**3GPP TSG-RAN WG2 Meeting #112-e *R2-2010805***

**Online, November 2nd - 13th, 2020**

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| *CR-Form-v12.1* |
| **CHANGE REQUEST** |
|  |
|  | **38.321** | **CR** | **0999** | **rev** | **-** | **Current version:** | **16.2.1** |  |
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| *For* ***[HE](http://www.3gpp.org/3G_Specs/CRs.htm%22%20%5Cl%20%22_blank)******[LP](http://www.3gpp.org/3G_Specs/CRs.htm%22%20%5Cl%20%22_blank)*** *on using this form: comprehensive instructions can be found at <http://www.3gpp.org/Change-Requests>.* |
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| ***Proposed change affects:*** | UICC apps |  | ME | **x** | Radio Access Network | **x** | Core Network |  |

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| ***Title:***  | Correction on BFR MAC CE Generation and Build after Triggering of BFR |
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| ***Source to WG:*** | ZTE, Ericsson, Nokia, Samsung |
| ***Source to TSG:*** | R2 |
|  |  |
| ***Work item code:*** | NR\_eMIMO-Core |  | ***Date:*** | 2020-11-20 |
|  |  |  |  |  |
| ***Category:*** | **F** |  | ***Release:*** | Rel-16 |
|  | *Use one of the following categories:****F*** *(correction)****A*** *(mirror corresponding to a change in an earlier release)****B*** *(addition of feature),* ***C*** *(functional modification of feature)****D*** *(editorial modification)*Detailed explanations of the above categories canbe found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | *Use one of the following releases:Rel-8 (Release 8)Rel-9 (Release 9)Rel-10 (Release 10)Rel-11 (Release 11)…Rel-15 (Release 15)Rel-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)* |
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| ***Reason for change:*** | Upon beam failure detection on SCell, a BFR is triggered and the MAC entity is required to transmit BFR MAC CE immediately upon availability of UL-SCH resources. However, in case the candidate beam evaluation is still ongoing when the BFR MAC CE is built, the MAC entity has no choice but report “no candidate available” to the network. The BFR MAC CE should be only generated and the beam failure indication should be indicated in a BFR MAC CE for an SCell when the candidate beam evaluation is completed so that the candidate availability is properly reported to the network. |
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| ***Summary of change:*** | 1: The generation of the BFR MAC CE for an SCell is done only upon completing evaluation of the candidate beams according to the requirements as specified in TS 38.133.2: The Beam failure indication in the BFR MAC CE for an SCell is indicated only upon completing evaluation of the candidate beams according to the requirements as specified in TS 38.133.**Impact analysis**Impacted 5G architecture options:NR SA, NR-DC, NE-DC, (NG)EN-DCImpacted functionality:BFR on SCellInter-operability: 1: If UE implements according to the CR while the NW does not, no inter-operability issue can be found.2: If the NW implements according to the CR and the UE does not, no inter-operability issue can be found. |
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| ***Consequences if not approved:*** | UE may generate a BFR MAC CE or indicate beam failure indication in the BFR MAC CE for a SCell when the candidate beam evaluation has not been completed. |
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| ***Clauses affected:*** | 5.17; 6.1.3.23 |
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|  | **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:*** | . |

**--------------------------------------- The first change start --------------------------------------------------**

## 5.17 Beam Failure Detection and Recovery procedure

The MAC entity may be configured by RRC per Serving Cell with a beam failure recovery procedure which is used for indicating to the serving gNB of a new SSB or CSI-RS when beam failure is detected on the serving SSB(s)/CSI-RS(s). Beam failure is detected by counting beam failure instance indication from the lower layers to the MAC entity. If *beamFailureRecoveryConfig* is reconfigured by upper layers during an ongoing Random Access procedure for beam failure recovery for SpCell, the MAC entity shall stop the ongoing Random Access procedure and initiate a Random Access procedure using the new configuration.

RRC configures the following parameters in the *BeamFailureRecoveryConfig* and the *RadioLinkMonitoringConfig* for the Beam Failure Detection and Recovery procedure:

- *beamFailureInstanceMaxCount* for the beam failure detection;

- *beamFailureDetectionTimer* for the beam failure detection;

- *beamFailureRecoveryTimer* for the beam failure recovery procedure;

- *rsrp-ThresholdSSB*: an RSRP threshold for the beam failure recovery;

- *powerRampingStep*: *powerRampingStep* for the SpCell beam failure recovery;

- *powerRampingStepHighPriority*: *powerRampingStepHighPriority* for the SpCell beam failure recovery;

- *preambleReceivedTargetPower*: *preambleReceivedTargetPower* for the SpCell beam failure recovery;

- *preambleTransMax*: *preambleTransMax* for the SpCell beam failure recovery;

- *scalingFactorBI*: *scalingFactorBI* for the SpCell beam failure recovery;

- *ssb-perRACH-Occasion*: *ssb-perRACH-Occasion* for the SpCell beam failure recovery;

- *ra-ResponseWindow*: the time window to monitor response(s) for the SpCell beam failure recovery using contention-free Random Access Preamble;

- *prach-ConfigurationIndex*: *prach-ConfigurationIndex* for the SpCell beam failure recovery;

- *ra-ssb-OccasionMaskIndex*: *ra-ssb-OccasionMaskIndex* for the SpCell beam failure recovery;

- *ra-OccasionList*: *ra-OccasionList* for the SpCell beam failure recovery.

The following UE variables are used for the beam failure detection procedure:

- *BFI\_COUNTER* (per Serving Cell): counter for beam failure instance indication which is initially set to 0.

The MAC entity shall for each Serving Cell configured for beam failure detection:

1> if beam failure instance indication has been received from lower layers:

2> start or restart the *beamFailureDetectionTimer*;

2> increment *BFI\_COUNTER* by 1;

2> if *BFI\_COUNTER* >= *beamFailureInstanceMaxCount*:

3> if the Serving Cell is SCell:

4> trigger a BFR for this Serving Cell;

3> else:

4> initiate a Random Access procedure (see clause 5.1) on the SpCell.

1> if the *beamFailureDetectionTimer* expires; or

1> if *beamFailureDetectionTimer*, *beamFailureInstanceMaxCount*, or any of the reference signals used for beam failure detection is reconfigured by upper layers associated with this Serving Cell:

2> set *BFI\_COUNTER* to 0.

1> if the Serving Cell is SpCell and the Random Access procedure initiated for SpCell beam failure recovery is successfully completed (see clause 5.1):

2> set *BFI\_COUNTER* to 0;

2> stop the *beamFailureRecoveryTimer*, if configured;

2> consider the Beam Failure Recovery procedure successfully completed.

1> else if the Serving Cell is SCell, and a PDCCH addressed to C-RNTI indicating uplink grant for a new transmission is received for the HARQ process used for the transmission of the BFR MAC CE or Truncated BFR MAC CE which contains beam failure recovery information of this Serving Cell; or

1> if the SCell is deactivated as specified in clause 5.9:

2> set *BFI\_COUNTER* to 0;

2> consider the Beam Failure Recovery procedure successfully completed and cancel all the triggered BFRs for this Serving Cell.

The MAC entity shall:

1> if the Beam Failure Recovery procedure determines that at least one BFR has been triggered and not cancelled for an SCell for which evaluation of the candidate beams according to the requirements as specified in TS 38.133 [11] has been completed :

2> if UL-SCH resources are available for a new transmission and if the UL-SCH resources can accommodate the BFR MAC CE plus its subheader as a result of LCP:

3> instruct the Multiplexing and Assembly procedure to generate the BFR MAC CE.

2> else if UL-SCH resources are available for a new transmission and if the UL-SCH resources can accommodate the Truncated BFR MAC CE plus its subheader as a result of LCP:

3> instruct the Multiplexing and Assembly procedure to generate the Truncated BFR MAC CE.

2> else:

3> trigger the SR for SCell beam failure recovery for each SCell for which BFR has been triggered, not cancelled, and for which evaluation of the candidate beams according to the requirements as specified in TS 38.133 [11] has been completed.

All BFRs triggered for an SCell shall be cancelled when a MAC PDU is transmitted and this PDU includes a BFR MAC CE or Truncated BFR MAC CE which contains beam failure information of that SCell.

**--------------------------------------- The first change end ---------------------------------------------**

**--------------------------------------- The Second change start --------------------------------------------------**

#### 6.1.3.23 BFR MAC CEs

The MAC CEs for BFR consists of either:

- BFR MAC CE; or

- Truncated BFR MAC CE.

The BFR MAC CE and Truncated BFR MAC CE are identified by a MAC subheader with LCID/eLCID as specified in Table 6.2.1-2 and Table 6.2.1-2b.

The BFR MAC CE and Truncated BFR MAC CE have a variable size. They include a bitmap and in ascending order based on the *ServCellIndex*, beam failure recovery information i.e. octets containing candidate beam availability indication (AC) for SCells indicated in the bitmap. For BFR MAC CE, a single octet bitmap is used when the highest *ServCellIndex* of this MAC entity's SCell for which beam failure is detected and the evaluation of the candidate beams according to the requirements as specified in TS 38.133 [11] has been completed is less than 8, otherwise four octets are used. A MAC PDU shall contain at most one BFR MAC CE.

For Truncated BFR MAC CE, a single octet bitmap is used for the following cases, otherwise four octets are used:

- the highest *ServCellIndex* of this MAC entity's SCell for which beam failure is detected and the evaluation of the candidate beams according to the requirements as specified in TS 38.133 [11] has been completed is less than 8; or

- beam failure is detected for SpCell (as specified in Clause 5.17) and the SpCell is to be indicated in a Truncated BFR MAC CE and the UL-SCH resources available for transmission cannot accommodate the Truncated BFR MAC CE with the four octets bitmap plus its subheader as a result of LCP.

The fields in the BFR MAC CEs are defined as follows:

- SP: This field indicates beam failure detection (as specified in clause 5.17) for the SpCell of this MAC entity. The SP field is set to 1 to indicate that beam failure is detected for SpCell only when BFR MAC CE or Truncated BFR MAC CE is to be included into a MAC PDU as part of Random Access Procedure (as specified in 5.1.3a and 5.1.4), otherwise, it is set to 0;

- Ci (BFR MAC CE): This field indicates beam failure detection (as specified in clause 5.17) and the presence of an octet containing the AC field for the SCell with *ServCellIndex* i as specified in TS 38.331 [5]. The Ci field set to 1 indicates that beam failure is detected, the evaluation of the candidate beams according to the requirements as specified in TS 38.133 [11] has been completed, and the octet containing the AC field is present for the SCell with *ServCellIndex* i. The Ci field set to 0 indicates that the beam failure is either not detected or the beam failure is detected but the evaluation of the candidate beams according to the requirements as specified in TS 38.133 [11] has not been completed, and the octet containing the AC field is not present for the SCell with *ServCellIndex* i. The octets containing the AC field are present in ascending order based on the *ServCellIndex*;

- Ci (Truncated BFR MAC CE): This field indicates beam failure detection (as specified in clause 5.17) for the SCell with *ServCellIndex* i as specified in TS 38.331 [5]. The Ci field set to 1 indicates that beam failure is detected, the evaluation of the candidate beams according to the requirements as specified in TS 38.133 [11] has been completed, and the octet containing the AC field for the SCell with *ServCellIndex* i may be present. The Ci field set to 0 indicates that the beam failure is either not detected or the beam failure is detected but the evaluation of the candidate beams according to the requirements as specified in TS 38.133 [11] has not been completed, and the octet containing the AC field is not present for the SCell with *ServCellIndex* i. The octets containing the AC field, if present, are included in ascending order based on the *ServCellIndex*. The number of octets containing the AC field included is maximised, while not exceeding the available grant size;

NOTE: The number of the octets containing the AC field in the Truncated BFR MAC CE can be zero.

- AC: This field indicates the presence of the Candidate RS ID field in this octet. If at least one of the SSBs with SS-RSRP above *rsrp-ThresholdBFR* amongst the SSBs in *candidateBeamRSSCellList* or the CSI-RSs with CSI-RSRP above *rsrp-ThresholdBFR* amongst the CSI-RSs in *candidateBeamRSSCellList* is available, the AC field is set to 1; otherwise, it is set to 0. If the AC field set to 1, the Candidate RS ID field is present. If the AC field set to 0, R bits are present instead;

- Candidate RS ID: This field is set to the index of an SSB with SS-RSRP above *rsrp-ThresholdBFR* amongst the SSBs in *candidateBeamRSSCellLis*t or to the index of a CSI-RS with CSI-RSRP above *rsrp-ThresholdBFR* amongst the CSI-RSs in *candidateBeamRSSCellLis*t. Index of an SSB or CSI-RS is the index of an entry in *candidateBeamRSSCellLis*t corresponding to the SSB or CSI-RS. Index 0 corresponds to the first entry in the *candidateBeamRSSCellLis*t, index 1 corresponds to the second entry inthe list and so on*.* The length of this field is 6 bits.

- R: Reserved bit, set to 0.



Figure 6.1.3.23-1: BFR and Truncated BFR MAC CE with the highest *ServCellIndex* of this MAC entity's SCell configured with BFD is less than 8



Figure 6.1.3.23-2: BFR and Truncated BFR MAC CE with the highest *ServCellIndex* of this MAC entity's SCell configured with BFD is equal to or higher than 8

**--------------------------------------- The Second change end --------------------------------------------------**