**3GPP TSG-RAN WG2 Meeting #124 *R2-23xxxxx***

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

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| *CR-Form-v12.2* |
| **CHANGE REQUEST** |
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|  | **38.321** | **CR** | **1554** | **rev** | **11** | **Current version:** | **17.6.0** |  |
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| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* |
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| ***Proposed change affects:*** | UICC apps |  | ME | **X** | Radio Access Network | **X** | Core Network |  |

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|  |
| ***Title:***  | Introduction of support for Network Controlled Repeaters |
|  |  |
| ***Source to WG:*** | Samsung |
| ***Source to TSG:*** | R2 |
|  |  |
| ***Work item code:*** | NR\_netcon\_repeater-Core |  | ***Date:*** | 2023-11-23 |
|  |  |  |  |  |
| ***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 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-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)Rel-19 (Release 19)* |
|  |  |
| ***Reason for change:*** | Ensure support for NCR by making necessary changes to the NR MAC specification. |
|  |  |
| ***Summary of change:*** | (Rev 0)* Editors note inserted in 5.17 (Beam Failure Detection and Recovery procedure) to capture the need to discuss whether NCR-Fwd behavior is to be captured in 38.321, or not. If yes, then further input from RAN1 is needed, including the behavior of NCR-Fwd when BFR/RLF happen in C-link (as per RAN1 agreement, this is an FFS).
* New MAC CE for (semi-static) Backhaul beam indication added to the list in 5.18.1 (General).
* Section placeholders created for new MAC CE for (semi-static) Backhaul beam indication (6.1.3.y), and the related description of handling of this MAC CE (5.18.x).
* Editors note inserted in both of above sections to explain that further input is awaited from RAN1 before RAN2 can design the MAC CE, including: 1. Whether a single, unified MAC-CE design (covering both Rel-15 and Rel-17 beam indication framework) is appropriate, or if we need two separate MAC CE formats (one that uses separate DL and UL beam indication methods, and another one, which uses TCI states for both UL and DL beam indication); and 2. Whether the Rel-17 option conveys (either isolated, or as part of unified design) both TCI ID and SRI, or just one of those two.
* Editors note inserted in 6.2.1 (MAC subheader for DL-SCH and UL-SCH) to indicate new (e)LCID value will need to be set aside.
* Editors note inserted in 7.1 (RNTI values) to capture RAN1 agreement to introduce a new RNTI for NCR-MT operation.

(Rev 1)* Added text to 5.18.x Backhaul Link Beam Indication for NCR (which was previously set aside but only contained an Editors note), describing handling of NCR Downlink & Uplink Backhaul beam indication MAC CEs. Editors note removed.
* Two new sections added for two new agreed BH MAC CEs (NCR Downlink & Uplink Backhaul beam indication MAC CEs). Previously only one section had been set aside for this purpose, and this has now been revised.
* Added section 5.18.t Access Link Beam Indication for NCR, describing handling of NCR Access Link Beam Indication MAC CE.
* A new section added for the newly agreed MAC CE for Access Link Beam indication.
* Three new eLCID values allocated to the three new agreed MAC CEs. Related Editors note revised.
* New RNTI value assigned. Related Editors note revised.
* Handling of beam failure added in 5.17. Related Editors note removed.

(Rev 2)* TP from R2-2303446 introduced, implementing the use of dl-OrJoint-TCIStateList in the UL BH Link Beam Indication MAC CE.
* Editors notes on new RNTI and use of eLCIDs removed, in line with agreements made at RAN2#121bis-e.
* Field name changed (from ‘Resource set ID’) for DL and UL BH Link Beam Indication MAC CE.
* Reverted back to one ‘R’ field for the UL BH Link Beam Indication MAC CE.

(Rev 3)* Only editorial changes compared to the endorsed version of the CR (which is Rev 2).
* Added relevant abbreviations and definitions (from endorsed version of stage-2 CR).
* Corrected typo dl-OrJoint-TCIStateList 🡪 dl-OrJointTCI-StateList, and several other typos.

(Rev 4)* Removed changes that were on top of other changes, including deteled Editors Notes.
* Introduced definition of SRI, and made it clear that in this (NCR) case the SRI field refers to one of the first 16 configured SRS-ResourceID values.
* Implemented the following agreements from RAN2#122:

Agreements:The TCI state and SRI indicated in MAC CE are associated with active DL/UL BWP.For the UL beam indication in the case of joint TCI state, the TCI state is selected from the TCI state list in the active DL BWP.(Rev 5)* Changed “this field contains an SRI (contained in the 4 rightmost bits) configured in the active UL BWP and referring to an SRS-ResourceID” to “this field contains an SRI (contained in the 4 rightmost bits) referring to an SRS-ResourceID configured in the active UL BWP”.

(Rev 6)* Used the most recent version of the MAC spec (17.5.0).
* Expanded the term ‘NR backhaul link’ (previously limited to IAB) to encompass the NCR case.

(Rev 7)* Reverted to changes from Rev 5, while using the most recent version of the MAC spec (17.5.0).
* Removed the changed definition of ‘NR backhaul link’ (introduced in Rev 6).

(Rev 8)* Rectified three incorrect references to the ‘Resource set ID’ field (where it was incorrectly referred to as ‘Resource list ID’ field, likely due to interchangeable use of list/set in other places in the CR).

(Rev 9)* Incorporated changes from R2-2310899, further clarifying that no partial update of the beam indices (in NCR Access Link Beam Indication MAC CE) is allowed.

(Rev 10)* Identical to Rev 9, save for author information for Track Changes (now unified so that only one ‘type’ of change appears).

(Rev 11)* Implemented changes from R2-2313508, as agreed at RAN2#124. Mentions of SRI removed. Expanded the useful number of bits from 4 to 6, and indicated SRS-ResourceID is contained in there.
* Made some minor editorial changes:
	+ Added word ‘link’ in six places where it was missing (replaced “NCR Downlink Backhaul Beam Indication MAC CE” with “NCR Downlink Backhaul Link Beam Indication MAC CE” in three places, and “NCR Uplink Backhaul Beam Indication MAC CE” with “NCR Uplink Backhaul Link Beam Indication MAC CE” in three places).
	+ Also removed ‘SRI’ in one place where R2-2313508 had failed to remove it (“Uplink TCI state ID or SRI: This field is used to…”) and replaced it with ‘SRS Resource ID’.
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| ***Consequences if not approved:*** | NR Rel-18 will not support NCR. |
|  |  |
| ***Clauses affected:*** | 3 Definitions, symbols and abbreviations 5.17 Beam Failure Detection and Recovery procedure5.18.1 General5.18.x Backhaul beam indication for NCR5.18.t Access Link Beam Indication for NCR6.1.3.z NCR Downlink Backhaul Link Beam Indication MAC CE6.1.3.y NCR Uplink Backhaul Link Beam Indication MAC CE6.1.3.u NCR Access Link Beam Indication MAC CE6.2.1 MAC subheader for DL-SCH and UL-SCH7.1 RNTI values |
|  |  |
|  | **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:*** | See Summary of change. |

FIRST CHANGE

# 3 Definitions, symbols and abbreviations

## 3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [1].

**Dormant BWP:** The dormant BWP is one of downlink BWPs configured by the network via dedicated RRC signaling. In the dormant BWP, the UE stop monitoring PDCCH on/for the SCell, but continues performing CSI measurements, Automatic Gain Control (AGC) and beam management, if configured.

**DRX group:** A group of Serving Cells that is configured by RRC and that have the same DRX Active Time.

**HARQ information:** HARQ information for DL-SCH, for UL-SCH, or for SL-SCH transmissions consists of New Data Indicator (NDI), Transport Block Size (TBS), Redundancy Version (RV), and HARQ process ID.

**IAB-donor:** gNB that provides network access to UEs via a network of backhaul and access links.

**IAB-node:** RAN node that supports NR access links to UEs and NR backhaul links to parent nodes and child nodes.

**Listen Before Talk**: A procedure according to which transmissions are not performed if the channel is identified as being occupied, see TS 37.213 [18].

**Msg3**: Message transmitted on UL-SCH containing a C-RNTI MAC CE or CCCH SDU, submitted from upper layer and associated with the UE Contention Resolution Identity, as part of a Random Access procedure.

**NCR-Fwd**: NCR-node function, which performs amplifying-and-forwarding of UL/DL RF signals between gNB and UE. The behavior of the NCR-Fwd is controlled according to the side control information received by the NCR-MT from a gNB.

**NCR-MT**: NCR-node entity which communicates with a gNB via a control link to receive side control information. The control link is based on NR Uu interface.

**NCR-node**: RAN node comprising NCR-MT and NCR-Fwd.

**Non-terrestrial network:** An NG-RAN consisting of gNBs, which provide non-terrestrial NR access to UEs by means of an NTN payload embarked on an airborne or space-borne NTN vehicle and an NTN Gateway.

**NR backhaul link:** NR link used for backhauling between an IAB-node and an IAB-donor, and between IAB-nodes in case of a multi-hop backhauling.

**NR sidelink communication**: AS functionality enabling at least V2X Communication as defined in TS 23.287 [19] and ProSe communication (including ProSe non-Relay and UE-to-Network Relay communication) as defined in TS 23.304 [26], between two or more nearby UEs, using NR technology but not traversing any network node.

**NR sidelink discovery**: AS functionality enabling ProSe non-Relay discovery and ProSe UE-to-Network Relay discovery for Proximity based Services as defined in TS 23.304 [26], between two or more nearby UEs, using NR technology but not traversing any network node.

**NR sidelink transmission**: Any NR Sidelink-based transmission, including both transmission for NR sidelink discovery and transmission for NR sidelink communication.

**PDCCH occasion**: A time duration (i.e. one or a consecutive number of symbols) during which the MAC entity is configured to monitor the PDCCH.

**PRS Processing Window**: A time window during which UE may perform PRS measurement inside the active DL BWP with the same numerology as the active DL BWP without measurement gap.

**RedCap UE:** A UE with reduced capabilities as specified in clause 4.2.21.1 in TS 38.306 [25].

**Serving Cell:** A PCell, a PSCell, or an SCell in TS 38.331 [5].

**Sidelink transmission information:** Sidelink transmission information included in an SCI for an SL-SCH transmission as specified in clause 8.3 and 8.4 of TS 38.212 [9] consists of Sidelink HARQ information including NDI, RV, Sidelink process ID, HARQ feedback enabled/disabled indicator, Sidelink identification information including cast type indicator, Source Layer-1 ID and Destination Layer-1 ID, and Sidelink other information including CSI request, a priority, a communication range requirement and Zone ID.

**Special Cell:** For Dual Connectivity operation the term Special Cell refers to the PCell of the MCG or the PSCell of the SCG depending on if the MAC entity is associated to the MCG or the SCG, respectively. Otherwise the term Special Cell refers to the PCell. A Special Cell supports PUCCH transmission and contention-based Random Access, and is always activated.

**Timing Advance Group:** A group of Serving Cells that is configured by RRC and that, for the cells with a UL configured, using the same timing reference cell and the same Timing Advance value. A Timing Advance Group containing the SpCell of a MAC entity is referred to as Primary Timing Advance Group (PTAG), whereas the term Secondary Timing Advance Group (STAG) refers to other TAGs.

**UE-gNB RTT:** For non-terrestrial networks, the sum of the UE's Timing Advance value (see TS 38.211 [8] clause 4.3.1) and *kmac*.

**V2X sidelink communication**: AS functionality enabling V2X Communication as defined in TS 23.285 [20], between nearby UEs, using E-UTRA technology but not traversing any network node.

NOTE 1: A timer is running once it is started, until it is stopped or until it expires; otherwise it is not running. A timer can be started if it is not running or restarted if it is running. A Timer is always started or restarted from its initial value. The duration of a timer is not updated until it is stopped or expires (e.g. due to BWP switching). When the MAC entity applies zero value for a timer, the timer shall be started and immediately expire unless explicitly stated otherwise.

NOTE 2: In this version of the specification, the SRS in the procedural description includes Positioning SRS except for the Positioning SRS for transmission in RRC\_INACTIVE as in clause 5.26. Positioning SRS except for the Positioning SRS for transmission in RRC\_INACTIVE is treated the same as SRS by the UE unless explicitly stated otherwise.

## 3.2 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1].

AP Aperiodic

BFR Beam Failure Recovery

BSR Buffer Status Report

BWP Bandwidth Part

CE Control Element

CG Cell Group

CG-SDT Configured Grant-based SDT

CI-RNTI Cancellation Indication RNTI

CSI Channel State Information

CSI-IM CSI Interference Measurement

CSI-RS CSI Reference Signal

CS-RNTI Configured Scheduling RNTI

DAPS Dual Active Protocol Stack

DCP DCI with CRC scrambled by PS-RNTI

DL-PRS DownLink-Positioning Reference Signal

G-CS-RNTI Group Configured Scheduling RNTI

G-RNTI Group RNTI

IAB Integrated Access and Backhaul

INT-RNTI Interruption RNTI

LBT Listen Before Talk

LCG Logical Channel Group

LCP Logical Channel Prioritization

MBS Multicast/Broadcast Services

MCCH MBS Control Channel

MCCH-RNTI MBS Control Channel RNTI

MCG Master Cell Group

MPE Maximum Permissible Exposure

MTCH MBS Traffic Channel

NCD-SSB Non Cell Defining SSB

NCR Network-Controlled Repeater

NSAG Network Slice AS Group

NUL Normal Uplink

NZP CSI-RS Non-Zero Power CSI-RS

PDB Packet Delay Budget

PEI-RNTI Paging Early Indication RNTI

PHR Power Headroom Report

PS-RNTI Power Saving RNTI

PTAG Primary Timing Advance Group

PTM Point to Multipoint

PTP Point to Point

QCL Quasi-colocation

PPW PRS Processing Window

PRS Positioning Reference Signal

RA-SDT Random Access-based SDT

RS Reference Signal

SCG Secondary Cell Group

SDT Small Data Transmission

SFI-RNTI Slot Format Indication RNTI

SI System Information

SL-RNTI Sidelink RNTI

SLCS-RNTI Sidelink Configured Scheduling RNTI

SpCell Special Cell

SP Semi-Persistent

SP-CSI-RNTI Semi-Persistent CSI RNTI

SPS Semi-Persistent Scheduling

SR Scheduling Request

SRI SRS Resource Indicator

SS Synchronization Signals

SSB Synchronization Signal Block

STAG Secondary Timing Advance Group

SUL Supplementary Uplink

TAG Timing Advance Group

TCI Transmission Configuration Indicator

TPC-SRS-RNTI Transmit Power Control-Sounding Reference Signal-RNTI

TRIV Time Resource Indicator Value

TRP Transmit/Receive Point

TRS CSI-RS for tracking

U2N UE-to-Network

UCI Uplink Control Information

V2X Vehicle-to-Everything

ZP CSI-RS Zero Power CSI-RS

NEXT CHANGE

## 5.17 Beam Failure Detection and Recovery procedure

The MAC entity may be configured by RRC per Serving Cell or per BFD-RS set 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. The Serving Cell is configured with two BFD-RS sets if and only if *failureDetectionSet1* and *failureDetectionSet2* are configured for the active DL BWP of the Serving Cell. When the SCG is deactivated, the UE performs beam failure detection on the PSCell if *bfd-and-RLM* is set to *true*.

RRC configures the following parameters in the *beamFailureRecoveryConfig*, *beamFailureRecoverySpCellConfig*, *beamFailureRecoverySCellConfig* and the *radioLinkMonitoringConfig* for the Beam Failure Detection and Recovery procedure:

- *beamFailureInstanceMaxCount* for the beam failure detection (per Serving Cell or per BFD-RS set of Serving Cell configured with two BFD-RS sets);

- *beamFailureDetectionTimer* for the beam failure detection (per Serving Cell or per BFD-RS set of Serving Cell configured with two BFD-RS sets);

- *beamFailureRecoveryTimer* for the beam failure recovery procedure for SpCell;

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

- *rsrp-ThresholdBFR*: an RSRP threshold for the SCell beam failure recovery or for the beam failure recovery of BFD-RS set of Serving Cell;

- *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 using contention-free Random Access Resources;

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

- *prach-ConfigurationIndex*: *prach-ConfigurationIndex* for the SpCell beam failure recovery using contention-free Random Access Resources;

- *ra-ssb-OccasionMaskIndex*: *ra-ssb-OccasionMaskIndex* for the SpCell beam failure recovery using contention-free Random Access Resources;

- *ra-OccasionList*: *ra-OccasionList* for the SpCell beam failure recovery using contention-free Random Access Resources;

- *candidateBeamRSList*: list of candidate beams for SpCell beam failure recovery;

- *candidateBeamRS-List-r16*: list of candidate beams for SCell beam failure recovery or list of candidate beams for beam failure recovery of a Serving Cell for BFD-RS set one;

- *candidateBeamRS-List2-r17*: list of candidate beams for beam failure recovery of a Serving Cell for BFD-RS set two.

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

- *BFI\_COUNTER* (per Serving Cell or per BFD-RS set of Serving Cell configured with two BFD-RS sets): 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 the Serving Cell is configured with two BFD-RS sets:

2> if beam failure instance indication for a BFD-RS set has been received from lower layers:

3> start or restart the *beamFailureDetectionTimer* of the BFD-RS set;

3> increment *BFI\_COUNTER* of the BFD-RS set by 1;

3> if *BFI\_COUNTER* of the BFD-RS set >= *beamFailureInstanceMaxCount*:

4> trigger a BFR for this BFD-RS set of the Serving Cell;

2> if BFR is triggered for both BFD-RS sets of the SpCell and the Beam Failure Recovery procedure is not successfully completed for any of the BFD-RS sets:

3> initiate a Random Access procedure (see clause 5.1) on the SpCell;

2> if the Serving Cell is SpCell and the Random Access procedure initiated for beam failure recovery of both BFD-RS sets of SpCell is successfully completed (see clause 5.1):

3> set *BFI\_COUNTER* of each BFD-RS set of SpCell to 0.

3> consider the Beam Failure Recovery procedure successfully completed.

2> if the *beamFailureDetectionTimer* of this BFD-RS set expires; or

2> if *beamFailureDetectionTimer*, *beamFailureInstanceMaxCount*, or any of the reference signals used for beam failure detection is reconfigured by upper layers or by the BFD-RS Indication MAC CE associated with a BFD-RS set of the Serving Cell; or

2> if the reference signal(s) associated with a BFD-RS set of the Serving Cell used for beam failure detection is changed:

3> set *BFI\_COUNTER* of the BFD-RS set to 0.

2> if 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 Enhanced BFR MAC CE or Truncated Enhanced BFR MAC CE which contains beam failure recovery information of this BFD-RS set of the Serving Cell:

3> set *BFI\_COUNTER* of the BFD-RS set to 0;

3> consider the Beam Failure Recovery procedure successfully completed for this BFD-RS set and cancel all the triggered BFRs of this BFD-RS set of the Serving Cell.

2> if the Serving Cell is SCell and the SCell is deactivated as specified in clause 5.9:

3> set *BFI\_COUNTER* of each BFD-RS set of SCell to 0;

3> consider the Beam Failure Recovery procedure successfully completed and cancel all the triggered BFRs of all BFD-RS sets of the Serving Cell.

1> else:

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

3> start or restart the *beamFailureDetectionTimer*;

3> increment *BFI\_COUNTER* by 1;

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

4> if the Serving Cell is SCell:

5> trigger a BFR for this Serving Cell;

4> else if the Serving Cell is PSCell and, the SCG is deactivated:

5> if beam failure of the PSCell has not been indicated to upper layers since the SCG was deactivated or since the deactivated SCG was last reconfigured with BFD-RS:

6> indicate beam failure of the PSCell to upper layers.

NOTE: After beam failure is indicated to upper layers, the UE may stop the *beamFailureDetectionTimer* and lower layer beam failure indication while *BFI\_COUNTER* >= *beamFailureInstanceMaxCount* for the deactivated SCG.

4> else:

5> initiate a Random Access procedure (see clause 5.1) on the SpCell;

5> if beam failure is detected for an NCR-MT:

6> indicate to NCR-Fwd to cease forwarding.

2> if the *beamFailureDetectionTimer* expires; or

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

2> if the reference signal(s) associated with this Serving Cell used for beam failure detection is changed:

3> set *BFI\_COUNTER* to 0.

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

3> set *BFI\_COUNTER* to 0;

3> stop the *beamFailureRecoveryTimer*, if configured;

3> if the Random Access procedure was triggered by beam failure recovery for NCR-MT:

4> indicate to NCR-Fwd to resume forwarding using the last forwarding configuration received by NCR-MT as part of side control information before beam failure detection;

3> consider the Beam Failure Recovery procedure successfully completed.

2> 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 MAC CE for BFR which contains beam failure recovery information of this Serving Cell; or

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

3> set *BFI\_COUNTER* to 0;

3> 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 and if none of the Serving Cell(s) of this MAC entity are configured with two BFD-RS sets:

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.

1> if the Beam Failure Recovery procedure determines that at least one BFR for any BFD-RS set 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; or

1> if the Beam Failure Recovery procedure determines that at least one BFR for only one BFD-RS set has been triggered and not cancelled for an SpCell for which evaluation of the candidate beams according to the requirements as specified in TS 38.133 [11] has been completed; or

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 and if at least one Serving Cell of this MAC entity is configured with two BFD-RS sets:

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

3> instruct the Multiplexing and Assembly procedure to generate the Enhanced 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 Enhanced BFR MAC CE plus its subheader as a result of LCP:

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

2> else:

3> trigger the SR for beam failure recovery of each BFD-RS set 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;

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 MAC CE for BFR which contains beam failure information of that SCell. All BFRs triggered for a BFD-RS set of a Serving Cell shall be cancelled when a MAC PDU is transmitted and this PDU includes an Enhanced BFR MAC CE or Truncated Enhanced BFR MAC CE which contains beam failure recovery information of that BFD-RS set of the Serving Cell.

NEXT CHANGE

## 5.18 Handling of MAC CEs

### 5.18.1 General

This clause specifies the requirements upon reception of the following MAC CEs:

- SP CSI-RS/CSI-IM Resource Set Activation/Deactivation MAC CE;

- Aperiodic CSI Trigger State Subselection MAC CE;

- TCI States Activation/Deactivation for UE-specific PDSCH MAC CE;

- TCI State Indication for UE-specific PDCCH MAC CE;

- SP CSI reporting on PUCCH Activation/Deactivation MAC CE;

- SP SRS Activation/Deactivation MAC CE;

- PUCCH spatial relation Activation/Deactivation MAC CE;

- Enhanced PUCCH spatial relation Activation/Deactivation MAC CE;

- SP ZP CSI-RS Resource Set Activation/Deactivation MAC CE;

- Recommended Bit Rate MAC CE;

- Enhanced SP/AP SRS Spatial Relation Indication MAC CE;

- SRS Pathloss Reference RS Update MAC CE;

- PUSCH Pathloss Reference RS Update MAC CE;

- Serving Cell set based SRS Spatial Relation Indication MAC CE;

- SP Positioning SRS Activation/Deactivation MAC CE;

- Timing Delta MAC CE;

- Guard Symbols MAC CEs;

- Positioning Measurement Gap Activation/Deactivation Command MAC CE;

- PPW Activation/Deactivation Command MAC CE;

- PUCCH spatial relation Activation/Deactivation for multiple TRP PUCCH repetition MAC CE;

- PUCCH Power Control Set Update for multiple TRP PUCCH repetition MAC CE;

- Unified TCI States Activation/Deactivation for UE-specific PDSCH MAC CE;

- Differential Koffset MAC CE;

- Case-7 Timing advance offset MAC CE;

- DL TX Power Adjustment MAC CE;

- Child IAB-DU Restricted Beam Indication MAC CE;

- Timing Case Indication MAC CE;

- NCR Backhaul Link Beam Indication MAC CEs;

- NCR Access Link Beam Indication MAC CE.

NEXT CHANGE

### 5.18.x Backhaul Link Beam Indication for NCR

NCR Downlink Backhaul Link Beam Indication MAC CE and NCR Uplink Backhaul Link Beam Indication MAC CE are used by a gNB to indicate to an NCR-node the beam to be used for the downlink and uplink backhaul transmission respectively between the gNB and the NCR-node.

Upon reception of an NCR Downlink Backhaul Link Beam Indication MAC CE, the NCR-node shall:

- indicate to NCR-Fwd to apply the configuration contained in NCR Downlink Backhaul Link Beam Indication MAC CE as received by the NCR-MT.

Upon reception of an NCR Uplink Backhaul Link Beam Indication MAC CE, the NCR-node shall:

- indicate to NCR-Fwd to apply the configuration contained in the NCR Uplink Backhaul Link Beam Indication MAC CE as received by the NCR-MT.

NEXT CHANGE

### 5.18.t Access Link Beam Indication for NCR

NCR Access Link Beam Indication MAC CE is used by a gNB to indicate to an NCR-node the forwarding resources to be used for the semi-persistent access link transmission between the NCR-node and the UE(s) served by this device.

Upon reception of an NCR Access Link Beam Indication MAC CE, the NCR-node shall:

- apply the configuration signalled in the MAC CE as received by NCR-MT to the forwarding resource lists indicated via RRC, and use it to operate the NCR-Fwd.

NEXT CHANGE

### 6.1.3 MAC Control Elements (CEs)

#### 6.1.3.z NCR Downlink Backhaul Link Beam Indication MAC CE

The NCR Downlink Backhaul Link Beam Indication MAC CE is identified by MAC subheader with eLCID as specified in Table 6.2.1-1b. It has a fixed size and consists of a single octet defined as follows (Figure 6.1.3.z-1):

- Downlink TCI state ID: This field is used to indicate the downlink beam to be used for backhaul link transmission. It contains *TCI-StateId* (comprising all 7 bits), as specified in TS 38.331 [5], of a TCI State in the active DL BWP. The length of the field is 7 bits;

- R: Reserved bit, set to 0.



Figure 6.1.3.z-1: NCR Downlink Backhaul Link Beam Indication MAC CE

NEXT CHANGE

#### 6.1.3.y NCR Uplink Backhaul Link Beam Indication MAC CE

The NCR Uplink Backhaul Link Beam Indication MAC CE is identified by MAC subheader with eLCID as specified in Table 6.2.1-1b. It has a fixed size and consists of a single octet defined as follows (Figure 6.1.3.y-1):

- Uplink TCI state ID or SRS Resource ID: This field is used to indicate the uplink beam to be used for backhaul link transmission. If the *dl-OrJointTCI-StateList* is configured as specified in TS 38.331 [5] and *unifiedTCI-StateType* is configured with a value *joint*, this field contains *TCI-StateId* (comprising all 7 bits) of a Joint TCI State configured in the active DL BWP, which is used as the uplink beam indication for backhaul link transmission. If the *ul-TCI-StateList* is configured as specified in TS 38.331 [5], this field contains *TCI-UL-State-Id* (contained in the 6 rightmost bits) of an UL TCI State configured in the active UL BWP, which is used as the uplink beam indication for backhaul link transmission, with the 1 remaining bit set to zero. Otherwise, 6 rightmost bits of this field contain *SRS-ResourceID* configured in the active UL BWP which is used as the uplink beam indication for backhaul link transmission, with the 1 remaining bit set to zero;

- R: Reserved bit, set to 0.



Figure 6.1.3.y-1: NCR Uplink Backhaul Link Beam Indication MAC CE

NEXT CHANGE

#### 6.1.3.u NCR Access Link Beam Indication MAC CE

The NCR Access Link Beam Indication MAC CE is identified by MAC subheader with eLCID as specified in Table 6.2.1-1b. It has a variable size and consists of the following fields (Figure 6.1.3.u-1):

- Resource set ID: This field is used to indicate one of forwarding semi-persistent resource lists signalled in NCR-*SemiPersistentFwdResourceSet* (as specified in TS 38.331 [5]). The field contains a list ID(comprising all 5 bits);

- A/D: If the value of this field is set to 1, the forwarding resource list indicated in Resource set ID field is being activated. If the value of this field is set to 0, the forwarding resource list indicated in Resource set ID field is being deactivated;

- C: If the value of this field is set to 1, the Beam index IDi field is present. If the value of this field is set to 0, the Beam index IDi field is absent. This field can be set to 1 only if MAC CE is used for activation, i.e., when the A/D field is set to 1. If MAC CE is used for deactivation, this field is set to 0;

- Beam index IDi: This field indicates the updated beam index for forwarding resources within the list indicated by the Resource set ID field. Beam index ID0 indicates the beam index for the first forwarding resource within the list; Beam index ID1 indicates the beam index for the second forwarding resource within the list and so on. The length of the field is 6 bits; the number of updated beams, *N*, is equal to the number of the beam indications in the semi-persistent resource set with ID *Resource set ID*;- R: Reserved bit, set to 0.



Figure 6.1.3.u-1: NCR Access Link Beam Indication MAC CE

NEXT CHANGE

## 6.2 Formats and parameters

### 6.2.1 MAC subheader for DL-SCH and UL-SCH

Table 6.2.1-1b Values of one-octet eLCID for DL-SCH

|  |  |  |
| --- | --- | --- |
| Codepoint | Index | LCID values |
| 0 to 223 | 64 to 287 | Reserved |
| 224 | 288 | NCR Access Link Beam Indication MAC CE |
| 225 | 289 | NCR Downlink Backhaul Link Beam Indication MAC CE |
| 226 | 290 | NCR Uplink Backhaul Link Beam Indication MAC CE |
| 227 | 291 | Serving Cell Set based SRS TCI State Indication MAC CE |
| 228 | 292 | SP/AP SRS TCI State Indication MAC CE |
| 229 | 293 | BFD-RS Indication MAC CE |
| 230 | 294 | Differential Koffset |
| 231 | 295 | Enhanced SCell Activation/Deactivation MAC CE with one octet Ci field |
| 232 | 296 | Enhanced SCell Activation/Deactivation MAC CE with four octet Ci field  |
| 233 | 297 | Unified TCI States Activation/Deactivation MAC CE |
| 234 | 298 | PUCCH Power Control Set Update for multiple TRP PUCCH repetition MAC CE |
| 235 | 299 | PUCCH spatial relation Activation/Deactivation for multiple TRP PUCCH repetition MAC CE |
| 236 | 300 | Enhanced TCI States Indication for UE-specific PDCCH |
| 237 | 301 | Positioning Measurement Gap Activation/Deactivation Command |
| 238 | 302 | PPW Activation/Deactivation Command |
| 239 | 303 | DL Tx Power Adjustment |
| 240 | 304 | Timing Case Indication |
| 241 | 305 | Child IAB-DU Restricted Beam Indication |
| 242 | 306 | Case-7 Timing advance offset |
| 243 | 307 | Provided Guard Symbols for Case-6 timing |
| 244 | 308 | Provided Guard Symbols for Case-7 timing |
| 245 | 309 | Serving Cell Set based SRS Spatial Relation Indication |
| 246 | 310 | PUSCH Pathloss Reference RS Update |
| 247 | 311 | SRS Pathloss Reference RS Update |
| 248 | 312 | Enhanced SP/AP SRS Spatial Relation Indication |
| 249 | 313 | Enhanced PUCCH Spatial Relation Activation/Deactivation |
| 250 | 314 | Enhanced TCI States Activation/Deactivation for UE-specific PDSCH |
| 251 | 315 | Duplication RLC Activation/Deactivation |
| 252 | 316 | Absolute Timing Advance Command |
| 253 | 317 | SP Positioning SRS Activation/Deactivation |
| 254 | 318 | Provided Guard Symbols |
| 255 | 319 | Timing Delta |

NEXT CHANGE

## 7.1 RNTI values

RNTI values are presented in Table 7.1-1.

Table 7.1-1: RNTI values.

|  |  |
| --- | --- |
| Value (hexa-decimal) | RNTI |
| 0000 | N/A |
| 0001–FFF2 | RA-RNTI, MSGB-RNTI, Temporary C-RNTI, C-RNTI, CI-RNTI, MCS-C-RNTI, CS-RNTI, TPC-PUCCH-RNTI, TPC-PUSCH-RNTI, TPC-SRS-RNTI, INT-RNTI, SFI-RNTI, SP-CSI-RNTI, PS-RNTI, SL-RNTI, SLCS-RNTI SL Semi-Persistent Scheduling V-RNTI, AI-RNTI, G-RNTI, G-CS-RNTI, CG-SDT-CS-RNTI, and NCR-RNTI |
| FFF3–FFFB | Reserved |
| FFFC | PEI-RNTI |
| FFFD | MCCH-RNTI |
| FFFE | P-RNTI |
| FFFF | SI-RNTI |

Table 7.1-2: RNTI usage.

|  |  |  |  |
| --- | --- | --- | --- |
| RNTI | Usage | Transport Channel | Logical Channel |
| P-RNTI | Paging and System Information change notification | PCH | PCCH |
| SI-RNTI | Broadcast of System Information | DL-SCH | BCCH |
| RA-RNTI | Random Access Response | DL-SCH | N/A |
| MSGB-RNTI | Random Access Response for 2-step RA type | DL-SCH | CCCH, DCCH, DTCH |
| Temporary C-RNTI | Contention Resolution(when no valid C-RNTI is available) | DL-SCH | CCCH, DCCH, DTCH |
| Temporary C-RNTI | Msg3 transmission | UL-SCH | CCCH, DCCH, DTCH |
| C-RNTI, MCS-C-RNTI | Dynamically scheduled unicast transmission | UL-SCH | DCCH, DTCH |
| C-RNTI | Dynamically scheduled unicast transmission | DL-SCH | CCCH, DCCH, DTCH |
| NCR-RNTI | Transmission of Side Control Information for NCR operation | N/A | N/A |
| MCS-C-RNTI | Dynamically scheduled unicast transmission | DL-SCH | DCCH, DTCH |
| C-RNTI | Triggering of PDCCH ordered random access | N/A | N/A |
| C-RNTI | Dynamically scheduled PTP retransmission for initial PTM transmission for multicast MBS. | DL-SCH | MTCH |
| CG-SDT-CS-RNTI | Dynamically scheduled unicast transmission(retransmission) | UL-SCH | CCCH, DCCH, DTCH |
| CS-RNTI | Configured scheduled unicast transmission(activation, reactivation and retransmission) | DL-SCH, UL-SCH | DCCH, DTCH |
| CS-RNTI | Configured scheduled unicast transmission(deactivation) | N/A | N/A |
| CS-RNTI | Configured scheduled unicast transmission(PTP retransmission for initial PTM transmission) | DL-SCH | MTCH |
| CS-RNTI | Configured scheduled unicast transmission(MBS SPS deactivation) | N/A | N/A |
| G-CS-RNTI | Configured scheduled multicast transmission(activation, reactivation and retransmission) | DL-SCH | MTCH |
| G-CS-RNTI | Configured scheduled multicast transmission (deactivation) | N/A | N/A |
| TPC-PUCCH-RNTI | PUCCH power control | N/A | N/A |
| TPC-PUSCH-RNTI | PUSCH power control | N/A | N/A |
| TPC-SRS-RNTI | SRS trigger and power control | N/A | N/A |
| INT-RNTI | Indication pre-emption in DL | N/A | N/A |
| SFI-RNTI | Slot Format Indication on the given cell | N/A | N/A |
| SP-CSI-RNTI | Activation of Semi-persistent CSI reporting on PUSCH | N/A | N/A |
| CI-RNTI | Cancellation indication in UL | N/A | N/A |
| PS-RNTI | DCP to indicate whether to start *drx-onDurationTimer* for associated DRX cycle | N/A | N/A |
| SL-RNTI | Dynamically scheduled sidelink transmission | SL-SCH | SCCH, STCH |
| SLCS-RNTI | Configured scheduled sidelink transmission(activation, reactivation and retransmission) | SL-SCH | SCCH, STCH |
| SLCS-RNTI | Configured scheduled sidelink transmission(deactivation) | N/A | N/A |
| SL Semi-Persistent Scheduling V-RNTI (NOTE 2) | Semi-Persistently scheduled sidelink transmission for V2X sidelink communication(activation, reactivation and retransmission) | SL-SCH | STCH |
| SL Semi-Persistent Scheduling V-RNTI(NOTE 2) | Semi-Persistently scheduled sidelink transmission for V2X sidelink communication(deactivation) | N/A | N/A |
| AI-RNTI | Availability indication on the given cell | N/A | N/A |
| G-RNTI | Dynamically scheduled MBS PTM transmission | DL-SCH | MTCH |
| MCCH-RNTI | Dynamically scheduled MCCH signalling and MCCH change notification | DL-SCH | MCCH |
| PEI-RNTI | Paging Early Indication | N/A | N/A |
| NOTE 1: The usage of MCS-C-RNTI is equivalent to that of C-RNTI in MAC procedures (except for the C-RNTI MAC CE).NOTE 2: The MAC entity uses SL Semi-Persistent Scheduling V-RNTI to control semi-persistently scheduled sidelink transmission on SL-SCH for V2X sidelink communication as specified in clause 5.14.1.1 of TS 36.321 [22].NOTE 3: The usage of CG-SDT-CS-RNTI is equivalent to that of CS-RNTI when there is an CG-SDT procedure ongoing. |

*End of Changes*