**3GPP TSG-RAN WG4 Meeting #102-e *R4-2207122***

**E-meeting, February 21 – March 03, 2022**

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| *CR-Form-v12.0* |
| **CHANGE REQUEST** |
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|  |  | **CR** | **-** | **rev** | **-** | **Current version:** | **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: RRM requirements for Rel-17 NR extension to 71GHz  |
|  |  |
| ***Source to WG:*** | Intel Corporation, Qualcomm |
| ***Source to TSG:*** |  |
|  |  |
| ***Work item code:*** | NR\_ext\_to\_71GHz-Core |  | ***Date:*** | 09 |
|  |  |  |  |  |
| ***Category:*** | B |  | ***Release:*** | Rel-17 |
|  | *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-12 (Release 12)**Rel-13 (Release 13)Rel-14 (Release 14)Rel-15 (Release 15)Rel-16 (Release 16)* |
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| ***Reason for change:*** | The existing requirements need to be updated to cover FR2-2This document includes the endoresed draft CRs:**Endorsed in RAN4 #102-e**:

|  |  |  |
| --- | --- | --- |
| TDoc Endorsed CR  | CR title | Source companies |
| R4-2204541 | Draft CR - Correction on BWP switch delay for dormant BWP in FR2-2 | Nokia, Nokia Shanghai Bell |
| R4-2204877 | Draft CR on interruption requirements for FR2-2 | Huawei, Hisilicon |
| R4-2206920 | Draft CR on deriveSSB-IndexFromCell tolerance | Qualcomm |
| R4-2206921 | Scheduling restriction due to L3 measurements for FR2-2 | MediaTek Inc. |
| R4-2206922 | Scheduling restriction due to L1 measurements for FR2-2 | MediaTek Inc. |
| R4-2206923 | Draft CR adding timing requirements for FR2-2 | Nokia, Nokia Shanghai Bell |
| R4-2206925 | Introduction of SCell activation with CCA for FR2-2 | MediaTek Inc. |
| R4-2206926 | Introduction of TCI state switch with CCA for FR2-2 | MediaTek Inc. |
| R4-2206927 | DraftCR for FR2-2 LBT support in Intra-Frequency measurements | Nokia, Nokia Shanghai Bell |
| R4-2206928 | Draft CR for FR2-2 LBT support in requirements for PSCell addition and release delay, PSCell change and Conditional PSCell change | vivo |
| R4-2206930 | Draft CR on RLM and link recovery requirements for FR2-2 unlicensed operation | Huawei, HiSilicon |
| R4-2206931 | DraftCR for FR2-2 LBT support in RRC\_IDLE and RRC\_CONNECTED state mobility requirements | Intel |

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| ***Summary of change:*** |

|  |  |  |
| --- | --- | --- |
| Index of change  | Clause impacted | Endorsed CRs |
| #1 | 4.2A.2 | R4-2206931 |
| #2 | 6.1B.1 | R4-2206931 |
| #3 | 6.2.1A.2.1 | R4-2206931 |
| #4 | 6.2.3.2.3 | R4-2206931 |
| #5 | 7.1 | R4-2206923 |
| #6 | 7.7.1 | R4-2206920 |
| #7 | 8.1.7.3 | R4-2206922 |
| #8 | 8.1A | R4-2206930 |
| #9 | 8.2.2.2.8 | R4-2204877 |
| #10 | 8.2.4.2.14 | R4-2204877 |
| #11 | 8.5.7.3 | R4-2206922 |
| #12 | 8.5.8.3 | R4-2206922 |
| #13 | 8.3A | R4-2206925 |
| #14 | 8.5A | R4-2206930 |
| #15 | 8.6.2, 8.6.2A | R4-2204541 |
| #16 | 8.9A | R4-2206928 |
| #17 | 8.10A | R4-2206926 |
| #18 | 8.11A | R4-2206928 |
| #19 | 8.11C | R4-2206928 |
| #20 | 9.2.5.3.3 | R4-2206921 |
| #21 | 9.2A | R4-2206927 |
| #22 | 9.5.6.3 | R4-2206922 |

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| ***Consequences if not approved:*** | Requirements for FR2-2 will not be complete |
|  |  |
| ***Clauses affected:*** | 4.2A.2, 6.1B.1, 6.2.1A.2.1, 6.2.3.2.3, 7.1, 7.7.1, 8.1.7.3, 8.1A, 8.2.2.2.8, 8.2.4.2.14, 8.5.7.3, 8.5.8.3, 8.3A, 8.5A, 8.6.2, 8.6.2A, 8.9A, 8.10A, 8.11A, 8.11C, 9.2.5.3.3, 9.2A, 9.5.6.3 |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **X** |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** |  | **X** |  Test specifications | TS/TR ... CR ...  |
| ***(show related CRs)*** |  | **X** |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** | - |
|  |  |
| ***This CR's revision history:*** |  |

## <Start of Change 1 (R4-2206931)>

#### 4.2A.2.2 Measurement and evaluation when subject to CCA on the serving cell

The UE shall measure the SS-RSRP and SS-RSRQ level of the serving cell and evaluate the cell selection criterion S defined in TS 38.304 [1] for the serving cell at least once every (1+Mn)\*M1\*N1 DRX cycles in Nserv\_CCA consecutive DRX cycles; where:

M1=2 if SMTC periodicity (TSMTC) > 20 ms and DRX cycle ≤ 0.64 second,

otherwise M1=1.

N1\*Mn is the maximum separation in DRX cycles between two measurements that are used for filtering.

The UE shall filter the SS-RSRP and SS-RSRQ measurements of the serving cell using at least 2 measurements. Within the set of measurements used for the filtering, at least two measurements shall be spaced by, at least DRX cycle/2 but not separated in time by more than N1\*Mn, where Mn=2.

If the UE has evaluated according to Table 4.2A.2.2-1 in Nserv\_CCA consecutive DRX cycles that the serving cell does not fulfil the cell selection criterion S, the UE shall initiate the measurements of all neighbour cells indicated by the serving cell, regardless of the measurement rules currently limiting UE measurement activities.

UE shall initiate measurements on neighbour cells indicated by the serving cell if it is unable to measure on the serving cell for at least N1\*Mp consecutive number of DRX cycles each with at least one SMTC occasion not available at the UE, where Mp=4 when DRX cycle length <1.28 s, Mp=2 when DRX cycle length ≥1.28 s.

 UE shall initiate the measurements on neighbour cells of any intra-frequency or inter-frequency if it is unable to measure on serving cell during at least consecutive N1\*Mq number of DRX cycles each with at least one SMTC occasion not available at the UE, regardless of any condition of SnonIntraSearchP and SnonIntraSearchQ, where Mq=8 when DRX cycle length <1.28 s, Mq=4 when DRX cycle length ≥1.28 s.

If the UE in RRC\_IDLE has not found any new suitable cell based on searches and measurements using the intra-frequency, inter-frequency and inter-RAT information indicated in the system information for 10 s, the UE shall initiate cell selection procedures for the selected PLMN as defined in TS 38.304 [1].

Table 4.2A.2.2-1: Nserv\_CCA

|  |  |  |
| --- | --- | --- |
| DRX cycle length [s] | Scaling Factor (N1) | Nserv\_CCA [number of DRX cycles] |
| FR1 | FR2-2 |
| 0.32 | 1 | [8] | N1\*M1\*(4+ Ms) |
| 0.64 | [5] | N1\*M1\*(4+ Ms) |
| 1.28 | [4] | N1\*(2+Ms) |
| 2.56 | [3] |  N1\*(2+Ms) |
| Note 1: Ms is the number of groups of consecutive N1 DRX cycles each group with at least one SMTC occasion not available at the UE during Nserv\_CCA, and Ms< Ms,maxNote2: Ms,max=8 for DRX cycle length < 1.28 s, Ms,max= 4 for DRX cycle length ≥ 1.28 s. |

The UE shall restart the measurements used for serving cell evaluation if Ms exceeds Ms,max.

#### 4.2A.2.3 Measurements of intra-frequency NR cells when subject to CCA on the serving cell and target cell

The UE shall be able to identify new intra-frequency cells with CCA and perform SS-RSRP and SS-RSRQ measurements of the identified intra-frequency cells without an explicit intra-frequency neighbour list containing physical layer cell identities.

The UE shall be able to evaluate whether a newly detectable intra-frequency cell meets the reselection criteria defined in TS38.304 within Tdetect,NR\_Intra\_CCAwhen that Treselection= 0. An intra frequency cell is considered to be detectable according to the conditions defined in Annex B. 2. 8 for a corresponding Band.

The UE shall measure SS-RSRP and SS-RSRQ at least every Tmeasure,NR\_Intra\_CCA (see table 4.2A.2.3-1) for intra-frequency cells that are identified and measured according to the measurement rules. For a cell that is already identified, after 2 unsuccessful measurement attempts due to exceeding the maximum number of SMTC occasions not available at the UE, the UE shall detect cells on any of the configured serving- and/or non-serving carriers.

The UE shall filter SS-RSRP and SS-RSRQ measurements of each measured intra-frequency cell using at least 2 measurements. Within the set of measurements used for the filtering, at least two measurements shall be spaced by at least Tmeasure,NR\_Intra\_CCA/2.

The UE shall not consider a NR neighbour cell in cell reselection, if it is indicated as not allowed in the measurement control system information of the serving cell.

For an intra-frequency cell that has been already detected, but that has not been reselected to, the filtering shall be such that the UE shall be capable of evaluating that the intra-frequency cell has met reselection criterion defined [1] within Tevaluate,NR\_Intra\_CCA when Treselection = 0as specified in table 4.2A.2.3-1 provided that:

when *rangeToBestCell* is not configured:

- the cell is at least 3dB better ranked in FR1 or [4.5]dB better ranked in FR2-2.

when *rangeToBestCell* is configured:

- the cell has the highest number of beams above the threshold *absThreshSS-BlocksConsolidation* among all detected cells whose cell-ranking criterion R value [1] is within *rangeToBestCell* of the cell-ranking criterion R value of the highest ranked cell.

- if there are multiple such cells, the cell has the highest rank among them.

- the cell is at least 3dB better ranked in FR1 or [4.5]dB better ranked in FR2-2 if the current serving cell is among them.

When evaluating cells for reselection, the SSB side conditions apply to both serving and non-serving intra-frequency cells.

If Treselection timer has a non-zero value and the intra-frequency cell is satisfied with the reselection criteria, which are defined in TS38.304 [1], the UE shall evaluate this intra-frequency cell for the Treselection time. If this cell remains satisfied with the reselection criteria within this duration, then the UE shall reselect that cell.

**Table 4.2A.2.3-1: Tdetect,NR\_Intra\_CCA, Tmeasure,NR\_Intra\_CCA and Tevaluate,NR\_Intra\_CCA**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **DRX cycle length [s]** | **Scaling Factor (N1)** | **Tdetect,NR\_Intra\_CCA [s] (number of DRX cycles)** | **Tmeasure,NR\_Intra\_CCA [s] (number of DRX cycles)** | **Tevaluate,NR\_Intra\_CCA****[s] (number of DRX cycles)** |
| **FR1** | **FR2-2** |
| 0.32 | 1 | [8] | 0.32xN1x(36+Md)xM2 {(36+Md)xN1xM2} | 0.32xN1x(4+Mm)xM2{(4+Mm)xN1 xM2 | 0.32xN1x(16+Me) x M2{(16+Me)xN1xM2} |
| 0.64 | [5] | 0.64xN1x(28+Md) {(28+Md)xN1 } | 0.64xN1x(2+Mm) {(2+Mm)xN1 } | 0.64xN1x(8+Me){(8+Me)xN1 } |
| 1.28 | [4] | 1.28xN1x(25+Md){(25+Md)xN1 } | 1.28xN1x(1+Mm){(1+Mm)xN1 } | 1.28xN1x(5+Me) {(5+Me)xN1 } |
| 2.56 | [3] | 2.56xN1x(23+Md){(23+Md)xN1 } | 2.56xN1x(1+Mm){(1+Mm)xN1 } | 2.56xN1x(3+Me) {(3+Me)xN1 } |
| Note 1: M2 = 1.5 if SMTC periodicity of measured intra-frequency cell > 20 ms; otherwise M2=1.Note 2: Md, Mm, Me are the number of groups of consecutive N1 DRX cycles each group with at least one SMTC occasion not available during the Tdetect,NR\_Intra\_CCA, Tmeasure,NR\_Intra\_CCA and Tevaluate,NR\_Intra\_CCA, and Mm ≤ Mm,max, Md ≤ Md,max and Me ≤  Me,max Note 3: Mm,max = 16 for DRX cycle length = 0.32s; Mm,max = 8 for DRX cycle length = 0.64s; Mm,max = 4 for DRX cycle length = 1.28s; Mm,max = 4 for DRX cycle length = 2.56s.Note 4: Md,max = 4\*Mm,max, Me,max = 2\*Mm,max. |

The UE shall restart the measurements upon exceeding Mm,max, Md,max, or Me,max.

#### 4.2A.2.4 Measurements of inter-frequency NR cells when subject to CCA on the target cell

The UE shall be able to identify new inter-frequency cells and perform SS-RSRP or SS-RSRQ measurements of identified inter-frequency cells if carrier frequency information is provided by the serving cell, even if no explicit neighbour list with physical layer cell identities is provided.

If Srxlev > SnonIntraSearchP  and Squal > SnonIntraSearchQ then the UE shall search for inter-frequency layers of higher priority at least every Thigher\_priority\_search where Thigher\_priority\_search is described in clause 4.2A.2.7.

If Srxlev ≤ SnonIntraSearchP or Squal ≤ SnonIntraSearchQ then the UE shall search for and measure inter-frequency layers of higher, equal or lower priority in preparation for possible reselection. In this scenario, the minimum rate at which the UE is required to search for and measure higher priority layers shall be the same as that defined below in this clause.

The UE shall be able to evaluate whether a newly detectable inter-frequency cell meets the reselection criteria defined in TS38.304 within Kcarrier \* Tdetect,NR\_Inter + Kcarrier\_CCA \* Tdetect,NR\_Inter\_CCA if at least carrier frequency information is provided for inter-frequency neighbour cells by the serving cells when Treselection = 0 provided that the reselection criteria is met by a margin of at least 5 dB in FR1 or [6.5]dB in FR2-2 for reselections based on ranking or 6dB in FR1 or [7.5]dB in FR2-2 for SS-RSRP reselections based on absolute priorities or 4dB in FR1 and [4]dB in FR2-2 for SS-RSRQ reselections based on absolute priorities. The parameter Kcarrier is the number of NR inter-frequency carriers on licensed band and Kcarrier\_CCA is the number of NR inter-frequency carriers on unlicensed band indicated by the serving cell. An inter-frequency cell is considered to be detectable according to the conditions defined in Annex B. 2. 9 for a corresponding Band.

When higher priority cells are found by the higher priority search, they shall be measured at least every Tmeasure,NR\_Inter\_CCA. If after detecting a cell in a higher priority search, it is determined that reselection has not occurred then the UE is not required to continuously measure the detected cell to evaluate the ongoing possibility of reselection. However, the minimum measurement filtering requirements specified later in this clause shall still be met by the UE before it makes any determination that it may stop measuring the cell. If the UE detects on a NR carrier a cell whose physical identity is indicated as not allowed for that carrier in the measurement control system information of the serving cell, the UE is not required to perform measurements on that cell.

The UE shall measure SS-RSRP or SS-RSRQ at least every Kcarrier \* Tmeasure,NR\_Inter + Kcarrier\_CCA \* Tmeasure,NR\_Inter\_CCA for identified lower or equal priority inter-frequency cells. If the UE detects on a NR carrier a cell whose physical identity is indicated as not allowed for that carrier in the measurement control system information of the serving cell, the UE is not required to perform measurements on that cell.

For a cell that is already identified, after 2 unsuccessful measurement attempts due to exceeding the maximum number of SMTC occasions not available at the UE, the UE shall detect cells on any of the configured serving- and/or non-serving carriers.

The UE shall filter SS-RSRP or SS-RSRQ measurements of each measured higher, lower and equal priority inter-frequency cell using at least 2 measurements. Within the set of measurements used for the filtering, at least two measurements shall be spaced by at least Tmeasure,NR\_Inter\_CCA/2.

The UE shall not consider a NR neighbour cell in cell reselection, if it is indicated as not allowed in the measurement control system information of the serving cell.

For an inter-frequency cell that has been already detected, but that has not been reselected to, the filtering shall be such that the UE shall be capable of evaluating that the inter-frequency cell has met reselection criterion defined TS 38.304 within Kcarrier \* Tevaluate,NR\_Inter + Kcarrier\_CCA \* Tevaluate,NR\_Inter\_CCA when Treselection = 0as specified in table 4.2A.2.4-1 provided that the reselection criteria is met by

- the condition when performing equal priority reselection and

when *rangeToBestCell* is not configured:

- the cell is at least 5dB better ranked in FR1 or [6.5]dB better ranked in FR2-2 or.

when *rangeToBestCell* is configured:

- the cell has the highest number of beams above the threshold *absThreshSS-BlocksConsolidation* among all detected cells whose cell-ranking criterion R value [1] is within *rangeToBestCell* of the cell-ranking criterion R value of the highest ranked cell.

- if there are multiple such cells, the cell has the highest rank among them

- the cell is at least 5dB better ranked in FR1 or [6.5]dB better ranked in FR2-2 if the current serving cell is among them. or

- 6dB in FR1 or [7.5]dB in FR2-2 for SS-RSRP reselections based on absolute priorities or

- 4dB in FR1 or [4]dB in FR2-2 for SS-RSRQ reselections based on absolute priorities.

When evaluating cells for reselection, the SSB side conditions apply to both serving and inter-frequency cells.

If Treselection timer has a non zero value and the inter-frequency cell is satisfied with the reselection criteria, the UE shall evaluate this inter-frequency cell for the Treselection time. If this cell remains satisfied with the reselection criteria within this duration, then the UE shall reselect that cell.

The UE is not expected to meet the measurement requirements for an inter-frequency carrier under DRX cycle=320 ms defined in Table 4.2A.2.4-1 under the following conditions:

- TSMTC\_intra = TSMTC\_inter = 160 ms; where TSMTC\_intra and TSMTC\_inter are periodicities of the SMTC occasions configured for the intra-frequency carrier and the inter-frequency carrier respectively, and

- SMTC occasions configured for the inter-frequency carrier occur up to 1 ms before the start or up to 1 ms after the end of the SMTC occasions configured for the intra-frequency carrier, and

- SMTC occasions configured for the intra-frequency carrier and for the inter-frequency carrier occur up to 1 ms before the start or up to 1 ms after the end of the paging occasion [1].

Table 4.2A.2.4-1: Tdetect,NR\_Inter\_CCA, Tmeasure,NR\_Inter\_CCA and Tevaluate,NR\_Inter\_CCA

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| DRX cycle length [s] | Scaling Factor (N1) | Tdetect,NR\_Inter\_CCA [s] (number of DRX cycles) | Tmeasure,NR\_Inter\_CCA [s] (number of DRX cycles) | Tevaluate,NR\_Inter\_CCA[s] (number of DRX cycles) |
| FR1 | FR2-2 |
| 0.32 | 1 | [8] | 0.32xN1x(36+Md)xM2 {(36+Md)xN1xM2} | 0.32xN1x(4+Mm) xM2{(4+Mm)xN1xM2} | 0.32xN1x(16+Me) x M2{(16+Me)xN1 xM2} |
| 0.64 | [5] | 0.64xN1x(28+Md) {(28+Md)xN1 } | 0.64xN1x(2+Mm) {(2+Mm)xN1 } | 0.64xN1x(8+Me) {(8+Me)xN1 } |
| 1.28 | [4] | 1.28xN1x(25+Md){(25+Md)xN1 } | 1.28xN1x(1+Mm){(1+Mm)xN1 } | 1.28xN1x(5+Me) {(5+Me)xN1} |
| 2.56 | [3] | 2.56xN1x(23+Md){(23+Md)xN1 } | 2.56xN1x(1+Mm){(1+Mm)xN1 } | 2.56xN1x(3+Me) {(3+Me)xN1} |
| Note 1: M2 = 1.5 if SMTC periodicity of measured intra-frequency cell > 20 ms; otherwise M2=1.Note 2: Md, Mm, Me are the number of groups of consecutive N1 DRX cycles each group with at least one SMTC occasion not available at the UE during Tdetect,NR\_Inter\_CCA, Tmeasure,NR\_Inter\_CCA and Tevaluate,NR\_Inter\_CCA, and M m ≤ Mm,max, Md ≤ Md,max and Me ≤  Me,max Note 3: Mm,max = 16 for DRX cycle length = 0.32s;  Mm,max = 8 for DRX cycle length = 0.64s; Mm,max = 4 for DRX cycle length = 1.28s; Mm,max = 4 for DRX cycle length = 2.56s Note 4: Md,max = 4\*Mm,max, Me,max = 2\*Mm,max. |

The UE shall restart the measurements upon exceeding Mm,max, Md.max, or Me,max.

<End of Change 1>

<Start of Change 2 (R4-2206931)>

#### 6.1B.1.3 NR FR2-2 NR FR2-2 Handover

The requirements in this clause are applicable to inter-frequency handovers from NR FR2-2 cell to NR FR2-2 cell in carrier frequencies with CCA, and to both intra-frequency and inter-frequency handovers from NR FR2-2 cell in carrier frequencies with CCA to NR FR2-2 cell in carrier frequencies with CCA.

##### 6.1B.1.3.1 Handover delay

When the UE receives a RRC message implying handover the UE shall be ready to start the transmission of the new uplink PRACH channel within Dhandover ms from the end of the last TTI containing the RRC command.

Where:

Dhandover equals the applicable RRC procedure delay defined in clause 12 in TS 38.331 [2] plus the interruption time stated in clause 6.1B.1.3.2.

##### 6.1B.1.3.2 Interruption time

The interruption time is the time between end of the last TTI containing the RRC command on the old PDSCH and the time the UE starts transmission of the new PRACH, excluding the RRC procedure delay.

When intra-frequency or inter-frequency handover is commanded, the interruption time shall be less than Tinterrupt

 Tinterrupt = Tsearch + TIU + Tprocessing + T∆ + Tmargin ms

Where:

 Tsearch is the time required to search the target cell when the handover command is received by the UE. If the target cell is a known cell, then Tsearch = 0 ms. If the target cell is an unknown intra-frequency cell and the target cell Es/Iot≥-2 dB, then Tsearch = (1+L1) \* N \* Trs ms. If the target cell is an unknown inter-frequency cell and the target cell Es/Iot≥-2 dB, then Tsearch = (3+L1´) \* N \* Trs where L1 and L1´ are the number of SMTC occasion groups not available at the UE during the intra-frequency and inter-frequency detection period, respectively. An SMTC occasion group consists of N consecutive SMTC occasions. An SMTC occasion group is not available, when at least one SMTC occasion in the group is not transmitted by the gNB. N is equal to [8]. Regardless of whether DRX is in use by the UE, Tsearch shall still be based on non-DRX target cell search times.

 Tprocessing is time for UE processing. Tprocessing can be up to 20ms.

 Tmargin is time for SSB post-processing. Tmargin can be up to 2ms.

 T∆ is time for fine time tracking and acquiring full timing information of the target cell. T∆ = (1+ L2) \* Trs, where L2 is the number of SMTC occasions not available at the UE during the time tracking period.

 TIU is the interruption uncertainty due to the random access procedure when sending PRACH to the new cell. TIU can be up to (1+ L3)\*TSSB,RO + 10ms, where TSSB,RO is SSB to PRACH occasion associated period is defined in the table 8.1-1 of TS 38.213 [3] and L3 is the number of consecutive SSB to PRACH occasion association periods during which no PRACH occasion is available for PRACH transmission due to UL CCA failure. L3 = 0 for Type 3 channel access procedure as defined in TS 37.213 [33].

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

NOTE 1: The interruption time considering the potential extensions caused by L1,L1´,L2 , L3 and by the UL CCA failure detection/recovery mechanism is limited by the T304 timer. The UE behaviour at the T304 timer expiry is detailed in TS 38.331 [2].

In FR2-2, the target cell is known if it has been meeting the following conditions:

- During the last 5 seconds before the reception of the handover command:

- the UE has sent a valid measurement report for the target cell and

- One of the SSBs measured from the NR target cell being configured remains detectable according to the cell identification conditions specified in Clause 9.2A.5 for intra-frequency handover and Clause 9.3A.4 for inter-frequency handover to a carrier frequency with CCA,

- One of the SSBs measured from the target cell also remains detectable during the handover delay according to the cell identification conditions specified in Clause 9.2A.5 for intra-frequency handover and Clause 9.3A.4 for inter-frequency handover to a carrier frequency with CCA.

otherwise it is unknown.

#### 6.1B.1.4 NR FR1- NR FR2-2 Handover

The requirements in this clause are applicable to inter-frequency handovers from NR FR1 cell to NR FR2-2 cell in carrier frequencies with CCA.

##### 6.1B.1.4.1 Handover delay

When the UE receives a RRC message implying handover the UE shall be ready to start the transmission of the new uplink PRACH channel within Dhandover ms from the end of the last TTI containing the RRC command.

Where:

Dhandover equals the applicable RRC procedure delay defined in clause 12 in TS 38.331 [2] plus the interruption time stated in clause 6.1B.1.4.2.

##### 6.1B.1.4.2 Interruption time

The interruption time is the time between end of the last TTI containing the RRC command on the old PDSCH and the time the UE starts transmission of the new PRACH, excluding the RRC procedure delay.

When in inter-frequency handover is commanded, the interruption time shall be less than Tinterrupt

 Tinterrupt = Tsearch + TIU + Tprocessing + T∆ + Tmargin ms

Where:

 Tsearch is the time required to search the target cell when the handover command is received by the UE. If the target cell is a known cell, then Tsearch = 0 ms. If the target cell is an unknown inter-frequency cell and the target cell Es/Iot≥-2 dB, then Tsearch = (3+L1) \* N \* Trs, where L1 is the number of SMTC occasion groups not available at the UE during the inter-frequency detection period. An SMTC occasion group consists of N consecutive SMTC occasions. An SMTC occasion group is not available, when at least one SMTC occasion in the group is not transmitted by the gNB. N is equal to [8]. Regardless of whether DRX is in use by the UE, Tsearch shall still be based on non-DRX target cell search times.

 Tprocessing is time for UE processing. Tprocessing can be up 40ms.

 Tmargin is time for SSB post-processing. Tmargin can be up to 2ms.

 T∆ is time for fine time tracking and acquiring full timing information of the target cell. T∆ = (1+ L2) \* Trs, where L2 is the number of SMTC occasions not available at the UE during the time tracking period.

 TIU is the interruption uncertainty due to the random access procedure when sending PRACH to the new cell. TIU can be up to (1+ L3)\*TSSB,RO + 10ms, where TSSB,RO is SSB to PRACH occasion associated period is defined in the table 8.1-1 of TS 38.213 [3] and L3 is the number of consecutive SSB to PRACH occasion association periods during which no PRACH occasion is available for PRACH transmission due to UL CCA failure. L3 = 0 for Type 3 channel access procedure as defined in TS 37.213 [33].

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

NOTE 1: The interruption time considering the potential extensions caused by L1,L2 , L3 and by the UL CCA failure detection/recovery mechanism is limited by the T304 timer. The UE behaviour at the T304 timer expiry is detailed in TS 38.331 [2].

In FR2-2, the target cell is known if it has been meeting the following conditions:

During the last 5 seconds before the reception of the handover command:

- the UE has sent a valid measurement report for the target cell and

 One of the SSBs measured from the NR target cell being configured remains detectable according to the cell identification conditions specified in Clause 9.2A.5 for intra-frequency handover and Clause 9.3A.4 for inter-frequency handover to a carrier frequency with CCA,

- One of the SSBs measured from the target cell also remains detectable during the handover delay according to the cell identification conditions specified in Clause 9.2A.5 for intra-frequency handover and Clause 9.3A.4 for inter-frequency handover to a carrier frequency with CCA.

otherwise it is unknown.

<End of Change 2>

<Start of Change 3 (R4-2206931)>

##### 6.2.1A.2.1 UE Re-establishment with CCA delay requirement

The UE re-establishment on the carrier with CCA delay (TUE\_re-establish\_delay\_CCA) is the time between the moments when any of the conditions requiring RRC re-establishment on the carrier with CCA as defined in clause 5.3.7 in TS 38.331 [2] is detected by the UE and when the UE sends PRACH to the target PCell on the carrier with CCA . The UE re-establishment delay requirement (TUE\_re-establish\_delay\_CCA) on the carrier with CCA shall be less than:

The intra-frequency target NR cell with CCA shall be considered detectable if each relevant SSB can satisfy that:

- SS-RSRP related side conditions given in clause 10.1.2 and 10.1.3 are fulfilled for a corresponding NR Band for FR1 and FR2-2, respectively, and

- the conditions of SSB\_RP and SSB Ês/Iot according to Annex B.2.3 for a corresponding NR Band are fulfilled.

The inter-frequency target NR cell on the carrier with CCA shall be considered detectable when for each relevant SSB:

- SS-RSRP related side conditions given in clause 10.1.4 and 10.1.5 are fulfilled for a corresponding NR Band for FR1 and FR2-2, respectively, and

- the conditions of SSB\_RP and SSB Ês/Iot according to Annex B.2.2 for a corresponding NR Band are fulfilled.

Tidentify\_intra\_NR\_CCA: If the target intra-frequency carrier is the carrier without CCA, it is the time to identify the target intra-frequency NR cell which is defined in clause 6.2.1; otherwise it is the time to identify the target intra-frequency NR cell on the carrier with CCA and it depends on whether the target NR cell on the carrier with CCA is known cell or unknown cell and on the frequency range (FR) of the target NR cell on the carrier with CCA. If the UE is not configured with intra-frequency NR carrier with CCA for RRC re-establishment then Tidentify\_intra\_NR\_CCA=0; otherwise Tidentify\_intra\_NR\_CCA shall not exceed the values defined in Table 6.2.1A.2.1-1.

Tidentify\_inter\_NR\_CCA,i: If the target inter-frequency carrier is the carrier without CCA, it is the time to identify the target inter-frequency NR cell which is defined in clause 6.2.1; otherwise it is the time to identify the target inter-frequency NR cell on inter-frequency carrier *i* with CCA configured for RRC re-establishment and it depends on whether the target NR cell on the inter-frequency carrier with CCA is known or unknown. Tidentify\_inter\_NR\_CCA,i shall not exceed the values defined in Table 6.2.1A.2.1-2.

TSMTC: It is the periodicity of the SMTC occasion configured for the intra-frequency carrier. If the UE has been provided with higher layer in TS 38.331 [2] signaling of *smtc2*, Tsmtc follows *smtc1* or *smtc2* according to the physical cell ID of the target cell.

TSMTC,i: It is the periodicity of the SMTC occasion configured for the inter-frequency carrier *i*. If it is not configured, the UE may assume that the target SSB periodicity is not larger than 20 ms.

TSI-NR\_CCA: It is the time required for receiving all the relevant system information according to the reception procedure and the RRC procedure delay of system information blocks defined in TS 38.331 [2] for the target NR cell on the carrier with CCA.

TPRACH\_CCA is the delay uncertainty in acquiring the first available PRACH occasion in the target NR Cell on the carrier with CCA:

TPRACH\_CCA = (1+ K3)\*TSSB,RO + 10 ms, where:

- TSSB,RO is the SSB to PRACH occasion association period as defined inTable 8.1-1 of TS 38.213 [39].

- K3 is the number of consecutive SSB to PRACH occasion association periods during which no PRACH occasion is available for PRACH transmission due to UL CCA failure. K3 = 0 for Type 2C UL channel access procedure as defined in TS 37.213 [57].

Nfreq: It is the total number of NR frequencies to be monitored for RRC re-establishment; Nfreq = 1 if the target NR cell on the intra-frequency carrier with CCA is known, else Nfreq = 2 and Tidentify\_intra\_NR\_CCA = 0 if the target NR cell on the inter-frequency carrier with CCA is known.

There is no requirement if the target cell on the carrier with CCA does not contain the UE context.

In the requirement defined in the below tables, the target FR1 cell on the carrier with CCA is known if it has been meeting the relevant cell identification requirement during the last 8 seconds otherwise it is unknown.

Table 6.2.1A.2.1-1: Time to identify target NR cell for RRC connection re-establishment to NR intra-frequency cell with CCA

|  |  |  |
| --- | --- | --- |
| Serving cell | Frequency range | Tidentify\_intra\_NR\_CCA [ms] |
| SSB Ês/Iot (dB) | (FR) of target NR cell | Known NR cell | Unknown NR cell |
| ≥ -8 | FR1 | MAX (200 ms, (5+K1) x TSMTC) | MAX (800 ms, (10+ K1) x TSMTC) |
| ≥ -8 | FR2-2 | N/A | MAX (1000 ms, N x (10+ K3) x TSMTC) |
| < -8 | FR1 | N/A | (800+20 x K1)Note1 |
| < -8 | FR2-2 | N/A | N x (440+20 x K3)Note1 |
| Note 1: The UE is not required to successfullyidentify a cell on any NR frequency layer with CCA when TSMTC > 20 ms and serving cell SSB Ês/Iot < -8 dB.Note 2: K1 is the number of SMTC occasions not available at the UE due during RRC re-establishment period on the carrier with CCA. Note 3: K3 is the number of SMTC occasion groups not available at the UE during RRC re-establishment period on the carrier with CCA. An SMTC occasion group consists of N consecutive SMTC occasions. An SMTC occasion group is not available, when at least one SMTC occasion in the group is not transmitted by the gNB. N is equal to [8] |

Table 6.2.1A.2.1-2: Time to identify target NR cell for RRC connection re-establishment to NR inter-frequency cell on the carrier with CCA

|  |  |  |
| --- | --- | --- |
| Serving cell SSB Ês/Iot (dB) | Frequency range | Tidentify\_inter\_NR\_CCA, i [ms] |
|  | (FR) of target NR cell | Known NR cell | Unknown NR cell |
| ≥ -8 | FR1 | MAX (200 ms, ([6]+K2,i) x TSMTC, i) | MAX (800 ms, ([13]+K2,i) x TSMTC, i) |
| ≥ -8 | FR2-2 | N/A | MAX (1000 ms, N x (13+K4,i) x TSMTC, i)) |
| < -8 | FR1 | N/A | (800+20 x K2,i) Note1 |
| < -8 | FR2-2 | N/A | N x (500+20 x K4,i) Note1 |
| Note 1: The UE is not required to successfully identify a cell on any NR frequency layer with CCA when TSMTC,i > 20 ms and serving cell SSB Ês/Iot < -8 dB.Note 2: K2,i is the number of SMTC occasions not available at the UE during RRC re-establishment period on the “i” th carrier with CCANote 3: K4,iis the number of SMTC occasion groups not available at the UE during RRC re-establishment period on the “i” th carrier with CCA. An SMTC occasion group consists of N consecutive SMTC occasions. An SMTC occasion group is not available, when at least one SMTC occasion in the group is not transmitted by the gNB. N is equal to [8] |

<End of Change 3>

<Start of Change 4 (R4-2206931)>

##### 6.2.3.2.3 RRC connection release with redirection to NR carrier subject to CCA

The UE shall be capable of performing the RRC connection release with redirection to the target NR cell subject to CCA within Tconnection\_release\_redirect\_NR\_CCA.

The time delay (Tconnection\_release\_redirect\_NR\_CCA) is the time between the end of the last slot containing the RRC command, “*RRCRelease*” (TS 38.331 [2]) on the NR PDSCH and the time the UE starts to send random access to the target NR cell. The time delay (Tconnection\_release\_redirect\_NR\_CCA) shall be less than:

 Tconnection\_release\_redirect\_NR\_CCA = TRRC\_procedure\_delay + Tidentify-NR\_CCA + TSI-NR\_CCA + TRACH\_CCA

The target NR cell shall be considered detetable when for each relevant SSB, the side conditions should be met that,

- the conditions of SSB\_RP and SSB Ês/Iot according to Annex B.2.5 for a corresponding NR Band are fulfilled.

TRRC\_procedure\_delay: It is the RRC procedure delay for processing the received message “*RRCRelease*” as defined in clause 6.2.2 of TS 38.331 [2].

Tidentify-NR\_CCA: It is the time to identify the target NR cell and is defined as:

- Tidentify-NR\_CCA = TPSS/SSS-sync + Tmeas; TPSS/SSS-sync is the cell search time and Tmeas is the measurement time due to cell selection criteria evaluation.

- For FR1 target NR cell: Tidentify-NR\_CCA = MAX (680 ms, (L1+11) × Trs);

 For FR2-2 target NR cell: Tidentify-NR\_CCA = MAX (880 ms, Nx(L1´+11) x Trs);

where L1 is the number of SMTC occasions not available at the UE due to DL CCA failures and L1´ is the number of SMTC occasion groups not available at the UE due to DL CCA failures. An SMTC occasion group consists of N consecutive SMTC occasions. An SMTC occasion group is not available, when at least one SMTC occasion in the group is not transmitted by the gNB. N is equal to [8]. If L1 > L1,max or L1´ > L1,max then the UE shall initiate cell selection procedures for the selected PLMN as defined in TS 38.304 [1]; where L1,max is defined in Table 6.2.3.2.3-1.

TSI-NR\_CCA: It is the time required for acquiring all the relevant system information of the target NR cell. This time depends upon whether the UE is provided with the relevant system information of the target NR cell or not by the old NR cell before the RRC connection is released.

TRACH\_CCA: It is the delay uncertainty in acquiring the first available PRACH occasion in the target NR cell:

- TRACH\_CCA = (1+L2)×TSSB,RO + 10 ms TPRACH; where:

- L2 is the consecutive number of SSB to PRACH occasion association periods during which no PRACH occasion is available for PRACH transmission due to UL CCA failures. L2 = 0 for Type 2C UL channel access procedure as defined in TS 37.213 [33].

- TSSB,RO is the SSB to PRACH occasion association period as defined in the table 8.1-1 of TS 38.213 [3].

- The value of L2 is limited by *PREAMBLE\_TRANSMISSION\_COUNTER*, which is increased when PRACH occasion is unavailable for PRACH transmission due to UL CCA failure as specified in TS 38.321 [7]. The UE behaviour when *PREAMBLE\_TRANSMISSION\_COUNTER* reaches the *preambleTransMax* is specified in TS 38.321 [7].

Trs is the SMTC periodicity of the target NR cell if the UE has been provided with an SMTC configuration for the target cell in the redirection command, otherwise Trs is the SMTC periodicity configured in the *measObjectNR* having the same SSB frequency and subcarrier spacing configured for the RRC connection release with redirection. If the UE is not provided with SMTC configuration or measurement object for the frequency which is also configured for the RRC connection release with redirection then:

- the requirement in this clause is applied with Trs = 20 ms if the SSB transmission periodicity is not larger than 20 ms;

- otherwise, there is no requirement if the SSB transmission periodicity is larger than 20ms.

Table 6.2.3.2.3-1: Maximum allowed number of missed SMTC occasions during cell identification

|  |  |
| --- | --- |
| SMTC periodicity (Trs) [ms] | Maximum allowed number of missed SMTC occasions (L1,max) |
| Trs ≤ 40 | 8 |
| Trs > 40 | 4 |

<End of Change 4>

<Start of Change 5 (R4-2206923)>

# 7 Timing

## 7.1 UE transmit timing

### 7.1.1 Introduction

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

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

.

### 7.1.2 Requirements

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

- when it is the first transmission in a DRX cycle for PUCCH, PUSCH and SRS, or it is the PRACH transmission, or it is the msgA transmission..

When the UL SCS is 120 kHz or smaller, the UE shall meet the Te requirement for an initial transmission provided that at least one SSB is available at the UE during the last 160 ms. When the UL SCS is 480 kHz the UE shall meet the Te requirement for an initial transmission provided that at least one SSB is available in the last 80 ms. When the UL SCS is 960 kHz the UE shall meet the Te requirement for an initial transmission provided that at least one SSB is available in the last 40 ms. The reference point for the UE initial transmit timing control requirement shall be the downlink timing of the reference cell minus . The downlink timing is defined as the time when the first detected path (in time) of the corresponding downlink frame is received from the reference cell. *N*TA for PRACH is defined as 0.

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

Table 7.1.2-1: Te Timing Error Limit

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

Table 7.1.2-2: The Value of 

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

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

Table 7.1.2-3: void

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

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

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

#### 7.1.2.1 Gradual timing adjustment

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

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

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

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

3) The maximum aggregate adjustment rate shall be Tq per 200 ms.

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

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

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency Range | SCS of uplink signals (kHz) | Tq | Tp  |
| 1 | 15 | 5.5\*64\*Tc | 5.5\*64\*Tc |
|  | 30 | 5.5\*64\*Tc | 5.5\*64\*Tc |
|  | 60 | 5.5\*64\*Tc | 5.5\*64\*Tc |
| 2-1 | 60 | 2.5\*64\*Tc | 2.5\*64\*Tc |
|  | 120 | 2.5\*64\*Tc | 2.5\*64\*Tc |
| 2-2 | 120 | 2.5\*64\*Tc | 2.5\*64\*Tc |
|  | 480 | TBD | TBD |
|  | 960 | TBD | TBD |
| NOTE: Tc is the basic timing unit defined in TS 38.211 [6] |

<End of Change 5>

<Start of Change 6 (R4-2206920)>

## 7.7 *deriveSSB-IndexFromCell* tolerance

### 7.7.1 Minimum requirements

When *deriveSSB-IndexFromCell* is enabled, the UE assumes frame boundary alignment (including half frame, subframe and slot boundary alignment) across cells on the same frequency carrier is within a tolerance not worse than

* min(2 SSB symbols, 1 PDSCH symbol) for sub-carrier spacings up-to 240 kHz,
* min (3 SSB symbols, NPDSCH PDSCH symbols) for sub-carrier spacing of 480 kHz and 960kHz where NPDSCH is defined in Table 7.7.1-1

and the SFNs of all cells on the same frequency carrier are the same.

Table 7.7.1-1 NPDSCH when deriveSSB-IndexFromCell is enabled

|  |  |  |
| --- | --- | --- |
| SSB SCS (KHz) | PDSCH SCS (KHz) | NPDSCH  |
| 120 | 480 | 3 |
| 120 | 960 | 6 |
| 480 | 120 | 1 |
| 480 | 480 | 3 |
| 480 | 960 | 6 |
| 960 | 120 | 1 |
| 960 | 480 | 2 |
| 960 | 960 | 3 |

When *deriveSSB-IndexFromCell* is not enabled, the UE assumes frame boundary alignment (including half frame, subframe and slot boundary alignment) across cells on the same frequency carrier is within a tolerance not worse than 6 SSB symbols for sub-carrier spacing of 960kHz and the SFNs of all cells on the same frequency carrier are the same.

<End of Change 6>

<Start of Change 7 (R4-2206922)>

#### 8.1.7.3 Scheduling availability of UE performing radio link monitoring on FR2

The following scheduling restriction applies due to radio link monitoring on an FR2 serving PCell and/or PSCell.

- If the RLM-RS is CSI-RS which is type-D QCLed with active TCI state for PDCCH or PDSCH, and the CSI-RS is not in a CSI-RS resource set with repetition ON,

- There are no scheduling restrictions due to radio link monitoring based on the CSI-RS.

- Otherwise

- For FR2-1 or the RLM-RS is not using 480 kHz SCS or 960 kHz SCS on FR2-2, the UE is not expected to transmit PUCCH, PUSCH or SRS or receive PDCCH, PDSCH or CSI-RS for tracking or CSI-RS for CQI on RLM-RS symbols to be measured for radio link monitoring.

- For FR2-2 and the RLM-RS is using 480 kHz SCS or 960 kHz SCS, the UE is not expected to transmit PUCCH, PUSCH or SRS or receive PDCCH, PDSCH or CSI-RS for tracking or CSI-RS for CQI on RLM-RS symbols to be measured for radio link monitoring, and on one data symbol before each RLM-RS symbol to be measured and one data symbol after each RLM-RS symbol to be measured.

When intra-band carrier aggregation in FR2 is performed, the scheduling restrictions on FR2 serving PCell or PSCell applies to all serving cells in the same band on the symbols that fully or partially overlap with restricted symbols.

When inter-band carrier aggregation in FR2 is performed, there are no scheduling restrictions on FR2 serving cell(s) in the bands for the following cases, provided that UE is capable of independent beam management on this FR2 band pair:

- when performing radio link monitoring performed on FR2 serving PCell or PSCell in different bands,

- the UE is configured with same or different numerology between SSB on one FR2 band and data on the other FR2 band.

For FR2, if following conditions are met,

- UE has been notified about system information update through paging,

- The gap between UE’s reception of PDCCH that UE monitors in the Type2-PDCCH CSS set and that notifies system information update, and the PDCCH that UE monitors in the Type0-PDCCH CSS set, is greater than 2 slots,

For the SSB for RLM and CORESET for RMSI scheduling multiplexing patterns 3, UE is expected to receive the PDCCH that UE monitors in the Type0-PDCCH CSS set, and the corresponding PDSCH, on SSB symbols to be measured for RLM; and

For the SSB for RLM and CORESET for RMSI scheduling multiplexing patterns 2, UE is expected to receive PDSCH that corresponds to the PDCCH that UE monitors in the Type0-PDCCH CSS set, on SSB symbols to be measured for RLM.

<End of Change 7>

<Start of Change 8 (R4-2206930)>

## 8.1A Radio Link Monitoring with CCA on Target Frequency

### 8.1A.1 Introduction

The requirements in clause 8.1A apply for radio link monitoring on a carrier frequency with CCA for cells:

- PCell in SA NR operation mode,

- PSCell in EN-DC operation mode.

- PSCell in NR-DC operation mode.

The UE shall monitor the downlink radio link quality based on the reference signal configured as RLM-RS resource(s) in order to detect the downlink radio link quality of the PCell and PSCell as specified in TS 38.213 [3]. The configured RLM-RS resources can be all SSBs, or all CSI-RSs, or a mix of SSBs and CSI-RSs. UE is not required to perform RLM outside the active DL BWP.

On each RLM-RS resource, the UE shall estimate the downlink radio link quality and compare it to the thresholds Qout,CCA and Qin,CCA for the purpose of monitoring downlink radio link quality of the cell.

The threshold Qout,CCA is defined as the level at which the downlink radio link cannot be reliably received and shall correspond to the out-of-sync block error rate (BLERout,CCA) as defined in Table 8.1A.1-1. For SSB based radio link monitoring, Qout\_SSB,CCA is derived based on the hypothetical PDCCH transmission parameters listed in Table 8.1A.2.1-1.

The threshold Qin,CCA is defined as the level at which the downlink radio link quality can be received with significantly higher reliability than at Qout,CCA and shall correspond to the in-sync block error rate (BLERin) as defined in Table 8.1A.1-1. For SSB based radio link monitoring, Qin\_SSB,CCA is derived based on the hypothetical PDCCH transmission parameters listed in Table 8.1A.2.1-2.

The out-of-sync block error rate (BLERout,CCA) and in-sync block error rate (BLERin,CCA) are determined from the network configuration via parameter *rlmInSyncOutOfSyncThreshold* signalled by higher layers. When UE is not configured with *rlmInSyncOutOfSyncThreshold* from the network, UE determines out-of-sync and in-sync block error rates from Configuration #0 in Table 8.1A.1-1 as default. All requirements in clause 8.1A are applicable for BLER Configuration #0 in Table 8.1A.1-1.

Table 8.1A.1-1: Out-of-sync and in-sync block error rates

|  |  |  |
| --- | --- | --- |
| Configuration | BLERout,CCA | BLERin,CCA |
| 0 | 10% | 2% |

UE shall be able to monitor up to NRLM RLM-RS resources of the same or different types in each corresponding carrier frequency range, depending on a maximum number Lmax of SSBs per half frame according to TS 38.213 [3], where NRLM is specified in Table 8.1A.1-2, and meet the requirements as specified in clause 8.1A. UE is not required to meet the requirements in clause 8.1A if RLM-RS is not configured and no TCI state for PDCCH is activated.

Table 8.1A.1-2: Maximum number of RLM-RS resources NRLM

|  |  |  |
| --- | --- | --- |
| Carrier frequency range of PCell/PSCell | Lmax | Maximum number of RLM-RS resources, NRLM  |
| FR1 | 8 | 4 |
| FR2-2 | 64 | 8 |

In the requirements of clause 8.1A, the term RLM-RS SSB occasion not available at the UE refers to when the RLM-RS SSB is configured by gNB in a cell on a carrier frequency subject to CCA, but the first two successive candidate SSB positions for the same SSB index within the set of configured RLM-RS resources are not available at the UE due to DL CCA failures at gNB during the corresponding evaluation period; otherwise the RLM-RS SSB is considered as available at the UE.

The requirements in clause 8.1A apply for any *channelAccessMode* configuration [TS 38.331, 2].

### 8.1A.2 Requirements for SSB Based Radio Link Monitoring

#### 8.1A.2.1 Introduction

The requirements in this clause apply for each SSB based RLM-RS resource configured for PCell or PSCell, provided that the SSB configured for RLM are actually configured to be transmitted within UE active DL BWP during the entire evaluation period specified in clause 8.1A.2.2 but occasionally may not be transmitted due to CCA operation.

Table 8.1A.2.1-1: PDCCH transmission parameters for out-of-sync evaluation

|  |  |
| --- | --- |
| Attribute | Value for BLER Configuration #0 |
| DCI format | 1-0 |
| Number of control OFDM symbols | 2 |
| Aggregation level (CCE) | 8 |
| Ratio of hypothetical PDCCH RE energy to average SSS RE energy | 4 dB |
| Ratio of hypothetical PDCCH DMRS energy to average SSS RE energy | 4 dB |
| Bandwidth (PRBs) | 24 |
| Sub-carrier spacing (kHz) | SCS of the active DL BWP |
| DMRS precoder granularity | REG bundle size |
| REG bundle size | 6 |
| CP length | Normal |
| Mapping from REG to CCE | Distributed |

Table 8.1A.2.1-2: PDCCH transmission parameters for in-sync evaluation

|  |  |
| --- | --- |
| Attribute | Value for BLER Configuration #0 |
| DCI payload size | 1-0 |
| Number of control OFDM symbols | 2 |
| Aggregation level (CCE) | 4 |
| Ratio of hypothetical PDCCH RE energy to average SSS RE energy | 0dB |
| Ratio of hypothetical PDCCH DMRS energy to average SSS RE energy | 0dB |
| Bandwidth (PRBs) | 24 |
| Sub-carrier spacing (kHz) | SCS of the active DL BWP |
| DMRS precoder granularity | REG bundle size |
| REG bundle size | 6 |
| CP length | Normal |
| Mapping from REG to CCE | Distributed |

#### 8.1A.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,CCA [ms] period becomes worse than the threshold Qout\_SSB,CCA within TEvaluate\_out\_SSB,CCA [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,CCA [ms] period becomes better than the threshold Qin\_SSB,CCA within TEvaluate\_in\_SSB,CCA [ms] evaluation period. During the in-sync evaluation procedure, layer 1 of the UE shall not send any in-sync indication for the cell to the higher layers when Lin exceeds Lin,max, where Lin and Lin,max are defined in Table 8.1A.2.2-1.

TEvaluate\_out\_SSB,CCA and TEvaluate\_in\_SSB,CCA are defined in Table 8.1A.2.2-1 for FR1.

TEvaluate\_out\_SSB,CCA and TEvaluate\_in\_SSB,CCA are defined in Table 8.1A.2.2-2 for FR2-2 with scaling factor N = TBD.

For FR1,

- , when in the monitored cell there are measurement gaps configured for intra-frequency, inter-frequency or inter-RAT measurements, and these measurement gaps are overlapping with some but not all occasions of the SSB RLM-RS resources; and

- P=1 when in the monitored cell there are no measurement gaps overlapping with any occasion of the SSB RLM-RS resources.

For FR2-2,

- , when RLM-RS resource is not overlapped with measurement 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 measurement gap and RLM-RS resource is fully overlapped with SMTC period (TSSB = TSMTCperiod).

- , when the RLM-RS resource is partially overlapped with measurement gap and the RLM-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and

- TSMTCperiod ≠ MGRP or

- TSMTCperiod = MGRP and TSSB < 0.5\*TSMTCperiod

- , when the RLM-RS is partially overlapped with measurement gap and the RLM-RS is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and TSMTCperiod = MGRP and TSSB = 0.5 × TSMTCperiod

-- , when the RLM-RS resource is partially overlapped with measurement gap and the RLM-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is partially or fully overlapped with measurement gap

- , when the RLM-RS resource is partially overlapped with measurement gap and the RLM-RS resource is fully overlapped with SMTC occasion (TSSB = TSMTCperiod) and SMTC occasion is partially overlapped with measurement gap (TSMTCperiod < MGRP)

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

* not overlapped with the SSB symbols indicated by *SSB-ToMeasure* and TBD data symbol before each consecutive SSB symbols indicated by *SSB-ToMeasure* and TBD 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 TBD data symbol before each RSSI symbol indicated by *ss-RSSI-Measurement* and TBD data symbol after each RSSI symbol indicated by *ss-RSSI-Measurement*, given that *ss-RSSI-Measurement* is configured.

- Psharing factor = 3, otherwise.

where,

 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 FR2-2 band, provided the SMTC offset of all CCs in FR2-2 have the same offset.

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, SMTC occasion, and measurement gap configurations does not meet previous conditions.

Table 8.1A.2.2-1: Evaluation period TEvaluate\_out\_SSB,CCA and TEvaluate\_in\_SSB,CCA for FR1

|  |  |  |
| --- | --- | --- |
| Configuration | TEvaluate\_out\_SSB,CCA (ms) | TEvaluate\_in\_SSB,CCA (ms) |
|  | RLM-RS SSB Es/IotNote4 ≥-7 dB | RLM-RS SSB Es/Iot Note4 <-7 dB |  |
| no DRX | Max(200, Ceil(17\*P)\*TSSB) | Max(200, Ceil(24\*P)\*TSSB) | Max(100, Ceil((5+Lin)\*P)\*TSSB) |
| DRX cycle≤320 | Max(200, Ceil(1.5\*15\*P)\*Max(TDRX,TSSB)) | Max(200, Ceil(1.5\*20\*P)\*Max(TDRX,TSSB)) | Max(100, Ceil(1.5\*(5+Lin)\*P)\*Max(TDRX,TSSB)) |
| DRX cycle>320 | Ceil(13\*P)\*TDRX | Ceil(16\*P)\*TDRX | Ceil((5+Lin)\*P)\*TDRX |
| NOTE 1: TSSB is the periodicity of the SSB configured for RLM. TDRX is the DRX cycle length.NOTE 2: When DRX is not configured, Lin is the number of RLM-RS SSB occasions which are not available at the UE during TEvaluate\_in\_SSB,CCA, where Lin ≤ Lin,max. When DRX is configured, Lin is the number of DRX cycles in which at least one RLM-RS SSB occasion is not available at the UE during TEvaluate\_in\_SSB,CCA, where Lin ≤ Lin,max. The UE is not required to determine the availability of SSB occasions more frequent than once per DRX cycle length, when configured with DRX.NOTE 3: Lin,max=7 for Max(TDRX,TSSB) ≤ 40 assuming TDRX=0 for non-DRX case,  Lin,max=5 for 40<Max(TDRX,TSSB)≤320, Lin,max=3 for TDRX>320.NOTE 4: RLM-RS SSB Es/Iot is the averaged Es/Iot over the most recent previous out-of-sync evaluation period. |

Table 8.1A.2.2-2: Evaluation period TEvaluate\_out\_SSB,CCA and TEvaluate\_in\_SSB,CCA for FR2-2

|  |  |  |
| --- | --- | --- |
| Configuration | TEvaluate\_out\_SSB,CCA (ms) | TEvaluate\_in\_SSB,CCA (ms) |
|  |  |
| no DRX | TBD | Max(100, Ceil((5 +Lin)\*P\* N)\*TSSB) |
| DRX cycle≤320 | TBD | Max(100, Ceil(1.5\*(5 +Lin)\*P\* N)\*Max(TDRX,TSSB)) |
| DRX cycle>320 | TBD | Ceil((5+Lin)\*P\* N)\*TDRX |
| NOTE 1: TSSB is the periodicity of the SSB configured for RLM. TDRX is the DRX cycle length.NOTE 2: When DRX is not configured, Lin is the number of RLM-RS SSB occasions groups which are not available at the UE during TEvaluate\_in\_SSB,CCA, where Lin ≤ Lin,max. A RLM-RS SSB occasions group consists of N consecutive RLM-RS SSB occasions, and the RLM-RS SSB occasions group is not available at the UE when at least one RLM-SSB occasion in the group is not transmitted by the gNB. When DRX is configured, Lin is the number of DRX cycles groups which are not available at the UE during TEvaluate\_in\_SSB,CCA, where Lin ≤ Lin,max. A DRX group consists of N DRX cycles, and the DRX group is not available when there is at least one DRX in which at least one RLM-RS SSB occasion is not available. The UE is not required to determine the availability of SSB occasions more frequent than once per DRX cycle length, when configured with DRX.NOTE 3: Lin,max=7 for Max(TDRX,TSSB) ≤ 40 assuming TDRX=0 for non-DRX case,  Lin,max=5 for 40<Max(TDRX,TSSB)≤320, Lin,max=3 for TDRX>320. |

8.1A.2.3 Measurement Restrictions for SSB based RLM

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

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

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

- If SSB and CSI-RS have different SCS,

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

- If UE does not support *simultaneousRxDataSSB-DiffNumerology*, UE is required to measure SSB for RLM.

For FR2-2, when the SSB for RLM measurement on one CC is in the same OFDM symbol as CSI-RS for RLM, BFD, CBD or L1-RSRP measurement on the same CC or different CCs in the same band, UE is required to measure one of but not both SSB for RLM and CSI-RS. Longer measurement period for SSB based RLM is expected, and no requirements are defined.

### 8.1A.3 Minimum requirement at transitions

When the UE transitions between DRX and no DRX or when DRX cycle periodicity changes, for each RLM-RS resource, for a duration of time equal to the evaluation period corresponding to the second mode after the transition occurs, the UE shall use an evaluation period that is no less than the minimum of evaluation period corresponding to the first mode and the second mode. Subsequent to this duration, the UE shall use an evaluation period corresponding to the second mode for each RLM-RS resource. This requirement shall be applied to both out-of-sync evaluation and in-sync evaluation of the monitored cell.

When the UE transitions from a first configuration of RLM resources to a second configuration of RLM resources that is different from the first configuration, for each RLM resource present in the second configuration, for a duration of time equal to the evaluation period corresponding to the second configuration after the transition occurs, the UE shall use an evaluation period that is no less than the minimum of evaluation periods corresponding to the first configuration and the second configuration. Subsequent to this duration, the UE shall use an evaluation period corresponding to the second configuration for each RLM resource present in the second configuration. This requirement shall be applied to both out-of-sync evaluation and in-sync evaluation of the monitored cell.

### 8.1A.4 Minimum requirement for UE turning off the transmitter

The transmitter power of the UE in the monitored cell shall be turned off within 40ms after expiry of T310 timer as specified in TS 38.331 [2]. The UE shall not perform CCA procedure on any of the serving carrier frequencies with CCA after the expiry of T310.

### 8.1A.5 Minimum requirement for L1 indication

When the downlink radio link quality on all the configured RLM-RS resources is worse than Qout,CCA, layer 1 of the UE shall send an out-of-sync indication for the cell to the higher layers. A layer 3 filter shall be applied to the out-of-sync indications as specified in TS 38.331 [2].

When the downlink radio link quality on at least one of the configured RLM-RS resources is better than Qin,CCA, layer 1 of the UE shall send an in-sync indication for the cell to the higher layers. A layer 3 filter shall be applied to the in-sync indications as specified in TS 38.331 [2].

The out-of-sync and in-sync evaluations for the configured RLM-RS resources shall be performed as specified in clause 5 in TS 38.213 [3]. Two successive indications from layer 1 shall be separated by at least TIndication\_interval,CCA.

When DRX is not used TIndication\_interval,CCA is max(10ms, TRLM-RS,M), where TRLM,M is the shortest periodicity of all configured RLM-RS resources for the monitored cell, which corresponds to TSSB specified in clause 8.1A.2 if the RLM-RS resource is SSB.

In case DRX is used, TIndication\_interval,CCA is Max(10ms, 1.5 × DRX\_cycle\_length, 1.5 × TRLM-RS,M)) if DRX cycle\_length is less than or equal to 320ms, and TIndication\_interval,CCA is DRX\_cycle\_length if DRX cycle\_length is greater than 320ms. Upon start of T310 timer as specified in TS 38.331 [2], the UE shall monitor the configured RLM-RS resources for recovery using the evaluation period and layer 1 indication interval corresponding to the no DRX mode until the expiry or stop of T310 timer.

### 8.1A.6 Scheduling availability of UE during radio link monitoring

When the reference signal to be measured for RLM on a carrier frequency with CCA has different subcarrier spacing than PDSCH/PDCCH, there are restrictions on the scheduling availability as described in the following clauses.

#### 8.1A.6.1 Scheduling availability of UE performing radio link monitoring with the same subcarrier spacing as PDSCH/PDCCH on FR1

There are no scheduling restrictions due to radio link monitoring performed with a same subcarrier spacing as PDSCH/PDCCH on FR1.

#### 8.1A.6.2 Scheduling availability of UE performing radio link monitoring with a different subcarrier spacing than PDSCH/PDCCH on FR1

For UEs which support *simultaneousRxDataSSB-DiffNumerology* [14] there are no restrictions on scheduling availability due to radio link monitoring based on SSB as RLM-RS. For UEs which do not support *simultaneousRxDataSSB-DiffNumerology* [14] the following restrictions apply due to radio link monitoring based on SSB as RLM -RS.

- The UE is not expected to transmit PUCCH, PUSCH or SRS or receive PDCCH, PDSCH or CSI-RS for tracking or CSI-RS for CQI on SSB symbols to be measured for radio link monitoring.

When intra-band carrier aggregation is performed, the scheduling restrictions on PCell or PSCell applies to all serving cells in the same band on the symbols that fully or partially overlap with the restricted symbols.

#### 8.1A.6.3 Scheduling availability of UE performing radio link monitoring on FR2-2

The following scheduling restriction applies due to radio link monitoring on an FR2-2 serving PCell and/or PSCell.

- If the RLM-RS is CSI-RS which is type-D QCLed with active TCI state for PDCCH or PDSCH, and the CSI-RS is not in a CSI-RS resource set with repetition ON,

- There are no scheduling restrictions due to radio link monitoring based on the CSI-RS.

- Otherwise

- The UE is not expected to transmit PUCCH, PUSCH or SRS or receive PDCCH, PDSCH or CSI-RS for tracking or CSI-RS for CQI on RLM-RS symbols to be measured for radio link monitoring, and on TBD data symbol before each RLM-RS symbols and TBD data symbols after each RLM-RS symbols for radio link monitoring..

When intra-band carrier aggregation in FR2-2 is performed, the scheduling restrictions on FR2-2 serving PCell or PSCell applies to all serving cells in the same band on the symbols that fully or partially overlap with restricted symbols.

For FR2-2, if following conditions are met,

- UE has been notified about system information update through paging,

- The gap between UE’s reception of PDCCH that UE monitors in the Type2-PDCCH CSS set and that notifies system information update, and the PDCCH that UE monitors in the Type0-PDCCH CSS set, is greater than 2 slots,

For the SSB for RLM and CORESET for RMSI scheduling multiplexing patterns 3, UE is expected to receive the PDCCH that UE monitors in the Type0-PDCCH CSS set, and the corresponding PDSCH, on SSB symbols to be measured for RLM; and

For the SSB for RLM and CORESET for RMSI scheduling multiplexing patterns 2, UE is expected to receive PDSCH that corresponds to the PDCCH that UE monitors in the Type0-PDCCH CSS set, on SSB symbols to be measured for RLM.

#### 8.1A.6.4 Scheduling availability of UE performing radio link monitoring on FR1 or FR2-2 in case of FR1-FR2-2 inter-band CA and NR-DC

There are no scheduling restrictions on FR1 serving cell(s) due to radio link monitoring performed on FR2-2 serving PCell and/or PSCell.

There are no scheduling restrictions on FR2-2 serving cell(s) due to radio link monitoring performed on FR1 serving PCell and/or PSCell.

<End of Change 8>

<Start of Change 9 (R4-2204877)>

##### 8.2.2.2.8 Interruptions due to UE-specific CBW change

When UE receives an RRC reconfiguration that changes *offsetToCarrier* or *carrierBandwidth*, the UE is allowed to cause interruption of up to X slot to other active serving cells due to switching its CBW. X is defined in Table 8.2.2.2.8-1. The interruption is only allowed within the delay TRRCprocessingDelay + TCBWchangeDelayRRC defined in clause 8.13.

Table 8.2.2.2.8-1: interruption length X

|  |  |  |
| --- | --- | --- |
|  | NR Slot  | Interruption length X (slots) |
|  | length (ms) |  |
| 0 | 1 | 1 |
| 1 | 0.5 | 1 |
| 2 | 0.25 | 3 |
| 3 | 0.125 | 5 |
| 5 | 0.03125 | 17 |
| 6 | 0.015625 | 33 |

<End of Change 9>

<Start of Change 10 (R4-2204877)>

##### 8.2.4.2.14 Interruptions due to UE-specific CBW change

The requirements in clause 8.2.2.2.8 apply for this clause.

<End of Change 10>

<Start of Change 11 (R4-2206922)>

#### 8.5.7.3 Scheduling availability of UE performing beam failure detection on FR2

The following scheduling restriction applies due to beam failure detection.

- For the case where no RSs are provided for BFD, or when CSI-RS is configured for BFD is explicitly configured and is type-D QCLed with active TCI state for PDCCH or PDSCH, and the CSI-RS is not in a CSI-RS resource set with repetition ON

- There are no scheduling restrictions due to beam failure detection performed based on the CSI-RS.

- Otherwise

- For FR2-1 or the BFD-RS is not using 480 kHz SCS or 960 kHz SCS on FR2-2, the UE is not expected to transmit PUCCH, PUSCH or SRS or receive PDCCH, PDSCH or CSI-RS for tracking or CSI-RS for CQI on BFD-RS resource symbols to be measured for beam failure detection.

- For FR2-2 and the BFD-RS is using 480 kHz SCS or 960 kHz SCS, the UE is not expected to transmit PUCCH, PUSCH or SRS or receive PDCCH, PDSCH or CSI-RS for tracking or CSI-RS for CQI on BFD-RS resource symbols to be measured for beam failure detection, and on one data symbol before each BFD-RS symbol to be measured and one data symbol after each BFD-RS symbol to be measured.

When intra-band carrier aggregation in FR2 is performed, the scheduling restrictions on FR2 serving PCell or PSCell apply to all serving cells in the same band on the symbols that fully or partially overlap with restricted symbols.

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

For FR2, if following conditions are met,

- UE has been notified about system information update through paging,

- The gap between UE’s reception of PDCCH that UE monitors in the Type2-PDCCH CSS set and that notifies system information update, and the PDCCH that UE monitors in the Type0-PDCCH CSS set, is greater than 2 slots,

For the SSB and CORESET for RMSI scheduling multiplexing patterns 3, UE is expected to receive the PDCCH that UE monitors in the Type0-PDCCH CSS set, and the corresponding PDSCH, on SSB symbols to be measured for BFD mesurement; and

For the SSB and CORESET for RMSI scheduling multiplexing patterns 2, UE is expected to receive PDSCH that corresponds to the PDCCH that UE monitors in the Type0-PDCCH CSS set, on SSB symbols to be measured for BFD mesurement.

<End of Change 11>

<Start of Change 12 (R4-2206922)>

#### 8.5.8.3 Scheduling availability of UE performing L1-RSRP measurement on FR2

The following scheduling restriction applies due to candidate beam detection

- For FR2-1 or the reference symbols to be measured for candidate beam detection is not using 480 kHz SCS or 960 kHz SCS on FR2-2, the UE is not expected to transmit PUCCH, PUSCH or SRS or receive PDCCH, PDSCH, CSI-RS for tracking or CSI-RS for CQI on reference symbols to be measured for candidate beam detection.

- For FR2-2 and the reference symbols to be measured for candidate beam detection is using 480 kHz SCS or 960 kHz SCS, the UE is not expected to transmit PUCCH, PUSCH or SRS or receive PDCCH, PDSCH, CSI-RS for tracking or CSI-RS for CQI on reference symbols to be measured for candidate beam detection, and on one data symbol before each reference symbol to be measured for candidate beam detection and one data symbol after each reference symbol to be measured for candidate beam detection.

When intra-band carrier aggregation in FR2 is configured, the scheduling restrictions on to one serving cell apply to all serving cells in the same band on the symbols that fully or partially overlap with restricted symbols.

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

For FR2, if following conditions are met,

- UE has been notified about system information update through paging,

- The gap between UE’s reception of PDCCH that UE monitors in the Type2-PDCCH CSS set and that notifies system information update, and the PDCCH that UE monitors in the Type0-PDCCH CSS set, is greater than 2 slots,

For the SSB and CORESET for RMSI scheduling multiplexing patterns 3, UE is expected to receive the PDCCH that UE monitors in the Type0-PDCCH CSS set, and the corresponding PDSCH, on SSB symbols to be measured for CBD mesurement; and

For the SSB and CORESET for RMSI scheduling multiplexing patterns 2, UE is expected to receive PDSCH that corresponds to the PDCCH that UE monitors in the Type0-PDCCH CSS set, on SSB symbols to be measured for CBD mesurement.

<End of Change 12>

<Start of Change 13 (R4-2206925)>

## 8.3A SCell Activation and Deactivation Delay in Carriers with CCA

### 8.3A.1 Introduction

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

In the requirements of clause 8.3A, the term SMTC occasion not available at the UE refers to when the SMTC contains SSBs configured by gNB in a cell on a carrier frequency subject to CCA, but the first two successive candidate SSB positions for the same SSB index within the discovery burst transmission window are not available at the UE due to DL CCA failures at gNB during the corresponding period; otherwise the SMTC occasion is considered as available at the UE.

In the requirements of clause 8.3A, the term CSI-RS occasion not available at the UE due to DL CCA failures referes to when the CSI-RS is configured by gNB for the UE but not available at the UE due to DL CCA failures at gNB during the corresponding period.

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

### 8.3A.2 SCell Activation Delay Requirement for Deactivated SCell

The requirements in this clause shall apply for the UE configured with one downlink SCell operating with CCA in EN-DC or in standalone NR carrier aggregation and when one SCell operating with CCA is being activated but none of the RRC parameters *CO-DurationPerCell-r16*, *SlotFormatIndicator*, and *CSI-RS-ValidationWith-DCI-r16* is configured and all of the CSI reporting resources for being-activated SCell are available.

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 + (THARQ + Tactivation\_time\_withCCA + TCSI\_reporting\_withCCA)/*NR\_slot\_length*, where:

- THARQ (in ms) is the timing between DL data transmission and acknowledgement as specified in TS 38.213 [3]. In the event of UE not being able to transmit the acknowledgment due to UL CCA failures: THARQ is extended to also include the time to all next HARQ feedback transmission and retransmission opportunities, until the time of its successful transmission, as specified in TS 38.213 [3]; no extension of THARQ due to UL CCA failures is allowed for Type 2C UL channel access procedure as defined in TS 37.213 [57].

- Tactivation\_time\_withCCA is the SCell activation delay in millisecond.

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

- TFirstSSB + L1\*Trs + 5ms, if the SCell measurement cycle is equal to or smaller than 160ms.

- TFirstSSB\_MAX + L2,1\*TSMTC\_MAX + (1 +L2,2)\*Trs + 5ms, if the SCell measurement cycle is larger than 160ms.

- If the SCell is unknown and belongs to FR1, provided that the side condition Ês/Iot ≥ -2 dB is fulfilled and the SCell can be successfully detected in one attempt, Tactivation\_time\_withCCA is:

- TFirstSSB\_MAX + (1 + L3,1)\*TSMTC\_MAX + (2 + L3,2)\*Trs + 5ms.

- If the SCell being activated belongs to FR2-2 and if there is at least one active serving cell on that FR2-2 band, if the UE supporting *scellWithoutSSB* is not provided with any SMTC for the target SCell, Tactivation\_time\_withCCA 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 FR2-2 band.

- If the SCell being activated belongs to FR2-2 and if there is no active serving cell on that FR2-2 band provided that PCell or PSCell is in FR1 or in FR2-2:

- If the target SCell is known to UE and semi-persistent CSI-RS is used for CSI reporting, then Tactivation\_time\_withCCA 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-FR2-2 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\_withCCA is:

- 6ms + TFirstSSB\_MAX + (15+[N\*L4,1])\*TSMTC\_MAX + (8+[ N \*L4,2])\*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 periodic CSI-RS is used for CSI reporting, provided that the side condition Ês/Iot ≥ -2dB is fulfilled, then Tactivation\_time\_withCCA is:

- 3ms + TFirstSSB\_MAX + (15+[ N\*L5,1])\*TSMTC\_MAX + (8+[ N \*L5,2])\*Trs + TL1-RSRP, measure + TL1-RSRP, report + max {(THARQ + Tuncertainty\_MAC + 5ms + TFineTiming), (Tuncertainty\_RRC + TRRC\_delay)}.

 Where,

 TSMTC\_MAX:

- In case of intra-band SCell activation, TSMTC\_MAX is the longest 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 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 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 configured SSB burst indicated by the SMTC after slot n + (THARQ+3ms)/*NR\_slot\_length*

 TFirstSSB\_MAX: is the time to the end of first complete configured SSB burst indicated by the SMTC after slot n + (THARQ+3ms)/*NR\_slot\_length* when all active serving cells and SCells being activated or released have configured SSB bursts in the same slot for intra-band scenario. In case of inter-band SCell activation, TFirstSSB\_MAX is the time to the end of the first complete configured SSB burst of the SCell being activated. In FR2-2, the occasion when all active serving cells and SCells being activated or released are transmitting SSB bursts in the same slot.

 L1 (L1 ≤ L1,max) is the number of configured SMTC occasions not available at the UE. L1,max = 2 if Trs ≤ 40 ms; otherwise L1,max = 1.

 L2,1 (L2,1 ≤ L2,1,max) and L3,1 (L3,1 ≤ L3,1,max) are the numbers of configured SMTC occasions not available at the UE, for a known and unknown SCell activation respectively,

 in the SCell being activated, for inter-band scenario, or

 in any of the SCells already activated or being activated provided their cell specific reference signals are configured in the same slot, for intra-band scenario

 and L2,1,max = 2 if TSMTC\_MAX ≤ 40 ms; otherwise L2,1,max = 1. L3,1,max = 2 if TSMTC\_MAX ≤ 40 ms; otherwise L3,1,max = 1.

 L2,2 (L2,2 ≤ L2,2,max) and L3,2 (L3,2 ≤ L3,2,max)are the number of configured SMTC occasions not available at the UE in the SCell being activated. L2,2,max = 2 if Trs ≤ 40 ms; otherwise L2,2,max = 1. L3,2,max = 2 if Trs ≤ 40 ms; otherwise L3,2,max = 1.

 N = TBD for an FR2-2 unknown SCell activation.

 L4,1 (L4,1 ≤ L4,1,max) and L5,1 (L5,1 ≤ L5,1,max) are the numbers of SMTC occasions groups not available at the UE, for an FR2-2 unknown SCell activation,

 in the SCell being activated, for inter-band scenario, or

 in any of the SCells already activated or being activated provided their cell specific reference signals are configured in the same slot, for intra-band scenario

and L4,1,max = 2 if TSMTC\_MAX ≤ 40 ms; otherwise L4,1,max = 1. L5,1,max = 2 if TSMTC\_MAX ≤ 40 ms; otherwise L5,1,max = 1.

 L4,2 (L4,2 ≤ L4,2,max) and L5,2 (L5,2 ≤ L5,2,max)are the number of SMTC occasions groups not available at the UE in the FR2-2 unknown SCell being activated. L4,2,max = 2 if Trs ≤ 40 ms; otherwise L4,2,max = 1. L5,2,max = 2 if Trs ≤ 40 ms; otherwise L5,2,max = 1.

 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\_CCA msas defined in clause 9.5A.4.1 with the assumption of M=1.

 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 FR2-2 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\_withCCA = TCSI\_reporting + TCSI\_ReportingDelay , where

 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].

 TCSI\_ReportingDelay is the additional delay in transmission of CSI reporting due to UL CCA failures at the UE. If there are no uplink resources for reporting the valid CSI, then the UE shall use the next available opportunities for reporting the corresponding valid CSI as specified in TS 38.213 [3].

Upon exceeding any of the maximum numbers L1,max, L2,1,max, L2,2,max, L3,1,max, and L3,2,max of SMTC occasions or CSI-RS occasions, respectively, not available at the UE, the UE shall abandon the SCell activation procedure.

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

- During the period equal to max(5 measCycleSCell,  5 DRX cycles) 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 in the SMTC occasions available at the UE, according to the cell identification conditions specified in clause 9.2A and 9.3A.

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

Otherwise SCell operating with CCA in FR1 is unknown.

For the first SCell activation with CCA in FR2-2 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

- 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 with CCA in FR2-2 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.

For intra-band CA, 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+ and not occur after slot n+1+ , where TX is:

- TFirstSSB, for known SCell activation when SCell measurement cycle is equal to or smaller than 160ms;

- TFirstSSB\_MAX + L2,1\* TSMTC\_MAX for known SCell activation when SCell measurement cycle is greater than 160ms;

- TFirstSSB\_MAX + L3,1\* TSMTC\_MAX for unknown SCell activation

For inter-band CA, 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+ and not occur after slot n+1+ , where TX is:

- TFirstSSB, for known SCell activation when SCell measurement cycle is equal to, or smaller than, 160ms.

For intra-band CA,

- While the SCell being activated is known with measurement cycle equal to or smaller than 160ms, no more than one interruption is allowed during SCell activation.

- While the SCell being activated is known with measurement cycle greater than 160ms, up to 1+L2,1 interruptions are allowed during SCell activation,

- While the SCell being activated is unknown, up to 1+L3,1 interruptions are allowed during SCell activation. When L3,1>0, performance degradation may be expected on any activated intra-band victim cells during the SCell activation

- For a single interruption (L=0), interruption window length at SCell activation does not depend on DL CCA failures.

For inter-band CA,

- For any active cell in the same band with the SCell being activated, the interruption requirements (i.e. number of interruptions and starting point of an interruption) for intra-band CA apply.

- For any active cell outside the band with the SCell being activated, a single interruption applies

The number of interruptions and length of each 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. For a single interruption (L=0), the interruption window length at SCell activation does not depend on DL CCA failures.

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.

The requirements in this section do not apply when *sCellDeactivationTimer* [2] is not configured and when Tactivation\_time\_withCCA exceeds 1280 ms.

### 8.3A.3 SCell Deactivation Delay Requirement for Activated SCell

The requirements in this clause shall apply for the UE configured with one downlink SCell operating with CCA in EN-DC or in standalone NR carrier aggregation.

Upon receiving SCell deactivation command in slot *n*, the UE shall accomplish the deactivation actions for the SCell being deactivated no later than in slot *n+*(THARQ +3ms)/*NR\_slot\_length*. 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+ and not occur after slot n+1+, where NR slot length is with respect to the numerology used in the SCell being deactivated.

Upon expiry of the *sCellDeactivationTimer* in slot *n*, the UE shall accomplish the deactivation actions for the SCell being deactivated no later than in slot *n +*. 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 and not occur after slot n+1+, where NR slot length is with respect to the numerology used in the SCell being deactivated.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 section do not apply when *sCellDeactivationTimer* [2] is not configured and when SCell deactivation delay exceeds 1280 ms.

<End of Change 13>

<Start of Change 14 (R4-2206930)>

## 8.5A Link Recovery Procedures when CCA is used on target frequency

### 8.5A.1 Introduction

The requirements for link recovery procedure in the clause apply when CCA is used on a serving frequency on the downlink.

The UE shall assess the downlink radio link quality of a serving cell based on the reference signal in the set as specified in TS 38.213 [3] in order to detect beam failure on:

- PCell in SA operation mode,

- PSCell in EN-DC operation mode.

- PSCell in NR-DC operation mode.

The RS resource configurations in the set can be periodic SSBs. UE is not required to perform beam failure detection outside the active DL BWP. UE is not required to meet the requirements in clause 8.5A.2 and 8.5A.3 if UE does not have set .

On each RS resource configuration in the set , the UE shall estimate the radio link quality and compare it to the threshold Qout\_LR,CCA for the purpose of accessing downlink radio link quality of the serving cell beams.

The threshold Qout\_LR,CCA is defined as the level at which the downlink radio level link of a given resource configuration on set cannot be reliably received and shall correspond to the BLERout,CCA = 10% block error rate of a hypothetical PDCCH transmission. For SSB based beam failure detection, Qout\_LR\_SSB,CCA is derived based on the hypothetical PDCCH transmission parameters listed in Table 8.5A.2.1-1.

Upon request the UE shall deliver configuration indexes from the set as specified in TS 38.213 [3] , to higher layers, and the corresponding L1-RSRP measurement provided that the measured L1-RSRP is equal to or better than the threshold Qin\_LR,CCA, which is indicated by higher layer parameter *rsrp-ThresholdSSB*. The UE applies the Qin\_LR,CCA threshold to the L1-RSRP measurement obtained from an SSB. The RS resource configurations in the set can be periodic SSBs. UE is not required to perform candidate beam detection outside the active DL BWP.

In the requirements of clause 8.5A, the term CBD-RS SSB occasions not available at the UE refers to when the CBD-RS SSB is configured by gNB in a cell on a carrier frequency subject to CCA, but the first two successive candidate SSB positions for the same SSB index within the set of configured CBD-RS resources are not available at the UE due to DL CCA failures at gNB during the corresponding evaluation period; otherwise the CBD-RS SSB is considered as available at the UE.

The requirements in clause 8.5A apply for any *channelAccessMode* configuration [TS 38.331, 2].

### 8.5A.2 Requirements for SSB based beam failure detection

#### 8.5A.2.1 Introduction

The requirements in this clause apply for each SSB resource in the set configured for a serving cell, provided that the SSB configured for beam failure detection is actually transmitted within the UE active DL BWP during the entire evaluation period specified in clause 8.5A.2.2, but occasionally may not be transmitted due to CCA operation.

Table 8.5A.2.1-1: PDCCH transmission parameters for beam failure instance

|  |  |
| --- | --- |
| Attribute | Value for BLER |
| DCI format | 1-0 |
| Number of control OFDM symbols | 2 |
| Aggregation level (CCE) | 8 |
| Ratio of hypothetical PDCCH RE energy to average SSS RE energy | 0dB |
| Ratio of hypothetical PDCCH DMRS energy to average SSS RE energy | 0dB |
| Bandwidth (PRBs) | 24 |
| Sub-carrier spacing (kHz) | Same as the SCS of RMSI CORESET |
| DMRS precoder granularity | REG bundle size |
| REG bundle size | 6 |
| CP length | Normal |
| Mapping from REG to CCE | Distributed |

#### 8.5A.2.2 Minimum requirement

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

The value of TEvaluate\_BFD\_SSB\_CCA is defined in Table 8.5A.2.2-1 for FR1.

The value of TEvaluate\_BFD\_SSB\_CCA is defined in Table 8.5A.2.2-2 for FR2-2 with scaling factor N=TBD.

- , when in the monitored cell there are measurement gaps configured for intra-frequency, inter-frequency or inter-RAT measurements, which are overlapping with some but not all occasions of the BFD-RS SSB.

- P=1 when in the monitored cell there are no measurement gaps overlapping with any occasion of the BFD-RS SSB.

For FR2-2,

- , when BFD-RS resource is not overlapped with measurement gap 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 measurement gap and the BFD-RS resource is fully overlapped with SMTC period (TSSB = TSMTCperiod).

- , when the BFD-RS resource is partially overlapped with measurement gap and the BFD-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and

- TSMTCperiod ≠ MGRP or

- TSMTCperiod = MGRP and TSSB < 0.5\*TSMTCperiod

- , when the BFD-RS resource is partially overlapped with measurement gap and the BFD-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and TSMTCperiod = MGRP and TSSB = 0.5\*TSMTCperiod

- , when the BFD-RS resource is partially overlapped with measurement gap (TSSB <MGRP) and the BFD-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is partially or fully overlapped with measurement gap.

- , when the BFD-RS resource is partially overlapped with measurement gap and the BFD-RS resource is fully overlapped with SMTC occasion (TSSB = TSMTCperiod) and SMTC occasion is partially overlapped with measurement gap (TSMTCperiod < MGRP)

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

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

- not overlapped with the RSSI symbols indicated by ss-RSSI-Measurement and TBD data symbol before each RSSI symbol indicated by ss-RSSI-Measurement and TBD data symbol after each RSSI symbol indicated by ss-RSSI-Measurement, given that ss-RSSI-Measurement is configured.- Psharing factor = 3, otherwise.

where,

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 FR2-2 band, given the SMTC offset of all CCs in FR2-2 provided the same offset.

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*.

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

Table 8.5A.2.2-1: Evaluation period TEvaluate\_BFD\_SSB\_CCA for FR1

|  |  |
| --- | --- |
| Configuration | TEvaluate\_BFD\_SSB\_CCA (ms)  |
|  | BFD-RS SSB Es/Iot Note2 ≥ -7 dB | BFD-RS SSB Es/Iot Note2 < -7 dB |
| no DRX | Max(50, Ceil((10 × P) × TSSB)) | Max(50, Ceil((12 × P) × TSSB)) |
| DRX cycle ≤ 320ms | Max(50, Ceil(1.5 × 8 × P) × Max(TDRX,TSSB)) | Max(50, Ceil(1.5 × 10 × P) × Max(TDRX,TSSB)) |
| DRX cycle > 320ms | Ceil(7 × P) × TDRX | Ceil(8 × P) × TDRX |
| Note 1: TSSB is the periodicity of SSB in the set . TDRX is the DRX cycle length.Note 2: BFD-RS SSB Es/Iot is the averaged BFD-RS SSB Es/Iot over the most recent previous evaluation period. |

Table 8.5A.2.2-2: Evaluation period TEvaluate\_BFD\_SSB\_CCA for FR2-2

|  |  |
| --- | --- |
| Configuration | TEvaluate\_BFD\_SSB\_CCA (ms)  |
|  |
| no DRX | TBD |
| DRX cycle ≤ 320ms | TBD |
| DRX cycle > 320ms | TBD |
| Note 1: TSSB is the periodicity of SSB in the set . TDRX is the DRX cycle length. |

#### 8.5A.2.3 Measurement restriction for SSB based beam failure detection

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

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

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

- If SSB and CSI-RS have different SCS,

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

- If UE does not support *simultaneousRxDataSSB-DiffNumerology*, UE is required to measure SSB for BFD measurement.

For FR2-2, when the SSB for BFD measurement on one CC is in the same OFDM symbol as CSI-RS for RLM, BFD, CBD or L1-RSRP measurement on the same CC or different CCs in the same band, UE is required to measure one of but not both SSB for BFD measurement and CSI-RS. Longer measurement period for SSB based BFD measurement is expected, and no requirements are defined.

### 8.5A.4 Minimum requirement for L1 indication

When the radio link quality on all the RS resources in set is worse than Qout\_LR,CCA, layer 1 of the UE shall send a beam failure instance indication to the higher layers.

The beam failure instance evaluation for the RS resources in set shall be performed as specified in clause 6 in TS 38.213 [3]. Two successive indications from layer 1 shall be separated by at least TIndication\_interval\_BFD\_CCA.

When DRX is not used, TIndication\_interval\_BFD\_CCA is max(2ms, TSSB-RS,M) ), where TSSB-RS,M is the shortest periodicity of all RS resources in set for the accessed cell, corresponding to either the shortest periodicity of the SSB in the set .

When DRX is used, for SSB based link quality measurement,

- TIndication\_interval\_BFD\_CCA = Max(1.5 × DRX\_cycle\_length, 1.5 × TSSB-RS,M), if DRX\_cycle\_length ≤ 320ms,

- TIndication\_interval\_BFD\_CCA = DRX\_cycle\_length, if DRX\_cycle\_length > 320ms.

### 8.5A.5 Requirements for SSB based candidate beam detection

#### 8.5A.5.1 Introduction

The requirements in this clause apply for each CBD-RS SSB resource in the set configured for a serving cell, provided that the SSBs configured for candidate beam detection are actually transmitted within UE active DL BWP during the entire evaluation period specified in clause 8.5A.5.2, but occasionally may not be transmitted due to CCA operation.

#### 8.5A.5.2 Minimum requirement

Upon request the UE shall be able to evaluate whether the L1-RSRP measured on the configured CBD-RS SSB resource in set  estimated over the last TEvaluate\_CBD\_SSB\_CCA ms period becomes better than the threshold Qin\_LR,CCA 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 8.5A.5.2-1 corresponding to the non-DRX mode, if the configured DRX cycle ≤ 320ms.

The value of TEvaluate\_CBD\_SSB\_CCA is defined in Table 8.5A.5.2-1 for FR1.

The value of TEvaluate\_CBD\_SSB\_CCA is defined in Table 8.5A.5.2-2 for FR2-2 with scaling factor N=TBD.

For FR1,

- , when in the monitored cell there are measurement gaps configured for intra-frequency, inter-frequency or inter-RAT measurements, which are overlapping with some but not all occasions of the CBD-RS SSB,

- P = 1 when in the monitored cell there are no measurement gaps overlapping with any occasion of the CBD-RS SSB.

For FR2-2,

- , when candidate beam detection RS is not overlapped with measurement 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 measurement gap and candidate beam detection RS is fully overlapped with SMTC period (TSSB = TSMTCperiod).

- , when candidate beam detection RS is partially overlapped with measurement gap and candidate beam detection RS is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and

- TSMTCperiod ≠ MGRP or

- TSMTCperiod = MGRP and TSSB < 0.5 × TSMTCperiod

- , when candidate beam detection RS is partially overlapped with measurement gap and candidate beam detection RS is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is not overlapped with measurement gap and TSMTCperiod = MGRP and TSSB = 0.5 × TSMTCperiod

- , when candidate beam detection RS is partially overlapped with measurement gap and candidate beam detection RS is partially overlapped with SMTC occasion (TSSB < TSMTCperiod) and SMTC occasion is partially or fully overlapped with measurement gap

- , when candidate beam detection RS is partially overlapped with measurement gap and candidate beam detection RS is fully overlapped with SMTC occasion (TSSB = TSMTCperiod) and SMTC occasion is partially overlapped with measurement gap (TSMTCperiod < MGRP)

- Psharing factor = 1, if the candidate beam detection RS outside measurement gap is

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

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

- Psharing factor = 3, otherwise.

where,

 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 FR2-2 band, provided the SMTC offset of all CCs in FR2-2 have the same offset.

Table 8.5A.5.2-1: Evaluation period TEvaluate\_CBD\_SSB\_CCA for FR1

|  |  |
| --- | --- |
| Configuration | TEvaluate\_CBD\_SSB\_CCA (ms)  |
| non-DRX, DRX cycle ≤ 320ms | Max(25, Ceil((3 + LCBD) × P) × TSSB) |
| DRX cycle > 320ms | Ceil((3 + LCBD) × P) × TDRX |
| Note 1: TSSB is the periodicity of SSB in the set . TDRX is the DRX cycle length.Note 2: When DRX is not configured, LCBD is the number of CBD-RS SSB occasions not available at the UE during TEvaluate\_CBD\_SSB\_CCA where LCBD ≤ LCBD,max. When DRX is configured, LCBD is the number of DRX cycles in which at least one of the CBD-RS SSB occasions not available at the UE during TEvaluate\_CBD\_SSB\_CCA where LCBD ≤ LCBD,max. The UE is not required to determine the availability of SSB occasions more frequent than once per DRX cycle length, when configured with DRX.Note 3: LCBD,max=7 for Max(TDRX, TSSB) ≤ 40 assuming TDRX=0 for non-DRX, LCBD,max=5 for 40 < Max(TDRX, TSSB) ≤ 320, LCBD,max=3 for TDRX > 320.Note 4 If LCBD>LCBD,max, the UE shall assume no new candidate beams are found for this evaluation period. |

Table 8.5A.5.2-2: Evaluation period TEvaluate\_CBD\_SSB\_CCA for FR2-2

|  |  |
| --- | --- |
| Configuration | TEvaluate\_CBD\_SSB\_CCA (ms)  |
| non-DRX, DRX cycle ≤ 320ms | Max(25, Ceil((3 + LCBD) × P× N) × TSSB) |
| DRX cycle > 320ms | Ceil((3 + LCBD) × P × N) × TDRX |
| Note 1: TSSB is the periodicity of SSB in the set . TDRX is the DRX cycle length.Note 2: When DRX is not configured, Lin is the number of CBD-RS SSB occasions group which are not available at the UE during TEvaluate\_CBD\_SSB,CCA, where LCBD ≤ LCBD,max. A CBD-RS SSB occasions group consists of N consecutive CBD-RS SSB occasions, and the CBD-RS SSB occasions group is not available at the UE when at least one CBD-SSB occasion in the group is not transmitted by the gNB. When DRX is configured, Lin is the number of DRX cycles groups which are not available at the UE during TEvaluate\_CBD\_SSB,CCA, where Lin ≤ LCBD,max. A DRX group consists of N DRX cycles, and the DRX group is not available when there is at least one DRX in which at least one CBD-RS SSB occasion is not available. The UE is not required to determine the availability of SSB occasions more frequent than once per DRX cycle length, when configured with DRX.Note 3: LCBD,max=7 for Max(TDRX, TSSB) ≤ 40 assuming TDRX=0 for non-DRX, LCBD,max=5 for 40 < Max(TDRX, TSSB) ≤ 320, LCBD,max=3 for TDRX > 320.Note 4 If LCBD>LCBD,max, the UE shall assume no new candidate beams are found for this evaluation period. |

#### 8.5A.5.3 Measurement restriction for SSB based candidate beam detection

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

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

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

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

- If UE does not support *simultaneousRxDataSSB-DiffNumerology*, UE is required to measure SSB for CBD measurement.

For FR2-2, when the SSB for CBD measurement on one CC is in the same OFDM symbol as CSI-RS for RLM, BFD, CBD or L1-RSRP measurement on the same CC or different CCs in the same band, UE is required to measure one of but not both SSB for CBD measurement and CSI-RS. Longer measurement period for SSB based CBD measurement is expected, and no requirements are defined.

### 8.5A.7 Scheduling availability of UE during beam failure detection

Scheduling availability restrictions when the UE is performing beam failure detection are described in the following clauses.

#### 8.5A.7.1 Scheduling availability of UE performing beam failure detection with a same subcarrier spacing as PDSCH/PDCCH

In this clause, the same requirements apply as in Clause 8.5.7.1.

#### 8.5A.7.2 Scheduling availability of UE performing beam failure detection with a different subcarrier spacing than PDSCH/PDCCH on FR1

In this clause, the same requirements apply as in Clause 8.5.7.2.

#### 8.5A.7.3 Scheduling availability of UE performing beam failure detection on FR2-2

In this clause, the same requirements apply as in Clause 8.5.7.3.

#### 8.5A.7.4 Scheduling availability of UE performing beam failure detection on FR1 or FR2-2 in case of FR1-FR2-2 inter-band CA and NR DC

In this clause, the same requirements apply as in Clause 8.5.7.4.

### 8.5A.8 Scheduling availability of UE during candidate beam detection

Scheduling availability restrictions when the UE is performing L1-RSRP measurement for candidate beam detection are described in the following clauses.

#### 8.5A.8.1 Scheduling availability of UE performing L1-RSRP measurement with a same subcarrier spacing as PDSCH/PDCCH on FR1

In this clause, the same requirements apply as in Clause 8.5.8.1.

#### 8.5A.8.2 Scheduling availability of UE performing L1-RSRP measurement with a different subcarrier spacing than PDSCH/PDCCH on FR1

In this clause, the same requirements apply as in Clause 8.5.8.2.

#### 8.5A.8.3 Scheduling availability of UE performing L1-RSRP measurement on FR2-2

In this clause, the same requirements apply as in Clause 8.5.8.3.

#### 8.5.8.4 Scheduling availability of UE performing L1-RSRP measurement on FR1 or FR2-2 in case of FR1-FR2-2 inter-band CA and NR-DC

In this clause, the same requirements apply as in Clause 8.5.8.4.

<End of Change 14>

<Start of Change 15 (R4-2204541)>

8.6.2 DCI and timer based BWP switch delay on a single CC

The requirements in this clause only apply to the case that the BWP switch is performed on a single CC with more than one BWP configurations configured.

For DCI-based BWP switch, after the UE receives BWP switching request at DL slot n on a serving cell, UE shall be able to receive PDSCH (for DL active BWP switch) or transmit PUSCH (for UL active BWP switch) on the new BWP on the serving cell on which BWP switch on the first DL or UL slot occurs right after a time duration of TBWPswitchDelay + Y which starts from the beginning of DL slot n. Where,

- Y=0, if the serving cell where UE receives DCI for BWP switch request is same as the serving cell on which BWP switch occurs.

- Y equals to the length of 1 slot, if the serving cell where UE receives DCI for BWP switch is different from the serving cell on which BWP switch occurs for any involved serving cell. In this scenario, TBWPswitchDelay + Y shall follow the smaller SCS of scheduling cell, scheduled cells before and scheduled cells after active BWP change.If both scheduling cell and scheduled cell are in FR2-2, Y shall follow the SCS of 120 KHz.

The UE is not required to transmit UL signals or receive DL signals until the first DL or UL slot occurs right after a time duration of TBWPswitchDelay which starts from the beginning of DL slot n except DCI triggering BWP switch on the cell where DCI-based BWP switch occurs. The UE is not required to follow the requirements defined in this clause when performing a DCI-based BWP switch between the BWPs in disjoint channel bandwidths or in partially overlapping channel bandwidths.

For timer-based BWP switch, the UE shall start BWP switch at DL slot n, where slot n is the first slot of a DL subframe (FR1) or DL half-subframe (FR2) immediately after a BWP-inactivity timer *bwp-InactivityTimer* [2] expires on a serving cell, and the UE shall be able to receive PDSCH (for DL active BWP switch) or transmit PUSCH (for UL active BWP switch) on the new BWP on the serving cell on which BWP switch on the first DL or UL slot occurs right after a time duration of TBWPswitchDelay which starts from the beginning of DL slot n.

The UE is not required to transmit UL signals or receive DL signals during time duration TBWPswitchDelay after *bwp-InactivityTimer* [2] expires on the cell where timer-based BWP switch occurs.

Depending on UE capability *bwp-SwitchingDelay* [2], UE shall finish BWP switch within the time duration TBWPswitchDelay defined in Table 8.6.2-1.

**Table 8.6.2-1: BWP switch delay**

|  |  |  |
| --- | --- | --- |
|  | **NR Slot length**  | **BWP switch delay TBWPswitchDelay (slots)** |
|  | **(ms)** | **Type 1Note 1** | **Type 2Note 1** |
| 0 | 1 | 1 | 3 |
| 1 | 0.5 | 2 | 5 |
| 2 | 0.25 | 3 | 9 |
| 3 | 0.125 | 6 | 18 |
| 5 | 0.03125 | 20 | 65 |
| 6 | 0.015625 | 39 | 129 |
| Note 1: Depends on UE capability.Note 2: If the BWP switch involves changing of SCS, the BWP switch delay is determined by the smaller SCS between the SCS before BWP switch and the SCS after BWP switch. |

Provided the UE does not have the required TCI-state information to receive PDCCH and PDSCH in the new BWP, the UE shall use old TCI-states before the BWP switch until a new MAC CE updating the required TCI-state information for PDCCH and PDSCH is received after the BWP switch.

If UE has the information on the required TCI-state information to receive PDCCH and PDSCH in the new BWP,

- UE shall be able to receive PDCCH and PDSCH with old TCI-states before the delay as specified in Clause 8.10 in the new BWP.

- UE shall be able to receive PDCCH and PDSCH with new TCI-states after the delay as specified in Clause 8.10 in the new BWP.

If the BWP switch is triggered within or outside DRX active time, and one of the two BWPs in a BWP switching is a dormant BWP [TS 38.321, 7], UE shall be able to complete active BWP switching within the time duration of

- TdormantBWPswitchDelay =TBWPswitchDelay+ X, provided that the dormancy indication is received in any of the first 3 OFDM symbols of a slot in the serving cell where DCI for dormancy indication is receiveds, or

- TdormantBWPswitchDelay =TBWPswitchDelay + X + Z, provided that the dormancy indication is received after the first 3 OFDM symbols of a slot in the serving cell where DCI for dormancy indication is received, where

- TBWPswitchDelay is defined in Table 8.6.2-1 corresponding to the smallest value among the SCS of the serving cell where UE receives dormancy indication and the SCSs of the dormant BWP and the active BWP immediately before or after switching the BWP of the serving cell where BWP switching occurs;

- X equals to the length of 1 slot corresponding to the smallest value among the SCS of the serving cell where UE receives dormancy indication and the SCSs of the dormant BWP and the active BWP immediately before or after switching the BWP of the serving cell where BWP switching occurs. If both scheduling cell and scheduled cell are in FR2-2, X shall follow the SCS of 120 KHz.

- Z equals to the length of 1 slot corresponding to the SCS of the serving cell where UE receives dormancy indication.

For DCI-based BWP switch, if the new BWP is a dormant BWP, after the UE receives BWP switching request at DL slot n on a serving cell, UE shall be able to receive CSI-RS (for DL active BWP switch) on the new BWP on the serving cell on which BWP switch on the first DL slot occurs right after a time duration of TdormantBWPswitchDelay which starts from the beginning of DL slot n.

8.6.2A DCI based BWP switch delay on multiple CCs

The requirements in this clause only apply to the case when the same type of BWP switch (DCI based BWP switch) is performed on multiple CCs simultaneously or over partially overlapping time period.

8.6.2A.1 Simultaneous DCI based BWP switch delay on multiple CCs

The delay requirements for simultaneous DCI based BWP switch on multiple CCs in this clause apply only if the timing difference among the first symbol of slot carrying DCI for all CCs is received within the MRTD for inter-band CA as defined in clause 7.6.4.

For DCI-based BWP switch on multiple CCs, after the UE receives BWP switching request, UE shall be able to receive PDSCH (for DL active BWP switch) or transmit PUSCH (for UL active BWP switch) on the new BWPs on the serving cells on which BWP switch on the first DL or UL slot occurs right after a time duration of TMultipleBWPswitchDelay which starts from the beginning of DL slot n, where slot n is slot which UE receives the earliest BWP switching request among CCs on which UE is performing simultaneous DCI-based BWP switching.

The UE is not required to transmit UL signals or receive DL signals until the first DL or UL slot occurs right after a time duration of TMultipleBWPswitchDelay which starts from the beginning of DL slot n except DCI triggering BWP switch on the cell where DCI-based BWP switch occurs. The UE is not required to follow the requirements defined in this clause when performing a DCI-based BWP switch between the BWPs in disjoint channel bandwidths or in partially overlapping channel bandwidths on any serving cell.

UE shall finish BWP switch within the time duration TMultipleBWPswitchDelay + Y, which is defined as:

 TMultipleBWPswitchDelay = TBWPswitchDelay + D\*(N-1)

Where:

- TBWPswitchDelay is the BWP switching delay on single CC defined in Table 8.6.2-1 depending on UE capability *bwp-SwitchingDelay* [2]. TBWPswitchDelay shall be based on the smallest SCS among SCS of all involved CCs before and after BWP switch. If the BWP switch on multiple CCs results in the change of the SCS on any CC among involved CCs, TBWPswitchDelay should be based on the smallest SCS among all SCS values of all involved CCs.

- D is the incremental delay for each additional CC involved in simultaneous BWP switch and depends on UE capability *bwp-SwitchingMultiCCs-r16* [TS 38.306, 14] for switching between non-dormant BWPs, and *bwp-SwitchingMultiDormancyCCs-r16* for switching between non-dormant and dormant BWPs.

- For UE which is capable of per-FR gap, and no BWP switch involves SCS change, N is the number of CCs in same FR; For UE which is not capable of per-FR gap, or the BWP switches on any CC involves SCS changing, N is the number of CCs undergoing simultaneous BWP switch.

* Y=0, ­if the serving cell where UE receives DCI for BWP switch is same as the serving cell on which BWP switch occurs for each involved serving cell.

Y equals to the length of one slot at smaller SCS of scheduling cell, scheduled cells before and scheduled cells after active BWP change, ­if the serving cell where UE receives DCI for BWP switch is different from the serving cell on which BWP switch occurs for any involved serving cell. If both scheduling cell and scheduled cell are in FR2-2, Y shall follow the SCS of 120 KHz.

Provided the UE does not have the required TCI-state information to receive PDCCH and PDSCH in the new BWP, the UE shall use old TCI-states before the BWP switch until a new MAC CE updating the required TCI-state information for PDCCH and PDSCH is received after the BWP switch.

If UE has the information on the required TCI-state information to receive PDCCH and PDSCH in the new BWP,

- UE shall be able to receive PDCCH and PDSCH with old TCI-states before the delay as specified in Clause 8.10 in the new BWP.

- UE shall be able to receive PDCCH and PDSCH with new TCI-states after the delay as specified in Clause 8.10 in the new BWP.

If the BWP switch is triggered on multiple CCs simultaneously within or outside DRX active time, and one of the two BWPs on each CC in a BWP switching is a dormant BWP [TS 38.321, 7], UE shall be able to complete active BWP switching within the time duration of

- TDormantMultipleBWPswitchDelay = TMultipleBWPswitchDelay+X, provided that the dormancy indication is received in any of the first 3 OFDM symbols of a slot in the serving cell where DCI for dormancy indication is received, or

- TDormantMultipleBWPswitchDelay = TMultipleBWPswitchDelay +X+Z, provided that the dormancy indication is received after the first 3 OFDM symbols of a slot in the serving cell where DCI for dormancy indication is received, where

- TMultipleBWPswitchDelay is defined above corresponding to the smallest value among the SCS of the serving cell where UE receives dormancy indication and the SCSs of the dormant BWP and the active BWP immediately before or after switching the BWP of the serving cell where BWP switching occurs;

- X equals to the length of 1 slot corresponding to the smallest value among the SCS of the serving cell where UE receives dormancy indication and the SCSs of the dormant BWP and the active BWP immediately before or after switching the BWP of the serving cell where BWP switching occurs. If both scheduling cell and scheduled cell are in FR2-2, X shall follow the SCS of 120 KHz.

- Z equals to the length of 1 slot corresponding to the SCS of the serving cell where DCI for dormancy indication is received.

The number of CCs, N, on which the UE can simultaneously switch BWPs while still meeting the requirements, if any, related to allocations on downlink, uplink, or transmission of HARQ-ACK, depends on the UE reported capabilities related to BWP switching, the network configuration and the BWP switch method.

<End of Change 15>

<Start of Change 16 (R4-2206928)>

## 8.9A NR-DC: PSCell Addition and Release Delay in Carriers with CCA

### 8.9A.1 Introduction

This clause defines requirements for the delay within which the UE shall be able to configure an PSCell in FR2-2 with CCA in NR dual connectivity. The requirements are applicable to an NR dual connectivity capable UE.

### 8.9A.2 PSCell Addition Delay Requirement

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

Upon receiving PSCell addition in subframe *n*, the UE shall be capable to transmit PRACH preamble towards PSCell in FR2-2 no later than in slot :

where:

 Tconfig\_PSCell\_CCA = TRRC\_delay + Tprocessing + Tsearch\_CCA + T∆\_CCA + TPSCell\_ DU + 2 ms

 TRRC\_delay is the RRC procedure delay as specified in TS 38.331 [2].

 Tprocessing is the SW processing time needed by UE, including RF warm up period. Tprocessing = 40 ms.

 Tsearch\_CCA is the time for AGC settling and PSS/SSS detection. If the target cell is known, Tsearch = 0 ms. If the target cell is unknown and the target cell Ês/Iot ≥ -2dB, Tsearch = (24+L1\*N) \* Trs ms, where L1 is the number of SMTC occasions groups with at least one SSB/SMTC occasion in the group is not transmitted by the gNB during the AGC settling and PSS/SSS detection. L1, max=TBD, N is the Rx beam sweeping factor for FR2-2.

 T∆\_CCA is time for fine time tracking and acquiring full timing information of the target cell. T∆ = (1+L2) \*Trs ms for a known or unknown PSCell, where L2 is the number of SMTC occasions not avaible at the UE during the time tracking period. L2, max =TBD.

TPSCell\_ DU is the interruption uncertainty due to the random access procedure when sending PRACH to the new cell. TPSCell\_ DU can be up to: (1+ L3) \* TSSB,RO + 10 ms where TSSB,RO is the SSB to PRACH occasion association period as defined in Table 8.1-1 of TS 38.213 [3] and L3 is the number of consecutive SSB to PRACH occasion association periods during which no PRACH occasion is available for PRACH transmission due to UL CCA failure. L3 = 0 for Type 3 UL channel access procedure as defined in TS 37.213 [33].

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

NOTE 1: The interruption time considering the potential extensions caused by L1,L2, L3 and by the UL CCA failure detection/recovery mechanism is limited by the T304 timer. The UE behaviour at the T304 timer expiry is detailed in TS 38.331 [2].

In FR2-2, the PSCell is known if it has been meeting the following conditions:

- During the last 5 seconds before the reception of the PSCell configuration command:

- the UE has sent a valid measurement report for the PSCell being configured and

- One of the SSBs measured from the PSCell being configured remains detectable according to the cell identification conditions specified in clause 9.3A.

- One of the SSBs measured from PSCell being configured also remains detectable during the PSCell configuration delay Tconfig\_PSCell\_CCA according to the cell identification conditions specified in clause 9.3A.

otherwise it is unknown.

The PCell interruption specified in clause 8.2 is allowed only during the RRC reconfiguration procedure [2].

### 8.9A.3 PSCell Release Delay Requirement

The requirements in this clause shall apply for a UE which is configured with PCell in FR1 and one PSCell in FR2-2.

Upon receiving PSCell release in subframe *n*, the UE shall accomplish the release actions specified in TS 38.331 [2] no later than in slot :

where

 TRRC\_delay is the RRC procedure delay as specified in TS 38.331 [2].

The PCell interruption specified in clause 8.2 is allowed only during the RRC reconfiguration procedure [2].

<End of Change 16>

<Start of Change 17 (R4-2206926)>

## 8.10A Active TCI state switching delay with CCA

### 8.10A.1 Introduction

The requirements in this clause apply for a UE configured with one or more TCI state configurations on serving cell in EN-DC with PSCell on a carrier frequency with CCA or SA NR with PCell on a carrier frequency with CCA. UE shall complete the switch of active TCI state within the delay defined in this clause.

In the requirements of clause 8.10A, the term SSB occasion not available at the UE refers to when the SSB is configured by gNB in a cell on a carrier frequency subject to CCA, but the first two successive candidate SSB positions for the same SSB index within the discovery burst transmission window are not available at the UE due to DL CCA failures at gNB during the corresponding period; otherwise the SSB occasion is considered as available at the UE.

### 8.10A.2 Known conditions for TCI state

The TCI state is known if the following conditions are met:

- During the period from the last transmission of the RS resource used for the L1-RSRP measurement reporting for the target TCI state to the completion of active TCI state switch, where the RS resource for L1-RSRP measurement is the RS in target TCI state or QCLed to the target TCI state

- TCI state switch command is received within 1280 ms of the last transmission of the RS resource for beam reporting or measurement

- The UE has sent at least 1 L1-RSRP report for the target TCI state before the TCI state switch command

- The TCI state remain detectable during the TCI state switching period in the SSB occasions available at the UE

- The SSB associated with the TCI state remain detectable during the TCI switching period in the SSB occasions available at the UE

- SNR of the TCI state is ≥ -3dB

Otherwise, the TCI state is unknown.

### 8.10A.3 MAC-CE based TCI state switch delay

If the target TCI state is known, upon receiving PDSCH carrying MAC-CE activation command at slot n, UE shall be able to receive PDCCH with target TCI state of the serving cell on which TCI state switch occurs at the first slot that is after slot n+ +(THARQ +TOk\*(Tfirst-SSB + TSSB-proc+TSSB\*LMAC,known)) */NR slot length*. The UE shall be able to receive on the old TCI state until slot n + + (THARQ +TOk\*(Tfirst-SSB+ TSSB\*LMAC,known)) / *NR slot length*, where

 THARQ (in ms) is the timing between DL data transmission and acknowledgement as specified in TS 38.213 [3]. In the event of UE not being able to transmit the acknowledgment due to UL CCA failures: THARQ is extended to also include the time to all next HARQ feedback transmissions and retransmission opportunities, until the time of its successful transmission, as specified in TS 38.213 [3]; no extension of THARQ due to UL CCA failures is allowed for Type 2C UL channel access in TS 37.213;

 Tfirst-SSB is time to first SSB transmission occasion after MAC CE command is decoded by the UE, during which some SSB occasions may not be available at the UE due to DL CCA failures;

 The SSB shall be the QCL-TypeA or QCL-TypeC to target TCI state;

 TSSB-proc = 2 ms;

 TOk = 1 if target TCI state is not in the active TCI state list for PDSCH, 0 otherwise;

 TSSB = ssb-periodicityServingCell;

 LMAC,known≤ LMAC,known,max is the corresponding number of SSB occasions not available at the UE;

 LMAC,known,max =2 for TSSB≤40 ms, LMAC,known,max =1 for TSSB>40 ms.

If the target TCI state is unknown, upon receiving PDSCH carrying MAC-CE activation command at slot n, UE shall be able to receive PDCCH with target TCI state of the serving cell on which TCI state switch occurs at the first slot that is after slot n+ + (THARQ+ TL1-RSRP +TOuk\*(Tfirst-SSB+ TSSB-proc+TSSB\*LMAC,unknown)) / *NR slot length*. The UE shall be able to receive on the old TCI state until slot n+ + (THARQ+TOuk\*(Tfirst-SSB+ TSSB\*LMAC,unknown)) / *NR slot length*,

Where:

* LMAC,unknown≤LMAC,unknown,max is the corresponding number of SSB occasions groups not available at the UE;
* LMAC,unknown,max = 2 for TSSB≤40 ms, LMAC,unknown,max = 1 for TSSB>40 ms;
* TOuk = 1.

 - T L1-RSRP = 0 in FR1 or when the TCI state switching not involving QCL-TypeD in FR2-2. Otherwise,

- T L1-RSRP is the time for Rx beam refinement in FR2-2, defined as

- TL1-RSPR\_Measurement\_Period\_SSB\_CCA for SSB as specified in clause 9.5A.4.1,

- with the assumption of M=1

- with TReport = 0

- TOuk = 0 for SSB based L1-RSRP measurement when TCI state switching involves QCL-TypeD

- TOuk = 1 when TCI state switching involves other QCL types only

- Tfirst-SSB is time to first SSB transmission after L1-RSRP measurement when TCI state switching involves QCL-TypeD;

- Tfirst-SSB is time to first SSB transmission after MAC CE command is decoded by the UE for other QCL types;

- The SSB shall be the QCL-TypeA or QCL-TypeC to target TCI state

### 8.10A.4 DCI based TCI state switch delay

If the target TCI state is known, when a UE is configured with the higher layer parameter *tci-PresentInDCI* which is set as 'enabled'for the CORESET scheduling the PDSCH at slot n, UE shall be able to receive PDSCH with target TCI state of the serving cell on which TCI state switch occurs at the first slot that is after slot n+*timeDurationForQCL*, where, *timeDurationForQCL* is the time required by the UE to perform PDCCH reception and applying spatial QCL information received in DCI for PDSCH processing as described in TS 38.214 [26], the value of *timeDurationForQCL* is defined in TS 38.306 [14].

The known condition for TCI state defined in clause 8.10A.2 is applied.

### 8.10A.5 RRC based TCI state switch delay

If the target TCI state is known, UE shall be able to receive PDCCH with target TCI state of the serving cell on which TCI state switch occurs at the first slot that is after slot n+ (TRRC\_processing  +TOk\*(Tfirst-SSB + TSSB-proc+ TSSB\*LRRC,known)) / *NR slot length*. The UE is not required to receive PDCCH/PDSCH/CSI-RS or transmit PUCCH/PUSCH until the end of switching period.

Where

- Slot n is last slot overlapping with the PDSCH carrying RRC activation command.

- TRRC\_processing is the RRC processing delay defined in Clause 11.2 of 36.331 [16] is the corresponding RRC message is embedded in E-UTRA RRC message, otherwise it is the RRC processing delay defined in Clause 12 of TS38.331 [2]

- Tfirst-SSB is time to first SSB transmission occasion after RRC processing by the UE, during which some of the SSB occasions may not be availabledue to DL CCA failures;

- The SSB shall be the QCL-TypeA or QCL-TypeC to target TCI state;

- LRRC,known≤ LRRC,known,max is the corresponding number of SSB occasions not available at the UE;

- LRRC,known,max =2 for TSSB ≤ 40 ms, LRRC,known,max =1 for TSSB>40 ms.

- TSSB-proc, TOk, and TSSB are as defined in clause 8.10A.3.

If the target TCI state is unknown, UE shall be able to receive PDCCH with target TCI state of the serving cell on which TCI state switch occurs at the first slot that is after slot n+ (TRRC\_processing  +TL1-RSRP +TOuk\*(Tfirst-SSB+ TSSB-proc+TSSB\*LRRC,unknown) ) / *NR slot length*. The UE is not required to receive PDCCH/PDSCH/CSI-RS or transmit PUCCH/PUSCH until the end of switching period.

Where,

- Slot n is the last slot overlapping with the PDSCH carrying RRC activation command.

- TRRC\_processing is the RRC processing delay defined in Clause 11.2 of 36.331 [16] is the corresponding RRC message is embedded in E-UTRA RRC message, otherwise it is the RRC processing delay defined in Clause 12 of TS38.331 [2].

- Tfirst-SSB is time to first SSB transmission after L1-RSRP measurement when TCI state switching involves QCL-TypeD;

- Tfirst-SSB is time to first SSB transmission occasion after RRC processing time at the UE for other QCL types, during which some SSB occasions may not be available at the UE due to DL CCA failures;

- The SSB shall be the QCL-TypeA or QCL-TypeC to target TCI state;

- LRRC,unknown≤LRRC,unknown,max is the corresponding number of SSB occasions not available at the UE;

- LRRC,unknown,max = 2 for TSSB ≤40 ms, LRRC,unknown,max = 1 for TSSB>40 ms.

- TL1-RSRP, TOuk, TSSB-proc, and TSSB are as defined in clause 8.10A.3

The requirements for RRC based TCI state switch delay apply when only 1 TCI state is configured in RRC TCI state list. When a longer switching delay is allowed. Where is the time between DL data transmission and acknowledgement as specified in TS 38.213 [3].

### 8.10A.6 Active TCI state list update delay

If the target TCI state is known, upon receiving PDSCH carrying MAC-CE active TCI state list update at slot n, UE shall be able to receive PDCCH to schedule PDSCH with the new target TCI state at the first slot that is after n+ + (THARQ +TOk\*(Tfirst-SSB + TSSB-proc+TSSB\*LMAC,known)) / *NR slot length*. Where THARQ, Tfirst-SSB, TSSB-proc , TSSB, LMAC,known and TOk are as defined in clause 8.10A.3.

<End of Change 17>

<Start of Change 18 (R4-2206928)>

## 8.11A PSCell Change in Carriers with CCA

This clause defines requirements for the delay within which the UE shall be able to change PSCell in FR2-2 with CCA to other cell in NR-DC. The requirements in this clause are applicable to NR-DC.

The UE shall be capable of transmitting PRACH preamble towards the target PSCell no later than specified in clause 8.9A.2 for the case of NR-DC, where the following values for slot n, Tprocessing and TRRC\_delay shall override the existing ones:

- Slot n is the last slot overlapping with the PDSCH containing PSCell change,

- Tprocessing = 20 ms when source and target cells are in the same FR,

- Tprocessing = 40 ms when source and target cells are in different FRs.

- TRRC\_delay is the RRC procedure delay as specified in TS 38.331 [2].

If the SMTC periodicity of the target cell is not provided within the PSCell change message, and 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.

The target PSCell is known if it has been meeting the conditions in clause 8.9A.2 for the case of NR-DC.

The interruption on PCell and other serving cells specified in TS38.133 clause 8.2.4.2.1 for NR-DC is allowed only during the RRC reconfiguration procedure [2].

<End of Change 18>

<Start of Change 19 (R4-2206928)>

## 8.11C Conditional PSCell Change in Carriers with CCA

### 8.11C.1 Introduction

This clause defines requirements for the delay within which the UE shall be able to perform conditional PSCell in FR2-2 with CCA change in NR-DC. The requirements in this clause are applicable to NR-DC.

### 8.11C.2 Conditional PSCell Change delay

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

The UE shall be capable to transmit PRACH preamble towards the new target PSCell no later than in slot :

Where:

- Slot n is the last slot overlapping with the PDSCH containing conditional PSCell change.

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

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

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

- Tmeasure\_CCA is the measurements time stated in clause 8.11C.2.1.

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

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

- T∆\_CCA is time for fine time tracking and acquiring full timing information of the target cell. T∆ = (1+L2) \*Trs ms, where L2 is the number of SMTC occasions not avaible at the UE during the time tracking period. L2, max =TBD.

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

- TPSCell\_ DU is the interruption uncertainty due to the random access procedure when sending PRACH to the new cell. TPSCell\_ DU can be up to: (1+ L3) \* TSSB,RO + 10 ms where TSSB,RO is the SSB to PRACH occasion association period as defined in Table 8.1-1 of TS 38.213 [3] and L3 is the number of consecutive SSB to PRACH occasion association periods during which no PRACH occasion is available for PRACH transmission due to UL CCA failure. L3 = 0 for Type 3 UL channel access procedure as defined in TS 37.213 [33].

NOTE 1: The interruption time considering the potential extensions caused by L2, L3 and by the UL CCA failure detection/recovery mechanism is limited by the T304 timer. The UE behaviour at the T304 timer expiry is detailed in TS 38.331 [2].

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

#### 8.11C.2.1 Measurement time

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

For intra-frequency PSCell change, the measurement time delay measured without Time To Trigger (TTT) and L3 filtering shall be less than Tidentify intra\_cca with index or Tidentify\_intra\_cca\_without\_index defined in clause 9.2A.5.1 or clause 9.2A.6.2.

For inter-frequency PSCell change, the measurement time delay measured without Time To Trigger (TTT) and L3 filtering shall be less than Tidentify\_inter\_cca\_without\_index or Tidentify\_inter\_cca\_with\_index defined in clause 9.3A.4. When TTT or L3 filtering is used an additional delay can be expected.

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

<End of Change 19>

<Start of Change 20 (R4-2206921)>

##### 9.2.5.3.3 Scheduling availability of UE performing measurements on FR2

The following scheduling restriction applies due to SS-RSRP or SS-SINR measurement on an FR2 intra-frequency cell

- If *deriveSSB\_IndexFromCell* is enabled the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on SSB symbols to be measured, and on K data symbol(s) before each consecutive SSB symbols to be measured and K data symbol(s) after each consecutive SSB symbols to be measured within SMTC window duration.

- If *deriveSSB\_IndexFromCell* is not enabled and the SCS of data and SSB symobls are smaller than 960kHz, the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on all symbols within SMTC window duration.

- If *deriveSSB\_IndexFromCell* is not enabled and the SCS of data or SSB symobls is 960kHz, the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI SSB symbols to be measured, and on K’ data symbol(s) before each consecutive SSB symbols to be measured and K’ data symbol(s) after each consecutive SSB symbols to be measured within SMTC window duration.

The following scheduling restriction applies to SS-RSRQ measurement on an FR2 intra-frequency cell

- If *deriveSSB\_IndexFromCell* is enabled the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on SSB symbols to be measured, RSSI measurement symbols, and on K data symbol(s) before each consecutive SSB to be measured/RSSI symbols and K data symbol(s) after each consecutive SSB to be measured/RSSI symbols within SMTC window duration

*-*  If *deriveSSB\_IndexFromCell* is not enabled and the SCS of data and SSB symobls are smaller than 960kHz, the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on all symbols within SMTC window duration.

*-*  If *deriveSSB\_IndexFromCell* is not enabled and the SCS of data or SSB symobls is 960kHz, the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on SSB symbols to be measured, RSSI measurement symbols, and on K’ data symbol(s) before each consecutive SSB to be measured/RSSI symbols and K’ data symbol(s) after each consecutive SSB to be measured/RSSI symbols within SMTC window duration.

where

- If the high layer signalling of *smtc2*is configured in TS 38.331 [2], the SMTC periodicityfollows *smtc2*; Otherwise the SMTC periodicity follows *smtc1.*

- The signaling *deriveSSB\_IndexFromCell* is always enabled for FR2-1 and FR2-2 when SSB is using 120 kHz SCS and 480 kHz SCS.

- K=1 for a serving cell with data symbols of 120 kHz SCS

- K=4 for a serving cell with data symbols of 480 kHz SCS and SSB symobls of 120kHz SCS

- K=3 for a serving cell with data symbols of 480 kHz SCS and SSB symobls of [480kHz or] 960kHz SCS

- K=7 for a serving cell with data symbols of 960 kHz SCS and SSB symobls of 120kHz or 480kHz SCS

- K=4 for a serving cell with data symbols of 960 kHz SCS and SSB symobls of 960kHz SCS

- K’=[2] for a serving cell with data symbols of 120 kHz SCS and SSB symobls of 960kHz SCS

- K’=[4] for a serving cell with data symbols of 480 kHz SCS and SSB symobls of 960kHz SCS

- K’=[7] for a serving cell with data symbols of 960 kHz SCS and SSB symobls of 960kHz SCS

<End of Change 20>

<Start of Change 21 (R4-2206927)>

### 9.2A.1 Introduction

The requirements in clause 9.2.A apply for intra-frequency measurements on carrier frequency with CCA.

A measurement is defined as a SSB based intra-frequency measurement provided the centre frequency of the SSB of the serving cell indicated for measurement and the centre frequency of the SSB of the neighbour cell are the same, and the subcarrier spacing of the two SSBs are also the same.

The UE shall be able to identify new intra-frequency cells and perform SS-RSRP, SS-RSRQ, and SS-SINR measurements of identified intra-frequency cells if carrier frequency information is provided by PCell or the PSCell, even if no explicit neighbour list with physical layer cell identities is provided.

The UE can perform intra-frequency SSB based measurements without measurement gaps if

- the SSB is completely contained in the active BWP of the UE, or

- the active downlink BWP is initial BWP[3].

For intra-frequency SSB based measurements without measurement gaps, UE may cause scheduling restriction as specified in clause 9.2A.5.3.

SSB based measurements are configured along with one or two measurement timing configuration(s) (SMTC(s)) which provides periodicity, duration and offset information on a window of up to 5ms where the measurements are to be performed. For intra-frequency connected mode measurements, up to two measurement window periodicities may be configured. A single measurement window offset and measurement duration are configured per intra-frequency measurement object.

When measurement gaps are needed, the UE is not expected to detect SSB which start earlier than the gap starting time + switching time, nor detect SSB which end later than the gap end – switching time. Switching time is 0.5ms for frequency range FR1 and 0.25 ms for frequency range FR2-2.

In the requirements of clause 9.2A, the term SMTC occasion not available at the UE refers to when the SMTC contains SSBs configured by gNB in a cell on a carrier frequency subject to CCA, but *NSSB* candidate SSB positions for the same SSB index within the discovery burst transmission window are not available at the UE due to DL CCA failures at gNB during the corresponding period, where:

- For the cell detection procedure: *NSSB* is at least one candidate SSB position (NOTE: the one candidate SSB position for the cell detection shall not be impacted by the set of candidate SSB positions which are already being measured by the UE within the current measurement period of the on-going measurements), and

- For other procedures in clause 9.2A: *NSSB* are the first two successive candidate SSB positions when two or more candidate SSB positions are configured for this SSB index in one discovery burst transmission window, otherwise  *NSSB* is one candidate SSB position;

otherwise the SMTC occasion is considered as available at the UE.

For the FR2-2 requirements of clause 9.2A, an SMTC occasion group consists of N consecutive SMTC occasions. An SMTC occasion group is not available, when at least one SMTC occasion in the group is not transmitted by the gNB.

### 9.2A.2 Requirements applicability

The requirements in clause 9.2A apply, provided:

- The cell being identified or measured is detectable.

An intra-frequency cell shall be considered detectable when for each relevant SSB:

- SS-RSRP related side conditions given in clause 10.1.27 and TBD for FR1 and FR2-2, respectively, for a corresponding Band,

- SS-RSRQ related side conditions given in clause 10.1.29 and TBD for FR1 and FR2-2, respectively, for a corresponding Band,

- SS-SINR related side conditions given in clause 10.1.31 and TBD for FR1 and FR2-2, respectively, for a corresponding Band,

- SSB\_RP and SSB Ês/Iot according to Annex B.2.8 for a corresponding Band.

### 9.2A.3 Number of cells and number of SSB

#### 9.2A.3.1 Requirements for FR1

For each intra-frequency layer, during each layer 1 measurement period, the UE shall be capable of performing SS-RSRP, SS-RSRQ, and SS-SINR measurements for at least:

- 8 identified cells, and

- 14 SSBs with different SSB index and/or PCI on the intra-frequency layer, where the number of SSBs in the serving cell (except for the SCell) is not smaller than the number of configured RLM-RS SSB resources.

#### 9.2A.3.2 Requirements for FR2-2

For one single intra-frequency layer in a band, during each layer 1 measurement period, the UE shall be capable of performing SS-RSRP, SS-RSRQ, and SS-SINR measurements for at least:

- 6 identified cells, and

- 24 SSBs with different SSB index and/or PCI,

where this single intra-frequency layer shall be:

- PCC when UE is configured with SA NR operation mode with PCC in the band; or

- PSCC when UE is configured with NR-DC with PSCC in the band; or

- One of the SCCs on which UE is configured to report SSB based measurements when neither PCC nor PSCC is in the same band, so that the selected SCC shall be an SCC where the UE is configured with SS-RSRP measurement reporting if such SCC exists, otherwise the selected SCC is determined by UE implementation.

The UE shall also be capable of performing SS-RSRP, SS-RSRQ, and SS-SINR measurements for at least 2 SSBs on serving cell for each of the other intra-frequency layer(s) in the same band.

### 9.2A.4 Measurement Reporting Requirements

9.2A.4.1 Periodic Reporting

Reported RSRP, RSRQ, and RS-SINR measurements contained in periodically triggered measurement reports shall meet the requirements in clauses 10.1.36 (RSRP for FR1), TBD (RSRP for FR2-2), 10.1.29 (RSRQ for FR1), TBD (RSRQ for FR2-2), 10.1.31 (RS-SINR for FR1) and TBD (RS-SINR for FR2-2), respectively.

9.2A.4.2 Event-triggered Periodic Reporting

Reported RSRP, RSRQ, and RS-SINR measurements contained in periodically triggered measurement reports shall meet the requirements in clauses 10.1.36 (RSRP for FR1), TBD (RSRP for FR2-2), 10.1.29 (RSRQ for FR1), TBD (RSRQ for FR2-2), 10.1.31 (RS-SINR for FR1) and TBD (RS-SINR for FR2-2) , respectively.

The first report in event triggered periodic measurement reporting shall meet the requirements specified in clause 9.2A.4.3.

9.2A.4.3 Event Triggered Reporting

Reported RSRP, RSRQ, and RS-SINR measurements contained in periodically triggered measurement reports shall meet the requirements in clauses 10.1.36 (RSRP for FR1), TBD (RSRP for FR2-2), 10.1.29 (RSRQ for FR1), TBD (RSRQ for FR2-2), 10.1.31 (RS-SINR for FR1) and TBD (RS-SINR for FR2-2), respectively.

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

The measurement reporting delay is defined as the time between an event that will trigger a measurement report and the point when the UE starts to transmit the measurement report over the air interface. This requirement assumes that the measurement report is not delayed by other RRC signalling on the DCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 x TTIDCCH. This measurement reporting delay excludes a delay which caused by no UL resources being available for UE to send the measurement report on, and all delays due to UL CCA failures until the successful transmission of the report.

The event triggered measurement reporting delay, measured without L3 filtering shall be less than T identify intra with index\_CCA or T identify intra without index\_CCA defined in clause 9.2A.5.1 or clause 9.2A.6.2.When L3 filtering is used an additional delay can be expected.

A cell is detectable only if at least one SSBs measured from the Cell being configured remains detectable during the time period T identify\_intra\_without\_index\_CCA or T identify\_intra\_with\_index\_CCA as defined in clause 9.2A.5.1 or clause 9.2A.6.2. If a cell which has been detectable at least for the time period T identify intra without index\_CCA or T identify intra with index\_CCA defined in clause 9.2A.5.1 or clause 9.2A.6.2 becomes undetectable for a period≤ 8 seconds and then the cell becomes detectable again with the same spatial reception parameter and triggers an event, the event triggered measurement reporting delay shall be less than TSSB\_measurement\_period\_intra\_CCA provided the timing to that cell has not changed more than ± 3200 Tc while the measurement gap has not been available and the L3 filter has not been used. When L3 filtering is used, an additional delay can be expected.

### 9.2A.5 Intra-frequency measurements without measurement gaps

9.2A.5.1 Intra-frequency cell identification

The UE shall be able to identify a new detectable intra frequency cell within Tidentify\_intra\_without\_index\_CCA if UE is not indicated to report SSB based RRM measurement result with the associated SSB index(*reportQuantityRsIndexes* or *maxNrofRSIndexesToReport* is not configured), or the UE is indicated that the neighbour cell is synchronous with the serving cell (*deriveSSB-IndexFromCell* is enabled). Otherwise UE shall be able to identify a new detectable intra frequency cell within Tidentify\_intra\_with\_index\_CCA. The UE shall be able to identify a new detectable intra frequency SS block of an already detected cell within Tidentify\_intra\_without\_index\_CCA.

 Tidentify\_intra\_without\_index\_CCA = (TPSS/SSS\_sync\_intra\_CCA + T SSB\_measurement\_period\_intra\_CCA) ms

 Tidentify\_intra\_with\_index CCA = (TPSS/SSS\_sync\_intra\_CCA + T SSB\_measurement\_period\_intra\_CCA + TSSB\_time\_index\_intra\_CCA) ms

Where:

 TPSS/SSS\_sync\_intra\_CCA: it is the time period used in PSS/SSS detection given in table 9.2A.5.1-1, 9.2A.5.1-3 (deactivated Scell) .

 TSSB\_time\_index\_intra\_CCA: it is the time period used to acquire the index of the SSB being measured given in table 9.2A.5.1-2 or 9.2A.5.1-4 (deactivated SCell).

 T SSB\_measurement\_period\_intra\_CCA: equal to a measurement period of SSB based measurement given in table 9.2A.5.2-1, 9.2A.5.2-2 (deactivated Scell).

 CSSFintra: it is a carrier specific scaling factor and is determined

- according to CSSFoutside\_gap,i in clause 9.1.5.1 for measurement conducted outside measurement gaps, i.e. when intra-frequency SMTC is fully non overlapping or partially overlapping with measurement gaps, or according to CSSFwithin\_gap,i in clause 9.1.5.2 for measurement conducted within measurement gaps, i.e. when intra-frequency SMTC is fully overlapping with measurement gaps.

Mpss/sss\_sync\_w/o\_gaps\_CCA : TBD

 Mmeas\_period\_w/o\_gaps\_CCA: TBD

N: is the UE Rx beam sweeping scaling factor. N= TBD.

 When intra-frequency SMTC is fully non overlapping with measurement gaps or intra-frequency SMTC is fully overlapping with MGs, Kp=1

 When intra-frequency SMTC is partially overlapping with measurent gaps, Kp = 1/(1- (SMTC period /MGRP)), where SMTC period < MGRP.

For FR2-2,

 Klayer1\_measurement=TBD

If MCG DRX is in use, intra-frequency cell identification requirements specified in Table 9.2A.5.1-1, Table 9.2A.5.1-2, Table 9.2A.5.1-3, Table 9.2A.5.1-4, Table 9.2A.5.1-5 and Table 9.2A.5.1-6 shall depend on the MCG DRX cycle. If SCG DRX is in use, intra-frequency cell identification requirements specified in Table 9.2A.5.1-1, Table 9.2A.5.1-2, Table 9.2A.5.1-3, Table 9.2A.5.1-4, Table 9.2A.5.1-5 and Table 9.2A.5.1-6 shall depend on the SCG DRX cycle. Otherwise, the requirements for when DRX is not in use shall apply.

 The requirements apply provided any two closest SMTC occasions available at the UE for the measurement shall be separated by no more than the maximum time requirement for the cell to remain known defined in clause 9.2A.4.3.

Table 9.2A.5.1-1: Time period for PSS/SSS detection (FR1)

|  |  |
| --- | --- |
| Condition | TPSS/SSS\_sync\_intra\_CCA |
| No DRX | max( 600ms, ceil((5+LPSS/SSS) x Kp) x SMTC period)Note 1 x CSSFintra |
| DRX cycle≤ 320ms | max( 600ms, ceil(1.5x (5+LPSS/SSS) x Kp) x max(SMTC period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | ceil((5+LPSS/SSS) x Kp) x DRX cycle x CSSFintra |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identifiedNOTE 2: When DRX is not configured, LPSS/SSS is the number of SMTC occasions not available at the UE during TPSS/SSS\_sync\_intra\_CCA for PSS/SSS detection, where LPSS/SSS< LPSS/SSS,max. When DRX is configured, LPSS/SSS is the number of DRX cycles in which at least one SMTC occasion is not available at the UE during TPSS/SSS\_sync\_intra\_CCA for PSS/SSS detection, where LPSS/SSS< LPSS/SSS,max. When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle. FFS: The UE is not required to determine the availability of SMTC occasions more frequent than what is required by CSSFintra.NOTE 3: LPSS/SSS,max =7 for Max(DRX cycle,SMTC period)≤40ms where DRX cycle is 0 for non-DRX, LPSS/SSS,max =5 for 40ms<Max(DRX cycle,SMTC period)≤320ms, LPSS/SSS,max = 3 for DRX cycle>320ms.NOTE 4: Upon exceeding LPSS/SSS,max, the UE is not required to meet the requirements for PSS/SSS detection. |

Table 9.2A.5.1-2: Time period for time index detection (FR1)

|  |  |
| --- | --- |
| Condition | TSSB\_time\_index\_intra\_CCA |
| No DRX | max(120ms, ceil((3+Lind) x Kp )x SMTC period)Note 1 x CSSFintra |
| DRX cycle≤ 320ms | max(120ms, ceil (1.5 x (3+Lind) x Kp) x max(SMTC period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | Ceil((3+Lind) x Kp) x DRX cycle x CSSFintra |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identifiedNOTE 2: When DRX is not configured, Lind is the number of SMTC occasions not available at the UE during TSSB\_time\_index\_intra\_CCA for index detection, where Lind ≤ Lind,max. When DRX is configured, Lind is the number of DRX cycles in which at least one SMTC occasion is not available at the UE during TSSB\_time\_index\_intra\_CCA for index detection, where Lind ≤ Lind,max. When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle. FFS: The UE is not required to determine the availability of SMTC occasions more frequent than what is required by CSSFintra.NOTE 3: Lind,max = 5 for Max(DRX cycle,SMTC period)≤40ms where DRX cycle is 0 for non-DRX, Lind,max = 3 for 40ms<Max(DRX cycle,SMTC period)≤320ms, Lind,max =2 for DRX cycle>320ms.NOTE 4: Upon exceeding Lind,max over the period of time TSSB\_time\_index\_intra\_CCA, the UE has to restart the time index detection procedure. |

Table 9.2A.5.1-3: Time period for PSS/SSS detection, deactivated SCell (FR1)

|  |  |
| --- | --- |
| Condition | TPSS/SSS\_sync\_intra\_CCA |
| No DRX | (5 + LPSS/SSS,deact) x measCycleSCell x CSSFintra |
| DRX cycle≤ 320ms | (5 + LPSS/SSS, deact) x max(measCycleSCell, 1.5xDRX cycle) x CSSFintra |
| DRX cycle>320ms | (5 + LPSS/SSS, deact) x max(measCycleSCell, DRX cycle) x CSSFintra |
| NOTE 1: When DRX is not configured, LPSS/SSS, deact is the number of SMTC occasions not available at the UE during TPSS/SSS\_sync\_intra\_CCA for PSS/SSS detection, where LPSS/SSS, deact< LPSS/SSS, deact,max. When DRX is configured, LPSS/SSS, deact is the number of DRX cycles in which at least one SMTC occasion is not available at the UE during TPSS/SSS\_sync\_intra\_CCA for PSS/SSS detection, where LPSS/SSS, deact< LPSS/SSS, deact,max.When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle. When configured with measurement cycles, the UE is not required to determine the availability of SMTC occasions more frequent than once per measurement cycle. FFS: The UE is not required to determine the availability of SMTC occasions more frequent than what is required by CSSFintra.NOTE 2: LPSS/SSS, deact,max, = 7 for Max(DRX cycle, measCycleSCell)≤40ms where DRX cycle is 0 for non-DRX, LPSS/SSS, deact,max = 5 for 40ms<Max(DRX cycle, measCycleSCell)≤320ms, LPSS/SSS, deact,max = 3 for DRX cycle>320ms.NOTE 3: Upon exceeding LPSS/SSS, deact,max,, the UE is not required to meet the requirements for PSS/SSS detection. |

Table 9.2A.5.1-4: Time period for time index detection, deactivated SCell (FR1)

|  |  |
| --- | --- |
| Condition | TSSB\_time\_index\_intra\_CCA |
| No DRX | (3+Lind,deact) x measCycleSCell x CSSFintra |
| DRX cycle≤ 320ms |  (3+Lind,deact) x max(measCycleSCell, 1.5xDRX cycle) x CSSFintra |
| DRX cycle>320ms | (3+Lind,deact) x max(measCycleSCell, DRX cycle) x CSSFintra |
| NOTE 1: When DRX is not configured, Lind,deact is the number of SMTC occasions not available at the UE during TSSB\_time\_index\_intra\_CCA for index detection, where Lind,deact < Lind,deact,max. When DRX is configured, Lind,deact is the number of DRX cycles in which at least one SMTC occasion is not available at the UE during TSSB\_time\_index\_intra\_CCA for index detection, where Lind,deact < Lind,deact,max. When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle. When configured with measurement cycles, the UE is not required to determine the availability of SMTC occasions more frequent than once per measurement cycle. FFS: The UE is not required to determine the availability of SMTC occasions more frequent than what is required by CSSFintra.NOTE 2: Lind,deact,max, = 5 for Max(DRX cycle, measCycleSCell)≤40ms where DRX cycle is 0 for non-DRX, Lind,deact,max = 3 for 40ms<Max(DRX cycle, measCycleSCell)≤320ms, Lind,deact,max = 2 for DRX cycle>320ms.NOTE 3: Upon exceeding Lind,deact,max over the period of time TSSB\_time\_index\_intra\_CCA,the UE has to restart the time index detection procedure. |

Table 9.2A.5.1-5: Time period for PSS/SSS detection, (Frequency range FR2-2)

|  |  |
| --- | --- |
| Condition | TPSS/SSS\_sync\_intra\_CCA |
| No DRX | max(600ms, ceil((Mpss/sss\_sync\_w/o\_gaps\_CCA + [N] x LPSS/SSS) x Kp x Klayer1\_measurement)x SMTC period)Note 1 x CSSFintra |
| DRX cycle≤ 320ms | max(600ms, ceil(1.5 x (Mpss/sss\_sync\_w/o\_gaps\_CCA + [N] x LPSS/SSS) x Kp x Klayer1\_measurement)x max(SMTC period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | ceil((Mpss/sss\_sync\_w/o\_gaps\_CCA + [N] x LPSS/SSS) x Kp x Klayer1\_measurement) x DRX cycle x CSSFintra |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identifiedNOTE 2: When DRX is not configured, LPSS/SSS is the number of SMTC occasion groups not available at the UE during TPSS/SSS\_sync\_intra\_CCA for PSS/SSS detection, where LPSS/SSS< LPSS/SSS,max. A SMTC occasion group consists of N consecutive SMTC occasions. An SMTC occasion group is not available, when at least one SMTC occasion in the group is not transmitted by the gNB. When DRX is configured, LPSS/SSS is the number of [DRX cycle groups] in which at least one SMTC occasion is not available at the UE during TPSS/SSS\_sync\_intra\_CCA for PSS/SSS detection, where LPSS/SSS< LPSS/SSS,max. [A [DRX occasion group consists of N consecutive DRX cycles. A DRX occasion group occasion group is not available, when at least one SMTC occasion in the group is not transmitted by the gNB.] When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle.NOTE 3: LPSS/SSS,max =[7] for Max(DRX cycle,SMTC period)≤40ms where DRX cycle is 0 for non-DRX, LPSS/SSS,max =[5] for 40ms<Max(DRX cycle,SMTC period)≤320ms, LPSS/SSS,max = [3] for DRX cycle>320ms.NOTE 4: Upon exceeding LPSS/SSS,max, the UE is not required to meet the requirements for PSS/SSS detection. |

**Table 9.2A.5.1-6: Time period for PSS/SSS detection, deactivated SCell (FR2-2)**

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra\_CCA |
| No DRX | Ceil((Mpss/sss\_sync\_w/o\_gaps + [N] x LPSS/SSS,deact) x Kp) x measCycleSCell x CSSFintra |
| DRX cycle≤ 320ms | Ceil((Mpss/sss\_sync\_w/o\_gaps + [N] x LPSS/SSS,deact) x Kp) x max(measCycleSCell, 1.5xDRX cycle) x CSSFintra |
| DRX cycle> 320ms | Ceil((Mpss/sss\_sync\_w/o\_gaps + [N] x LPSS/SSS,deact) x Kp) x max(measCycleSCell, DRX cycle) x CSSFintra |
| NOTE 1: When DRX is not configured, LPSS/SSS, deact is the number of SMTC occasions groups not available at the UE during TPSS/SSS\_sync\_intra\_CCA for PSS/SSS detection, where LPSS/SSS, deact< LPSS/SSS, deact,max. A SMTC occasion group consists of N consecutive SMTC occasions. An SMTC occasion group is not available, when at least one SMTC occasion in the group is not transmitted by the gNB. When DRX is configured, LPSS/SSS, deact is the number of [DRX cycle groups] in which at least one SMTC occasion is not available at the UE during TPSS/SSS\_sync\_intra\_CCA for PSS/SSS detection, where LPSS/SSS, deact< LPSS/SSS, deact,max.When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle. [A DRX occasion group consists of N consecutive DRX cycles. A DRX occasion group occasion group is not available, when at least one SMTC occasion in the group is not transmitted by the gNB.] When configured with measurement cycles, the UE is not required to determine the availability of SMTC occasions more frequent than once per measurement cycle. NOTE 2: LPSS/SSS, deact,max, = [7] for Max(DRX cycle, measCycleSCell)≤40ms where DRX cycle is 0 for non-DRX, LPSS/SSS, deact,max = [5] for 40ms<Max(DRX cycle, measCycleSCell)≤320ms, LPSS/SSS, deact,max = [3] for DRX cycle>320ms.NOTE 3: Upon exceeding LPSS/SSS, deact,max,, the UE is not required to meet the requirements for PSS/SSS detection. |

*Editor’s note: FFS: time period for time index detection in FR2-2.*

#### 9.2A.5.2 Measurement period

The measurement period for intra-frequency measurements without gaps is as shown in table 9.2A.5.2-1, 9.2A.5.2-2 (deactivated SCell).

If SCG DRX is in use, intra-frequency measurement period requirements specified in Table 9.2A.5.2-1, Table 9.2A.5.2-2 shall depend on the SCG DRX cycle. Otherwise, the requirements for when DRX is not in use shall apply.

The requirements apply provided any two closest SMTC occasions available at the UE for the measurement shall be separated by no more than the maximum time requirement for the cell to remain known defined in clause 9.2A.4.3.

When the time period of unsuccessful measurement attempts due to exceeding the maximum number of unavailable at the UE SMTC occasions of an already identified cell exceeds the maximum time requirement for the cell to remain known defined in clause 9.2A.4.3, UE shall stop the measurement attempts on this SSB and perform the detection procedure again like for any other SSB.

Table 9.2A.5.2-1: Measurement period for intra-frequency measurements without gaps (FR1)

|  |  |
| --- | --- |
| Condition | T SSB\_measurement\_period\_intra\_CCA  |
| No DRX | max(200ms, ceil((5+Lmeas) x Kp) x SMTC period)Note 1 x CSSFintra |
| DRX cycle≤ 320ms | max(200ms, ceil(1.5x (5+Lmeas) x Kp) x max(SMTC period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | ceil((5+Lmeas) x Kp ) x DRX cycle x CSSFintra |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identifiedNOTE 2: When DRX is not configured, Lmeas is the number of SMTC occasions not available at the UE during T SSB\_measurement\_period\_intra\_CCA for measurement, where Lmeas <Lmeas,max. When DRX is configured, Lmeas is the number of DRX cycles in which at least one SMTC occasion is not available at the UE during T SSB\_measurement\_period\_intra\_CCA for measurement, where Lmeas <Lmeas,max. When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle. FFS: The UE is not required to determine the availability of SMTC occasions more frequent than what is required by CSSFintra.NOTE 3: Lmeas,max = 7 for Max(DRX cycle,SMTC period)≤40ms where DRX cycle is 0 for non-DRX, Lmeas,max = 5 for 40ms<Max(DRX cycle,SMTC period)≤320ms, Lmeas,max = 3 for DRX cycle>320ms.NOTE 4: Upon exceeding Lmeas,max over the period of time T SSB\_measurement\_period\_intra\_CCA, the UE has to restart the measurement procedure. |

Table 9.2A.5.2-2: Measurement period for intra-frequency measurements without gaps,deactivated SCell (FR1)

|  |  |
| --- | --- |
| Condition | T SSB\_measurement\_period\_intra\_CCA  |
| No DRX | (5+Lmeas,deact) x measCycleSCell x CSSFintra |
| DRX cycle≤ 320ms | (5+Lmeas, deact) x max(measCycleSCell, 1.5xDRX cycle) x CSSFintra |
| DRX cycle>320ms | (5+Lmeas, deact) x max(measCycleSCell, DRX cycle) x CSSFintra |
| NOTE 1: When DRX is not configured, Lmeas,deact is the number of SMTC occasions not available at the UE during T SSB\_measurement\_period\_intra\_CCA for measurement, where Lmeas,deact <Lmeas, ,deact ,max. When DRX is configured, Lmeas,deact is the number of DRX cycles in which at least one SMTC occasion is not available at the UE during T SSB\_measurement\_period\_intra\_CCA for measurement, where Lmeas,deact <Lmeas, ,deact ,max. When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle. When configured with measurement cycles, the UE is not required to determine the availability of SMTC occasions more frequent than once per measurement cycle. FFS: The UE is not required to determine the availability of SMTC occasions more frequent than what is required by CSSFintra.NOTE 2: Lmeas, ,deact ,max, = 7 for Max(DRX cycle, measCycleSCell)≤40ms where DRX cycle is 0 for non-DRX, Lmeas, ,deact ,max = 5 for 40ms<Max(DRX cycle, measCycleSCell)≤320ms, Lmeas, ,deact ,max = 3 for DRX cycle>320ms.NOTE 3: Upon exceeding Lmeas,deact,max over the period of time T SSB\_measurement\_period\_intra\_CCA, the UE has to restart the measurement procedure. |

Table 9.2A.5.2-3: Measurement period for intra-frequency measurements without gaps (FR2-2)

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra\_CCA  |
| No DRX | max(400ms, ceil((Mmeas\_period\_w/o\_gaps\_CCA + [N] x Lmeas) x Kp x Klayer1\_measurement) x SMTC period)Note 1 x CSSFintra |
| DRX cycle≤ 320ms | max(400ms, ceil(1.5x (Mmeas\_period\_w/o\_gaps\_CCA + [N] x Lmeas) x Kp x Klayer1\_measurement) x max(SMTC period,DRX cycle)) x CSSFintra  |
| DRX cycle>320ms | ceil((Mmeas\_period\_w/o\_gaps\_CCA + [N] x Lmeas) x Kp x Klayer1\_measurement ) x DRX cycle x CSSFintra |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identifiedNOTE 2: When DRX is not configured, Lmeas is the number of SMTC occasion groups not available at the UE during T SSB\_measurement\_period\_intra\_CCA for measurement, where Lmeas <Lmeas,max. A SMTC occasion group consists of N consecutive SMTC occasions. An SMTC occasion group is not available, when at least one SMTC occasion in the group is not transmitted by the gNB. When DRX is configured, Lmeas is the number of [DRX cycle groups] in which at least one SMTC occasion is not available at the UE during T SSB\_measurement\_period\_intra\_CCA for measurement, where Lmeas <Lmeas,max. . [A DRX occasion group consists of N consecutive DRX cycles. A DRX occasion group occasion group is not available, when at least one SMTC occasion in the group is not transmitted by the gNB.] When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle. NOTE 3: Lmeas,max = [7] for Max(DRX cycle,SMTC period)≤40ms where DRX cycle is 0 for non-DRX, Lmeas,max = [5] for 40ms<Max(DRX cycle,SMTC period)≤320ms, Lmeas,max = [3] for DRX cycle>320ms.NOTE 4: Upon exceeding Lmeas,max over the period of time T SSB\_measurement\_period\_intra\_CCA, the UE has to restart the measurement procedure. |

**Table 9.2.5.2-4: Measurement period for intra-frequency measurements without gaps, deactivated Scell (FR2-2)**

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra\_CCA  |
| No DRX | Ceil((Mmeas\_period\_w/o\_gaps\_CCA + [N] x Lmeas,deact) x Kp) x measCycleSCell x CSSFintra |
| DRX cycle≤ 320ms | Ceil((Mmeas\_period\_w/o\_gaps\_CCA + [N] x Lmeas,deact) x Kp) x max(measCycleSCell, 1.5xDRX cycle) x CSSFintra |
| DRX cycle> 320ms | Ceil((Mmeas\_period\_w/o\_gaps\_CCA + [N] x Lmeas,deact) x Kp) x max(measCycleSCell, DRX cycle) x CSSFintra |
| NOTE 1: When DRX is not configured, Lmeas,deact is the number of SMTC occasion groups not available at the UE during T SSB\_measurement\_period\_intra\_CCA for measurement, where Lmeas,deact <Lmeas, ,deact ,max. A SMTC occasion group consists of N consecutive SMTC occasions. An SMTC occasion group is not available, when at least one SMTC occasion in the group is not transmitted by the gNB. When DRX is configured, Lmeas,deact is the number of [DRX cycle groups] in which at least one SMTC occasion is not available at the UE during T SSB\_measurement\_period\_intra\_CCA for measurement, where Lmeas,deact <Lmeas, ,deact ,max. [A DRX occasion group consists of N consecutive DRX cycles. A DRX occasion group occasion group is not available, when at least one SMTC occasion in the group is not transmitted by the gNB.] When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle. When configured with measurement cycles, the UE is not required to determine the availability of SMTC occasions more frequent than once per measurement cycle. FFS: The UE is not required to determine the availability of SMTC occasions more frequent than what is required by CSSFintra.NOTE 2: Lmeas, ,deact ,max, = [7] for Max(DRX cycle, measCycleSCell)≤40ms where DRX cycle is 0 for non-DRX, Lmeas, ,deact ,max = [5] for 40ms<Max(DRX cycle, measCycleSCell)≤320ms, Lmeas, ,deact ,max = [3] for DRX cycle>320ms.NOTE 3: Upon exceeding Lmeas,deact,max over the period of time T SSB\_measurement\_period\_intra\_CCA, the UE has to restart the measurement procedure. |

#### 9.2A.5.3 Scheduling availability of UE during intra-frequency measurements

UE shall be capable of measuring without measurement gaps when the SSB is completely contained in the active bandwidth part of the UE. When any of the conditions in the following clauses is met, there are restrictions on the scheduling availability; otherwise, there is no scheduling restriction. Note that the SSB symbols to be measured in the following clauses are the SSB symbols indicated by *SSB-ToMeasure* [2], if it is configured; otherwise, all *L* SSB symbols within SMTC window duration defined in clause 4.1 of TS 38.213 [3] are included.

##### 9.2A.5.3.1 Scheduling availability of UE performing measurements in TDD bands on FR1

When UE performs intra-frequency measurements in a TDD band, the following restrictions apply due to SS-RSRP or SS-SINR measurement

- The UE is not expected to transmit PUCCH/PUSCH/SRS on SSB symbols configured to be measured, and on 1 data symbol before each consecutive SSB symbols configured to be measured and 1 data symbol after each consecutive SSB symbols configured to be measured within SMTC window duration if *deriveSSB\_IndexFromCell* is enabled. If the high layer in TS 38.331[2] signaling of smtc2 is configured, the SMTC periodicity follows smtc2; Otherwise SMTC periodicity follows smtc1.

- The UE is not expected to transmit PUCCH/PUSCH/SRS on all symbols within SMTC window duration if *deriveSSB\_IndexFromCell* is not enabled. If the high layer in TS 38.331 [2] signaling of smtc2 is configured, the SMTC periodicity follows smtc2; Otherwise SMTC periodicity follows smtc1.

When the UE performs intra-frequency measurements in a TDD band, the following restrictions apply due to SS-RSRQ measurement

- The UE is not expected to transmit PUCCH/PUSCH/SRS on SSB symbols configured to be measured, RSSI measurement symbols, and on 1 data symbol before each consecutive SSB configured to be measured/RSSI symbols and 1 data symbol after each consecutive SSB configured to be measured/RSSI symbols within SMTC window duration if *deriveSSB\_IndexFromCell* is enabled. If the high layer signaling of smtc2 is configured (in TS 38.331), the SMTC periodicity follows smtc2; Otherwise the SMTC periodicity follows smtc1.

- The UE is not expected to transmit PUCCH/PUSCH/SRS on all symbols within SMTC window duration if *deriveSSB\_IndexFromCell* is not enabled. If the high layer in TS 38.331 signaling of smtc2 is configured, the SMTC periodicity follows smtc2; Otherwise SMTC periodicity follows smtc1.

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

##### 9.2A.5.3.2 Scheduling availability of UE performing measurements with a different subcarrier spacing than PDSCH/PDCCH on FR1

For UE which do not support *simultaneousRxDataSSB-DiffNumerology* [14] the following restrictions apply due to SS-RSRP/RSRQ/SINR measurement

- If *deriveSSB\_IndexFromCell* is enabled the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on SSB symbols to be measured, and on 1 data symbol before each consecutive SSB symbols to be measured and 1 data symbol after each consecutive SSB symbols to be measured within SMTC window duration.

- If *deriveSSB\_IndexFromCell* is not enabled the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on all symbols within SMTC window duration.

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

##### 9.2A.5.3.3 Scheduling availability of UE performing measurements in TDD bands on FR2-2

TBD

### 9.2A.6 Intra-frequency measurements with measurement gaps

#### 9.2A.6.1 Intra-frequency cell identification

The UE shall be able to identify a new detectable intra frequency cell within Tidentify\_intra\_without\_index\_CCA if UE is not indicated to report SSB based RRM measurement result with the associated SSB index (*reportQuantityRsIndexes* or *maxNrofRSIndexesToReport* is not configured), or the UE has been indicated that the neighbour cell is synchronous with the serving cell (*deriveSSB-IndexFromCell* is enabled). Otherwise UE shall be able to identify a new detectable intra frequency cell within Tidentify\_intra\_with\_index\_CCA. The UE shall be able to identify a new detectable intra frequency SS block of an already detected cell within Tidentify\_intra\_without\_index CCA.

 Tidentify\_intra\_without\_index CCA = TPSS/SSS\_sync\_intra\_CCA + T SSB\_measurement\_period\_intra\_CCA ms

 Tidentify\_intra\_with\_index\_CCA = TPSS/SSS\_sync\_intra\_CCA + T SSB\_measurement\_period\_intra\_CCA + TSSB\_time\_index\_intra\_CCA

Where:

 TPSS/SSS\_sync\_intra\_CCA: it is the time period used in PSS/SSS detection given in table 9.2A.6.1-1.

 TSSB\_time\_index\_intra\_CCA: it is the time period used to acquire the index of the SSB being measured given in table 9.2A.6.1-2.

 T SSB\_measurement\_period\_intra\_CCA: equal to a measurement period of SSB based measurement given in table 9.2A.6.2-1 or 9.2A.6.1-3.

 CSSFintra: it is a carrier specific scaling factor and is determined according to CSSFwithin\_gap,i in clause 9.1.5.2 for measurement conducted within measurement gaps.

 Mpss/sss\_sync\_with\_gaps\_CCA : TBD

 Mmeas\_period\_ with\_gaps\_CCA: TBD

N: is the UE Rx beam sweeping scaling factor. N= TBD.

If MCG DRX is in use, intra-frequency cell identification requirements specified in Table 9.2A.6.1-1, Table 9.2A.6.1-2 and Table 9.2A.6.1-3 shall depend on the MCG DRX cycle. If SCG DRX is in use, intra-frequency cell identification requirements specified in Table 9.2A.6.1-1, Table 9.2A.6.1-2 and Table 9.2A.6.1-3 shall depend on the SCG DRX cycle. Otherwise, the requirements for when DRX is not in use shall apply.

The requirements apply provided any two closest SMTC occasions available at the UE for the measurement shall be separated by no more than the maximum time requirement for the cell to remain known defined in clause 9.2A.4.3.

Table 9.2A.6.1-1: Time period for PSS/SSS detection (FR1)

|  |  |
| --- | --- |
| Condition | TPSS/SSS\_sync\_intra\_CCA |
| No DRX  | max(600ms, (5+LPSS/SSS,gaps) x max(MGRP, SMTC period)) x CSSFintra |
| DRX cycle≤ 320ms  | max(600ms, ceil(1.5x (5+LPSS/SSS,gaps)) x max(DRX cycle, MGRP, SMTC period)) x CSSFintra |
| DRX cycle>320ms | (5+LPSS/SSS,gaps) x (MGRP, DRX cycle) x CSSFintra |
| NOTE 1: When DRX is not configured, LPSS/SSS,gaps is the number of SMTC occasions not available at the UE during TPSS/SSS\_sync\_intra\_CCA for PSS/SSS detection, where LPSS/SSS,gaps <LPSS/SSS,gaps,max. When DRX is configured, LPSS/SSS,gaps is the number of DRX cycles in which at least one SMTC occasion is not available at the UE during TPSS/SSS\_sync\_intra\_CCA for PSS/SSS detection, where LPSS/SSS,gaps <LPSS/SSS,gaps,max. When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle. When configured with measurement gaps, the UE is not required to determine the availability of SMTC occasions more frequent than once during MGRP. FFS: The UE is not required to determine the availability of SMTC occasions more frequent than what is required by CSSFintra.NOTE 2: LPSS/SSS,gaps,max, =7 for Max(DRX cycle, SMTC period, MGRP)≤40ms where DRX cycle is 0 for non-DRX, LPSS/SSS,gaps,max =5 for 40ms<Max(DRX cycle, SMTC period, MGRP)≤320ms, LPSS/SSS,gaps,max =3 for DRX cycle>320ms.NOTE 3: Upon exceeding LPSS/SSS,gaps,max, the UE is not required to meet the requirements for PSS/SSS detection. |

Table 9.2A.6.1-2: Time period for time index detection (FR1)

|  |  |
| --- | --- |
| Condition | TSSB\_time\_index\_intra\_CCA |
| No DRX  | max(120ms, (3+Lind,gaps) x max(MGRP, SMTC period)) x CSSFintra |
| DRX cycle≤ 320ms  | max(120ms, ceil(1.5x (3+Lind,gaps)) x max(MGRP, SMTC period,DRX cycle) x CSSFintra) |
| DRX cycle>320ms | (3+Lind,gaps) x (MGRP, DRX cycle) x CSSFintra |
| NOTE 1: When DRX is not configured, Lind,gaps is the number of SMTC occasions not available at the UE during TSSB\_time\_index\_intra\_CCA forindex detection where Lind,gaps < Lind,gaps,max. When DRX is configured, Lind,gaps is the number of DRX cycles in which at least one SMTC occasion is not available at the UE during TSSB\_time\_index\_intra\_CCA forindex detection where Lind,gaps < Lind,gaps,max. When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle. When configured with measurement gaps, the UE is not required to determine the availability of SMTC occasions more frequent than once during MGRP. FFS: The UE is not required to determine the availability of SMTC occasions more frequent than what is required by CSSFintra.NOTE 2: Lind,gaps,max, = 5 for Max(DRX cycle, SMTC period, MGRP)≤40ms where DRX cycle is 0 for non-DRX, Lind,gaps,max = 3 for 40ms<Max(DRX cycle, SMTC period, MGRP)≤320ms, Lind,gaps,max = 2 for DRX cycle>320ms.NOTE 3: Upon exceeding Lind,gaps,max over the TSSB\_time\_index\_intra\_CCA period of time, the UE has to restart the time index detection procedure. |

**Table 9.2A.6.1-3: Time period for PSS/SSS detection (FR2-2)**

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra\_CCA |
| No DRX | max(600ms, (Mpss/sss\_sync\_with\_gaps\_CCA + [N] x Lind,gaps ) x max(MGRP, SMTC period)) x CSSFintra |
| DRX cycle≤ 320ms | max(600ms, ceil(1.5x (Mpss/sss\_sync\_with\_gaps\_CCA + [N] x Lind,gaps )) x max(MGRP, SMTC period, DRX cycle))x CSSFintra |
| DRX cycle>320ms | (Mpss/sss\_sync\_with\_gaps\_CCA + [N] x Lind,gaps ) x max(MGRP, DRX cycle) x CSSFintra |
| NOTE 1: When DRX is not configured, Lind,gaps is the number of SMTC occasion groups not available at the UE during TSSB\_time\_index\_intra\_CCA forindex detection where Lind,gaps < Lind,gaps,max. A SMTC occasion group consists of N consecutive SMTC occasions. An SMTC occasion group is not available, when at least one SMTC occasion in the group is not transmitted by the gNB. When DRX is configured, Lind,gaps is the number of [DRX cycle groups] in which at least one SMTC occasion is not available at the UE during TSSB\_time\_index\_intra\_CCA forindex detection where Lind,gaps < Lind,gaps,max.[A DRX occasion group consists of N consecutive DRX cycles. A DRX occasion group occasion group is not available, when at least one SMTC occasion in the group is not transmitted by the gNB.] When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle. When configured with measurement gaps, the UE is not required to determine the availability of SMTC occasions more frequent than once during MGRP. NOTE 2: Lind,gaps,max, = [5] for Max(DRX cycle, SMTC period, MGRP)≤40ms where DRX cycle is 0 for non-DRX, Lind,gaps,max = [3] for 40ms<Max(DRX cycle, SMTC period, MGRP)≤320ms, Lind,gaps,max = [2] for DRX cycle>320ms.NOTE 3: Upon exceeding Lind,gaps,max over the TSSB\_time\_index\_intra\_CCA period of time, the UE has to restart the time index detection procedure. |

*Editor’s note: FFS: time period for time index detection in FR2-2.*

#### 9.2A.6.2 Intra-frequency Measurement Period

The measurement period for intra-frequency measurements with gaps is as shown in table 9.2A.6.2-1 and 9.2A.6.2-2.

If MCG DRX is in use, intra-frequency cell identification requirements specified in Table 9.2A.6.2-1 and 9.2A.6.2-2 shall depend on the MCG DRX cycle. If SCG DRX is in use, intra-frequency measurement period requirements specified in Table 9.2A.6.2-1 and 9.2A.6.2-2 shall depend on the SCG DRX cycle. Otherwise, the requirements for when DRX is not in use shall apply.

The requirements apply provided any two closest SMTC occasions available at the UE for the measurement shall be separated by no more than the maximum time requirement for the cell to remain known defined in clause 9.2A.4.3.

When the time period of unsuccessful measurement attempts due to exceeding the maximum number of unavailable at the UE SMTC occasions of an already identified cell exceeds the maximum time requirement for the cell to remain known defined in clause 9.2A.4.3, UE shall stop the measurement attempts on this SSB and perform the detection procedure again like for any other SSB.

Table 9.2A.6.2-1: Measurement period for intra-frequency measurements with gaps (FR1)

|  |  |
| --- | --- |
| Condition | T SSB\_measurement\_period\_intra\_CCA  |
| No DRX  | max(200ms, (5+Lmeas,gaps) x max(MGRP, SMTC period)) x CSSFintra |
| DRX cycle≤ 320ms  | max(200ms, ceil(1.5x (5+Lmeas,gaps)) x max(MGRP, SMTC period,DRX cycle))x CSSFintra |
| DRX cycle>320ms | (5+Lmeas,gaps) x (MGRP, DRX cycle) x CSSFintra |
| NOTE 1: When DRX is not configured, Lmeas,gaps is the number of SMTC occasions not available at the UE during TSSB\_time\_index\_intra\_CCA for measurement where Lmeas,gaps < Lmeas,gaps,max. When DRX is configured, Lmeas,gaps is the number of DRX cycles in which at least one SMTC occasion is not available at the UE during TSSB\_time\_index\_intra\_CCA for measurement where Lmeas,gaps < Lmeas,gaps,max. When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle. When configured with measurement gaps, the UE is not required to determine the availability of SMTC occasions more frequent than once during MGRP. FFS: The UE is not required to determine the availability of SMTC occasions more frequent than what is required by CSSFintra.NOTE 2: Lmeas,gaps,max = 7 for Max(DRX cycle, SMTC period, MGRP)≤40ms where DRX cycle is 0 for non-DRX, Lmeas,gaps,max = 5 for 40ms<Max(DRX cycle, SMTC period, MGRP)≤320ms, Lmeas,gaps,max = 3 for DRX cycle>320ms.NOTE 3: Upon exceeding Lmeas,gaps,max over the T SSB\_measurement\_period\_intra\_CCAperiod of time, the UE has to restart the measurement procedure. |

Table 9.2A.6.2-2: Measurement period for intra-frequency measurements with gaps (FR2-2)

|  |  |
| --- | --- |
| DRX cycle | T SSB\_measurement\_period\_intra\_CCA  |
| No DRX | max(400ms, (Mmeas\_period with\_gaps\_CCA + [N] x Lmeas,gaps ) x max(MGRP, SMTC period)) x CSSFintra |
| DRX cycle≤ 320ms | max(400ms, ceil(1.5 x (Mmeas\_period with\_gaps\_CCA + [N] x Lmeas,gaps )) x max(MGRP, SMTC period, DRX cycle)) Note 1 x CSSFintra |
| DRX cycle>320ms | (Mmeas\_period with\_gaps\_CCA + [N] x Lmeas,gaps ) x max(MGRP, DRX cycle) x CSSFintra |
| NOTE 1: When DRX is not configured, Lmeas,gaps is the number of SMTC occasion groups not available at the UE during TSSB\_time\_index\_intra\_CCA for measurement where Lmeas,gaps < Lmeas,gaps,max. A SMTC occasion group consists of N consecutive SMTC occasions. An SMTC occasion group is not available, when at least one SMTC occasion in the group is not transmitted by the gNB. When DRX is configured, Lmeas,gaps is the number of [DRX cycle groups] in which at least one SMTC occasion is not available at the UE during TSSB\_time\_index\_intra\_CCA for measurement where Lmeas,gaps < Lmeas,gaps,max. [A DRX occasion group consists of N consecutive DRX cycles. A DRX occasion group occasion group is not available, when at least one SMTC occasion in the group is not transmitted by the gNB.] When configured with DRX, the UE is not required to determine the availability of SMTC occasions more frequent than once per DRX cycle. When configured with measurement gaps, the UE is not required to determine the availability of SMTC occasions more frequent than once during MGRP. NOTE 2: Lmeas,gaps,max = [7] for Max(DRX cycle, SMTC period, MGRP)≤40ms where DRX cycle is 0 for non-DRX, Lmeas,gaps,max = [5] for 40ms<Max(DRX cycle, SMTC period, MGRP)≤320ms, Lmeas,gaps,max = [3] for DRX cycle>320ms.NOTE 3: Upon exceeding Lmeas,gaps,max over the T SSB\_measurement\_period\_intra\_CCAperiod of time, the UE has to restart the measurement procedure. |

### 9.2A.7 Intra-frequency RSSI and Channel occupancy measurements

#### 9.2A.7.1 Intra-frequency RSSI measurements

An RSSI measurement is defined as an intra-frequency measurement provided that the RSSI measurement bandwidth is fully contained within the current carrier bandwidth of the UE.

The UE physical layer shall be capable of performing the RSSI measurements, defined in TS 38.215 [4] on one or more serving carriers operating with CCA, TS 37.213 [33], if the carrier(s) are indicated by higher layers [2], and report the RSSI measurements to higher layers. The UE physical layer shall provide to higher layers a single RSSI sample for each OFDM symbol within each configured RSSI measurement duration [2] occurring with a configured RSSI measurement timing configuration periodicity [2], *rmtc-Periodicity*.

The UE can perform RSSI measurements without measurement gaps if RSSI measurement bandwidth is fully within the active DL BWP of the UE.

The measurement period for intra-frequency RSSI measurements without measurement gaps is as shown in Table 9.2A.7.1-1 and Table 9.2A.7.1-2. The measurement period for intra-frequency RSSI measurements with measurement gaps is as shown in Table 9.2A.7.1-3.

Table 9.2A.7.1-1: Measurement period for intra-frequency RSSI measurements without measurement gaps when SMTC and RMTC are overlapping (FR1)

|  |  |
| --- | --- |
| Condition NOTE1,2 | T RSSI\_measurement\_period\_intra\_cca |
| No DRX | max(*reportInterval*, *rmtc-Periodicity*\*CSSFoutside\_gap,i) |
| DRX | max(*reportInterval*, max(*rmtc-Periodicity*, DRX cycle) \*CSSFoutside\_gap,i) |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1NOTE 2: CSSFoutside\_gap, i is a carrier specific scaling factor and is determined according to CSSF outside\_gap,i in clause 9.1.5.1 for measurement conducted outside measurement gap. |

Table 9.2A.7.1-2: Measurement period for intra-frequency RSSI measurements without measurement gaps when SMTC and RMTC are not overlapping (FR1)

|  |  |
| --- | --- |
| Condition NOTE1,2 | T RSSI\_measurement\_period\_intra\_cca |
| No DRX | max(*reportInt*erval, Nintra-MO\**rmtc-Periodicity*) |
| DRX | max(*reportInt*erval, Nintra-MO\*max(*rmtc-Periodicity*, DRXcycle length)) |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1NOTE 2: Nintra-MO is defined as the number of measurement objects that can be measured without gaps |

Table 9.2A.7.1-3: Measurement period for intra-frequency RSSI measurements with measurement gaps (FR1)

|  |  |
| --- | --- |
| Condition NOTE1,2 | T RSSI\_measurement\_period\_intra\_cca |
| No DRX | max(*reportInterval*, max(*rmtc-Periodicity, MGRP*) x CSSFintra) |
| DRX | max(*reportInterval*, max(*rmtc-Periodicity*, MGRP,DRX cycle length) x CSSFintra) |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1NOTE 2: CSSFintra is a carrier specific scaling factor and is determined according to CSSFwithin\_gap,i in clause 9.1.5.2 for measurement conducted within measurement gaps. |

*Editor’s note: Requirements for RSSI measurements in FR2-2 are FFS.*

If the UE requires measurement gaps to perform intra-frequency measurements, a single measurement gap pattern is used for all concurrent intra-frequency measurements, including intra-frequency RSSI measurements. The RSSI measurement duration and the measurement gap should be aligned, and the following additional condition should be fulfilled:

- Entire RSSI measurement duration should be contained in the measurement gap.

The RSSI measurement performed and reported according to this clause shall meet the RSSI measurement accuracy requirement in Clause 10.1.34.1. The reported RSSI measurement values contained in measurement reports shall be based on the measurement report mapping requirements specified in Clause 10.1.34.3.

#### 9.2A.7.2 Intra-frequency Channel occupancy measurements

The UE shall be capable of estimating the channel occupancy on one or more serving carrier frequencies indicated by higher layers [2], based on RSSI samples provided by the physical layer.

The UE can perform channel occupancy measurements without measurement gaps if RSSI measurement bandwidth is fully within the active DL BWP of the UE.

The measurement period for intra-frequency channel occupancy measurements without measurement gap is as shown in Table 9.2A.7.2-1 and Table 9.2A.7.1-2. The measurement period for intra-frequency RSSI measurements with measurement gaps is as shown in Table 9.2A.7.2-3.

Table 9.2A.7.2-1: Measurement period for intra-frequency Channel Occupancy measurements without measurement gaps when SMTC and RMTC are overlapping (FR1)

|  |  |
| --- | --- |
| Condition NOTE1,2 | T RSSI\_measurement\_period\_intra\_cca |
| No DRX | max(*reportInterval*, *rmtc-Periodicity*\*CSSFoutside\_gap,i) |
| DRX | max(*reportInterval*, max(*rmtc-Periodicity*, DRX cycle) \*CSSFoutside\_gap,i) |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1NOTE 2: CSSFoutside\_gap, iis a carrier specific scaling factor and is determined according to CSSFwithin\_gap,i in clause 9.1.5.1 for measurement conducted outside measurement gap. |

Table 9.2A.7.2-2: Measurement period for intra-frequency Channel Occupancy measurements without measurement gaps when SMTC and RMTC are not overlapping (FR1)

|  |  |
| --- | --- |
| Condition NOTE1,2 | T RSSI\_measurement\_period\_intra\_cca |
| No DRX | max(*reportInt*erval, Nintra-MO\**rmtc-Periodicity*) |
| DRX | max(*reportInt*erval, Nintra-MO\*max(*rmtc-Periodicity*, DRXcycle length)) |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1NOTE 2: Nintra-MO is defined as the number of measurement objects that can be measured without gaps |

Table 9.2A.7.2-3: Measurement period for intra-frequency Channel Occupancy measurements with measurement gaps (FR1)

|  |  |
| --- | --- |
| Condition NOTE1,2 | T RSSI\_measurement\_period\_intra\_cca |
| No DRX | max(*reportInterval*, max(*rmtc-Periodicity, MGRP*) x CSSFintra) |
| DRX | max(*reportInterval*, max(*rmtc-Periodicity*, MGRP,DRX cycle length) x CSSFintra) |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1NOTE 2: CSSFintra is a carrier specific scaling factor and is determined according to CSSFwithin\_gap,i in clause 9.1.5.2 for measurement conducted within measurement gaps. |

If the UE requires measurement gaps to perform intra-frequency measurements, a single measurement gap pattern is used for all concurrent intra-frequency measurements, including intra-frequency RSSI measurements. The RSSI measurement duration and the measurement gap should be aligned, and the following additional condition should be fulfilled:

- Entire RSSI measurement duration should be contained in the measurement gap.

The channel occupancy measurement performed and reported according to this clause shall meet the channel occupancy measurement accuracy requirements in Clause 10.1.35.1. The reported channel occupancy measurement values contained in measurement reports shall be based on the measurement reporting range specified in TS 38.331 [2].

#### 9.2A.7.3 Scheduling restriction during RSSI and Channel Occupancy measurements in FR1

When the UE performs intra-frequency RSSI/CO measurements in unlicensed spectrum, the following restrictions apply due to RSSI/CO measurements:

- The UE is not expected to transmit PUCCH/PUSCH/SRS on UL symbols which are overlapping in time with the RSSI measurement symbols configured by RMTC.

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

<End of Change 21>

<Start of Change 22 (R4-2206922)>

#### 9.5.6.3 Scheduling availability of UE performing L1-RSRP measurement on FR2

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

- For the case where RS for L1-RSRP measurement is CSI-RS which is QCLed with active TCI state for PDCCH/PDSCH and not in a CSI-RS resource set with repetition ON, and N=1 applies as specified in clause 9.5.4.2

- There are no scheduling restrictions due to L1-RSRP measurement performed based on the CSI-RS.

- Otherwise

- For FR2-1 or the reference symbols to be measured for L1-RSRP is not using 480 kHz SCS or 960 kHz SCS on FR2-2, the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/CSI-RS for tracking/CSI-RS for CQI on

- symbols corresponding to the SSB indexes configured for L1-RSRP measurement, and/or

- symbols corresponding to the periodic CSI-RS resource configured for L1-RSRP measurement, and/or

- symbols corresponding to the semi-perssitent CSI-RS resource configured for L1-RSRP measurement when the resource is activated, and/or

- symbols corresponding to the aperiodic CSI-RS resource configured for L1-RSRP measurement when the reporting is triggered.

- For FR2-2 and the reference symbols to be measured for L1-RSRP is using 480 kHz SCS or 960 kHz SCS, the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/CSI-RS for tracking/CSI-RS for CQI on

- symbols corresponding to the SSB indexes configured for L1-RSRP measurement, and on one data symbol before and one data symbol after the symbols corresponding to the SSB indexes configured for L1-RSRP measurement, and/or

- symbols corresponding to the periodic CSI-RS resource configured for L1-RSRP measurement, and on one data symbol before and one data symbol after the symbols corresponding to the periodic CSI-RS resource configured for L1-RSRP measurement, and/or

- symbols corresponding to the semi-perssitent CSI-RS resource configured for L1-RSRP measurement when the resource is activated, and on one data symbol before and one data symbol after the symbols corresponding to the semi-perssitent CSI-RS resource configured for L1-RSRP measurement when the resource is activated, and/or

- symbols corresponding to the aperiodic CSI-RS resource configured for L1-RSRP measurement when the reporting is triggered, and on one data symbol before and one data symbol after the symbols corresponding to the aperiodic CSI-RS resource configured for L1-RSRP measurement when the reporting is triggered.

When intra-band carrier aggregation in FR2 is performed, the scheduling restrictions on serving cell where L1-RSRP measurement is performed apply to all serving cells in the band on the symbols that fully or partially overlap with restricted symbols.

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

If following conditions are met,

- UE has been notified about system information update through paging,

- The gap between UE’s reception of PDCCH that UE monitors in the Type 2-PDCCH CSS set and that notifies system information update, and the PDCCH that UE monitors in the Type0-PDCCH CSS set, is greater than 2 slots,

For the SSB and CORESET for RMSI scheduling multiplexing patterns 3, UE is expected to receive the PDCCH that UE monitors in the Type0-PDCCH CSS set, and the corresponding PDSCH, on SSB symbols to be measured for L1-RSRP measurement; and

For the SSB and CORESET for RMSI scheduling multiplexing patterns 2, UE is expected to receive PDSCH that corresponds to the PDCCH that UE monitors in the Type0-PDCCH CSS set, on SSB symbols to be measured for L1-RSRP measurement.

<End of Change 22>