**3GPP TSG-RAN4 Meeting #109R4-2321643**

**Chicago, US, November 13 – 17, 2023**

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| *CR-Form-v12.2* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **38.106** | **CR** |  | **rev** |  | **Current version:** | **18.2.0** |  |
|  | | | | | | | | |
| *For* ***[HE](http://www.3gpp.org/3G_Specs/CRs.htm" \l "_blank)******[LP](http://www.3gpp.org/3G_Specs/CRs.htm" \l "_blank)*** *on using this form: comprehensive instructions can be found at  <http://www.3gpp.org/Change-Requests>.* | | | | | | | | |
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| ***Proposed change affects:*** | UICC apps |  | ME |  | Radio Access Network | **x** | Core Network |  |

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| ***Title:*** | Big CR to TS 38.133 on RRM core requirements for NR network-controlled repeaters | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | ZTE Corporation,Ericsson,Nokia | | | | | | | | | |
| ***Source to TSG:*** | R4 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_netcon\_repeater-Core | | | | |  | ***Date:*** | | | 2023-10-30 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **B** |  | | | | | ***Release:*** | | | Rel-18 |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) … Rel-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18)*  *Rel-19 (Release 19)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | During the RAN4#108 meeting, the following drat CR are endorsed.  R4-2314374 Draft CR On NCR RRM Random Access Requirements to 38.106  R4-2314375 DraftCR on UE timing requirements for NR NCR-MT  R4-2314377 Draft CR on RRC connection re-establishment requirements for LA NCR-MT  R4-2317416,Draft CR to TS38.106 the introduction of BFD/BFR/RLM for NCR-MT, | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | To capture all the endorsed draft CR into big draft CR to TS 38.106. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | The RRM requirement for NCR-MT is not guaranteed if without proper requirement definition. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 2, 14.1 and 14.2 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **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----------------------------**

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non‑specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 38.104: “NR; Base Station (BS) radio transmission and reception”.

[3] 3GPP TR 25.942: "RF system scenarios".

[4] Recommendation ITU-R SM.328: "Spectra and bandwidth of emissions".

[5] ITU-R Recommendation SM.329: "Unwanted emissions in the spurious domain".

[6] ITU-R Recommendation M.1545: “Measurement uncertainty as it applies to test limits for the terrestrial component of International Mobile Telecommunications – 2000”.

[7] 3GPP TS 38.115-1: “NR; Repeater conformance testing - Part 1: Conducted conformance testing”.

[8] 3GPP TS 38.115-2: “NR; Repeater conformance testing - Part 2: Radiated conformance testing”.

[9] ERC Recommendation 74-01, "Unwanted emissions in the spurious domain".

[10] "Title 47 of the Code of Federal Regulations (CFR)", Federal Communications Commission.

[11] Void

[12] Void

[13] 3GPP TS 38.101-1: “NR User Equipment (UE) radio transmission and reception; Part 1: Range 1 Standalone”.

[14] 3GPP TS 38.101-2: “NR User Equipment (UE) radio transmission and reception: Part 2: Range 2 Standalone”.

[15] Void

[16] Void

[17] Void

[18] Void

[19] 3GPP TS 38.213: “NR; Physical layer procedures for control”.

[20] 3GPP TS 36.104: “Evolved Universal Terrestrial Radio Access (E-UTRA); Base Station (BS) radio transmission and reception”.

[23] 3GPP TS 38.331: “NR; Radio Resource Control (RRC); Protocol specification”.

[24] 3GPP TS 38.213: “NR; Physical layer procedures for control”.

[25] 3GPP TS 38.321: “NR; Medium Access Control (MAC) protocol specification”.

[26] 3GPP TS 38.211: “NR;  Physical channels and modulation”.

[27] 3GPP TS 38.306: “NR;  User Equipment (UE) radio access capabilities”.

**-----------------------------NEXT CHANGE------------------------------**

10.1.1.1 SA: RRC Re-establishment

10.1.1.1.1 Introduction

This clause contains requirements on the NCR-MT regarding RRC connection re-establishment procedure. The requirements in this clause are applicable only for local area (LA) NCR-MT.

RRC connection re-establishment is initiated when an NCR-MT in RRC\_CONNECTED state loses RRC connection due to any of failure cases, including radio link failure, handover failure, and RRC connection reconfiguration failure. The RRC connection re-establishment procedure is specified in clause 5.3.7 of TS 38.331 [23].

The requirements in this clause are applicable for RRC connection re-establishment to NR cell.

10.1.1.1.2 Requirements

In RRC\_CONNECTED state the NCR-MT shall be capable of sending *RRCReestablishmentRequest* message within Tre-establish\_delay seconds from the moment it detects a loss in RRC connection. The total RRC connection delay (Tre-establish\_delay) shall be less than:

TUL\_grant: It is the time required to acquire and process uplink grant from the target PCell. The uplink grant is required to transmit *RRCReestablishmentRequest* message.

The NCR-MT re-establishment delay (TNCR-MT\_re-establish\_delay) is specified in clause 10.1.1.1.2.1.

10.1.1.1.2.1 NCR-MT Re-establishment delay requirement

The NCR-MT re-establishment delay (TNCR-MT\_re-establish\_delay) is the time between the moments when any of the conditions requiring RRC re-establishment as defined in clause 5.3.7 in TS 38.331 [23] is detected by the NCR-MT and when the NCR-MT sends PRACH to the target PCell. The NCR-MT re-establishment delay (TNCR-MT\_re-establish\_delay) requirement shall be less than:

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

- the conditions of SSB\_RP and SSB Ês/Iot according to Annex TBD for the LA NCR-MT class and NCR type are fulfilled.

The inter-frequency target NR cell shall be considered detectable when for each relevant SSB:

- the conditions of SSB\_RP and SSB Ês/Iot according to Annex TBD for the LA NCR-MT class and NCR type are fulfilled.

Tidentify\_intra\_NR: It is the time to identify the target intra-frequency NR cell and it depends on whether the target NR cell is known cell or unknown cell and on the frequency range (FR) of the target NR cell. If the NCR-MT is not configured with intra-frequency NR carrier for RRC re-establishment then Tidentify\_intra\_NR=0; otherwise Tidentify\_intra\_NR shall not exceed the values defined in Table 10.1.1.1.2.1-1.

Tidentify\_inter\_NR,i: It is the time to identify the target inter-frequency NR cell on inter-frequency carrier *i* configured for RRC re-establishment and it depends on whether the target NR cell is known cell or unknown cell and on the frequency range (FR) of the target NR cell. Tidentify\_inter\_NR,i shall not exceed the values defined in Table 10.1.1.1.2.1-2.

TSMTC: It is the periodicity of the SMTC occasion configured for the intra-frequency carrier. If the NCR-MT has been provided with higher layer signaling of *smtc2* [23] then 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 the NCR-MT is not provided with SMTC configuration then the NCR-MT may assume that the target SSB periodicity is no larger than 20 ms.

TSI-NR: 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 [23] for the target NR cell.

TPRACH: It is the delay uncertainty in acquiring the first available PRACH occasion in the target NR cell. TPRACH can be up to the summation of SSB to PRACH occasion association period and 10 ms. SSB to PRACH occasion associated period is defined in clause 14 of TS 38.213 [24].

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

There is no requirement if the target cell does not contain the NCR-MT context or if the SSB transmission periodicity is larger than 20 ms.

In the requirement defined in the below tables, the target FR1 cell is known if it has been meeting the relevant cell identification requirement during the last 5 seconds otherwise it is unknown.

**Table 10.1.1.1.2.1-1: Time to identify target NR cell for RRC connection re-establishment to NR intra-frequency cell**

|  |  |  |  |
| --- | --- | --- | --- |
| **Serving cell SSB Ês/Iot (dB)** | **Frequency range (FR) of target NR cell** | **Tidentify\_intra\_NR [ms]** | |
| **Known NR cell** | **Unknown NR cell** |
| ≥ -8 | FR1 | MAX (1600 ms, 40 x TSMTC) | MAX (6400 ms, 80 x TSMTC) |
| ≥ -8 | FR2-1 | N/A | MAX (8000 ms, 640 x TSMTC) |
| < -8 | FR1 | N/A | 6400Note1 |
| < -8 | FR2-1 | N/A | 28160Note1 |
| Note 1: The NCR-MT is not required to successfullyidentify a cell on any NR frequency layer when TSMTC >20 ms and serving cell SSB Ês/Iot < -8 dB. | | | |

**Table 10.1.1.1.2.1-2: Time to identify target NR cell for RRC connection re-establishment to NR inter-frequency cell**

|  |  |  |  |
| --- | --- | --- | --- |
| **Serving cell SSB Ês/Iot (dB)** | **Frequency range (FR) of target NR cell** | **Tidentify\_inter\_NR, i [ms]** | |
| **Known NR cell** | **Unknown NR cell** |
| ≥ -8 | FR1 | MAX (1600 ms, 48 x TSMTC, i) | MAX (6400 ms, 104 x TSMTC, i) |
| ≥ -8 | FR2-1 | N/A | MAX (8000 ms, 832 x TSMTC, i) |
| < -8 | FR1 | N/A | 6400Note1 |
| < -8 | FR2-1 | N/A | 32000Note1 |
| Note 1: The NCR-MT is not required to successfully identify a cell on any NR frequency layer when TSMTC,i >20 ms and serving cell SSB Ês/Iot < -8 dB. | | | |

**----------------------NEXT OF CHANGE----------------------------**

#### 10.1.1.2 Random access

##### 10.1.1.2.1 Introduction

This clause contains requirements on the NCR-MT regarding random access procedure. The random access procedure is initiated to establish uplink time synchronization for a NCR-MT which either has not acquired or has lost its uplink synchronization, or to convey NCR-MT’s request Other SI, or for beam failure recovery. The random access is specified in clause 8 of TS 38.213 [24] and the control of the RACH transmission is specified in clause 5.1 of TS 38.321 [25].

The requirements in this clause apply for LA NCR-MT.

##### 10.1.1.2.2 Requirements for 4-step RA type

The NCR-MT shall have capability to calculate PRACH transmission power according to the PRACH power formula defined in clause 7.4 of TS 38.213 [24] and apply this power level at the first preamble or additional preambles. The absolute power applied to the first preamble shall have an accuracy as specified in Table TBA for FR1 and in Table TBA for FR2-1. The relative power applied to additional preambles shall have an accuracy as specified in Table TBA for FR1 and clause TBA for FR2-1.

The NCR-MT shall indicate a random access problem to upper layers if the maximum number of preamble transmission counter has been reached for the random access procedure on PCell as specified in clause 5.1.4 in TS 38.321 [25].

The requirements in this clause apply for NCR-MT in SA operation mode.

###### 10.1.1.2.2.1 Contention based random access

10.1.1.2.2.1.1 Correct behaviour when transmitting Random Access Preamble

With the NCR-MT selected SSB with SS-RSRP above *rsrp-ThresholdSSB*, NCR-MT shall have the capability to select a Random Access Preamble randomly with equal probability from the Random Access Preambles associated with the selected SSB if the association between Random Access Preambles and SSB is configured, as specified in clause 5.1.2 in TS 38.321 [25].

With the NCR-MT selected SSB with SS-RSRP above *rsrp-ThresholdSSB*, NCR-MT shall have the capability to transmit Random Access Preamble on the next available PRACH occasion from the PRACH occasions corresponding to the selected SSB permitted by the restrictions given by the *ra-ssb-OccasionMaskIndex* if configured, if the association between PRACH occasions and SSBs is configured, and PRACH occasion shall be randomly selected with equal probability amongst the selected SSB associated PRACH occasions occurring simultaneously but on different subcarriers, as specified in clause 5.1.2 in TS 38.321 [25].

10.1.1.2.2.1.2 Correct behaviour when receiving Random Access Response

The NCR-MT may stop monitoring for Random Access Response(s) and shall transmit the msg3 if the Random Access Response contains a Random Access Preamble identifier corresponding to the transmitted Random Access Preamble.

The NCR-MT shall again perform the Random Access Resource selection procedure defined in clause 5.1.2 in TS 38.321 [25], and transmit with the calculated PRACH transmission power when the backoff time expires if all received Random Access Responses contain Random Access Preamble identifiers that do not match the transmitted Random Access Preamble.

10.1.1.2.2.1.3 Correct behaviour when not receiving Random Access Response

The NCR-MT shall again perform the Random Access Resource selection procedure defined in clause 5.1.2 in TS 38.321 [25], and transmit with the calculated PRACH transmission power when the backoff time expires if no Random Access Response is received within the RA Response window defined in clause 5.1.4 in TS 38.321 [25].

10.1.1.2.2.1.4 Correct behaviour when receiving an UL grant for msg3 retransmission

The NCR-MT shall re-transmit the msg3 upon the reception of an UL grant for msg3 retransmission.

10.1.1.2.2.1.5 SA: Correct behaviour when receiving a message over Temporary C-RNTI

The NCR-MT shall send ACK if the Contention Resolution is successful.

The NCR-MT shall again perform the Random Access Resource selection procedure defined in clause 5.1.2 in TS 38.321 [25], and transmit with the calculated PRACH transmission power when the backoff time expires unless the received message includes a NCR-MT Contention Resolution Identity MAC control element and the NCR-MT Contention Resolution Identity included in the MAC control element matches the CCCH SDU transmitted in the uplink message.

10.1.1.2.2.1.6 Correct behaviour when contention Resolution timer expires

The NCR-MT shall re-select a preamble and transmit with the calculated PRACH transmission power when the backoff time expires if the Contention Resolution Timer expires.

###### 10.1.1.2.2.2 Non-Contention based random access

10.1.1.2.2.2.1 Correct behaviour when transmitting Random Access Preamble

If the contention-free Random Access Resources and the contention-free PRACH occasions associated with SSBs is configured, with the NCR-MT selected SSB with SS-RSRP above *rsrp-ThresholdSSB* amongst the associated SSBs, NCR-MT shall have the capability to select the Random Access Preamble corresponding to the selected SSB, and to transmit Random Access Preamble on the next available PRACH occasion from the PRACH occasions corresponding to the selected SSB permitted by the restrictions given by the *ra-ssb-OccasionMaskIndex* if configured, and PRACH occasion shall be randomly selected with equal probability amongst the selected SSB associated PRACH occasions occurring simultaneously but on different subcarriers, as specified in clause 5.1.2 in TS 38.321 [25].

If the contention-free Random Access Resources and the contention-free PRACH occasions associated with CSI-RSs is configured, with the NCR-MT selected CSI-RS with CSI-RSRP above *rsrp-ThresholdCSI-RS* amongst the associated CSI-RSs, NCR-MT shall have the capability to select the Random Access Preamble corresponding to the selected CSI-RS, and to transmit Random Access Preamble on the next available PRACH occasion from the PRACH occasions in *ra-OccasionList* corresponding to the selected CSI-RS, and PRACH occasion shall be randomly selected with equal probability amongst the selected CSI-RS associated PRACH occasions occurring simultaneously but on different subcarriers, as specified in clause 5.1.2 in TS 38.321 [25].

If the random access procedure is initialized for beam failure recovery and if the contention-free Random Access Resources and the contention-free PRACH occasions for beam failure recovery request associated with any of the SSBs and/or CSI-RSs is configured, NCR-MT shall have the capability to select the Random Access Preamble corresponding to the selected SSB with SS-RSRP above *rsrp-ThresholdSSB* amongst the associated SSBs or the selected CSI-RS with CSI-RSRP above *rsrp-ThresholdCSI-RS* amongst the associated CSI-RSs, and to transmit Random Access Preamble on the next available PRACH occasion from the PRACH occasions corresponding to the selected SSB permitted by the restrictions given by the *ra-ssb-OccasionMaskIndex* if configured, or from the PRACH occasions in *ra-OccasionList* corresponding to the selected CSI-RS, and PRACH occasion shall be randomly selected with equal probability amongst the selected SSB associated PRACH occasions or the selected CSI-RS associated PRACH occasions occurring simultaneously but on different subcarriers, as specified in clause 5.1.2 in TS 38.321 [25].

10.1.1.2.2.2.2 Correct behaviour when receiving Random Access Response

The NCR-MT may stop monitoring for Random Access Response(s), if the Random Access Response contains a Random Access Preamble identifier corresponding to the transmitted Random Access Preamble, unless the random access procedure is initialized for Other SI request from NCR-MT.

The NCR-MT may stop monitoring for Random Access Response(s) and shall monitor the Other SI transmission if the Random Access Response only contains a Random Access Preamble identifier which is corresponding to the transmitted Random Access Preamble and the random access procedure is initialized for SI request from NCR-MT, as specified in clause 5.1.4 in TS 38.321 [25].

The NCR-MT may stop monitoring for Random Access Response(s), if the contention-free Random Access Preamble for beam failure recovery request was transmitted and if the PDCCH addressed to NCR-MT’s C-RNTI is received, as specified in clause 5.1.4 in TS 38.321 [25].

The NCR-MT shall again perform the Random Access Resource selection procedure defined in clause 5.1.2 in TS 38.321 [25] for the next available PRACH occasion, and transmit the preamblewith the calculated PRACH transmission power if all received Random Access Responses contain Random Access Preamble identifiers that do not match the transmitted Random Access Preamble.

10.1.1.2.2.2.3 Correct behaviour when not receiving Random Access Response

The NCR-MT shall again perform the Random Access Resource selection procedure defined in clause 5.1.2 in TS 38.321 [25] for the next available PRACH occasion, and transmit the preamble with the calculated PRACH transmission power, if no Random Access Response is received within the RA Response window configured in *RACH-ConfigCommon* or if no PDCCH addressed to NCR-MT’s C-RNTI is received within the RA Response window configured in *BeamFailureRecoveryConfig*, as defined in clause 5.1.4 in TS 38.321 [25].

**----------------------NEXT OF CHANGE----------------------------**

## 10.2 Timing

### 10.2.1 NCR-MT transmit timing

#### 10.2.1.1 Introduction

The NCR-MT 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. NCR-MT belonging to local area NCR-MT class as defined in clause 4.3A.2 shall use the SpCell as the reference cell for deriving the NCR-MT transmit timing. NCR-MT initial transmit timing accuracy, gradual timing adjustment requirements are defined in the following requirements.

#### 10.2.1.2 Requirements

The NCR-MT initial transmission timing error shall be less than or equal to ±Te where the timing error limit value Te is specified in Table 10.2.1.2-1. This requirement applies for PUCCH, PUSCH and SRS or it is the PRACH transmission.

The NCR-MT shall meet the Te requirement for an initial transmission provided that at least one SSB is available at the NCR-MT during the last 160 ms. The reference point for the NCR-MT initial transmit timing control requirement shall be the downlink timing of the reference cell minus . The downlink timing is defined as the time when the first path (in time) of the corresponding downlink frame used by the NCR-MT to determine downlink timing is received from the reference cell at the NCR-MT antenna. *N*TA for PRACH is defined as 0.

 (in *Tc* units) for other channels is the difference between NCR-MT transmission timing and the downlink timing immediately after when the last timing advance in clause 10.2.2 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 10.2.1.2-2.

Table 10.2.1.2-1: 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 |
| Note 1: Tc is the basic timing unit defined in TS 38.211 [26] | | | |

Table 10.2.1.2-2: The Value of 

|  |  |
| --- | --- |
| Frequency range and band of cell used for uplink transmission | (Unit: TC) |
| FR1 TDD band without LTE-NR coexistence case | 25600 (Note 1) |
| FR1 TDD band with LTE-NR coexistence case | 39936 (Note 1) |
| FR2-1 | 13792 |
| Note 1: The NCR-MT identifies  based on the information n-TimingAdvanceOffset as specified in TS 38.331 [23]. If NCR-MT is not provided with the information n-TimingAdvanceOffset, the default value of  is set as 25600 for FR1 band. | |

When it is the transmission for PUCCH, PUSCH and SRS transmission, the NCR-MT 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 10.2.3 is applied.

##### 10.2.1.2.1 Gradual timing adjustment

The requirements in this clause apply for NCR-MT belonging to local area NCR-MT class as defined in clause 4.3A.2.

When the transmission timing error between the NCR-MT and the reference timing exceeds ±Te then the NCR-MT 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 NCR-MT 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 10.2.1.2.1-1.

Table 10.2.1.2.1-1: 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 |
| NOTE: Tc is the basic timing unit defined in TS 38.211 [26]. | | | |

10.2.2 NCR-MT timer accuracy

#### 10.2.2.1 Introduction

NCR-MT timers are used in different protocol entities to control the NCR-MT behaviour.

The requirements in clause 10.2.2 apply for NCR-MT belonging to local area NCR-MT class as defined in clause 4.3A.2.

#### 10.2.2.2 Requirements

For NCR-MT timers specified in TS 38.331 [23], the NCR-MT shall comply with the timer accuracies according to Table 10.2.2.2-1.

The requirements are only related to the actual timing measurements internally in the NCR-MT. They do not include the following:

- Inaccuracy in the start and stop conditions of a timer (e.g. NCR-MT reaction time to detect that start and stop conditions of a timer is fulfilled), or

- Inaccuracies due to restrictions in observability of start and stop conditions of an NCR-MT timer (e.g. slot alignment when NCR-MT sends messages at timer expiry).

Table 10.2.2.2-1

|  |  |
| --- | --- |
| Timer value [s] | Accuracy |
| timer value < 4 | ± 0.1s |
| timer value ≥ 4 | ± 2.5% |

### 10.2.3 NCR-MT timing advance

#### 10.2.3.1 Introduction

The timing advance is initiated from gNB to NCR-MT, with MAC message that implies the adjustment of the timing advance, as defined in clause 5.2 of TS 38.321 [25].

#### 10.2.3.2 Requirements

##### 10.2.3.2.1 Timing Advance adjustment delay

NCR-MT shall adjust the timing of its uplink transmission timing at time slot *n*+ *k+1* for a timing advance command received in time slot *n*, and the value of *k* is defined in clause 4.2 in TS 38.213 [24]. The same requirement applies also when NCR-MT is not able to transmit a configured uplink transmission due to the channel assessment procedure.

##### 10.2.3.2.2 Timing Advance adjustment accuracy

The NCR-MT shall adjust the timing of its transmissions with a relative accuracy better than or equal to the NCR-MT Timing Advance adjustment accuracy requirement in Table 10.2.3.2.2-1, to the signalled timing advance value compared to the timing of preceding uplink transmission. The timing advance command step is defined in TS 38.213 [24].

Table 10.2.3.2.2-1: NCR-MT Timing Advance adjustment accuracy

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| UL Sub Carrier Spacing(kHz) | 15 | 30 | 60 | 120 |
| UE Timing Advance adjustment accuracy | ±256 Tc | ±256 Tc | ±128 Tc | ±32 Tc |
| NOTE: Tc is the basic timing unit defined in TS 38.211 [26]. | | | | |

## 10.3 Signalling Characteristics for NCR-MT

### 10.3.1 Radio Link Monitoring

#### 10.3.1.1 Introduction

The requirements in clause 8.1 apply for radio link monitoring on:

- PCell in SA NR,

The NCR-MT 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 as specified in TS 38.213 [24]. The configured RLM-RS resources can be all SSBs, or all CSI-RSs, or a mix of SSBs and CSI-RSs. NCR-MT is not required to perform RLM outside the active DL BWP.

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

The threshold Qout 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) as defined in Table 10.3.1-1. For SSB based radio link monitoring, Qout\_SSB is derived based on the hypothetical PDCCH transmission parameters listed in Table 10.3.1.2.1-1. For CSI-RS based radio link monitoring, Qout\_CSI-RS is derived based on the hypothetical PDCCH transmission parameters listed in Table 10.3.1.3.1-1.

The threshold Qin is defined as the level at which the downlink radio link quality can be received with significantly higher reliability than at Qout and shall correspond to the in-sync block error rate (BLERin) as defined in Table 10.3.1-1. For SSB based radio link monitoring, Qin\_SSB is derived based on the hypothetical PDCCH transmission parameters listed in Table 10.3.1.2.1-2. For CSI-RS based radio link monitoring, Qin\_CSI-RS is derived based on the hypothetical PDCCH transmission parameters listed in Table 10.3.1.3.1-2.

The out-of-sync block error rate (BLERout) and in-sync block error rate (BLERin) are determined from the network configuration via parameter *rlmInSyncOutOfSyncThreshold* signalled by higher layers. When NCR-MT is not configured with *rlmInSyncOutOfSyncThreshold* from the network, NCR-MT determines out-of-sync and in-sync block error rates from Configuration #0 in Table 10.3.1-1 by default. All requirements in clause 10.3.1 are applicable for BLER Configuration #0 in Table 10.3.1-1.

Table 10.3.1-1: Out-of-sync and in-sync block error rates

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

NCR-MT 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  of SSBs per half frame according to TS 38.213 [24], where NRLM is specified in Table 10.3.1-2 according TS 38.213 [24], and meet the requirements as specified in clause 10.3.1. NCR-MT is not required to meet the requirements in clause 10.3.1 if RLM-RS is not configured and no TCI state for PDCCH is activated.

Table 10.3.1-2: Maximum number of RLM-RS resources NRLM

|  |  |  |
| --- | --- | --- |
| Carrier frequency range of PCell |  | Maximum number of RLM-RS resources, NRLM |
| FR1, ≤ 3 GHzNote | 4 | 2 |
| FR1, > 3 GHzNote | 8 | 4 |
| FR2-1 | 64 | 8 |

#### 10.3.1.2 Requirements for SSB based radio link monitoring

##### 10.3.1.2.1 Introduction

The requirements in this clause apply for each SSB based RLM-RS resource configured for PCell, provided that the SSB configured for RLM is actually transmitted within NCR-MT active DL BWP during the entire evaluation period specified in clause 10.3.1.2.2.

Table 10.3.1.2.1-1: 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 | 4dB |
| Ratio of hypothetical PDCCH DMRS energy to average SSS RE energy | 4dB |
| 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 10.3.1.2.1-2: 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 |

##### 10.3.1.2.2 Minimum requirement

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

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

TEvaluate\_out\_SSB and TEvaluate\_in\_SSB are defined in Table 10.3.1.2.2-1 for FR1 with scaling factor K1 = 5.

TEvaluate\_out\_SSB and TEvaluate\_in\_SSB are defined in Table 10.3.1.2.2-2 for FR2-1 with scaling factor N=8 and K2 = 3.

For FR1,

- P = 1

For FR2-1,

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

- , when the RLM-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod).

- P = 3, when RLM-RS resource is fully overlapped with SMTC period (TSSB = TSMTCperiod).

If the high layer in TS 38.331 [23] signaling of smtc2 is present, TSMTCperiod follows smtc2; Otherwise TSMTCperiod follow smtc1.

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

Table 10.3.1.2.2-1: Evaluation period TEvaluate\_out\_SSB and TEvaluate\_in\_SSB for FR1

|  |  |  |
| --- | --- | --- |
| Configuration | TEvaluate\_out\_SSB (ms) | TEvaluate\_in\_SSB (ms) |
| no DRX | Max(200 × K1, Ceil(10 × P × K1) × TSSB) | Max(100 × K1, Ceil(5 × P × K1) × TSSB) |
| NOTE: TSSB is the periodicity of the SSB configured for RLM. | | |

Table 10.3.1.2.2-2: Evaluation period TEvaluate\_out\_SSB and TEvaluate\_in\_SSB for FR2-1

|  |  |  |
| --- | --- | --- |
| Configuration | TEvaluate\_out\_SSB (ms) | TEvaluate\_in\_SSB (ms) |
| no DRX | Max(200 × K2, Ceil(10 × P × N × K2) × TSSB) | Max(100 × K2, Ceil(5 × P × N × K2) × TSSB) |
| NOTE: TSSB is the periodicity of the SSB configured for RLM. | | |

##### 10.3.1.2.3 Measurement restrictions for SSB based RLM

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

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

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

- If SSB and CSI-RS have different SCS,

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

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

For FR2-1, 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, NCR-MT 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.

#### 10.3.1.3 Requirements for CSI-RS based radio link monitoring

##### 10.3.1.3.1 Introduction

The requirements in this clause apply for each CSI-RS based RLM-RS resource configured for PCell, provided that the CSI-RS configured for RLM is actually transmitted within NCR-MT active DL BWP during the entire evaluation period specified in clause 10.3.1.3.2. NCR-MT is not expected to perform radio link monitoring measurements on the CSI-RS configured as RLM-RS if the CSI-RS is not in the active TCI state of any CORESET configured in the NCR-MT active BWP.

Table 10.3.1.3.1-1: 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 CSI-RS RE energy | 4dB |
| Ratio of hypothetical PDCCH DMRS energy to average CSI-RS RE energy | 4dB |
| Bandwidth (PRBs) | 48 |
| 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 10.3.1.3.1-2: 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 CSI-RS RE energy | 0dB |
| Ratio of hypothetical PDCCH DMRS energy to average CSI-RS RE energy | 0dB |
| Bandwidth (PRBs) | 48 |
| 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 |

##### 10.3.1.3.2 Minimum requirement

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

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

- TEvaluate\_out\_CSI-RS and TEvaluate\_in\_CSI-RS are defined in Table 10.3.1.3.2-1 for FR1 with scaling factor K1 = 5.

- TEvaluate\_out\_CSI-RS and TEvaluate\_in\_CSI-RS are defined in Table 10.3.1.3.2-2 for FR2-1 with scaling factor K2 = 3.

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

For FR1,

- P=1 .

For FR2-1,

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

- , when the RLM-RS resource is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod).

- P = 3, when the RLM-RS resource is fully overlapped with SMTC occasion (TCSI-RS = TSMTCperiod).

If the high layer in TS 38.331 [23] signaling of smtc2 is present, TSMTCperiod follows smtc2; Otherwise TSMTCperiod follow smtc1.

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

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

The values of Mout and Min used in Table 10.3.1.3.2-1 and Table 10.3.1.3.2-2 are defined as:

- Mout = 20 and Min = 10, if the CSI-RS resource configured for RLM is transmitted with higher layer CSI-RS parameter *density* [8, clause 7.4.1] set to 3 and over the bandwidth ≥ 24 PRBs.

Table 10.3.1.3.2-1: Evaluation period TEvaluate\_out\_CSI-RS and TEvaluate\_in\_CSI-RS for FR1

|  |  |  |
| --- | --- | --- |
| Configuration | TEvaluate\_out\_CSI-RS (ms) | TEvaluate\_in\_CSI-RS (ms) |
| no DRX | Max(200 × K1, Ceil(Mout×P × K1)×TCSI-RS) | Max(100 × K1, Ceil(Min×P × K1) × TCSI-RS) |
| NOTE: TCSI-RS is the periodicity of the CSI-RS resource configured for RLM. The requirements in this table apply for TCSI-RS equal to 5 ms, 10ms, 20 ms or 40 ms. | | |

Table 10.3.1.3.2-2: Evaluation period TEvaluate\_out\_CSI-RS and TEvaluate\_in\_CSI-RS for FR2-1

|  |  |  |
| --- | --- | --- |
| Configuration | TEvaluate\_out\_CSI-RS (ms) | TEvaluate\_in\_CSI-RS (ms) |
| no DRX | Max(200 × K2, Ceil(Mout×P × K2)×TCSI-RS) | Max(100 × K2, Ceil(Min×P × K2) × TCSI-RS) |
| NOTE: TCSI-RS is the periodicity of the CSI-RS resource configured for RLM. The requirements in this table apply for TCSI-RS equal to 5 ms, 10 ms, 20 ms or 40 ms. | | |

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

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

For both FR1 and FR2-1, when the CSI-RS for RLM is in the same OFDM symbol as SSB for RLM, BFD, CBD or L1-RSRP measurement, NCR-MT is not required to receive CSI-RS for RLM in the PRBs that overlap with an SSB.

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

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

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

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

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

For FR2-1, when the CSI-RS for RLM measurement on one CC is in the same OFDM symbol as SSB for RLM, BFD, or L1-RSRP measurement on the same CC or different CCs in the same band, or in the same symbol as SSB for CBD measurement on the same CC or different CCs in the same band when beam failure is detected, NCR-MT is required to measure one of but not both CSI-RS for RLM and SSB. Longer measurement period for CSI-RS based RLM is expected, and no requirements are defined.

For FR2-1, when the CSI-RS for RLM measurement on one CC is in the same OFDM symbol as another CSI-RS for RLM, BFD, CBD or L1-RSRP measurement on the same CC or different CCs in the same band,

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

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

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

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

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

#### 10.3.1.4 Minimum requirement for NCR-MT turning off the transmitter

The transmitter power of the NCR-MT in the monitored cell shall be turned off within 40ms after expiry of T310 timer as specified in TS 38.331 [23].

#### 10.3.1.5 Minimum requirement for L1 indication

When the downlink radio link quality on all the configured RLM-RS resources is worse than Qout, layer 1 of the NCR-MT 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 [23].

When the downlink radio link quality on at least one of the configured RLM-RS resources is better than Qin, layer 1 of the NCR-MT 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 [23].

The out-of-sync and in-sync evaluations for the configured RLM-RS resources shall be performed as specified in clause 5 [25]. Two successive indications from layer 1 shall be separated by at least TIndication\_interval.

TIndication\_interval 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 10.3.1.2 if the RLM-RS resource is SSB, or TCSI-RS specified in clause 10.3.1.3 if the RLM-RS resource is CSI-RS.

#### 10.3.1.6 Scheduling availability of NCR-MT during radio link monitoring

When the reference signal to be measured for RLM has different subcarrier spacing than PDSCH/PDCCH or is on frequency range 2, there are restrictions on the scheduling availability as described in the following clauses.

##### 10.3.1.6.1 Scheduling availability of NCR-MT performing radio link monitoring with a 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.

##### 10.3.1.6.2 Scheduling availability of NCR-MT performing radio link monitoring with a different subcarrier spacing than PDSCH/PDCCH on FR1

For NCR-MTs which support *simultaneousRxDataSSB-DiffNumerology* [27] there are no restrictions on scheduling availability due to radio link monitoring based on SSB as RLM-RS. For NCR-MTs which do not support *simultaneousRxDataSSB-DiffNumerology* [27] the following restrictions apply due to radio link monitoring based on SSB as RLM -RS.

- The NCR-MT 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.

##### 10.3.1.6.3 Scheduling availability of NCR-MT performing radio link monitoring on FR2-1

The following scheduling restriction applies due to radio link monitoring on an FR2-1 serving PCell .

- 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 NCR-MT 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 FR2-1, if following conditions are met,

- NCR-MT has been notified about system information update through paging,

- The gap between NCR-MT’s reception of PDCCH that NCR-MT monitors in the Type2-PDCCH CSS set and that notifies system information update, and the PDCCH that NCR-MT 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, NCR-MT is expected to receive the PDCCH that NCR-MT 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, NCR-MT is expected to receive PDSCH that corresponds to the PDCCH that NCR-MT monitors in the Type0-PDCCH CSS set, on SSB symbols to be measured for RLM.

### 10.3.2 Link Recovery Procedure

#### 10.3.2.1 Introduction

The NCR-MT 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 [24] in order to detect beam failure on:

- PCell in SA NR,,

The RS resource configurations in the set  on PCell can be periodic CSI-RS resources and/or SSBs. RS resource configuration in the set  on SCell shall be periodic CSI-RS. NCR-MT is not required to perform beam failure detection outside the active DL BWP. NCR-MT is not required to meet the requirements in clause 10.3.2.2 and 10.3.2.3 if NCR-MT does not have set .

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

The threshold Qout\_LR 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 = 10% block error rate of a hypothetical PDCCH transmission. For SSB based beam failure detection, Qout\_LR\_SSB is derived based on the hypothetical PDCCH transmission parameters listed in Table 10.3.2.2.1. For CSI-RS based beam failure detection, Qout\_LR\_CSI-RS is derived based on the hypothetical PDCCH transmission parameters listed in Table 10.3.2.3.1-1.

Upon request the NCR-MT shall deliver configuration indexes from the set as specified in TS 38.213 [24] , 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, which is indicated by higher layer parameter *rsrp-ThresholdSSB*. The NCR-MT applies the Qin\_LR threshold to the L1-RSRP measurement obtained from an SSB. The NCR-MT applies the Qin\_LR threshold to the L1-RSRP measurement obtained for a CSI-RS resource after scaling a respective CSI-RS reception power with a value provided by higher layer parameter *powerControlOffsetSS*. The RS resource configurations in the set  can be periodic CSI-RS resources or SSBs or both SSB and CSI-RS resources. NCR-MT is not required to perform candidate beam detection outside the active DL BWP.

#### 10.3.2.2 Requirements for SSB based beam failure detection

##### 10.3.2.2.1 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 NCR-MT active DL BWP during the entire evaluation period specified in clause 10.3.2.2.2. The requirements in this clause could not be applicable if NCR-MT is required to perform beam failure detection on more than 1 serving cell per band.

Table 10.3.2.2.1-1: 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 |

##### 10.3.2.2.2 Minimum requirement

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

The value of TEvaluate\_BFD\_SSB is defined in Table 10.3.2.2.2-1 for FR1.

The value of TEvaluate\_BFD\_SSB is defined in Table 10.3.2.2.2-2 for FR2-1 with scaling factor N= 8.

For FR1,

- P=1.

For FR2-1,

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

- , when the BFD-RS resource is partially overlapped with SMTC occasion (TSSB < TSMTCperiod).

- P = 3, when the BFD-RS resource is fully overlapped with SMTC period (TSSB = TSMTCperiod).

If the high layer in TS 38.331 [23] signaling of smtc2 is present, TSMTCperiod follows smtc2; Otherwise TSMTCperiod follow smtc1.

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

Table 10.3.2.2.2-1: Evaluation period TEvaluate\_BFD\_SSB for FR1

|  |  |
| --- | --- |
| Configuration | TEvaluate\_BFD\_SSB (ms) |
| no DRX | Max(50, Ceil(5 × P) × TSSB) |
| Note: TSSB is the periodicity of SSB in the set . | |

Table 10.3.2.2.2-2: Evaluation period TEvaluate\_BFD\_SSB for FR2-1

|  |  |
| --- | --- |
| Configuration | TEvaluate\_BFD\_SSB (ms) |
| no DRX | Max(50, Ceil(5 × P × N) × TSSB) |
| Note: TSSB is the periodicity of SSB in the set . | |

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

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

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

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

- If SSB and CSI-RS have different SCS,

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

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

For FR2-1, 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 in the same band, NCR-MT 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.

#### 10.3.2.3 Requirements for CSI-RS based beam failure detection

##### 10.3.2.3.1 Introduction

The requirements in this clause apply for each CSI-RS resource in the set  of resource configurations for a serving cell, provided that the CSI-RS resource(s) in set for beam failure detection are actually transmitted within the NCR-MT active DL BWP during the entire evaluation period specified in clause 10.3.2.3.2. NCR-MT is not expected to perform beam failure detection measurements on the CSI-RS configured for BFD if the CSI-RS is not QCL-ed, with QCL-TypeD when applicable, with the RS in the active TCI state of any CORESET configured in the NCR-MT active BWP. The requirements in this clause apply when NCR-MT is required to perform beam failure detection on no more than 1 serving cell per band.

Table 10.3.2.3.1-1: 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 CSI-RS RE energy | 0dB |
| Ratio of hypothetical PDCCH DMRS energy to average CSI-RS RE energy | 0dB |
| Bandwidth (PRBs) | 48 |
| 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 |

##### 10.3.2.3.2 Minimum requirement

NCR-MT shall be able to evaluate whether the downlink radio link quality on the CSI-RS resource in set  estimated over the last TEvaluate\_BFD\_CSI-RS ms period becomes worse than the threshold Qout\_LR\_CSI-RS within TEvaluate\_BFD\_CSI-RS ms period.

The value of TEvaluate\_BFD\_CSI-RS is defined in Table 10.3.2.3.2-1 for FR1.

The value of TEvaluate\_BFD\_CSI-RS is defined in Table 10.3.2.3.2-2 for FR2-1 with N=1.

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

For FR1,

- P = 1.

For FR2-1,

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

- , when the BFD-RS resource is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod).

- P = Psharing factor, when BFD-RS resource is fully overlapped with SMTC occasion (TCSI-RS = TSMTCperiod).

- Psharing factor = 3**.**

If the high layer in TS 38.331 [23] signaling of smtc2 is present, TSMTCperiod follows smtc2; Otherwise TSMTCperiod follow smtc1.

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

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

The values of MBFD used in Table 10.3.2.3.2-1 and Table 10.3.2.3.2-2 are defined as

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

Table 10.3.2.3.2-1: Evaluation period TEvaluate\_BFD\_CSI-RS for FR1

|  |  |
| --- | --- |
| Configuration | TEvaluate\_BFD\_CSI-RS (ms) |
| no DRX | Max(50, [MBFD × P] × TCSI-RS) |
| Note: TCSI-RS is the periodicity of CSI-RS resource in the set . | |

Table 10.3.2.3.2-2: Evaluation period TEvaluate\_BFD\_CSI-RS for FR2-1

|  |  |
| --- | --- |
| Configuration | TEvaluate\_BFD\_CSI-RS (ms) |
| no DRX | Max(50, [MBFD × P × N] × TCSI-RS) |
| Note: TCSI-RS is the periodicity of CSI-RS resource in the set . | |

##### 10.3.2.3.3 Measurement restrictions for CSI-RS based beam failure detection

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

For both FR1 and FR2-1, when the CSI-RS for BFD measurement is in the same OFDM symbol as SSB for RLM, BFD, CBD or L1-RSRP measurement, NCR-MT is not required to receive CSI-RS for BFD measurement in the PRBs that overlap with an SSB.

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

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

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

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

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

For FR2-1, when the CSI-RS for BFD measurement on one CC is in the same OFDM symbol as SSB for RLM, BFD or L1-RSRP measurement on the same CC in the same band, or in the same symbol as SSB for CBD measurement on the same CC in the same band when beam failure is detected, NCR-MT is required to measure one of but not both CSI-RS for BFD measurement and SSB. Longer measurement period for CSI-RS based BFD measurement is expected, and no requirements are defined.

For FR2-1, when the CSI-RS for BFD measurement on one CC is in the same OFDM symbol as another CSI-RS for RLM, BFD, CBD or L1-RSRP measurement on the same CC in the same band,

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

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

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

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

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

#### 10.3.2.4 Minimum requirement for L1 indication

When the radio link quality on all the RS resources in set  is worse than Qout\_LR, layer 1 of the NCR-MT shall send a beam failure instance indication to the higher layers. A layer 3 filter may be applied to the beam failure instance indications as specified in TS 38.331 [23].

The beam failure instance evaluation for the RS resources in set  shall be performed as specified in clause 6 in TS 38.213 [24]. Two successive indications from layer 1 shall be separated by at least TIndication\_interval\_BFD.

TIndication\_interval\_BFD is max(2ms, TSSB-RS,M) ) or max(2ms, TCSI-RS,M), where TSSB-RS,M and TCSI-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  or CSI-RS resource in the set .

#### 10.3.2.5 Requirements for SSB based candidate beam detection

##### 10.3.2.5.1 Introduction

The requirements in this clause apply for each SSB resource in the set  configured for a serving cell, provided that the SSBs configured for candidate beam detection are actually transmitted within NCR-MT active DL BWP during the entire evaluation period specified in clause 10.3.2.5.2.

##### 10.3.2.5.2 Minimum requirement

Upon request the NCR-MT shall be able to evaluate whether the L1-RSRP measured on the configured SSB resource in set  estimated over the last TEvaluate\_CBD\_SSB ms period becomes better than the threshold Qin\_LR provided SSB\_RP and SSB Ês/Iot are according to Annex Table in B.2.4.1 [23] for a corresponding band.

The NCR-MT shall monitor the configured SSB resources using the evaluation period in table 10.3.2.5.2-1 and 10.3.2.5.2-2 which is applicable to the non-DRX mode only.

The value of TEvaluate\_CBD\_SSB is defined in Table 10.3.2.5.2-1 for FR1.

The value of TEvaluate\_CBD\_SSB is defined in Table 10.3.2.5.2-2 for FR2-1 with scaling factor N=8.

Where,

For FR1,,

- P = 1.

For FR2-1,

- P=1, when the candidate beam detection RS resource is not overlapped with SMTC occasion.

- , when candidate beam detection RS is partially overlapped with SMTC occasion (TSSB < TSMTCperiod).

- P = 3, when candidate beam detection RS is fully overlapped with SMTC period (TSSB = TSMTCperiod).

If the high layer in TS 38.331 [23] signaling of smtc2 is present, TSMTCperiod follows smtc2; Otherwise TSMTCperiod follow smtc1.

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

Table 10.3.2.5.2-1: Evaluation period TEvaluate\_CBD\_SSB for FR1

|  |  |
| --- | --- |
| Configuration | TEvaluate\_CBD\_SSB (ms) |
| non-DRX | Ceil(3 × P) × TSSB |
| Note: TSSB is the periodicity of SSB in the set . | |

Table 10.3.2.5.2-2: Evaluation period TEvaluate\_CBD\_SSB for FR2-1

|  |  |
| --- | --- |
| Configuration | TEvaluate\_CBD\_SSB (ms) |
| non-DRX | Ceil(3 × P × N) × TSSB |
| Note: TSSB is the periodicity of SSB in the set . | |

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

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

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

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

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

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

For FR2-1, 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 in the same band, NCR-MT 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.

#### 10.3.2.6 Requirements for CSI-RS based candidate beam detection

##### 10.3.2.6.1 Introduction

The requirements in this clause apply for each CSI-RS resource in the set  configured for a serving cell, provided that the CSI-RS resources configured for candidate beam detection are actually transmitted within NCR-MT active DL BWP during the entire evaluation period specified in clause 10.3.2.6.2.

##### 10.3.2.6.2 Minimum requirement

Upon request the NCR-MT shall be able to evaluate whether the L1-RSRP measured on the configured CSI-RS resource in set  estimated over the last TEvaluate\_CBD\_CSI-RS [ms] period becomes better than the threshold Qin\_LR within TEvaluate\_CBD\_CSI-RS [ms] period provided CSI-RS Ês/Iot is according to Annex Table in B.2.4.2 [23] for a corresponding band.

The NCR-MT shall monitor the configured CSI-RS resources using the evaluation period in table 10.3.2.6.2-1 and 10.3.2.6.2-2 which is applicable to the non-DRX mode only.

The value of TEvaluate\_CBD\_CSI-RS is defined in Table 10.3.2.6.2-1 for FR1.

The value of TEvaluate\_CBD\_CSI-RS is defined in Table 10.3.2.6.2-2 for FR2-1 with scaling factor N=8.

For FR1,

- P = 1.

For FR2-1,

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

- , when candidate beam detection RS is partially overlapped with SMTC occasion (TCSI-RS < TSMTCperiod).

- P = 3, when candidate beam detection RS is fully overlapped with SMTC occasion (TCSI-RS = TSMTCperiod).

If the high layer in TS 38.331 [23] signaling of smtc2 is present, TSMTCperiod follows smtc2; Otherwise TSMTCperiod follow smtc1.

Longer evaluation period would be expected if the CSI-RS is on the same OFDM symbols with RLM, BFD, BM-RS, or other CBD-RS, according to the measurement restrictions defined in clause 10.3.2.6.3.

The values of MCBD used in Table 10.3.2.6.2-1 and Table 10.3.2.6.2-2 are defined as

- MCBD = 3, if the CSI-RS resource configured in the set  is transmitted with Density = 3.

Table 10.3.2.6.2-1: Evaluation period TEvaluate\_CBD\_CSI-RS for FR1

|  |  |
| --- | --- |
| Configuration | TEvaluateC\_CBD\_CSI-RS (ms) |
| non-DRX | Max(25, Ceil(MCBD × P) × TCSI-RS) |
| Note: TCSI-RS is the periodicity of CSI-RS resource in the set . | |

Table 10.3.2.6.2-2: Evaluation period TEvaluate\_CBD\_CSI-RS for FR2-1

|  |  |
| --- | --- |
| Configuration | TEvaluate\_CBD\_CSI-RS (ms) |
| non-DRX | Max(25, Ceil(MCBD × P × N) × TCSI-RS) |
| Note: TCSI-RS is the periodicity of CSI-RS resource in the set . | |

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

For both FR1 and FR2-1, when the CSI-RS for CBD measurement is in the same OFDM symbol as SSB for RLM, BFD, CBD or L1-RSRP measurement, NCR-MT is not required to receive CSI-RS for CBD measurement in the PRBs that overlap with an SSB.

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

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

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

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

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

For FR2-1, when the CSI-RS for CBD measurement on one CC is in the same OFDM symbol as SSB for RLM, BFD, CBD or L1-RSRP measurement on the same CC in the same band, NCR-MT is required to measure one of but not both CSI-RS for CBD measurement and SSB. Longer evaluation period for CSI-RS based CBD measurement is expected, and no requirements are defined.

For FR2-1, when the CSI-RS for CBD measurement on one CC is in the same OFDM symbol as another CSI-RS for RLM, BFD, CBD or L1-RSRP measurement on the same CC in the same band, NCR-MT is required to measure one of but not both CSI-RS for CBD measurement and the other CSI-RS. Longer evaluation period for CSI-RS based CBD measurement is expected, and no requirements are defined.

#### 10.3.2.7 Scheduling availability of NCR-MT during beam failure detection

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

##### 10.3.2.7.1 Scheduling availability of NCR-MT performing beam failure detection with a same subcarrier spacing as PDSCH/PDCCH on FR1

There are no scheduling restrictions due to beam failure detection performed on SSB and CSI-RS configured for BFD with the same SCS as PDSCH or PDCCH in FR1.

##### 10.3.2.7.2 Scheduling availability of NCR-MT performing beam failure detection with a different subcarrier spacing than PDSCH/PDCCH on FR1

For NCR-MTs which support *simultaneousRxDataSSB-DiffNumerology* [27] there are no restrictions on scheduling availability due to beam failure detection when SSB is configured as BFD. For NCR-MTs which do not support *simultaneousRxDataSSB-DiffNumerology* [27] the following restrictions apply due to beam failure detection when SSB is configured as BFD.

- The NCR-MT 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 beam failure detection.

##### 10.3.2.7.3 Scheduling availability of NCR-MT performing beam failure detection on FR2-1

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

- The NCR-MT 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 FR2-1, if following conditions are met,

- NCR-MT has been notified about system information update through paging,

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

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

#### 10.3.2.8 Scheduling availability of NCR-MT during candidate beam detection

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

##### 10.3.2.8.1 Scheduling availability of NCR-MT performing L1-RSRP measurement with a same subcarrier spacing as PDSCH/PDCCH on FR1

There are no scheduling restrictions due to L1-RSRP measurement performed on SSB and CSI-RS configured as link recovery detection resource with the same SCS as PDSCH or PDCCH in FR1.

##### 10.3.2.8.2 Scheduling availability of NCR-MT performing L1-RSRP measurement with a different subcarrier spacing than PDSCH/PDCCH on FR1

For NCR-MTs which support *simultaneousRxDataSSB-DiffNumerology* [27] there are no restrictions on scheduling availability due to L1-RSRP measurement based on SSB as link recovery detection resource. For NCR-MTs which do not support *simultaneousRxDataSSB-DiffNumerology* [27] the following restrictions apply due to L1-RSRP measurement based on SSB configured as link recovery detection resource.

- The NCR-MT is not expected to transmit PUCCH, PUSCH or SRS or receive PDCCH, PDSCH, TRS, CSI-RS for tracking or CSI-RS for CQI on SSB symbols to be measured for L1-RSRP.

##### 10.3.2.8.3 Scheduling availability of NCR-MT performing L1-RSRP measurement on FR2-1

The following scheduling restriction applies due to candidate beam detection

- The NCR-MT 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 FR2-1, if following conditions are met,

- NCR-MT has been notified about system information update through paging,

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

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

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

**----------------------End OF CHANGE----------------------------**