

- that are overlapped with PCell ON duration corresponding to the LB CA switching pattern, for the BFD on PCell for a UE supporting *LowBandSwitching-r19* and configured with low band CA via switching,

- that are overlapped with SCell ON duration corresponding to the LB CA switching pattern, for the BFD on SCell for a UE supporting *LowBandSwitching-r19* and configured with low band CA via switching, and

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

- an SSB resource occasion for beam failure detection is considered to be overlapped with the MUSIM gap if it overlaps a MUSIM gap occasion, and- TL1 is periodicity of the target BFD-RS.

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

- for UE not supporting LB CA via switching, switching pattern periodicity is not applicable.

- BFD requirement in this clause is not applied when Noutside\_MG = 0.

Otherwise, for a UE neither supporting *concurrentMeasGap-r17* nor *[support for Case 1 requirements]* nor *[support for Case 2 requirements]* nor supporting *[musim-GapPreference-r17]* or when neither of the above configurations applies, i.e. concurrent measurement gaps, concurrent measurement gap(s) with Pre-MG(s) and concurrent measurement gap(s) with NCSG(s), and periodic MUSIM gaps,

For FR1,

- $P=\frac{1}{1−\frac{T\_{SSB}}{xRP}}$, 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 higher layer in TS 38.331 [2] signalling of *smtc2* is configured, TSMTCperiod corresponds to the value of higher layer parameter *smtc2*; Otherwise TSMTCperiod corresponds to the value of higher layer parameter *smtc1*. TSMTCperiod is the shortest SMTC period among all CCs in the same FR2 band, given the SMTC offset of all CCs in FR2 provided the same offset.

- When a GAP is configured only and the GAP is not NCSG,

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

- xRP = MGRP

- Otherwise, when NCSG only is configured,

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

- it overlaps the VIL1 or VIL2 of NCSG, or

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

- and

- xRP = VIRP

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

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

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

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

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

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

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 ≤ 320 ms | Max(50, Ceil(7.5 × P) × Max(TDRX,TSSB)) |
| DRX cycle > 320 ms | Ceil(5 × P) × TDRX |
| NOTE: TSSB is the periodicity of SSB in the set $\overbar{q}\_{0}$. 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 ≤ 320 ms | Max(50, Ceil(7.5 × P × N) × Max(TDRX,TSSB)) |
| DRX cycle > 320 ms | Ceil(5 × P × N) × TDRX |
| NOTE: TSSB is the periodicity of SSB in the set $\overbar{q}\_{0}$. 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 ≤ 80 ms | Max(50, Ceil(7.5 × P × N Note2) × Max(TDRX,TSSB)) |
| Note 1: TSSB is the periodicity of SSB in the set $\overbar{q}\_{0}$. 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 *simultaneousReceptionTwoQCL-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 *simultaneousReceptionTwoQCL-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 ≤ 320 ms | Ceil(7.5 × P) × Max(measCyclePscell, TDRX) |
| DRX cycle > 320 ms | 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 ≤ 320 ms | Ceil(7.5 × P × N) × Max(measCyclePscell, TDRX) |
| DRX cycle > 320 ms | 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 #3>

# <Start of Change #4>

#### 8.5.3.2 Minimum requirement

UE shall be able to evaluate whether the downlink radio link quality on the CSI-RS resource in set $\bar{q}\_{0}$ estimated over the last TEvaluate\_BFD\_CSI-RS period becomes worse than the threshold Qout\_LR\_CSI-RS within TEvaluate\_BFD\_CSI-RS period.

The value of TEvaluate\_BFD\_CSI-RS is defined in table 8.5.3.2-1 or table 8.5.3.2-3 (deactivated PSCell) for FR1.

The value of TEvaluate\_BFD\_CSI-RS is defined in table 8.5.3.2-2 or table 8.5.3.2-4 (deactivated PSCell) for FR2 with N=1. The requirements of TEvaluate\_BFD\_CSI-RS apply provided that the CSI-RS for BFD is not in a resource set configured with repetition ON. The requirements shall not apply when the CSI-RS resource in the active TCI state of CORESET is the same CSI-RS resource for BFD and the TCI state information of the CSI-RS resource is not given, wherein the TCI state information means QCL Type-D to SSB for L1-RSRP or CSI-RS with repetition ON.

- For a UE supporting LowBandCA-via-Switching-r19, or for a UE supporting *concurrentMeasGapsPreMG-r18* and when concurrent measurement gap(s) with Pre-MG(s) are configured, or a UE supporting *concurrentMeasGapsNCSG-r18* and when concurrent measurement gap(s) with NCSG(s) are configured, or a UE supporting *concurrentMeasGap-r17* or *[musim-GapPreference-r17]* or both *concurrentMeasGap-r17* and *musim-GapPreference-r17,* and when concurrent gaps or periodic MUSIM gaps or both concurrent GAPs and periodic MUSIM gaps are configured,

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

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

- Ntotal / Noutside\_MG in FR1

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

- Ntotal / Navailable in FR2 with Navailable> 0

- For a window W of duration max(TL1, xRP\_max, switching pattern periodicity), where xRP\_max is the maximum xRP across all configured per-UE measurement gaps or MUSIM gap(s) or NCSGs and per-FR measurement gaps or NCSGs, and, in case of Pre-MG, all activated per-UE measurement gaps and per-FR measurement gaps, within the same FR as serving cell, and starting at the beginning of any BFD-RS resource occasion:

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

For UEs supporting LB CA via switching and configured with low band CA via switching:

- for the BFD monitoring on PCell, Ntotal also includes SSB resource occasions that overlap with the SDL ON duration within the window,

- for the BFD monitoring on SCell, Ntotal also includes SSB resource occasions that overlap with the PCell ON duration within the window, as defined by the configured switching pattern, and

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

 - that are overlapped with PCell ON duration corresponding to the LB CA switching pattern, for the BFD on PCell for a UE supporting *LowBandSwitching-r19* and configured with low band CA via switching,

- that are overlapped with SCell ON duration corresponding to the LB CA switching pattern, for the BFD on SCell for a UE supporting *LowBandSwitching-r19* and configured with low band CA via switching, and

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

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

 TL1 is periodicity of the target BFD-RS.

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

- for UE not supporting LB CA via switching, switching pattern periodicity is not applicable.

- BFD requirement in this clause is not applied when Noutside\_MG = 0.

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

For FR1,

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

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

For FR2,

- P = 1, when the BFD-RS resource is not overlapped with GAP and also not overlapped with SMTC occasion.

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

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

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

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

- TSMTCperiod ≠ xRP or

- TSMTCperiod = xRP and TCSI-RS < 0.5 × TSMTCperiod

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

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

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

where,

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

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

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

- Psharing factor = 3, otherwise.

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

- When a GAP is configured only and the GAP is not NCSG,

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

- xRP = MGRP

- Otherwise, when NCSG GAP only is configured,

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

- it overlaps the VIL1 or VIL2 of NCSG, or

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

- and

- xRP = VIRP

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

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

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

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

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

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

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

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

The values of MBFD used in table 8.5.3.2-1 and table 8.5.3.2-2 are defined as

- MBFD = 10, if the CSI-RS resource(s) in set  used for BFD is transmitted with Density = 3 and over the bandwidth ≥ 24 PRBs.

The values of PBFD used in table 8.5.3.2-1 and table 8.5.3.2-2 are defined as

 For each CSI-RS resource in the set  configured for PCell or PSCell in EN-DC or NE-DC or SA; or PCell in NR-DC

- PBFD = 1.

 For each CSI-RS resource in the set  configured for PSCell in NR-DC

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

 For each CSI-RS resource in the set  configured for a SCell

- PBFD = Z in EN-DC or NE-DC or SA.

- PBFD = 2\* Z in NR-DC.

- Where Z is the number of band(s) on which UE is performing beam failure detection only for SCell.

Table 8.5.3.2-1: Evaluation period TEvaluate\_BFD\_CSI-RS for FR1

|  |  |
| --- | --- |
| Configuration | TEvaluate\_BFD\_CSI-RS (ms)  |
| no DRX | Max(50, Ceil(MBFD × P × PBFD) × TCSI-RS) |
| DRX cycle ≤ 320 ms | Max(50, Ceil(1.5 × MBFD × P × PBFD) × Max(TDRX, TCSI-RS)) |
| DRX cycle > 320 ms | Ceil(MBFD × P × PBFD) × TDRX |
| NOTE: TCSI-RS is the periodicity of CSI-RS resource in the set . TDRX is the DRX cycle length. |

Table 8.5.3.2-2: Evaluation period TEvaluate\_BFD\_CSI-RS for FR2

|  |  |
| --- | --- |
| Configuration | TEvaluate\_BFD\_CSI-RS (ms)  |
| no DRX | Max(50, Ceil(MBFD × P × N × PBFD) × TCSI-RS) |
| DRX cycle ≤ 320 ms | Max(50, Ceil(1.5 × MBFD × P × N × PBFD) × Max(TDRX, TCSI-RS)) |
| DRX cycle > 320 ms | Ceil(MBFD × P × N × PBFD) × TDRX |
| NOTE: TCSI-RS is the periodicity of CSI-RS resource in the set . TDRX is the DRX cycle length. |

Table 8.5.3.2-3: Evaluation period TEvaluate\_BFD\_CSI-RS for deactivated PSCell in FR1

|  |  |
| --- | --- |
| **Configuration** | **TEvaluate\_BFD\_CSI-RS (ms)**  |
| no DRX | Ceil(MBFD × P × PBFD) × measCyclePscell |
| DRX cycle ≤ 320 ms | Ceil(1.5 × MBFD × P × PBFD) × Max(TDRX, measCyclePscell) |
| DRX cycle > 320 ms | Ceil(MBFD × P × PBFD) × Max(TDRX, measCyclePscell) |
| NOTE: DRX cycle is the configured DRX cycle of the PSCell. measCyclePSCell is the measurement cycle length of the deactivated PSCell.  |

Table 8.5.3.2-4: Evaluation period TEvaluate\_BFD\_CSI-RS for deactivated PSCell in FR2

|  |  |
| --- | --- |
| **Configuration** | **TEvaluate\_BFD\_CSI-RS (ms)**  |
| no DRX | Ceil(MBFD × P × N × PBFD) × measCyclePscell |
| DRX cycle ≤ 320 ms | Ceil(1.5 × MBFD × P × N × PBFD) × Max(TDRX, measCyclePscell) |
| DRX cycle > 320 ms | Ceil(MBFD × P × N × PBFD) × Max(TDRX, measCyclePscell) |
| NOTE: DRX cycle is the configured DRX cycle of the PSCell. measCyclePSCell is the measurement cycle length of the deactivated PSCell.  |

# <End of Change #4>

# <Start of Change #5>

#### 8.5.5.2 Minimum requirement

Upon request the UE shall be able to evaluate whether the L1-RSRP measured on the configured SSB resource in set $\bar{q}\_{1} $estimated over the last TEvaluate\_CBD\_SSB period becomes better than the threshold Qin\_LR provided SSB\_RP and SSB Ês/Iot are according to Annex table B.2.4.1 for a corresponding band.

The UE shall monitor the configured SSB resources using the evaluation period in table 8.5.5.2-1 and 8.5.5.2-2 corresponding to the non-DRX mode, if the configured DRX cycle ≤ 320 ms.

The value of TEvaluate\_CBD\_SSB is defined in table 8.5.5.2-1 for FR1.

The value of TEvaluate\_CBD\_SSB is defined in table 8.5.5.2-2 for FR2 with scaling factor N, where

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

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

- N=12 for FR2-2.

- For a UE supporting LowBandCA-via-Switching-r19, or for a UE supporting *concurrentMeasGapsPreMG-r18* and when concurrent measurement gap(s) with Pre-MG(s) are configured, or a UE supporting *concurrentMeasGapsNCSG-r18* and when concurrent measurement gap(s) with NCSG(s) are configured, or a UE supporting *concurrentMeasGap-r17* or *musim-GapPreference-r17* or both *concurrentMeasGap-r17* and *musim-GapPreference-r17*, and when concurrent gaps or periodic MUSIM gaps or both concurrent GAPs and periodic MUSIM gaps are configured,

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

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

- Ntotal / Noutside\_MG in FR1

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

- Ntotal / Navailable in FR2 with Navailable> 0

- For a window W of duration max(TL1, xRP\_max, switching pattern periodicity), where xRP\_max is the maximum xRP across all configured per-UE measurement gaps or periodic MUSIM gap(s) or NCSGs and per-FR measurement gaps or NCSGs, and, in case of Pre-MG, all activated per-UE measurement gaps and per-FR measurement gaps, within the same FR as serving cell, and starting at the beginning of any CBD-RS resource occasion:

- Ntotal is the total number of CBD-RS resource occasions within the window W, including those overlapped with GAP occasions, MUSIM gap occasions or SMTC occasions within the window W,

For UEs supporting LB CA via switching and configured with low band CA via switching:

- for the BFD monitoring on PCell, Ntotal also includes SSB resource occasions that overlap with the SDL ON duration within the window,

- for the BFD monitoring on SCell, Ntotal also includes SSB resource occasions that overlap with the PCell ON duration within the window, as defined by the configured switching pattern, and

- Noutside\_MG is the number of CBD-RS resource occasions within the window W,

- that are not overlapped with any non-dropped GAP occasion nor non-dropped MUSIM gap occasion, and

- that are overlapped with PCell ON duration corresponding to the LB CA switching pattern, for the BFD on PCell for a UE supporting *LowBandSwitching-r19* and configured with low band CA via switching.

- that are overlapped with SCell ON duration corresponding to the LB CA switching pattern, for the BFD on SCell for a UE supporting *LowBandSwitching-r19* and configured with low band CA via switching, and

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

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

- TL1 is periodicity of the target CBD-RS.

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

- for UE not supporting LB CA via switching, switching pattern periodicity is not applicable.

- CBD requirement in this clause is not applied when Noutside\_MG = 0.

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

For FR1,

- $P=\frac{1}{1−\frac{T\_{SSB}}{xRP}}$, 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 candidate beam detection RS is not overlapped with GAP and candidate beam detection RS is partially overlapped with SMTC occasion (TSSB < TSMTCperiod).

- P is Psharing factor, when candidate beam detection RS is not overlapped with GAP and candidate beam detection RS is fully overlapped with SMTC occasion (TSSB = TSMTCperiod).

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

- TSMTCperiod ≠ xRP or

- TSMTCperiod = xRP and TSSB < 0.5 × TSMTCperiod

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

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

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

where,

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

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

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

- Psharing factor = 3, otherwise.

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

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

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

- xRP = MGRP

- Otherwise, when NCSG is measurement gap only is configured,

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

- it overlaps the VIL1 or VIL2 of NCSG, or

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

- and

- xRP = VIRP

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

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

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

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

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

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

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

The values of PCBD used in table 8.5.5.2-1 and table 8.5.5.2-2 are defined as

 For each SSB resource in the set $\bar{q}\_{1}$ configured for PCell or PSCell in EN-DC or NE-DC or SA; or PCell in NR-DC

- PCBD = 1.

 For each SSB resource in the set $\bar{q}\_{1}$ configured for PSCell in NR-DC

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

 For each SSB resource in the set $\bar{q}\_{1}$ configured for a SCell

- PCBD = Z in EN-DC or NE-DC or SA.

- PCBD = 2\* Z in NR-DC.

- Where Z is the number of band(s) on which UE is performing candidate beam detection only for SCell

- PCBD is the number of band(s) on which UE is performing candidate beam detection only for SCell.

Table 8.5.5.2-1: Evaluation period TEvaluate\_CBD\_SSB for FR1

|  |  |
| --- | --- |
| **Configuration** | **TEvaluate\_CBD\_SSB (ms)**  |
| non-DRX, DRX cycle ≤ 320 ms | Max(25, Ceil(3 × P × PCBD) × TSSB) |
| DRX cycle > 320 ms | Ceil(3 × P × PCBD) × TDRX |
| NOTE: Note: TSSB is the periodicity of SSB in the set $\bar{q}\_{1}$. TDRX is the DRX cycle length. |

Table 8.5.5.2-2: Evaluation period TEvaluate\_CBD\_SSB for FR2

|  |  |
| --- | --- |
| **Configuration** | **TEvaluate\_CBD\_SSB (ms)**  |
| non-DRX, DRX cycle ≤ 320 ms | Max(25, Ceil(3 × P × N × PCBD) × TSSB) |
| DRX cycle > 320 ms | Ceil(3 × P × N × PCBD) × TDRX |
| NOTE: TSSB is the periodicity of SSB in the set . TDRX is the DRX cycle length. |

# <End of Change #5>

# <Start of Change #6>

#### 8.5.6.2 Minimum requirement

Upon request the UE shall be able to evaluate whether the L1-RSRP measured on the configured CSI-RS resource in set $\bar{q}\_{1}$ estimated over the last TEvaluate\_CBD\_CSI-RS period becomes better than the threshold Qin\_LR within TEvaluate\_CBD\_CSI-RS period provided CSI-RS Ês/Iot is according to annex B.2.4.2 for a corresponding band.

The UE shall monitor the configured CSI-RS resources using the evaluation period in table 8.5.6.2-1 and 8.5.6.2-2 corresponding to the non-DRX mode, if the configured DRX cycle ≤ 320 ms.

The value of TEvaluate\_CBD\_CSI-RS is defined in table 8.5.6.2-1 for FR1.

The value of TEvaluate\_CBD\_CSI-RS is defined in table 8.5.6.2-2 for FR2 with scaling factor N, where

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

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

- N=12 for FR2-2.

For a UE supporting LowBandCA-via-Switching-r19, or for a UE supporting *concurrentMeasGapsPreMG-r18* and when concurrent measurement gap(s) with Pre-MG(s) are configured, or a UE supporting *concurrentMeasGapsNCSG-r18* and when concurrent measurement gap(s) with NCSG(s) are configured, or a UE supporting *concurrentMeasGap-r17* or *musim-GapPreference-r17* or both *concurrentMeasGap-r17* and *musim-GapPreference-r17* and when concurrent gaps or periodic MUSIM gaps or both concurrent GAPs and periodic MUSIM gaps are configured,

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

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

- Ntotal / Noutside\_MG in FR1

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

- Ntotal / Navailable in FR2 with Navailable> 0

- For a window W of duration max(TL1, xRP\_max, switching pattern periodicity), where xRP\_max is the maximum xRP across all configured per-UE measurement gaps or periodic MUSIM gap(s) or NCSGs and per-FR measurement gaps or NCSGs, and, in case of Pre-MG, all activated per-UE measurement gaps and per-FR measurement gaps, within the same FR as serving cell, and starting at the beginning of any CBD-RS resource occasion:

- Ntotal is the total number of CBD-RS resource occasions within the window W, including those overlapped with GAP occasions, MUSIM gap occasions or SMTC occasions within the window W,

For UEs supporting LB CA via switching and configured with low band CA via switching:

- for the CBD monitoring on PCell, Ntotal also includes SSB resource occasions that overlap with the SDL ON duration within the window,

- for the CBD monitoring on SCell, Ntotal also includes SSB resource occasions that overlap with the PCell ON duration within the window, as defined by the configured switching pattern, and

- Noutside\_MG is the number of CBD-RS resource occasions within the window W,

- that are not overlapped with any non-dropped GAP occasion nor non-dropped MUSIM gap occasion, and

- that are overlapped with PCell ON duration corresponding to the LB CA switching pattern, for the CBD on PCell for a UE supporting *LowBandSwitching-r19* and configured with low band CA via switching, or

- that are overlapped with SCell ON duration corresponding to the LB CA switching pattern, for the CBD on SCell for a UE supporting *LowBandSwitching-r19* and configured with low band CA via switching, and

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

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

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

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

- for UE not supporting LB CA via switching, switching pattern periodicity is not applicable.

- CBD requirement in this clause is not applied when Noutside\_MG = 0.

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

For FR1,

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

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

For FR2,

- P = 1, when candidate beam detection RS is not overlapped with GAP and also not overlapped with SMTC occasion.

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

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

- P =Psharing factor, when candidate beam detection RS is not overlapped with GAP and candidate beam detection RS is fully overlapped with SMTC occasion (TCSI-RS = TSMTCperiod).

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

- TSMTCperiod ≠ xRP or

- TSMTCperiod = xRP and TCSI-RS < 0.5 × TSMTCperiod

- $P=\frac{P\_{sharing factor}}{1−\frac{T\_{CSI−RS}}{xRP}}$, when candidate beam detection RS is partially overlapped with GAP and candidate beam detection RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is not overlapped with GAP and TSMTCperiod = xRP and TCSI-RS = 0.5 × TSMTCperiod

- $P=\frac{1}{1−\frac{T\_{CSI−RS}}{Min(xRP, T\_{SMTCperiod})}}$, when candidate beam detection RS is partially overlapped with GAP and candidate beam detection RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod) and SMTC occasion is partially or fully overlapped with GAP

- $P=\frac{3}{1−\frac{T\_{CSI−RS}}{xRP}}$,, when candidate beam detection RS is partially overlapped with GAP and candidate beam detection RS is fully overlapped with SMTC occasion (TCSI-RS = TSMTCperiod) and SMTC occasion is partially overlapped with GAP (TSMTCperiod < xRP)

where,

- Psharing factor = 1, if the CBD-RS resource outside GAP is

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

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

- Psharing factor = 3, otherwise.

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

- When a GAP is configured only and the GAP is not NCSG,

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

- xRP = MGRP

- Otherwise, when NCSG GAP only is configured,

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

- it overlaps the VIL1 or VIL2 of NCSG, or

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

- and

- xRP = VIRP

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

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

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

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

Longer evaluation period would be expected if the CSI-RS is on the same OFDM symbols with RLM, BFD, BM-RS, or other CBD-RS, according to the measurement restrictions defined in clause 8.5.6.3.

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

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

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

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

The values of MCBD used in table 8.5.6.2-1 and table 8.5.6.2-2 are defined as

- MCBD = 3, if the CSI-RS resource configured in the set $\bar{q}\_{1}$ is transmitted with Density = 3 and over the bandwidth ≥ 24 PRBs.

The values of PCBD used in table 8.5.6.2-1 and table 8.5.6.2-2 are defined as

- For each CSI-RS resource in the set $\bar{q}\_{1}$ configured for PCell or PSCell in EN-DC or NE-DC or SA; or PCell in NR-DC

- PCBD = 1.

- For each CSI-RS resource in the set $\bar{q}\_{1}$ configured for PSCell in NR-DC

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

- For each CSI-RS resource in the set $\bar{q}\_{1}$ configured for a SCell

- PCBD = Z in EN-DC or NE-DC or SA.

- PCBD = 2\* Z in NR-DC.

- Where Z is the number of band(s) on which UE is performing candidate beam detection only for SCell

- PCBD is the number of band(s) on which UE is performing candidate beam detection only for SCell.

Table 8.5.6.2-1: Evaluation period TEvaluate\_CBD\_CSI-RS for FR1

|  |  |
| --- | --- |
| **Configuration** | **TEvaluateC\_CBD\_CSI-RS (ms)**  |
| non-DRX, DRX cycle ≤ 320 ms | Max(25, Ceil(MCBD × P × PCBD) × TCSI-RS) |
| DRX cycle > 320 ms | Ceil(MCBD × P × PCBD) × TDRX |
| NOTE: TCSI-RS is the periodicity of CSI-RS resource in the set . TDRX is the DRX cycle length. |

Table 8.5.6.2-2: Evaluation period TEvaluate\_CBD\_CSI-RS for FR2

|  |  |
| --- | --- |
| **Configuration** | **TEvaluate\_CBD\_CSI-RS (ms)**  |
| non-DRX, DRX cycle ≤ 320 ms | Max(25, Ceil(MCBD × P × N × PCBD) × TCSI-RS) |
| DRX cycle > 320 ms | Ceil(MCBD × P × N × PCBD) × TDRX |
| Note: TCSI-RS is the periodicity of CSI-RS resource in the set $\bar{q}\_{1}$. TDRX is the DRX cycle length. |

# <End of Change #6>