**3GPP TSG-RAN4 Meeting # 112 *R4-2413086***

**Maastricht, Netherlands, 19th – 23rd August, 2024**

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| *CR-Form-v12.3* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **38.133** | **CR** | **4896** | **rev** |  | **Current version:** | **18.6.0** |  |
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| *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 | **x** | Radio Access Network |  | Core Network |  |

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| ***Title:*** | CR on R18 multi-Rx link recovery procedures | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | ZTE Corporation, Sanechips | | | | | | | | | |
| ***Source to TSG:*** | R4 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | [NR\_FR2\_multiRX\_DL-Core] | | | | |  | ***Date:*** | | | 2024-08-09 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | F |  | | | | | ***Release:*** | | | Rel-18 |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories 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-17 (Release 17) Rel-18 (Release 18) Rel-19 (Release 19)  Rel-20 (Release 20)* | |
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| ***Reason for change:*** | | In last meeting, some progress regarding CBD was achieved, we revise the relevant clauses to align the agreements.  Furthermore, there is some redundant or incorrect description in 38.133, we refine such description. | | | | | | | | |
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| ***Summary of change:*** | | 1. Revise the relevant clauses to align the agreements achieved in last meeting; 2. Refining the redundant or incorrect description. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | Not align with the progress | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 8.5.1, 8.5.7.3, 8.18.2.2, 8.18.5.2, 8.18.6.1, 8.18.6.2, 8.18.8.3 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **X** | Other core specifications | | | | TS/TR ... CR ... | | |
| ***affected:*** | | **X** |  | Test specifications | | | | TS 38.533 | | |
| ***(show related CRs)*** | |  | **X** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

# <Start of Change #1>

## 8.5 Link Recovery Procedures

### 8.5.1 Introduction

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, NR-DC, or NE-DC operation mode,

- PSCell in NR-DC and EN-DC operation mode,

- SCell in SA, NR-DC, NE-DC or EN-DC operation mode,

- Deactivated PSCell in NR-DC and EN-DC operation mode

The RS resource configurations in the set  on PCell, PSCell or deactivated PSCell (if configured with *bfd-and-RLM* with value *true*) can be periodic CSI-RS resources and/or SSBs. RS resource configuration in the set  on SCell shall be periodic CSI-RS. UE is not required to perform beam failure detection outside the active DL BWP unless the UE supports *bwpOperationMeasWithoutInterrupt-r18*, provided that the SSB is within the configured UE-specific CBW. UE is not required to meet the requirements in clause 8.5.2 and 8.5.3 if UE does not have set . UE is not required to perform beam failure detection on a deactivated SCell, and also not required to perform beam failure detection on resources which is implicitly configured for a deactivated SCell. When more than 2 periodic CSI-RS resources on a CC are configured in the set  for current SCell or implicitly configured in the set  for other SCell, it is up to UE implementation to select two of CSI-RS resources in active BWP in current CC to perform beam failure detection. UE is not required to perform beam failure detection on a SCell on which  is not configured.

On each RS resource configuration in the set , the UE 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.

When a CORESET that the UE uses for monitoring PDCCH includes two TCI states and the UE is provided *sfnSchemePdcch* set to 'sfnSchemeA' or 'sfnSchemeB', the UE shall estimate a single downlink radio link quality to derive a single SNR and compare it to the single thresholds Qout\_LR for the purpose of accessing downlink radio link quality of the serving cell beams. How to compute the single SNR based on two active TCI states is up to UE implementation.

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 8.5.2.1-1. For CSI-RS based beam failure detection, Qout\_LR\_CSI-RS is derived based on the hypothetical PDCCH transmission parameters listed in Table 8.5.3.1-1.

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, which is indicated by higher layer parameter *rsrp-ThresholdSSB*. The UE applies the Qin\_LR threshold to the L1-RSRP measurement obtained from an SSB. The UE 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. UE is not required to perform candidate beam detection outside the active DL BWP unless the UE supports *bwpOperationMeasWithoutInterrupt-r18*, provided that the SSB is within the configured UE-specific CBW. UE is not required to perform candidate beam detection on a SCell on which  is not configured.

For a deactivated SCG, the UE may be provided via an RRC reconfiguration message with *tci-info* for PDCCH/PDSCH reception at the transition from deactivated SCG to activated SCG while the SCG is deactivated. After the reception of the RRC reconfiguration message the UE shall perform the BFD on the PSCellof the deactivated SCG using the TCI states accroding to *tci-info* specified in clause 6.3.2 in TS38.331[2]*.*

For UE supporting *ncd-SSB-BWP-Wor-r18*, the SSB and SMTC in this section applies for both CD-SSB and NCD-SSB if it is not additional specified. If SSB in the active DL BWP of serving cell *i* is NCD-SSB, for serving cell *i* the requirements in clause 8.1 apply provided that serving cell *i* is PCell or activated PSCell.

# <End of Change #1>

# <Start of Change #2>

### 8.5.7 Scheduling availability of UE during beam failure detection

#### 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.

- For the case when UE supporting schedulingMeasurementRelaxation-r18 in FR2-1 is configured to receive two PDSCH transmission occasions from two different QCL sources on the cell according to the conditions in clause 3.6.19, there are no scheduling restrictions for the PDSCHs due to beam failure detection performed based on the CSI-RS, when following conditions are met:

- the CSI-RS configured for BFD is not in a CSI-RS resource set with repetition ON, and

- the CSI-RS configured for BFD has same QCL source as the active TCI state of one of PDSCHs and has different QCL-TypeD from the other PDSCH, and

- [The two CSI-RS resources and both PDSCHs are overlapped on the same OFDM symbol], and

- Resources of the active TCI states for the two PDSCHs have been reported as a resource group in Rel-17 group-based RSRP report

- 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 shall receive the PDCCH that UE monitors in the Type0-PDCCH CSS set, and the corresponding PDSCH, on SSB symbols to be measured for BFD measurement; and

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

# <End of Change #2>

# <Start of Change #3>

## 8.18 TRP specific Link Recovery Procedures

### 8.18.2 Requirements for TRP specific SSB based beam failure detection

#### 8.18.2.2 Minimum requirement

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

The value of TEvaluate\_BFD\_SSB is defined in Table 8.18.2.2-1 for FR1.

The value of TEvaluate\_BFD\_SSB is defined in Table 8.18.2.2-2 for FR2 with scaling factor N, where

N = 2, 4, or 6 in FR2-1 for UE supporting *fastBeamSweepingMultiRx-r1*8 [additional conditions FFS], according to the conditions described in clause 3.6.19, and

N=8 for other cases in FR2.

**--- Unchanged text in this clause is omitted ---**

# <End of Change #3>

# <Start of Change #4>

### 8.18.5 Requirements for SSB based candidate beam detection

#### 8.18.5.2 Minimum requirement

Upon request the UE shall be able to evaluate whether the L1-RSRP measured on the configured SSB resource in the two sets and ,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 B.2.4.1 for a corresponding band.

The UE shall monitor the configured SSB resources using the evaluation period in table 8.18.5.2-1 and 8.18.5.2-2 corresponding to the non-DRX mode, if the configured DRX cycle ≤ 320ms.

The value of TEvaluate\_CBD\_SSB is defined in Table 8.18.5.2-1 for FR1.

The value of TEvaluate\_CBD\_SSB is defined in Table 8.18.5.2-2 for FR2 with scaling factor N=8.~~, where~~

~~N = [TBD] in FR2-1 if the UE supports [fast beam sweeping capability] [additional conditions FFS], according to the conditions described in clause 3.6.x, The UE is activated with multi-Rx operation when the UE is configured with Rel-17 group-based beam reporting.~~

~~N=8 for other cases in FR2.~~

For UE supporting [*musim-GapPreference-r17]* and is configured with one or more per-UE periodic MUSIM gaps,

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

- Ntotal / Noutside\_MG in FR1

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

- Ntotal / Navailable in FR2 with Navailable > 0

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

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

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

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

- TSSB is periodicity of the target SSB resource for CBD.

When the configured aperiodic MUSIM gap is overlapping with configured CBD SSB resource occasions, longer evaluation period would be expected.

Requirements in this clause do not apply when Noutside MG = 0 due to fully overlapping between target SSB resource for CBD and MUSIM gap occasions within the window W.

Otherwise, when UE is not configured with periodic MUSIM gap(s) or not supporting MUSIM gap capability,

**--- Unchanged text in this clause is omitted ---**

# <End of Change #4>

# <Start of Change #5>

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

#### 8.18.6.2 Minimum requirement

Upon request the UE shall be able to evaluate whether the L1-RSRP measured on the configured CSI-RS resource in sets and 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 B.2.4.2 for a corresponding band.

The UE shall monitor the configured CSI-RS resources using the evaluation period in table 8.18.6.2-1 and 8.18.6.2-2 corresponding to the non-DRX mode, if the configured DRX cycle ≤ 320ms.

The value of TEvaluate\_CBD\_CSI-RS is defined in Table 8.18.6.2-1 for FR1.

The value of TEvaluate\_CBD\_CSI-RS is defined in Table 8.18.6.2-2 for FR2 with scaling factor N=8.~~, where~~

~~N = [TBD] in FR2-1 if the UE supports [fast beam sweeping capability] [additional conditions FFS], according to the conditions described in clause 3.6.x. The UE is activated with multi-Rx operation when the UE is configured with Rel-17 group-based beam reporting., and~~

~~N=8 for other cases in FR2.~~

For UE supporting [*musim-GapPreference-r17]* and is configured with one or more per-UE periodic MUSIM gaps,

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

- Ntotal / Noutside\_MG in FR1

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

- Ntotal / Navailable in FR2 with Navailable > 0

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

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

- Noutside\_MG is the number of configured CBD CSI-RS resource occasions that are not overlapped with any MUSIM gap occasions within the window W

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

- TCSI-RS is periodicity of the target CSI-RS resource for CBD.

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

Requirements in this clause do not apply when Noutside MG = 0 due to fully overlapping between target CSI-RS resource for CBD and MUSIM gap occasions within the window W.

Otherwise, when UE is not configured with periodic MUSIM gap(s) or not supporting MUSIM gap capability,

**--- Unchanged text in this clause is omitted ---**

# <End of Change #5>

# <Start of Change #6>

### 8.18.8 Scheduling availability of UE during TRP specific beam failure detection

#### 8.18.8.3 Scheduling availability of UE performing TRP specific beam failure detection on FR2

The following scheduling restriction applies due to TRP specific beam failure detection.

- For FR2-1, for UE supporting *schedulingMeasurementRelaxation-r1*8 according to the conditions described in clause 3.6.19, if CSI-RS for BFD and the other CSI-RS for tracking or for CQI in the same or overlapping OFDM symbol are configured with different QCL-TypeD in the cell and the following conditions apply:

- The CSI-RS is not in a CSI-RS resource set with repetition ON.

- The CSI-RS has same QCL source as the active TCI state of one of the PDSCHs and has different QCL-TypeD from the other PDSCH.

- The CSI-RS and both of the PDSCHs are on the same OFDM symbol(s), or the CSI-RS and one of the PDSCHs with different QCL typeD are on the same OFDM symbol(s) when partially overlapping PDSCHs are scheduled, and

- Resources of the active TCI states for the two PDSCHs have been reported as a resource group in Rel-17 group-based RSRP report.

- There are no scheduling restrictions due to TRP specific beam failure detection performed 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 BFD-RS resource symbols to be measured for TRP specific beam failure detection.

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 shall receive the PDCCH that UE monitors in the Type0-PDCCH CSS set, and the corresponding PDSCH, on SSB symbols to be measured for BFD measurement; and

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

# <End of Change #6>