**3GPP TSG-RAN WG2 Meeting #130  *R2-25xxxxx***

**St Julian's, Malta, 19 - 23 May 2025**

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| *CR-Form-v12.3* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **38.321** | **CR** | **DraftCR** | **rev** | **-** | **Current version:** | **18.5.0** |  |
|  | | | | | | | | |
| *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:*** | MAC running CR for Evolution of NR duplex operation: Sub-band full duplex (SBFD) | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Samsung | | | | | | | | | |
| ***Source to TSG:*** | R2 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_duplex\_evo-Core | | | | |  | ***Date:*** | | | 2025-05-19 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **B** |  | | | | | ***Release:*** | | | Rel-19 |
|  | *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)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | This is a draft MAC running CR for supporting Rel-19 Sub-Band Full Duplex (SBFD), considering the following features, based on the relevant RAN2 agreements. The full RAN2 agreements made so far for Rel-19 SBFD are provided in Annex A.  **Feature#1**: Regarding SBFD for 4-step/2-step RA type:   * During RAN2#127, it was agreed that *RAN2* *focus on 4-step RACH for SBFD RA, FFS on 2-step if needed.*   **Feature#2**: Regarding RO type selection in CFRA:   * During RAN2#128, it was agreed that *the RO type is indicated by NW for CFRA. FFS on signaling (can FFS for the SI request case if needed).* * During RAN2#129bis, it was agreed that *on RO type signaling for CFRA, 1) For CFRA triggered by BFR, the RO type is indicated in BeamFailureRecoveryConfig, 2) for CFRA triggered by ReconfigurationwithSync, the RO type is indicated in RACH-ConfigDedicated.* * During RAN2#129bis, it was agreed that *Random access procedure in SBFD symbols is supported for all the existing RACH trigger events except for SI request. FFS for LTM.*   **Feature#3**: Regarding RO type switching during PRACH (re)transmissions:   * During RAN2#127bis, it was agreed that *for the PRACH transmission re-attempt in one RACH procedure, after certain (configured) number of times of RACH attempt in SBFD RACH occasions, UE is allowed to switch to legacy RACH occasions. FFS about the case when UE select legacy ROs first.* * During RAN2#129bis, it was agreed that *RO-Type change procedure on RO type selection from legacy RO to additional RO in SBFD symbols is supported when the number of PRACH transmission attempts exceed a threshold (we assume it is the same threshold with the fallback from additional RO to legacy RO). If fallback from legacy RO to additional RO occurs, no further fallback to legacy RO is supported.*   **Feature#4**: Regarding RO type selection in CBRA:   * During RAN2#129, it was agreed that *for initial RA transmission, the network can indicate the RO type (legacy RO or additional RO) to the SBFD-aware UE for the case of CBRA. Detailed signalling is FFS.* * During RAN2#129, it was agreed that *if no RO type indication is provided by the NW, a UE selects RO type based on a SSB RSRP threshold. FFS whether NW can further indicate whether to select the additional RO type below or above this SSB RSRP threshold.* * During RAN2#129bis, it was agreed that *NW indicate via explicit signaling whether the SBFD RO is selected when SSB RSRP are 'below' or 'above' the configured threshold.* * During RAN2#129bis, it was agreed that *when both NW indication on RO type and RSRP threshold are absent, it is up to UE implementation to select the RO type.* * During RAN2#129bis, a working assumption is made as *for SBFD-aware UE, the selection of RO type is suggested to be performed before the selection of the set of Random Access resources.*   **Feature#5**: Regarding new SP CLI measurement resource set act/deact MAC CE:   * During RAN2#129, it was agreed that *a new SP CLI measurement resource set activation/deactivation MAC CE is introduced to activate/deactivate the SP CLI measurement resource.* * During RAN2#129bis, a working assumption is made as *the configured SP CLI measurement resource sets are initially deactivated upon (re-) configuration by upper layers and after reconfiguration with sync.* * During RAN2#129bis, it was agreed that *SP CLI measurement resource set activation/deactivation MAC CE includes following fields: A/D, Serving Cell ID, BWP ID, CLI measurement resource set ID (for CLI-RSSI or SRS-RSRP measurement), TCI State IDs*. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | **Change#1**: Reflect SBFD only for 4-step RA procedure.  **Change#2**: Add RO type selection for CFRA.  **Change#3**: Add RO type switching between SBFD RO and non-SBFD RO.  **Change#4**: Add RO type selection for CBRA.  **Change#5**: Add new MAC CE for SP CLI measurement resource act/deact. | | | | | | | | |
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| ***Consequences if not approved:*** | | NR enhancements related to SBFD cannot be supported in Rel-19. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  |  | Other core specifications | | | | TS 38.331 CR TBD  TS 38.300 CR TBD  TS 38.306 CR TBD | | |
| ***affected:*** | |  | **x** | Test specifications | | | | TS/TR ... CR ... | | |
| ***(show related CRs)*** | |  | **x** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

# 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].

**A2X communication**: A communication to support A2X services leveraging PC5 reference points, as defined in TS 23.256 [31]. A2X services are realized by various types of A2X applications, e.g., BRID or DAA.

**Air to Ground network:** An NG-RAN consisting of ground-based gNBs, which provide cell towers that send signals up to an aircraft's antenna(s) of onboard ATG terminal, with typical vertical altitude of around 10,000 m and take-off/landing altitudes down to 3000 m.

**BWP for SRS for positioning Tx frequency hopping**:For SRS for positioning Tx frequency hopping, separate BWP configuration outside BWP configuration for data transmission.

**Dedicated SL-PRS resource pool**:A sidelink resource pool which can be used for the transmission of SL-PRS and cannot be used for the transmission of PSSCH.

**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.

**eRedCap UE**: A UE with enhanced reduced capabilities as specified in clause 4.2.22.1 of TS 38.306 [25].

**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].

**LTM candidate cell**: A candidate cell configured for LTM as defined in TS 38.331 [5].

**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.

**Multi-path**: Mode of operation of a UE in RRC\_CONNECTED configured with one direct path on which the UE connects to gNB using NR Uu, and one indirect path on which the UE connects to the same gNB via another UE using PC5 unicast link or non-3GPP connection (N3C).

**Multi-PUSCH configured grant**: A configured grant configuration configured with *nrOfSlotsInCG-Period* (see TS 38.331 [5]). It includes multiple consecutive configured uplink grants within a single periodicity.

**N3C indirect path:** In Multi-path, the indirect path using Non-3GPP Connection between remote UE and relay UE.

**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-SBFD RO**: [TBD]

Editor’s Note: The rapporteur will align the terminology of legacy RO as well as its definition with RAN1 running CR once available.

**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, UE-to-Network Relay and UE-to-UE Relay communication (including ProSe UE-to-UE Relay communication with integrated discovery)) 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, ProSe UE-to-Network Relay discovery and ProSe UE-to-UE 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 transmission for NR sidelink discovery, transmission for NR sidelink communication, transmission for Ranging/Sidelink Positioning, and transmission for A2X 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.

**Positioning SRS Bandwidth Aggregation**: Transmission of positioning SRS on multiple carriers in RRC\_CONNECTED and RRC\_INACTIVE where the positioning SRS resources are linked in RRC configuration as defined in TS 38.331 [5].

**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.

**Ranging/Sidelink Positioning**:AS functionality enabling ranging-based services and sidelink positioning as specified in TS 23.586 [30].

**RB set**: A RB set refers to a contiguous set of resource blocks (RBs) on which a channel access procedure is performed in shared spectrum as defined in TS 37.213 [18].

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

**SBFD RO**: [TBD]

Editor’s Note: The rapporteur will align the terminology of additional RO as well as its definition with RAN1 running CR once available.

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

**Shared SL-PRS resource pool**:A sidelink resource pool which can be used for the transmission of both SL-PRS and PSSCH.

**Sidelink transmission information**: Sidelink transmission information included in an SCI for an SL-SCH transmission or SL-PRS transmission with or without SL-SCH transmission on Shared SL-PRS resource pool 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, SL-PRS request, SL-PRS resource ID, a priority, a communication range requirement and Zone ID and COT sharing information.

**SL-PRS delay budget**: Delay budget before which the SL-PRS is expected to be transmitted by the Tx UE.

**SL-PRS transmission information on Dedicated SL-PRS resource pool**:SL-PRS transmission information on Dedicated SL-PRS resource pool is included in an SCI for an SL-PRS transmission on Dedicated SL-PRS resource pool, as specified in TS 38.212 [9], consisting of

- SL-PRS identification information, including cast type indicator, source ID and destination ID;

- SL-PRS transmission other information, including SL-PRS priority, SL-PRS request, SL-PRS resource ID and resource reservation period.

**SRS for positioning Tx frequency hopping**: Transmit frequency hopping of positioning SRS in RRC\_INACTIVE and RRC\_CONNECTED.

**SRS positioning validity area**:An area consisting of a list of cells within which the corresponding positioning SRS configuration is considered as valid.

**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].

A2X Aircraft-to-Everything

AP Aperiodic

BFR Beam Failure Recovery

BRID Broadcast Remote Identification

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

DAA Detect And Avoid

DAPS Dual Active Protocol Stack

DCP DCI with CRC scrambled by PS-RNTI

DL-PRS DownLink-Positioning Reference Signal

DSR Delay Status Report

DTX Discontinuous Transmission

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

LTM L1/L2 Triggered Mobility

MBS Multicast/Broadcast Services

MCCH MBS Control Channel

MCCH-RNTI MBS Control Channel RNTI

MCG Master Cell Group

MO-SDT Mobile Originated SDT

MPE Maximum Permissible Exposure

MTCH MBS Traffic Channel

MT-SDT Mobile Terminated SDT

N3C Non-3GPP Connection

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

PQI PC5 QoS Identifier

PS-RNTI Power Saving RNTI

PSI PDU Set Importance

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

RRH Remote Radio Head

RS Reference Signal

SBFD Sub-Band Full Duplex

SCG Secondary Cell Group

SDT Small Data Transmission

SFI-RNTI Slot Format Indication RNTI

SI System Information

SL-PRS-CS-RNTI SL-PRS-Configured Scheduling-RNTI

SL-PRS-RNTI SL-PRS-RNTI

SL-CS-RNTI Sidelink-Configured Scheduling-RNTI

SL-PRS Sidelink-PRS

SL-RNTI Sidelink-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

STx2P Simultaneous Transmission with 2 Panels

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

U2U UE-to-UE

UCI Uplink Control Information

UTO-UCI Unused Transmission Occasion - UCI

UTW Uplink Time Window

V2X Vehicle-to-Everything

ZP CSI-RS Zero Power CSI-RS

**--------------------------------------------------[Next change]----------------------------------------------------**

# 5 MAC procedures

## 5.1 Random Access procedure

### 5.1.1 Random Access procedure initialization

The Random Access procedure described in this clause is initiated by a PDCCH order, by the MAC entity itself, or by RRC for the events in accordance with TS 38.300 [2]. There is only one Random Access procedure ongoing at any point in time in a MAC entity. The Random Access procedure on an SCell or an LTM candidate cell shall only be initiated by a PDCCH order with *ra-PreambleIndex* different from 0b000000.

NOTE 1: If a new Random Access procedure is triggered while another is already ongoing in the MAC entity, it is up to UE implementation whether to continue with the ongoing procedure or start with the new procedure (e.g. for SI request).

NOTE 2: If there was an ongoing Random Access procedure that is triggered by a PDCCH order while the UE receives another PDCCH order indicating the same Random Access Preamble, PRACH mask index and uplink carrier, the Random Access procedure is considered as the same Random Access procedure as the ongoing one and not initialized again.

When a Random Access procedure is initiated, UE selects a set of Random Access resources as specified in clause 5.1.1b and initialises the following parameters for the Random Access procedure according to the values configured by RRC for the selected set of Random Access resources:

- *prach-ConfigurationIndex*: the available set of PRACH occasions for the transmission of the Random Access Preamble for Msg1. These are also applicable to the MSGA PRACH if the PRACH occasions are shared between 2-step and 4-step RA types;

- *prach-ConfigurationPeriodScaling-IAB*: the scaling factor defined in TS 38.211 [8] and applicable to IAB-MTs, extending the periodicity of the PRACH occasions baseline configuration indicated by *prach-ConfigurationIndex*;

- *prach-ConfigurationFrameOffset-IAB*: the frame offset defined in TS 38.211 [8] and applicable to IAB-MTs, altering the ROs frame defined in the baseline configuration indicated by *prach-ConfigurationIndex*;

- *prach-ConfigurationSOffset-IAB*: the subframe/slot offset defined in TS 38.211 [8] and applicable to IAB-MTs, altering the ROs subframe or slot defined in the baseline configuration indicated by *prach-ConfigurationIndex*;

- *msgA-PRACH-ConfigurationIndex*: the available set of PRACH occasions for the transmission of the Random Access Preamble for MSGA in 2-step RA type;

- *preambleReceivedTargetPower*: initial Random Access Preamble power for 4-step RA type;

- *msgA-PreambleReceivedTargetPower*: initial Random Access Preamble power for 2-step RA type;

Editor’s Note: Will reflect SBFD version of *preambleReceivedTargetPower* based on RRC running CR once it becomes stable.

- *rsrp-ThresholdSSB*: an RSRP threshold for the selection of the SSB for 4-step RA type. If the Random Access procedure is initiated for beam failure recovery, *rsrp-ThresholdSSB* used for the selection of the SSB within *candidateBeamRSList* refers to *rsrp-ThresholdSSB* in *BeamFailureRecoveryConfig* IE;

- *rsrp-ThresholdCSI-RS*: an RSRP threshold for the selection of CSI-RS for 4-step RA type. If the Random Access procedure is initiated for beam failure recovery, *rsrp-ThresholdCSI-RS* is equal to *rsrp-ThresholdSSB* in *BeamFailureRecoveryConfig* IE;

- *msgA-RSRP-ThresholdSSB*: an RSRP threshold for the selection of the SSB for 2-step RA type;

- *rsrp-ThresholdSSB-SUL*: an RSRP threshold for the selection between the NUL carrier and the SUL carrier;

*- msgA-RSRP-Threshold*: an RSRP threshold for selection between 2-step RA type and 4-step RA type when both 2-step and 4-step RA type Random Access Resources are configured in the UL BWP;

*- rsrp-ThresholdMsg1-RepetitionNum2*: an RSRP threshold for Msg1 repetition with repetition number 2 (see clause 5.1.1b);

*- rsrp-ThresholdMsg1-RepetitionNum4*: an RSRP threshold for Msg1 repetition with repetition number 4 (see clause 5.1.1b);

*- rsrp-ThresholdMsg1-RepetitionNum8*: an RSRP threshold for Msg1 repetition with repetition number 8 (see clause 5.1.1b);

Editor’s Note: Will reflect *rsrp-ThresholdMsg1-RepetitionNumX* for SBFD RO based on 38.331 running CR, when it becomes stable.

*- rsrp-ThresholdMsg3*: an RSRP threshold for Msg3 repetition (see clause 5.1.1b);

*- rsrp-ThresholdSBFD*: an RSRP threshold for the selection of the initial RO type between SBFD RO and non-SBFD RO in contention-based 4-step Random Access procedure;

Editor’s Note: The name of *rsrp-ThresholdSBFD* is tentative and will be aligned with 38.331 running CR, when it becomes stable.

*- FeatureCombination*: feature or a combination of features associated with a set of Random Access resources;

*- featurePriorities*: priorities for features, such as (e)RedCap, Slicing, etc. (see clause 5.1.1d);

- *msgA-TransMax*: The maximum number of MSGA transmissions when both 4-step and 2-step RA type Random Access Resources are configured;

- *candidateBeamRSList*: a list of reference signals (CSI-RS and/or SSB) identifying the candidate beams for recovery and the associated Random Access parameters;

- *recoverySearchSpaceId*: the search space identity for monitoring the response of the beam failure recovery request;

- *powerRampingStep*: the power-ramping factor;

- *msgA-PreamblePowerRampingStep*: the power ramping factor for MSGA preamble;

- *powerRampingStepHighPriority*: the power-ramping factor in case of prioritized Random Access procedure;

- *scalingFactorBI*: a scaling factor for prioritized Random Access procedure;

- *ra-PreambleIndex*: Random Access Preamble;

- *ra-ssb-OccasionMaskIndex*: defines PRACH occasion(s) associated with an SSB in which the MAC entity may transmit a Random Access Preamble (see clause 7.4);

- *msgA-SSB-SharedRO-MaskIndex*: Indicates the subset of 4-step RA type PRACH occasions shared with 2-step RA type PRACH occasions for each SSB. If 2-step RA type PRACH occasions are shared with 4-step RA type PRACH occasions and *msgA-SSB-SharedRO-MaskIndex* is not configured, then all 4-step RA type PRACH occasions are available for 2-step RA type (see clause 7.4);

- *ssb-SharedRO-MaskIndex*: defines PRACH occasions, on which preambles are allocated for a feature or a combination of features, associated with an SSB in which the MAC entity may transmit a Random Access Preamble (see clause 7.4);

- *ra-OccasionList*: defines PRACH occasion(s) associated with a CSI-RS in which the MAC entity may transmit a Random Access Preamble;

- *ra-PreambleStartIndex*: the starting index of Random Access Preamble(s) for on-demand SI request;

- *startPreambleForThisPartition*: the first preamble associated with the set of Random Access Resources applicable to the Random Access procedure;

- *preambleTransMax*: the maximum number of Random Access Preamble transmission;

- *preambleTransMax-Msg1-Repetition*: the maximum number of Random Access Preamble transmissions with a given Msg1 repetition number before switching to Msg1 repetition with the next available higher Msg1 repetition number;

- *preambleTransMaxRO-Type*: the maximum number of Random Access Preamble transmissions before switching RO type between SBFD RO and non-SBFD RO;

Editor’s Note: The name of *preambleTransMaxRO-Type* istentative and will be aligned with 38.331 running CR, when it becomes stable.

- *ssb-perRACH-OccasionAndCB-PreamblesPerSSB*: defines the number of SSBs mapped to each PRACH occasion for 4-step RA type and the number of contention-based Random Access Preambles mapped to each SSB;

- *msgA-CB-PreamblesPerSSB-PerSharedRO*: defines the number of contention-based Random Access Preambles for 2-step RA type mapped to each SSB when the PRACH occasions are shared between 2-step and 4-step RA types;

- *msgA-SSB-PerRACH-OccasionAndCB-PreamblesPerSSB*: defines the number of SSBs mapped to each PRACH occasion for 2-step RA type and the number of contention-based Random Access Preambles mapped to each SSB;

- *numberOfPreamblesPerSSB-ForThisPartition*: defines the number ofconsecutive preambles for a feature or a combination of features mapped to each SSB;

- *msgA-PUSCH-ResourceGroupA*: defines MSGA PUSCH resources that the UE shall use when performing MSGA transmission using Random Access Preambles group A;

- *msgA-PUSCH-ResourceGroupB*: defines MSGA PUSCH resources that the UE shall use when performing MSGA transmission using Random Access Preambles group B;

- *msgA-PUSCH-Resource-Index*: identifies the index of the PUSCH resource used for MSGA in case of contention-free Random Access with 2-step RA type;

- if *groupBconfigured* is configured, then Random Access Preambles group B is configured for 4-step RA type.

- Amongst the contention-based Random Access Preambles associated with an SSB (as defined in TS 38.213 [6]), the first *numberOfRA-PreamblesGroupA* included in *groupBconfigured* Random Access Preambles belong to Random Access Preambles group A. The remaining Random Access Preambles associated with the SSB belong to Random Access Preambles group B (if configured).

- if *groupB-ConfiguredTwoStepRA* is configured, then Random Access Preambles group B is configured for 2-step RA type.

- Amongst the contention-based Random Access Preambles for 2-step RA type associated with an SSB (as defined in TS 38.213 [6]), the first *numberOfRA-PreamblesGroupA* included in *GroupB-ConfiguredTwoStepRA* Random Access Preambles belong to Random Access Preambles group A. The remaining Random Access Preambles associated with the SSB belong to Random Access Preambles group B (if configured).

NOTE 3: If Random Access Preambles group B is supported by the cell Random Access Preambles group B is included for each SSB.

- if Random Access Preambles group B is configured for 4-step RA type:

- *ra-Msg3SizeGroupA*: the threshold to determine the groups of Random Access Preambles for 4-step RA type;

- *msg3-DeltaPreamble*: ∆*PREAMBLE\_Msg3* in TS 38.213 [6];

- *messagePowerOffsetGroupB*: the power offset for preamble selection included in *groupBconfigured*;

- *numberOfRA-PreamblesGroupA*: defines the number of Random Access Preambles in Random Access Preamble group A for each SSB included in *groupBconfigured*.

- if Random Access Preambles group B is configured for 2-step RA type:

- *msgA-DeltaPreamble*: ∆*MsgA\_PUSCH* in TS 38.213 [6];

- *messagePowerOffsetGroupB*: the power offset for preamble selection included in *GroupB-ConfiguredTwoStepRA*;

- *numberOfRA-PreamblesGroupA*: defines the number of Random Access Preambles in Random Access Preamble group A for each SSB included in *GroupB-ConfiguredTwoStepRA*;

- *ra-MsgA-SizeGroupA*: the threshold to determine the groups of Random Access Preambles for 2-step RA type.

- the set of Random Access Preambles and/or PRACH occasions for SI request, if any;

- the set of Random Access Preambles and/or PRACH occasions for beam failure recovery request, if any;

- the set of Random Access Preambles and/or PRACH occasions for reconfiguration with sync, if any;

- *ra-ResponseWindow*: the time window to monitor RA response(s) (SpCell only);

- *ra-ContentionResolutionTimer*: the Contention Resolution Timer (SpCell only);

- *msgB-ResponseWindow*: the time window to monitor RA response(s) for 2-step RA type (SpCell only).

In addition, the following information for related Serving Cell is assumed to be available for UEs:

- if Random Access Preambles group B is configured:

- if the Serving Cell for the Random Access procedure is configured with supplementary uplink as specified in TS 38.331 [5], and SUL carrier is selected for performing Random Access Procedure:

- PCMAX,f,c of the SUL carrier as specified in TS 38.101-1 [14], TS 38.101-2 [15], and TS 38.101-3 [16].

- else:

- PCMAX,f,c of the NUL carrier as specified in TS 38.101-1 [14], TS 38.101-2 [15], and TS 38.101-3 [16].

The following UE variables are used for the Random Access procedure:

- *PREAMBLE\_INDEX*;

- *PREAMBLE\_TRANSMISSION\_COUNTER*;

- *PREAMBLE\_POWER\_RAMPING\_COUNTER*;

- *PREAMBLE\_POWER\_RAMPING\_STEP*;

- *PREAMBLE\_RECEIVED\_TARGET\_POWER*;

- *PREAMBLE\_BACKOFF*;

- *PCMAX*;

- *SCALING\_FACTOR\_BI*;

- *TEMPORARY\_C-RNTI*;

- *RA\_TYPE*;

- *POWER\_OFFSET\_2STEP\_RA*;

- *MSGA\_PREAMBLE\_POWER\_RAMPING\_STEP*;

- *RO\_TYPE*.

When the Random Access procedure is initiated on a Serving Cell or for an LTM candidate cell, the MAC entity shall:

1> flush the Msg3 buffer;

1> flush the MSGA buffer;

1> set the *PREAMBLE\_TRANSMISSION\_COUNTER* to 1;

1> if the Random Access procedure is initiated on a Serving Cell; or

1> if the Random Access procedure is initiated by the PDCCH order for an LTM candidate cell and the PDCCH order indicates preamble initial transmission; or

1> if the Random Access procedure is initiated by the PDCCH order for an LTM candidate cell, which is different from the cell to which the UE performed the last Random Access Preamble transmission, and the PDCCH order indicates preamble re-transmission:

2> set the *PREAMBLE\_POWER\_RAMPING\_COUNTER* to 1;

1> set the *PREAMBLE\_BACKOFF* to 0 ms;

1> set *POWER\_OFFSET\_2STEP\_RA* to 0 dB;

1> if the carrier to use for the Random Access procedure is explicitly signalled:

2> select the signalled carrier for performing Random Access procedure;

2> set the *PCMAX* to PCMAX,f,c of the signalled carrier.

1> else if the carrier to use for the Random Access procedure is not explicitly signalled; and

1> if the Serving Cell for the Random Access procedure is configured with supplementary uplink as specified in TS 38.331 [5]; and

1> if the RSRP of the downlink pathloss reference is less than *rsrp-ThresholdSSB-SUL*:

2> select the SUL carrier for performing Random Access procedure;

2> set the *PCMAX* to PCMAX,f,c of the SUL carrier.

1> else:

2> select the NUL carrier for performing Random Access procedure;

2> set the *PCMAX* to PCMAX,f,c of the NUL carrier.

NOTE 4: Void.

1> perform the BWP operation as specified in clause 5.15, except when the Random Access procedure is initiated by the PDCCH order for an LTM candidate cell;

1> if the RO type for the Random Access procedure is signalled as [*SBFD RO*]:

2> set the *RO\_TYPE* to *SBFD-RO*.

1> else if the RO type for the Random Access procedure is signalled as [*non-SBFD RO*]:

2> set the *RO\_TYPE* to *non-SBFD-RO*.

Editor’s Note: The exact signalling [*SBFD RO*] and [*non-SBFD RO*] aretentative and will be aligned with 38.331 running CR, when it becomes stable.

1> else if the RO type for the Random Access procedure is not signalled:

2> if *rsrp-ThresholdSBFD* is configured for the Random Access procedure:

3> if the RSRP of the downlink pathloss reference satisfies *rsrp-ThresholdSBFD* (as specified in TS 38.331 [5]):

4> set the *RO\_TYPE* to *SBFD-RO*.

3> else:

4> set the *RO\_TYPE* to *non-SBFD-RO*.

NOTE x: When the SBFD ROs for the transmission of the Random Access Preamble have been provided by RRC for the Random Access procedure, if the RO type for the Random Access procedure is not signalled, and *rsrp-ThresholdSBFD* is not configured, it is up to UE implementation how to set the *RO\_TYPE* between *SBFD RO* and *non-SBFD RO* as the initial RO type for the Random Access procedure.

1> select the set of Random Access resources applicable to the current Random Access procedure according to clause 5.1.1b;

1> if the Random Access procedure is initiated by PDCCH order and if the *ra-PreambleIndex* explicitly provided by PDCCH is not 0b000000; or

1> if the Random Access procedure was initiated for SI request (as specified in TS 38.331 [5]) and the Random Access Resources for SI request have been explicitly provided by RRC; or

1> if the Random Access procedure was initiated for SpCell beam failure recovery (as specified in clause 5.17) and if the contention-free Random Access Resources for beam failure recovery request for 4-step RA type have been explicitly provided by RRC for the BWP selected for Random Access procedure; or

1> if the Random Access procedure was initiated for reconfiguration with sync not initiated for recovery using an LTM candidate configuration as specified in TS 38.331 [5] clause 5.3.7.3 and if the contention-free Random Access Resources for 4-step RA type have been explicitly provided in *rach-ConfigDedicated* for the BWP selected for Random Access procedure; or

1> if the contention-free Random Access Resources have been explicitly provided in the LTM Cell Switch Command MAC CE:

2> set the *RA\_TYPE* to *4-stepRA*.

1> else if the BWP selected for Random Access procedure is configured with both 2-step and 4-step RA type Random Access Resources within the selected set of Random Access resources (as specified in clause 5.1.1b) and the RSRP of the downlink pathloss reference is above *msgA-RSRP-Threshold*; or

1> if the BWP selected for Random Access procedure is only configured with 2-step RA type Random Access resources within the selected set of Random Access resources according to clause 5.1.1b; or

1> if the Random Access procedure was initiated for reconfiguration with sync not initiated for recovery using an LTM candidate configuration as specified in TS 38.331 [5] clause 5.3.7.3 and if the contention-free Random Access Resources for 2-step RA type have been explicitly provided in *rach-ConfigDedicated* for the BWP selected for Random Access procedure:

2> set the *RA\_TYPE* to *2-stepRA*.

1> else:

2> set the *RA\_TYPE* to *4-stepRA*.

1> perform initialization of variables specific to Random Access type as specified in clause 5.1.1a;

1> if *RA\_TYPE* is set to *2-stepRA*:

2> perform the Random Access Resource selection procedure for 2-step RA type (see clause 5.1.2a).

1> else:

2> perform the Random Access Resource selection procedure (see clause 5.1.2).

### 5.1.1a Initialization of variables specific to Random Access type

The MAC entity shall:

1> if *RA\_TYPE* is set to *2-stepRA*:

2> set *PREAMBLE\_POWER\_RAMPING\_STEP* to *msgA-PreamblePowerRampingStep*;

2> set *SCALING\_FACTOR\_BI* to 1;

2> apply *preambleTransMax* included in the *RACH-ConfigGenericTwoStepRA*;

2> if the Random Access procedure was initiated for reconfiguration with sync not initiated for recovery using an LTM candidate configuration as specified in TS 38.331 [5] clause 5.3.7.3 or for SCG activation; and

2> if *cfra-TwoStep* is configured for the selected carrier:

3> if *msgA-TransMax* is configured in the *cfra-TwoStep*:

4> apply *msgA-TransMax* configured in the *cfra-TwoStep*.

2> else if *msgA-TransMax* is included in the *RACH-ConfigCommonTwoStepRA*:

3> apply *msgA-TransMax* included in the *RACH-ConfigCommonTwoStepRA*.

2> if the Random Access procedure was initiated for SpCell beam failure recovery (as specified in clause 5.17); and

2> if *beamFailureRecoveryConfig* is configured for the active UL BWP of the selected carrier; and

2> if *ra-PrioritizationTwoStep* is configured in the *beamFailureRecoveryConfig*:

3> set *PREAMBLE\_POWER\_RAMPING\_STEP* to the *powerRampingStepHighPriority* included in the *ra-PrioritizationTwoStep* in *beamFailureRecoveryConfig*;

3> if *scalingFactorBI* is configured in the *ra-PrioritizationTwoStep* in *beamFailureRecoveryConfig*:

4> set *SCALING\_FACTOR\_BI* to the *scalingFactorBI*.

2> else if the Random Access procedure was initiated for reconfiguration with sync not initiated for recovery using an LTM candidate configuration as specified in TS 38.331 [5] clause 5.3.7.3 or for SCG activation; and

2> if *rach-ConfigDedicated* is configured for the selected carrier; and

2> if *ra-PrioritizationTwoStep* is configured in the *rach-ConfigDedicated*:

3> set *PREAMBLE\_POWER\_RAMPING\_STEP* to the *powerRampingStepHighPriority* included in the *ra-PrioritizationTwoStep* in *rach-ConfigDedicated*;

3> if *scalingFactorBI* is configured in *ra-PrioritizationTwoStep* in the *rach-ConfigDedicated*:

4> set *SCALING\_FACTOR\_BI* to the *scalingFactorBI*.

2> else if both *ra-PrioritizationForSlicingTwoStep* for a *NSAG-ID* and *ra-PrioritizationForAccessIdentityTwoStep* are configured for the selected carrier; and

2> if the MAC entity is provided by upper layers with both this *NSAG-ID* and Access Identity 1 or 2; and

2> if for at least one of these Access Identities the corresponding bit in the *ra-PrioritizationForAI* is set to *one*:

3> if *enableRA-PrioritizationForSlicing* is set to *true*:

4> if *powerRampingStepHighPriority* is configured in the *ra-PrioritizationForSlicingTwoStep* for this *NSAG-ID*:

5> set *PREAMBLE\_POWER\_RAMPING\_STEP* to the *powerRampingStepHighPriority*.

4> if *scalingFactorBI* is configured in the *ra-PrioritizationForSlicingTwoStep* for this *NSAG-ID*:

5> set *SCALING\_FACTOR\_BI* to the *scalingFactorBI*.

3> else if *enableRA-PrioritizationForSlicing* is set to *false*:

4> if *powerRampingStepHighPriority* is configured in the *ra-PrioritizationForAccessIdentityTwoStep*:

5> set *PREAMBLE\_POWER\_RAMPING\_STEP* to the *powerRampingStepHighPriority*.

4> if *scalingFactorBI* is configured in the *ra-PrioritizationForAccessIdentityTwoStep*:

5> set *SCALING\_FACTOR\_BI* to the *scalingFactorBI*.

2> else if *ra-PrioritizationForSlicingTwoStep* for a *NSAG-ID* is configured for the selected carrier; and

2> if the MAC entity is provided by upper layers with this *NSAG-ID*:

3> if *powerRampingStepHighPriority* is configured in the *ra-PrioritizationForSlicingTwoStep* for this *NSAG-ID*:

4> set *PREAMBLE\_POWER\_RAMPING\_STEP* to the *powerRampingStepHighPriority*.

3> if *scalingFactorBI* is configured in the *ra-PrioritizationForSlicingTwoStep* for this *NSAG-ID*:

4> set *SCALING\_FACTOR\_BI* to the *scalingFactorBI*.

2> else if *ra-PrioritizationForAccessIdentityTwoStep* is configured for the selected carrier; and

2> if the MAC entity is provided by upper layers with Access Identity 1 or 2; and

2> if for at least one of these Access Identities the corresponding bit in the *ra-PrioritizationForAI* is set to *one*:

3> if *powerRampingStepHighPriority* is configured in the *ra-PrioritizationForAccessIdentityTwoStep*:

4> set *PREAMBLE\_POWER\_RAMPING\_STEP* to the *powerRampingStepHighPriority*.

3> if *scalingFactorBI* is configured in the *ra-PrioritizationForAccessIdentityTwoStep*:

4> set *SCALING\_FACTOR\_BI* to the *scalingFactorBI*.

2> set *MSGA\_PREAMBLE\_POWER\_RAMPING\_STEP* to *PREAMBLE\_POWER\_RAMPING\_STEP*.

1> else (i.e. *RA\_TYPE* is set to *4-stepRA*):

2> set *PREAMBLE\_POWER\_RAMPING\_STEP* to *powerRampingStep*;

2> set *SCALING\_FACTOR\_BI* to 1;

2> set *preambleTransMax* to *preambleTransMax* included in the *RACH-ConfigGeneric*;

2> if the Random Access procedure was initiated for SpCell beam failure recovery (as specified in clause 5.17); and

2> if *beamFailureRecoveryConfig* is configured for the active UL BWP of the selected carrier:

3> start the *beamFailureRecoveryTimer*, if configured;

3> apply the parameters *powerRampingStep*, *preambleReceivedTargetPower*, and *preambleTransMax* configured in the *beamFailureRecoveryConfig*.

Editor’s Note: Will reflect SBFD version of *preambleReceivedTargetPower*, based on RRC running CR, once it becomes stable.

2> if the Random Access procedure was initiated for beam failure recovery (as specified in clause 5.17); and

2> if *beamFailureRecoveryConfig* is configured for the active UL BWP of the selected carrier; and

2> if *ra-Prioritization* is configured in the *beamFailureRecoveryConfig*:

3> set *PREAMBLE\_POWER\_RAMPING\_STEP* to the *powerRampingStepHighPriority* included in the *ra-Prioritization* in *beamFailureRecoveryConfig*;

3> if *scalingFactorBI* is configured in *ra-Prioritization* in the *beamFailureRecoveryConfig*:

4> set *SCALING\_FACTOR\_BI* to the *scalingFactorBI*.

2> else if the Random Access procedure was initiated for reconfiguration with sync not initiated for recovery using an LTM candidate configuration as specified in TS 38.331 [5] clause 5.3.7.3 or for SCG activation; and

2> if *rach-ConfigDedicated* is configured for the selected carrier; and

2> if *ra-Prioritization* is configured in the *rach-ConfigDedicated*:

3> set *PREAMBLE\_POWER\_RAMPING\_STEP* to the *powerRampingStepHighPriority* included in the *ra-Prioritization* in *rach-ConfigDedicated*;

3> if *scalingFactorBI* is configured in *ra-Prioritization* in the *rach-ConfigDedicated*:

4> set *SCALING\_FACTOR\_BI* to the *scalingFactorBI*.

2> else if both *ra-PrioritizationForSlicing* for a *NSAG-ID* and *ra-PrioritizationForAccessIdentity* are configured for the selected carrier; and

2> if the MAC entity is provided by upper layers with both this *NSAG-ID* and Access Identity 1 or 2; and

2> if for at least one of these Access Identities the corresponding bit in the *ra-PrioritizationForAI* is set to *one*:

3> if *enableRA-PrioritizationForSlicing* is set to *true*:

4> if *powerRampingStepHighPriority* is configured in the *ra-PrioritizationForSlicing* for this *NSAG-ID*:

5> set *PREAMBLE\_POWER\_RAMPING\_STEP* to the *powerRampingStepHighPriority*.

4> if *scalingFactorBI* is configured in the *ra-PrioritizationForSlicing* for this *NSAG-ID*:

5> set *SCALING\_FACTOR\_BI* to the *scalingFactorBI*.

3> else if *enableRA-PrioritizationForSlicing* is set to *false*:

4> if *powerRampingStepHighPriority* is configured in the *ra-PrioritizationForAccessIdentity*:

5> set *PREAMBLE\_POWER\_RAMPING\_STEP* to the *powerRampingStepHighPriority*.

4> if *scalingFactorBI* is configured in the *ra-PrioritizationForAccessIdentity*:

5> set *SCALING\_FACTOR\_BI* to the *scalingFactorBI*.

2> else if *ra-PrioritizationForSlicing* for a *NSAG-ID* is configured for the selected carrier; and

2> if the MAC entity is provided by upper layers with this *NSAG-ID*:

3> if *powerRampingStepHighPriority* is configured in the *ra-PrioritizationForSlicing* for this *NSAG-ID*:

4> set *PREAMBLE\_POWER\_RAMPING\_STEP* to the *powerRampingStepHighPriority*.

3> if *scalingFactorBI* is configured in the *ra-PrioritizationForSlicing* for this *NSAG-ID*:

4> set *SCALING\_FACTOR\_BI* to the *scalingFactorBI*.

2> else if *ra-PrioritizationForAccessIdentity* is configured for the selected carrier; and

2> if the MAC entity is provided by upper layers with Access Identity 1 or 2; and

2> if for at least one of these Access Identities the corresponding bit in the *ra-PrioritizationForAI* is set to *one*:

3> if *powerRampingStepHighPriority* is configured in the *ra-PrioritizationForAccessIdentity*:

4> set *PREAMBLE\_POWER\_RAMPING\_STEP* to the *powerRampingStepHighPriority*.

3> if *scalingFactorBI* is configured in the *ra-PrioritizationForAccessIdentity*:

4> set *SCALING\_FACTOR\_BI* to the *scalingFactorBI*.

2> if *RA\_TYPE* is switched from *2-stepRA* to *4-stepRA* during this Random Access procedure:

3> set *POWER\_OFFSET\_2STEP\_RA* to (*PREAMBLE\_POWER\_RAMPING\_COUNTER* – 1) × (*MSGA\_PREAMBLE\_POWER\_RAMPING\_STEP* – *PREAMBLE\_POWER\_RAMPING\_STEP*).

NOTE: If *enableRA-PrioritizationForSlicing* is not configured in *BWP-UplinkCommon* and if both the provided *NSAG-ID* and the provided Access Identity whose corresponding bit in the *ra-PrioritizationForAI* is set to *one* are configured with *ra-Prioritization* either in *RACH-ConfigCommon* or *RACH-ConfigCommonTwoStepRA*, it is up to UE implementation how to determine the values of *PREAMBLE\_POWER\_RAMPING\_STEP* and *SCALING\_FACTOR\_BI*.

### 5.1.1b Selection of the set of Random Access resources for the Random Access procedure

The MAC entity shall:

1> if the BWP selected for Random Access procedure is configured with both set(s) of Random Access resources with *msg3-Repetitions* set to *true* and set(s) of Random Access resources without *msg3-Repetitions* set to *true* and the RSRP of the downlink pathloss reference is less than *rsrp-ThresholdMsg3*; or

1> if the BWP selected for Random Access procedure is only configured with the set(s) of Random Access resources with *msg3-Repetitions* set to *true*:

2> assume Msg3 repetition is applicable for the current Random Access procedure.

1> else:

2> assume Msg3 repetition is not applicable for the current Random Access procedure.

1> if contention-free Random Access Resources have been provided for this Random Access procedure in the LTM Cell Switch Command MAC CE and a non-zero Msg1 repetition number is indicated in the LTM Cell Switch Command MAC CE:

2> assume that Msg1 repetition is applicable and that the Msg1 repetition number applicable for the current Random Access procedure is the Msg1 repetition number indicated in the LTM Cell Switch Command MAC CE.

1> else if contention-free Random Access Resources have been provided for this Random Access procedure and a Msg1 repetition number is indicated in *rach-ConfigDedicated*:

2> assume Msg1 repetition is applicable and Msg1 repetition number applicable for the current Random Access procedure is the Msg1 repetition number indicated in *rach-ConfigDedicated*.

1> else if contention free Random Access Resources have not been provided for this Random Access procedure and the BWP selected for the Random Access procedure is configured with set(s) of Random Access resources with *msg1-Repetitions* set to *true* and set(s) of Random Access resources without *msg1-Repetitions* set to *true*:

2> if the BWP selected for the Random Access procedure is configured with set(s) of Random Access resources associated with Msg1 repetition number 8 and the RSRP of the downlink pathloss reference is less than *rsrp-ThresholdMsg1-RepetitionNum8*:

3> assume Msg1 repetition is applicable and Msg1 repetition number applicable for the current Random Access procedure includes 8.

2> if the BWP selected for the Random Access procedure is configured with set(s) of Random Access resources associated with Msg1 repetition number 4 and the RSRP of the downlink pathloss reference is less than *rsrp-ThresholdMsg1-RepetitionNum4*:

3> assume Msg1 repetition is applicable and Msg1 repetition number applicable for the current Random Access procedure includes 4.

2> if the BWP selected for the Random Access procedure is configured with set(s) of Random Access resources associated with Msg1 repetition number 2 and the RSRP of the downlink pathloss reference is less than *rsrp-ThresholdMsg1-RepetitionNum2*:

3> assume Msg1 repetition is applicable and Msg1 repetition number applicable for the current Random Access procedure includes 2.

2> else if the RSRP of the downlink pathloss reference is not less than any configured *rsrp-ThresholdMsg1-RepetitionNumX*:

3> assume Msg1 repetition is not applicable for the current Random Access procedure.

1> else ifthe BWP selected for Random Access procedure is configured only with the set(s) of Random Access resources with *msg1-Repetitions* set to *true*:

2> assume Msg1 repetition is applicable for the current Random Access procedure;

2> if at least one of *rsrp-ThresholdMsg1-RepetitionNumX* is configured:

3> if *rsrp-ThresholdMsg1-RepetitionNum8* is configured and the RSRP of the downlink pathloss reference is less than *rsrp-ThresholdMsg1-RepetitionNum8*;

4> assume Msg1 repetition number applicable for the current Random Access procedure includes 8.

3> if *rsrp-ThresholdMsg1-RepetitionNum4* is configured and the RSRP of the downlink pathloss reference is less than *rsrp-ThresholdMsg1-RepetitionNum4*:

4> assume Msg1 repetition number applicable for the current Random Access procedure includes 4.

3> if *rsrp-ThresholdMsg1-RepetitionNum2* is configured and the RSRP of the downlink pathloss reference is less than *rsrp-ThresholdMsg1-RepetitionNum2*:

4> assume Msg1 repetition number applicable for the current Random Access procedure includes 2.

3> else if the RSRP of the downlink pathloss reference is not less than any configured *rsrp-ThresholdMsg1-RepetitionNumX*:

4> assume Msg1 repetition number applicable for the current Random Access procedure is the lowest Msg1 repetition number configured for this BWP.

2> else (none of *rsrp-ThresholdMsg1-RepetitionNumX* is configured):

3> assume Msg1 repetition number applicable for the current Random Access procedure is the Msg1 repetition number that configured for this BWP.

Editor’s Note: Will reflect *rsrp-ThresholdMsg1-RepetitionNumX* for SBFD RO, based on RRC running CR, once it becomes stable.

NOTE 1: Void.

1> if neither contention-free Random Access Resources nor Random Access Resources for SI request have been provided for this Random Access procedure and one or more of the features including (e)RedCap and/or Slicing and/or SDT and/or MSG3 repetition and/or MSG1 repetition is applicable for this Random Access procedure:

NOTE 2: The applicability of SDT is determined by MAC entity according to clause 5.27. The applicability of *NSAG-ID* is determined by upper layers when the Random Access procedure is initiated. The applicability of (e)RedCap is also determined by upper layers when Random Access procedure is initiated and it is applicable to the Random Access procedures initiated by PDCCH orders and any Random Access procedure initiated by the MAC entity.

NOTE 3: SDT is not applicable for the Random Access procedure initiated by upper layers for MT-SDT.

2> if none of the sets of Random Access resources are available for any feature applicable to the current Random Access procedure (as specified in clause 5.1.1c):

3> select the set(s) of Random Access resources that are not associated with any feature indication (as specified in clause 5.1.1c) for this Random Access procedure.

2> else if there is one set of Random Access resources available which can be used for indicating all features triggering this Random Access procedure:

3> select this set of Random Access resources for this Random Access procedure.

2> else if there are more than one set of Random Access resources available which can be used for indicating all features triggering this Random Access procedure and Msg1 repetition is applicable for this Random Access procedure:

3> select the set of Random Access resources that associated with highest repetition number among the sets of Random Access resources.

2> else (i.e. there are one or more sets of Random Access resources available that are configured with indication(s) for a subset of all features triggering this Random Access procedure):

3> select a set of Random Access resources from the available set(s) of Random Access resources based on the priority order indicated by upper layers as specified in clause 5.1.1d for this Random Access Procedure.

1> else if this Random Access procedure is initiated by PDCCH order with the *PRACH association indicator* field in DCI set to 1 and *SSB-MTC-AdditionalPCI* is configured by upper layers, as specified in clause 7.3.1.2.1 of TS 38.212 [9]:

2> select the set of Random Access resources corresponding to the *additionalPCI* associated with active TCI states.

1> else if this Random Access procedure is initiated by PDCCH order for an LTM candidate cell:

2> select the set of Random Access resources configured in *EarlyUL-SyncConfig* corresponding to the carrier and the cell indicated by the field *UL/SUL indicator* and the field *Cell indicator* in the PDCCH order respectively, as specified in TS 38.212 [9].

1> else if contention-free Random Access Resources have been provided for this Random Access procedure by PDCCH order:

2> if RedCap is applicable for the current Random Access procedure:

3> if there is one set of Random Access resources available that is only configured with RedCap indication:

4> select this set of Random Access resources for this Random Access procedure.

3> else:

4> select the set of Random Access resources that is not associated with any feature indication (as specified in clause 5.1.1c) for this Random Access procedure.

2> else if eRedCap is applicable for the current Random Access procedure:

3> if there is one set of Random Access resources available that is only configured with eRedCap indication:

4> select this set of Random Access resources for this Random Access procedure.

3> else if there is one set of Random Access resources available that is only configured with RedCap indication:

4> select this set of Random Access resources for this Random Access procedure.

3> else:

4> select the set of Random Access resources that is not associated with any feature indication (as specified in clause 5.1.1c) for this Random Access procedure.

2> else:

3> select the set of Random Access resources that is not associated with any feature indication (as specified in clause 5.1.1c) for this Random Access procedure.

1> else if contention-free Random Access Resources have been provided for this Random Access procedure in the LTM Cell Switch Command MAC CE:

2> if RedCap is applicable for this Random Access procedure:

3> if a non-zero Msg1 repetition number is indicated in the LTM Cell Switch Command MAC CE:

4> select the set of Random Access resources that is only configured with RedCap indication and Msg1 repetition indication and associated with the indicated Msg1 repetition number for this Random Access procedure.

3> else:

4> if there is one set of Random Access resources available that is only configured with RedCap indication:

5> select this set of Random Access resources for this Random Access procedure.

4> else:

5> select the set of Random Access resources that is not associated with any feature indication (as specified in clause 5.1.1c) for this Random Access procedure.

2> else if eRedCap is applicable for this Random Access procedure:

3> if a non-zero Msg1 repetition number is indicated in the LTM Cell Switch Command MAC CE:

4> select the set of Random Access resources that is only configured with eRedCap indication and Msg1 repetition indication and associated with the indicated Msg1 repetition number for this Random Access procedure.

3> else:

4> if there is one set of Random Access resources available that is only configured with eRedCap indication:

5> select this set of Random Access resources for this Random Access procedure.

4> else if there is one set of Random Access resources available that is only configured with RedCap indication:

5> select this set of Random Access resources for this Random Access procedure.

4> else:

5> select the set of Random Access resources that is not associated with any feature indication (as specified in clause 5.1.1c) for this Random Access procedure.

2> else:

3> if a non-zero Msg1 repetition number is indicated in the LTM Cell Switch Command MAC CE:

4> select the set of Random Access resources that is only configured with Msg1 repetition indication and associated with the indicated Msg1 repetition number for this Random Access procedure.

3> else:

4> select the set of Random Access resources that is not associated with any feature indication (as specified in clause 5.1.1c) for this Random Access procedure.

1> else if contention-free Random Access Resources have been provided for this Random Access procedure in *rach-ConfigDedicated*:

2> if RedCap is applicable for this Random Access procedure:

3> if Msg1 repetition number is indicated in *rach-ConfigDedicated*:

4> select the set of Random Access resources that is only configured with RedCap indication and Msg1 repetition indication and associated with the indicated Msg1 repetition number for this Random Access procedure.

3> else:

4> if there is one set of Random Access resources available that is only configured with RedCap indication:

5> select this set of Random Access resources for this Random Access procedure.

4> else:

5> select the set of Random Access resources that is not associated with any feature indication (as specified in clause 5.1.1c) for this Random Access procedure.

2> else if eRedCap is applicable for this Random Access procedure:

3> if Msg1 repetition number is indicated in *rach-ConfigDedicated*:

4> select the set of Random Access resources that is only configured with eRedCap indication and Msg1 repetition indication and associated with the indicated Msg1 repetition number for this Random Access procedure.

3> else:

4> if there is one set of Random Access resources available that is only configured with eRedCap indication:

5> select this set of Random Access resources for this Random Access procedure.

4> else if there is one set of Random Access resources available that is only configured with RedCap indication:

5> select this set of Random Access resources for this Random Access procedure.

4> else:

5> select the set of Random Access resources that not is associated with any feature indication (as specified in clause 5.1.1c) for this Random Access procedure.

2> else:

3> if Msg1 repetition number is indicated in *rach-ConfigDedicated*:

4> select the set of Random Access resources that is only configured with Msg1 repetition indication and associated with the indicated Msg1 repetition number for this Random Access procedure.

3> else:

4> select the set of Random Access resources that is not associated with any feature indication (as specified in clause 5.1.1c) for this Random Access procedure.

1> else if contention-free Random Access Resources have been provided for this Random Access procedure in the *BeamFailureRecoveryConfig*:

2> if RedCap is applicable for this Random Access procedure:

3> if there is one set of Random Access resources available that is only configured with RedCap indication:

4> select this set of Random Access resources for this Random Access procedure.

3> else:

4> select the set of Random Access resources that is not associated with any feature indication (as specified in clause 5.1.1c) for this Random Access procedure.

2> else if eRedCap is applicable for this Random Access procedure:

3> if there is one set of Random Access resources available that is only configured with eRedCap indication:

4> select this set of Random Access resources for this Random Access procedure.

3> else if there is one set of Random Access resources available that is only configured with RedCap indication:

4> select this set of Random Access resources for this Random Access procedure.

3> else:

4> select the set of Random Access resources that is not associated with any feature indication (as specified in clause 5.1.1c) for this Random Access procedure.

2> else:

3> select the set of Random Access resources that is not associated with any feature indication (as specified in clause 5.1.1c) for this Random Access procedure.

1> else if Random Access resources for SI request have been provided for this Random Access procedure:

2> if Random Access Resources associated with Msg1 repetition for SI request and Msg1 repetition number have been provided for this Random Access procedure:

3> ifthe BWP selected for Random Access procedure is indicated by *initialUplinkBWP-RedCap*:

4> if RedCap is applicable for the current Random Access procedure:

5> select the set of Random Access Resources that is only configured with RedCap indication and Msg1 repetition indication and associated with the indicated Msg1 repetition number for this Random Access procedure.

4> else if eRedCap is applicable for the current Random Access procedure:

5> if there is one set of Random Access resources available that is only configured with RedCap indication and Msg1 repetition indication and associated with the indicated Msg1 repetition number:

6> select this set of Random Access resources for this Random Access procedure.

5> else:

6> select the set of Random Access Resources that is only configured with eRedCap indication and Msg1 repetition indication and associated with the indicated Msg1 repetition number for this Random Access procedure.

3> else:

4> select the set of Random Access resources that is only configured with Msg1 repetition indication and associated with the indicated Msg1 repetition number for this Random Access procedure.

2> else:

3> select the set of Random Access resources that is not associated with any feature indication (as specified in clause 5.1.1c) for the current Random Access procedure.

1> else:

2> select the set of Random Access resources that is not associated with any feature indication (as specified in clause 5.1.1c) for the current Random Access procedure.

**--------------------------------------------------[Next change]----------------------------------------------------**

### 5.1.2 Random Access Resource selection

If the selected *RA\_TYPE* is set to *4-stepRA*, the MAC entity shall:

1> if the Random Access procedure was initiated for SpCell beam failure recovery (as specified in clause 5.17); and

1> if the *beamFailureRecoveryTimer* (in clause 5.17) is either running or not configured; and

1> if the contention-free Random Access Resources for beam failure recovery request associated with any of the SSBs and/or CSI-RSs have been explicitly provided by RRC; and

1> if at least one of the SSBs with SS-RSRP above *rsrp-ThresholdSSB* amongst the SSBs in *candidateBeamRSList* or the CSI-RSs with CSI-RSRP above *rsrp-ThresholdCSI-RS* amongst the CSI-RSs in *candidateBeamRSList* is available:

2> select an SSB with SS-RSRP above *rsrp-ThresholdSSB* amongst the SSBs in *candidateBeamRSList* or a CSI-RS with CSI-RSRP above *rsrp-ThresholdCSI-RS* amongst the CSI-RSs in *candidateBeamRSList*;

2> if CSI-RS is selected, and there is no *ra-PreambleIndex* associated with the selected CSI-RS:

3> set the *PREAMBLE\_INDEX* to a *ra-PreambleIndex* corresponding to the SSB in *candidateBeamRSList* which is quasi-colocated with the selected CSI-RS as specified in TS 38.214 [7].

2> else:

3> set the *PREAMBLE\_INDEX* to a *ra-PreambleIndex* corresponding to the selected SSB or CSI-RS from the set of Random Access Preambles for beam failure recovery request.

1> else if the *ra-PreambleIndex* has been explicitly provided by PDCCH; and

1> if the *ra-PreambleIndex* is not 0b000000:

2> set the *PREAMBLE\_INDEX* to the signalled *ra-PreambleIndex*;

2> select the SSB signalled by PDCCH.

1> else if contention-free Random Access Resources have been explicitly provided by an LTM Cell Switch Command MAC CE and the SS-RSRP of the SSB signalled by the LTM Cell Switch Command MAC CE is above *rsrp-ThresholdSSB*:

2> set the *PREAMBLE\_INDEX* to the Random Access Preamble index signalled by the LTM Cell Switch Command MAC CE;

2> select the SSB signalled by the LTM Cell Switch Command MAC CE.

1> else if contention-free Random Access Resources have not been explicitly provided by an LTM Cell Switch Command MAC CE, the Random Access procedure was not initiated for recovery using an LTM candidate configuration as specified in TS 38.331 [5] clause 5.3.7.3, contention-free Random Access Resources associated with SSBs have been explicitly provided in *rach-ConfigDedicated* and at least one SSB with SS-RSRP above *rsrp-ThresholdSSB* amongst the associated SSBs is available:

2> select an SSB with SS-RSRP above *rsrp-ThresholdSSB* amongst the associated SSBs;

2> set the *PREAMBLE\_INDEX* to a *ra-PreambleIndex* corresponding to the selected SSB.

1> else if contention-free Random Access Resources have not been explicitly provided by an LTM Cell Switch Command MAC CE, the Random Access procedure was not initiated for recovery using an LTM candidate configuration as specified in TS 38.331 [5] clause 5.3.7.3, contention-free Random Access Resources associated with CSI-RSs have been explicitly provided in *rach-ConfigDedicated* and at least one CSI-RS with CSI-RSRP above *rsrp-ThresholdCSI-RS* amongst the associated CSI-RSs is available:

2> select a CSI-RS with CSI-RSRP above *rsrp-ThresholdCSI-RS* amongst the associated CSI-RSs;

2> set the *PREAMBLE\_INDEX* to a *ra-PreambleIndex* corresponding to the selected CSI-RS.

1> else if the Random Access procedure was initiated for SI request (as specified in TS 38.331 [5]); and

1> if the Random Access Resources for SI request have been explicitly provided by RRC:

2> if at least one of the SSBs with SS-RSRP above *rsrp-ThresholdSSB* is available:

3> select an SSB with SS-RSRP above *rsrp-ThresholdSSB*.

2> else:

3> select any SSB.

2> select a Random Access Preamble corresponding to the selected SSB, from the Random Access Preamble(s) determined according to *ra-PreambleStartIndex* as specified in TS 38.331 [5];

2> set the *PREAMBLE\_INDEX* to selected Random Access Preamble.

1> else (i.e. for the contention-based Random Access preamble selection):

2> if at least one of the SSBs with SS-RSRP above *rsrp-ThresholdSSB* is available:

3> select an SSB with SS-RSRP above *rsrp-ThresholdSSB*.

2> else:

3> select any SSB.

2> if the *RA\_TYPE* is switched from *2-stepRA* to *4-stepRA*:

3> if a Random Access Preambles group was selected during the current Random Access procedure:

4> select the same group of Random Access Preambles as was selected for the 2-step RA type.

3> else:

4> if Random Access Preambles group B is configured; and

4> if the transport block size of the MSGA payload configured in the *rach-ConfigDedicated* corresponds to the transport block size of the MSGA payload associated with Random Access Preambles group B:

5> select the Random Access Preambles group B.

4> else:

5> select the Random Access Preambles group A.

2> else if Msg3 buffer is empty:

3> if Random Access Preambles group B is configured:

4> if the potential Msg3 size (UL data available for transmission plus MAC subheader(s) and, where required, MAC CEs) is greater than *ra-Msg3SizeGroupA* and the pathloss is less than *PCMAX* (of the Serving Cell performing the Random Access Procedure) – *preambleReceivedTargetPower* – *msg3-DeltaPreamble* – *messagePowerOffsetGroupB*; or

Editor’s Note: Will reflect SBFD version of *preambleReceivedTargetPower*, based on RRC running CR, once it becomes stable.

4> if the Random Access procedure was initiated for the CCCH logical channel and the CCCH SDU size plus MAC subheader is greater than *ra-Msg3SizeGroupA*:

5> select the Random Access Preambles group B.

4> else:

5> select the Random Access Preambles group A.

3> else:

4> select the Random Access Preambles group A.

2> else (i.e. Msg3 is being retransmitted):

3> select the same group of Random Access Preambles as was used for the Random Access Preamble transmission attempt corresponding to the first transmission of Msg3.

2> select a Random Access Preamble randomly with equal probability from the Random Access Preambles associated with the selected SSB and the selected Random Access Preambles group;

2> set the *PREAMBLE\_INDEX* to the selected Random Access Preamble.

1> if the Random Access procedure was initiated for SI request (as specified in TS 38.331 [5]); and

1> if *ra-AssociationPeriodIndex* and *si-RequestPeriod* are configured:

2> determine the next available PRACH occasion from the PRACH occasions corresponding to the selected SSB in the association period given by *ra-AssociationPeriodIndex* in the *si-RequestPeriod* permitted by the restrictions given by the *ra-ssb-OccasionMaskIndex* if configured (the MAC entity shall select a PRACH occasion randomly with equal probability amongst the consecutive PRACH occasions according to clause 8.1 of TS 38.213 [6] corresponding to the selected SSB).

1> else if an SSB is selected above:

2> if the set of Random Access resources associated with Msg1 repetition is selected for this Random Access procedure:

3> determine the next available set of PRACH occasions of the selected RO type (as specified in TS 38.213 [6]) for the Msg1 repetition number applicable for this Random Access procedure corresponding to the selected SSB (the MAC entity shall select a set of PRACH occasions randomly with equal probability amongst sets of PRACH occasions of the selected RO type according to clause 8.1 of TS 38.213 [6] regardless the FR2 UL gap, corresponding to the selected SSB and selected Msg1 repetition number for this Random Access procedure; the MAC entity may take into account the possible occurrence of measurement gaps and MUSIM gaps when determining the next available set of PRACH occasions of the selected RO type corresponding to the selected SSB).

2> else:

3> determine the next available PRACH occasion from the PRACH occasions of the selected RO type corresponding to the selected SSB permitted by the restrictions given by the *ra-ssb-OccasionMaskIndex* if configured, or *ssb-SharedRO-MaskIndex* if configured, or indicated by PDCCH, or indicated by the LTM Cell Switch Command MAC CE (the MAC entity shall select a PRACH occasion randomly with equal probability amongst the consecutive PRACH occasions of the selected RO type according to clause 8.1 of TS 38.213 [6] regardless the FR2 UL gap, corresponding to the selected SSB; the MAC entity may take into account the possible occurrence of measurement gaps and MUSIM gaps when determining the next available PRACH occasion of the selected RO type corresponding to the selected SSB).

1> else if a CSI-RS is selected above:

2> if there is no contention-free Random Access Resource associated with the selected CSI-RS:

3> determine the next available PRACH occasion from the PRACH occasions of the selected RO type, permitted by the restrictions given by the *ra-ssb-OccasionMaskIndex* if configured, corresponding to the SSB in *candidateBeamRSList* which is quasi-colocated with the selected CSI-RS as specified in TS 38.214 [7] (the MAC entity shall select a PRACH occasion randomly with equal probability amongst the consecutive PRACH occasions of the selected RO type according to clause 8.1 of TS 38.213 [6] regardless the FR2 UL gap, corresponding to the SSB which is quasi-colocated with the selected CSI-RS; the MAC entity may take into account the possible occurrence of measurement gaps and MUSIM gaps when determining the next available PRACH occasion of the selected RO type corresponding to the SSB which is quasi-colocated with the selected CSI-RS).

2> else:

3> determine the next available PRACH occasion from the PRACH occasions of the selected RO type in *ra-OccasionList* corresponding to the selected CSI-RS (the MAC entity shall select a PRACH occasion randomly with equal probability amongst the PRACH occasions of the selected RO type occurring simultaneously but on different subcarriers regardless the FR2 UL gap, corresponding to the selected CSI-RS; the MAC entity may take into account the possible occurrence of measurement gaps and MUSIM gaps when determining the next available PRACH occasion of the selected RO type corresponding to the selected CSI-RS).

Editor’s Note: Need further discussion whether SBFD RO can be supported for CSI-RS based CFRA.

1> perform the Random Access Preamble transmission procedure (see clause 5.1.3).

NOTE 1: When the UE determines if there is an SSB with SS-RSRP above *rsrp-ThresholdSSB* or a CSI-RS with CSI-RSRP above *rsrp-ThresholdCSI-RS*, the UE uses the latest unfiltered L1-RSRP measurement.

NOTE 2: Void.

NOTE 3: If an (e)RedCap UE in RRC\_IDLE or RRC\_INACTIVE mode is configured with a BWP indicated by *initialDownlinkBWP-RedCap* which is not associated with any SSB, SS-RSRP measurement is performed based on the SSB associated with the BWP indicated by *initialDownlinkBWP*. If an (e)RedCap UE in RRC\_INACTIVE mode is configured with SDT and with a BWP indicated by *initialDownlinkBWP-RedCap* which is associated with NCD-SSB, SS-RSRP measurement can also be performed based on this NCD-SSB during SDT.

NOTE 4: If an (e)RedCap UE in RRC\_IDLE or RRC\_INACTIVE mode is configured with a BWP indicated by *initialDownlinkBWP-RedCap* which is not associated with any SSB for RACH, it is up to the UE implementation to perform a new RSRP measurements before Msg1/MsgA retransmission.

**--------------------------------------------------[Next change]----------------------------------------------------**

### 5.1.3 Random Access Preamble transmission

The MAC entity shall, for each Random Access Preamble:

1> if *PREAMBLE\_TRANSMISSION\_COUNTER* is greater than one; and

1> if the notification of suspending power ramping counter has not been received from lower layers; and

1> if LBT failure indication was not received from lower layers for the last Random Access Preamble transmission; and

1> if SSB or CSI-RS selected is not changed from the selection in the last Random Access Preamble transmission; and

1> if the Random Access procedure is not initiated by the PDCCH order for an LTM candidate cell:

2> increment *PREAMBLE\_POWER\_RAMPING\_COUNTER* by 1.

1> if the Random Access procedure is initiated by the PDCCH order for an LTM candidate cell as preamble re-transmission; and

1> if the PDCCH order indicates the same LTM candidate cell and the same SSB as the last Random Access Preamble transmission:

2> increment *PREAMBLE\_POWER\_RAMPING\_COUNTER* by 1.

1> select the value of *DELTA\_PREAMBLE* according to clause 7.3;

1> set *PREAMBLE\_RECEIVED\_TARGET\_POWER* to *preambleReceivedTargetPower* + *DELTA\_PREAMBLE* + (*PREAMBLE\_POWER\_RAMPING\_COUNTER* – 1) × *PREAMBLE\_POWER\_RAMPING\_STEP* + *POWER\_OFFSET\_2STEP\_RA*;

Editor’s Note: Will reflect SBFD version of *preambleReceivedTargetPower* based on RRC running CR once it becomes stable.

1> except for contention-free Random Access Preamble for beam failure recovery request and contention-free Random Access Preamble triggered by a PDCCH order for an LTM candidate cell, compute the RA-RNTI associated with the PRACH occasion in which the Random Access Preamble is transmitted;

1> instruct the physical layer to transmit the Random Access Preamble using the selected PRACH occasion, corresponding RA-RNTI (if available), *PREAMBLE\_INDEX*, and *PREAMBLE\_RECEIVED\_TARGET\_POWER*.

1> if the Random Access Procedure is triggered by a PDCCH order for an LTM candidate cell:

2> consider this Random Access procedure completed.

1> if LBT failure indication is received from lower layers for this Random Access Preamble transmission:

2> if *lbt-FailureRecoveryConfig* is configured:

3> perform the Random Access Resource selection procedure (see clause 5.1.2).

2> else:

3> increment *PREAMBLE\_TRANSMISSION\_COUNTER* by 1;

3> if *PREAMBLE\_TRANSMISSION\_COUNTER* = *preambleTransMax* + 1:

4> if the Random Access Preamble is transmitted on the SpCell:

5> indicate a Random Access problem to upper layers;

5> if this Random Access procedure was triggered for SI request:

6> consider the Random Access procedure unsuccessfully completed.

4> else if the Random Access Preamble is transmitted on an SCell:

5> consider the Random Access procedure unsuccessfully completed.

3> if the Random Access procedure is not completed:

4> perform the Random Access Resource selection procedure (see clause 5.1.2).

The RA-RNTI associated with the PRACH occasion in which the Random Access Preamble is transmitted or the RA-RNTI associated with the last valid PRACH occasion in the set of PRACH occasions (as specified in TS 38.213 [6]) for Msg1 repetition, is computed as:

RA-RNTI = 1 + s\_id + 14 × t\_id + 14 × 80 × f\_id + 14 × 80 × 8 × ul\_carrier\_id

where s\_id is the index of the first OFDM symbol of the PRACH occasion (0 ≤ s\_id < 14), t\_id is the index of the first slot of the PRACH occasion in a system frame (0 ≤ t\_id < 80), where the subcarrier spacing to determine t\_id is based on the value of μ specified in clause 5.3.2 in TS 38.211 [8] for μ = {0, 1, 2, 3}, and for μ = {5, 6}, t\_id is the index of the 120 kHz slot in a system frame that contains the PRACH occasion (0 ≤ t\_id < 80), f\_id is the index of the PRACH occasion in the frequency domain (0 ≤ f\_id < 8), and ul\_carrier\_id is the UL carrier used for Random Access Preamble transmission (0 for NUL carrier, and 1 for SUL carrier).

Editor’s Note: FFS whether RA-RNTI collision issue should be addressed in RAN2 or not.

**--------------------------------------------------[Next change]----------------------------------------------------**

### 5.1.4 Random Access Response reception

Once the Random Access Preamble is transmitted and regardless of the possible occurrence of a measurement gap, the MAC entity shall:

1> if the contention-free Random Access Preamble for beam failure recovery request was transmitted by the MAC entity:

2> if the contention-free Random Access Preamble for beam failure recovery request was transmitted on a non-terrestrial network:

3> start the *ra-ResponseWindow* configured in *BeamFailureRecoveryConfig* at the PDCCH occasion as specified in TS 38.213 [6].

2> else:

3> start the *ra-ResponseWindow* configured in *BeamFailureRecoveryConfig* at the first PDCCH occasion as specified in TS 38.213 [6] from the end of the Random Access Preamble transmission.

2> monitor for a PDCCH transmission on the search space indicated by *recoverySearchSpaceId* of the SpCell identified by the C-RNTI while *ra-ResponseWindow* is running.

1> else:

2> if the Random Access Preamble was transmitted on a non-terrestrial network:

3> if the Random Access Preamble is transmitted with repetitions:

4> start the *ra-ResponseWindow* configured in *RACH-ConfigCommon* at the PDCCH occasion from the end of all repetitions of the Random Access Preamble transmission as specified in TS 38.213 [6].

3> else:

4> start the *ra-ResponseWindow* configured in *RACH-ConfigCommon* at the PDCCH occasion as specified in TS 38.213 [6].

2> else if the Random Access Preamble is transmitted with repetitions:

3> start the *ra-ResponseWindow* configured in *RACH-ConfigCommon* at the first PDCCH occasion from the end of all repetitions of the Random Access Preamble transmission as specified in TS 38.213 [6].

2> else:

3> start the *ra-ResponseWindow* configured in *RACH-ConfigCommon* at the first PDCCH occasion as specified in TS 38.213 [6] from the end of the Random Access Preamble transmission.

2> monitor the PDCCH of the SpCell for Random Access Response(s) identified by the RA-RNTI while the *ra-ResponseWindow* is running.

1> if notification of a reception of a PDCCH transmission on the search space indicated by *recoverySearchSpaceId* is received from lower layers on the Serving Cell where the preamble was transmitted; and

1> if PDCCH transmission is addressed to the C-RNTI; and

1> if the contention-free Random Access Preamble for beam failure recovery request was transmitted by the MAC entity:

2> consider the Random Access procedure successfully completed.

1> else if a valid (as specified in TS 38.213 [6]) downlink assignment has been received on the PDCCH for the RA-RNTI and the received TB is successfully decoded:

2> if the Random Access Response contains a MAC subPDU with Backoff Indicator:

3> set the *PREAMBLE\_BACKOFF* to value of the BI field of the MAC subPDU using Table 7.2-1, multiplied with *SCALING\_FACTOR\_BI*.

2> else:

3> set the *PREAMBLE\_BACKOFF* to 0 ms.

2> if the Random Access Response contains a MAC subPDU with Random Access Preamble identifier corresponding to the transmitted *PREAMBLE\_INDEX* (see clause 5.1.3):

3> consider this Random Access Response reception successful.

2> if the Random Access Response reception is considered successful:

3> if the Random Access Response includes a MAC subPDU with RAPID only:

4> consider this Random Access procedure successfully completed;

4> indicate the reception of an acknowledgement for SI request to upper layers.

3> else:

4> apply the following actions for the Serving Cell where the Random Access Preamble was transmitted:

5> process the received Timing Advance Command (see clause 5.2);

5> indicate the *preambleReceivedTargetPower* and the amount of power ramping applied to the latest Random Access Preamble transmission to lower layers (i.e. (*PREAMBLE\_POWER\_RAMPING\_COUNTER* – 1) × *PREAMBLE\_POWER\_RAMPING\_STEP*);

Editor’s Note: Will reflect SBFD version of *preambleReceivedTargetPower* based on RRC running CR once it becomes stable.

5> if the Random Access procedure for an SCell is performed on uplink carrier where *pusch-Config* is not configured:

6> ignore the received UL grant.

5> else:

6> process the received UL grant value and indicate it to the lower layers.

4> if the Random Access Preamble was not selected by the MAC entity among the contention-based Random Access Preamble(s):

5> consider the Random Access procedure successfully completed.

4> else:

5> set the *TEMPORARY\_C-RNTI* to the value received in the Random Access Response;

5> if this is the first successfully received Random Access Response within this Random Access procedure:

6> if the transmission is not being made for the CCCH logical channel:

7> indicate to the Multiplexing and assembly entity to include a C-RNTI MAC CE in the subsequent uplink transmission.

6> if the Random Access procedure was initiated for SpCell beam failure recovery and *spCell-BFR-CBRA* with value *true* is configured:

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

8> indicate to the Multiplexing and assembly entity to include an Enhanced BFR MAC CE or a Truncated Enhanced BFR MAC CE in the subsequent uplink transmission.

7> else:

8> indicate to the Multiplexing and assembly entity to include a BFR MAC CE or a Truncated BFR MAC CE in the subsequent uplink transmission.

6> else if the Random Access procedure was initiated for beam failure recovery of both BFD-RS sets of SpCell:

7> indicate to the Multiplexing and assembly entity to include an Enhanced BFR MAC CE or a Truncated Enhanced BFR MAC CE in the subsequent uplink transmission.

6> obtain the MAC PDU to transmit from the Multiplexing and assembly entity and store it in the Msg3 buffer.

NOTE 1: If within a Random Access procedure, an uplink grant provided in the Random Access Response for the same group of contention-based Random Access Preambles has a different size than the first uplink grant allocated during that Random Access procedure, the UE behavior is not defined.

1> if *ra-ResponseWindow* configured in *BeamFailureRecoveryConfig* expires and if a PDCCH transmission on the search space indicated by *recoverySearchSpaceId* addressed to the C-RNTI has not been received on the Serving Cell where the preamble was transmitted; or

1> if *ra-ResponseWindow* configured in *RACH-ConfigCommon* expires, and if the Random Access Response containing Random Access Preamble identifiers that matches the transmitted *PREAMBLE\_INDEX* has not been received:

2> consider the Random Access Response reception not successful;

2> increment *PREAMBLE\_TRANSMISSION\_COUNTER* by 1;

2> if *PREAMBLE\_TRANSMISSION\_COUNTER* = *preambleTransMax* + 1:

3> if the Random Access Preamble is transmitted on the SpCell:

4> indicate a Random Access problem to upper layers;

4> if this Random Access procedure was triggered for SI request:

5> consider the Random Access procedure unsuccessfully completed.

3> else if the Random Access Preamble is transmitted on an SCell:

4> consider the Random Access procedure unsuccessfully completed.

2> if the Random Access procedure is not completed:

3> *if preambleTransMaxRO-Type* is applied, and *PREAMBLE\_TRANSMISSION\_COUNTER* = *preambleTransMaxRO-Type* + 1:

4> if *RO\_TYPE* is set to *SBFD-RO*:

5> set the *RO\_TYPE* to *non-SBFD-RO*.

4> else if *RO\_TYPE* is set to *non*-*SBFD-RO*:

5> set the *RO\_TYPE* to *SBFD-RO*.

Editor’s Note: FFS whether RA resource set reselection can be performed or not, after the RO type switching, given that the applicable Msg1 repetition number(s) may become different.

Editor’s Note: Whether Msg1 repetition number fallback can be supported with SBFD RO or not.

Editor’s Note: FFS the order of RO type fallback and Msg1 repetition number fallback if both are supported.

3> if the Random Access Preamble is transmitted with repetitions and neither contention-free Random Access Resources nor Random Access resources for SI request have been provided for this Random Access procedure:

4> if *PREAMBLE\_TRANSMISSION\_COUNTER* = [*preambleTransMax-Msg1-Repetition*] + 1; or

4> if *PREAMBLE\_TRANSMISSION\_COUNTER* = 2 × [*preambleTransMax-Msg1-Repetition*] + 1:

5> if set of Random Access resources configured with the same *prach-ConfigurationIndex* and associated with a higher Msg1 repetition number with the same feature or feature combination as the current set of Random Access resources is available:

6> select the set of Random Access resources associated with the next higher Msg1 repetition number with the same feature or feature combination for this Random Access procedure;

6> initialize *startPreambleForThisPartition*, *numberOfPreamblesPerSSB-ForThisPartition*, *numberOfRA-PreamblesGroupA* and *msg1-RepetitionTimeOffsetROGroup* parameters for the Random Access procedure according to the values configured by RRC for the selected set of Random Access resources.

3> select a random backoff time according to a uniform distribution between 0 and the *PREAMBLE\_BACKOFF*;

3> if the criteria (as defined in clause 5.1.2) to select contention-free Random Access Resources is met during the backoff time:

4> perform the Random Access Resource selection procedure (see clause 5.1.2).

3> else if the Random Access procedure for an SCell is performed on uplink carrier where *pusch-Config* is not configured:

4> delay the subsequent Random Access transmission until the Random Access Procedure is triggered by a PDCCH order with the same *ra-PreambleIndex*, *ra-ssb-OccasionMaskIndex*, and UL/SUL indicator TS 38.212 [9].

3> else:

4> perform the Random Access Resource selection procedure (see clause 5.1.2) after the backoff time.

The MAC entity may stop *ra-ResponseWindow* (and hence monitoring for Random Access Response(s)) after successful reception of a Random Access Response containing Random Access Preamble identifiers that matches the transmitted *PREAMBLE\_INDEX*.

HARQ operation is not applicable to the Random Access Response reception.

NOTE 2: For the case that RAR PDSCH bandwidth is larger than the bandwidth the eRedCap UE can receive or process per slot, and the UL grant in RAR indicates that the time is not enough for Msg3 transmission, as specified in TS 38.213 [6], it is up to UE implementation, e.g. either to consider the Random Access Response reception not successful, or transmit Msg3.

**--------------------------------------------------[Next change]----------------------------------------------------**

### 5.1.5 Contention Resolution

Once Msg3 is transmitted the MAC entity shall:

1> if the Msg3 transmission (i.e. initial transmission or HARQ retransmission) is scheduled with PUSCH repetition Type A:

2> if Msg3 is transmitted on a non-terrestrial network:

3> start or restart the ra-ContentionResolutionTimer in the first symbol after the end of all repetitions of the Msg3 transmission plus the UE-gNB RTT.

2> else:

3> start or restart the *ra-ContentionResolutionTimer* in the first symbol after the end of all repetitions of the Msg3 transmission.

1> else if Msg3 transmission (i.e. initial transmission or HARQ retransmission) is transmitted on a non-terrestrial network:

2> start or restart the ra-ContentionResolutionTimer in the first symbol after the end of the Msg3 transmission plus the UE-gNB RTT.

1> else:

2> start or restart the *ra-ContentionResolutionTimer* in the first symbol after the end of the Msg3 transmission.

1> monitor the PDCCH while the *ra-ContentionResolutionTimer* is running regardless of the possible occurrence of a measurement gap;

1> if notification of a reception of a PDCCH transmission of the SpCell is received from lower layers:

2> if the C-RNTI MAC CE was included in Msg3:

3> if the Random Access procedure was initiated for SpCell beam failure recovery or for beam failure recovery of both BFD-RS sets of SpCell (as specified in clause 5.17) and the PDCCH transmission is addressed to the C-RNTI; or

3> if the Random Access procedure was initiated by a PDCCH order and the PDCCH transmission is addressed to the C-RNTI; or

3> if the Random Access procedure was initiated for SDT beam failure recovery (as specified in clause 5.27.1) and the PDCCH transmission is addressed to the C-RNTI; or

3> if the Random Access procedure was initiated by the MAC sublayer itself or by the RRC sublayer and the PDCCH transmission is addressed to the C-RNTI and contains a UL grant for a new transmission:

4> consider this Contention Resolution successful;

4> stop *ra-ContentionResolutionTimer*;

4> discard the *TEMPORARY\_C-RNTI*;

4> consider this Random Access procedure successfully completed.

2> else if the CCCH SDU was included in Msg3 and the PDCCH transmission is addressed to its *TEMPORARY\_C-RNTI*:

3> if the MAC PDU is successfully decoded:

4> stop *ra-ContentionResolutionTimer*;

4> if the MAC PDU contains a UE Contention Resolution Identity MAC CE; and

4> if the UE Contention Resolution Identity in the MAC CE matches the CCCH SDU transmitted in Msg3:

5> consider this Contention Resolution successful and finish the disassembly and demultiplexing of the MAC PDU;

5> if this Random Access procedure was initiated for SI request:

6> indicate the reception of an acknowledgement for SI request to upper layers.

5> else:

6> set the C-RNTI to the value of the *TEMPORARY\_C-RNTI*;

5> discard the *TEMPORARY\_C-RNTI*;

5> consider this Random Access procedure successfully completed.

4> else:

5> discard the *TEMPORARY\_C-RNTI*;

5> consider this Contention Resolution not successful and discard the successfully decoded MAC PDU.

3> else, for eRedCap UE, if lower layer detects that PDSCH transmission scheduled by PDCCH has a larger bandwidth than UE can receive or process per slot:

4> stop *ra-ContentionResolutionTimer*;

4> discard the *TEMPORARY\_C-RNTI*;

4> consider this Contention Resolution not successful.

1> if *ra-ContentionResolutionTimer* expires:

2> if Msg3 transmission was transmitted on a non-terrestrial network:

3> if no PDCCH addressed to TC-RNTI indicating uplink grant for a Msg3 retransmission is received after the start of the *ra-ContentionResolutionTimer*:

4> discard the *TEMPORARY\_C-RNTI*;

4> consider the Contention Resolution not successful.

2> else:

3> discard the *TEMPORARY\_C-RNTI*;

3> consider the Contention Resolution not successful.

1> if the Contention Resolution is considered not successful:

2> flush the HARQ buffer used for transmission of the MAC PDU in the Msg3 buffer;

2> increment *PREAMBLE\_TRANSMISSION\_COUNTER* by 1;

2> if *PREAMBLE\_TRANSMISSION\_COUNTER* = *preambleTransMax* + 1:

3> indicate a Random Access problem to upper layers.

3> if this Random Access procedure was triggered for SI request:

4> consider the Random Access procedure unsuccessfully completed.

2> if the Random Access procedure is not completed:

3> if the *RA\_TYPE* is set to *4-stepRA*:

4> if *preambleTransMaxRO-Type* is applied, and *PREAMBLE\_TRANSMISSION\_COUNTER* = *preambleTransMaxRO-Type* + 1:

5> if *RO\_TYPE* is set to *SBFD-RO*:

6> set the *RO\_TYPE* to *non-SBFD-RO*.

5> else if *RO\_TYPE* is set to *non*-*SBFD-RO*:

6> set the *RO\_TYPE* to *SBFD-RO*.

Editor’s Note: FFS whether RA resource set reselection can be performed or not, after the RO type switching, given that the applicable Msg1 repetition number(s) may become different.

Editor’s Note: Whether Msg1 repetition number fallback can be supported with SBFD RO or not.

Editor’s Note: FFS the order of RO type fallback and Msg1 repetition number fallback if both are supported.

4> if the Random Access Preamble is transmitted with repetitions and contention-free Random Access Resources have not been provided for this Random Access procedure:

5> if *PREAMBLE\_TRANSMISSION\_COUNTER* = [*preambleTransMax-Msg1-Repetition*] + 1; or

5> if *PREAMBLE\_TRANSMISSION\_COUNTER* = 2 × [*preambleTransMax-Msg1-Repetition*] + 1:

6> if set of Random Access resources configured with the same *prach-ConfigurationIndex* and associated with a higher Msg1 repetition number with the same feature or feature combination as the current set of Random Access resources is available:

7> select the set of Random Access resources associated with the next higher Msg1 repetition number with the same feature or feature combination for this Random Access procedure;

7> initialize *startPreambleForThisPartition*, *numberOfPreamblesPerSSB-ForThisPartition*, *numberOfRA-PreamblesGroupA* and *msg1-RepetitionTimeOffsetROGroup* parameters for the Random Access procedure according to the values configured by RRC for the selected set of Random Access resources.

4> select a random backoff time according to a uniform distribution between 0 and the *PREAMBLE\_BACKOFF*;

4> if the criteria (as defined in clause 5.1.2) to select contention-free Random Access Resources is met during the backoff time:

5> perform the Random Access Resource selection procedure (see clause 5.1.2);

4> else:

5> perform the Random Access Resource selection procedure (see clause 5.1.2) after the backoff time.

3> else (i.e. the *RA\_TYPE* is set to *2-stepRA*):

4> if *msgA-TransMax* is applied (see clause 5.1.1a) and *PREAMBLE\_TRANSMISSION\_COUNTER* = *msgA-TransMax* + 1:

5> set the *RA\_TYPE* to *4-stepRA*;

5> perform initialization of variables specific to Random Access type as specified in clause 5.1.1a;

5> flush HARQ buffer used for the transmission of MAC PDU in the MSGA buffer;

5> discard explicitly signalled contention-free 2-step RA type Random Access Resources, if any;

5> perform the Random Access Resource selection as specified in clause 5.1.2.

4> else:

5> select a random backoff time according to a uniform distribution between 0 and the *PREAMBLE\_BACKOFF*;

5> if the criteria (as defined in clause 5.1.2a) to select contention-free Random Access Resources is met during the backoff time:

6> perform the Random Access Resource selection procedure for 2-step RA type as specified in clause 5.1.2a.

5> else:

6> perform the Random Access Resource selection for 2-step RA type procedure (see clause 5.1.2a) after the backoff time.

**--------------------------------------------------[Next change]----------------------------------------------------**

## 5.18 Handling of MAC CEs

### 5.18.1 General

This clause specifies the requirements upon reception or transmission 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;

- Enhanced 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 MAC CE;

- Differential Koffset MAC CE;

- Case-7 Timing advance offset MAC CE;

- DL TX Power Adjustment MAC CEs;

- Child IAB-DU Restricted Beam Indication MAC CE;

- Timing Case Indication MAC CE;

- PSI-Based SDU Discard Activation/Deactivation MAC CE;

- BFD-RS Indication MAC CE;

- IAB-MT Recommended Beam Indication MAC CE;

- UL PSD range adjustment for IAB MAC CE;

- Case-6 Timing Request MAC CE;

- NCR Backhaul Link Beam Indication MAC CEs;

- NCR Access Link Beam Indication MAC CE;

- Enhanced Unified TCI States Activation/Deactivation MAC CE;

- LTM Cell Switch Command MAC CE;

- Candidate Cell TCI States Activation/Deactivation MAC CE;

- Aggregated SP Positioning SRS Activation/Deactivation MAC CE;

- SP CLI Measurement Resource Set Activation/Deactivation MAC CE.

**--------------------------------------------------[Next change]----------------------------------------------------**

### 5.18.xx Activation/deactivation of semi-persistent CLI measurement resource set

The network may activate and deactivate the configured semi-persistent CLI measurement resource set of a Serving Cell by sending the SP CLI Resource Set Activation/Deactivation MAC CE described in clause 6.1.3.xx. The configured semi-persistent CLI measurement resource sets are initially deactivated upon (re-)configuration by upper layers and after reconfiguration with sync.

The MAC entity shall:

1> if the MAC entity receives an SP CLI Measurement Resource Set Activation/Deactivation MAC CE on a Serving Cell:

2> indicate to lower layers the information regarding the SP CLI Measurement Resource Set Activation/Deactivation MAC CE.

**--------------------------------------------------[Next change]----------------------------------------------------**

# 6 Protocol Data Units, formats and parameters

## 6.1 Protocol Data Units

(*omitted text*)

### 6.1.3 MAC Control Elements (CEs)

(*omitted text*)

#### 6.1.3.75 LTM Cell Switch Command MAC CE

The LTM Cell Switch Command MAC CE is identified by MAC subheader with eLCID as specified in Table 6.2.1-1b. It has a variable size with following fields (Figure 6.1.3.75-1):

- R: Reserved bit, set to 0;

- Target Configuration ID: This field indicates the index of candidate target configuration to apply for LTM cell switch, corresponding to *ltm-CandidateId* minus 1as specified in TS 38.331 [5]. The length of the field is 3 bits;

- Timing Advance Command: This field indicates whether the TA is valid for the LTM target cell (i.e. the SpCell corresponding to the target configuration indicated by Target Configuration ID field). If the value of this field is set to FFF, this field indicates that no valid timing adjustment is available for the PTAG of the LTM target cell; otherwise, this field indicates the index value *TA* used to control the amount of timing adjustment that the MAC entity has to apply in TS 38.213 [6], and that the UE can skip the Random Access procedure for this LTM cell switch. If *tag-Id-ptr* is configured for the TCI state indicated by the UL TCI state ID field, if present, or by the TCI state ID field otherwise, in the LTM target cell and *tag-Id-ptr* is set to value *n1*, this field indicates the TA for the TAG indicated by the *tag2-Id* of the LTM target cell; otherwise, this field indicates the TA for the TAG indicated by the *tag-id* of the LTM target cell. The length of the field is 12 bits;

- TCI state ID: This field indicates and activates the TCI state for the LTM target cell (i.e. the SpCell of the target configuration indicated by the Target Configuration ID field). The TCI state is identified by *TCI-StateId* in *ltm-DL-OrJointTCI-StateToAddModList* as specified in TS 38.331 [5]. If the value of *unifiedTCI-StateType* in the *ltm-TCI-Info* of the configuration indicated by Target Configuration ID fieldis *joint*, this field is for joint TCI state, otherwise, this field is for downlink TCI state. The length of the field is 7 bits;

- UL TCI state ID: This field indicates and activates the uplink TCI state for the LTM target cell (i.e. the SpCell of the target configuration indicated by the Target Configuration ID field). The UL TCI state is identified by *TCI-UL-StateId* in *ltm-UL-TCI-StateToAddModList* as specified in TS 38.331 [5]. The octet containing this field (i.e. this field and the two reserved bits in the same octet) is included if the value of *unifiedTCI-StateType* in the *ltm-TCI-Info* of the configuration indicated by Target Configuration ID fieldis *separate*. The length of the field is 6 bits;

- C: This field indicates the presence of the contention-free Random Access Resources fields. If the value of this field is set to 1, the following fields are present: Random Access Preamble index field, S/U field, SS/PBCH index field, PRACH Mask index field, Repetition number field and the reserved bits in the same octet. If the value of this field is set to 0, these fields are absent.

- S/U: This field indicates which UL carrier to transmit the PRACH of the contention-free Random Access Resources. If the value of this field is set to 1, SUL is used; otherwise, NUL is used. The length of the field is 1 bit;

- Random Access Preamble index: This field indicates the Random Access Preamble index of the contention-free Random Access Resources. This field should not be set to 0b000000. The length of the field is 6 bits;

- SS/PBCH index: This field indicates the SS/PBCH that shall be used to determine the RACH occasion for the PRACH transmission of the contention-free Random Access Resources. The length of the field is 6 bits;

- PRACH Mask index: This field indicates the RACH occasion(s) associated with the SS/PBCH indicated by 'SS/PBCH index' for the PRACH transmission of the contention-free Random Access Resources. It indicates a subset of RACH occasion(s) from the *rach-ConfigDedicated* for the UL carrier (indicated by S/U field), (if provided, otherwise it indicates a subset of RACH occasion(s) from the *rach-ConfigCommon* for the UL carrier (indicated by S/U field) in the UL BWP configuration of *firstActiveUplinkBWP-Id* as specified in TS 38.331 [5]. When the repetition number field is not set to 0, the UE ignores this field. The length of the field is 4 bits;

- Repetition number: This field indicates the Msg1 repetition number to be applied to the contention-free Random Access. If this field is set to 0, Msg1 repetition number does not apply. If this field is set to 1, the Msg1 repetition number is 2. If this field is set to 2, the Msg1 repetition number is 4. If this field is set to 3, the Msg1 repetition number is 8. The length of the field is 2 bits.

NOTE 1: Void



Figure 6.1.3.75-1: LTM Cell Switch Command MAC CE

NOTE 2: If UE receives the LTM Cell Switch Command MAC CE with a Target Configuration ID value not matching any configured *ltm-CandidateId* minus 1, as specified in TS 38.331 [5], the procedure of handling LTM Cell Switch Command MAC CE in clause 5.18.35 does not apply.

Editor’s Note: Will reflect further agreements, if any, on change for LTM cell switch command MAC CE.

**--------------------------------------------------[Next change]----------------------------------------------------**

#### 6.1.3.xx SP CLI Measurement Resource Set Activation/Deactivation MAC CE

The SP CLI Measurement Resource Set Activation/Deactivation MAC CE is identified by a MAC subheader with eLCID as specified in Table 6.2.1-1b. It has a variable size and consists of the following fields:

- A/D: This field indicates whether to activate or deactivate indicated SP CLI measurement resource set. The field is set to 1 to indicate activation, otherwise it indicates deactivation;

- Serving Cell ID: This field indicates the identity of the Serving Cell for which the MAC CE applies. The length of the field is 5 bits;

- BWP ID: This field indicates a DL BWP for which the MAC CE applies as the codepoint of the DCI *bandwidth part indicator* field as specified in TS 38.212 [9]. The length of the BWP ID field is 2 bits;

- SP CLI measurement resource set ID: This field contains either an index of *SRS-ResourceConfigCLI* containing Semi Persisten SRS-RSRP measurement resources as specified in TS 38.331 [5], indicating the Semi Persistent SRS-RSRP measurement resource set, or an index of *RSSI-ResourceConfigCLI* containing Semi Persistent CLI-RSSI measurement resources as specified in TS 38.331 [5], indicating the CLI-RSSI measurement resource set, which shall be activated or deactivated. The length of the field is [FFS] bits;

Editor’s Note: The field length of 6-bit in the figure is tentative, and only for illustration purpose. It will be aligned with further RAN1 agreement(s).

- TCI State IDi: This field contains *TCI-StateId*, as specified in TS 38.331 [5], of a TCI State, which is used as QCL source for the resource within either the Semi Persistent SRS-RSRP mesurement resource set or the Semi Persistent CLI-RSSI measurement resource set, indicated by SP CLI measurement resource set ID field. TCI State ID0 indicates TCI State for the first resource within the set, TCI State ID1 for the second one and so on. The length of the field is 7 bits. If the A/D field is set to 0, the octets containing TCI State ID field(s) are not present;

- R: Reserved bit, set to 0.



Figure 6.1.3.xx-1: SP CLI Measurement Resource Set Activation/Deactivation MAC CE

Editor’s Note: MAC CE format above is tentative and will be updated to reflect further RAN1/RAN2 agreement(s), if any.

**--------------------------------------------------[Last change]----------------------------------------------------**

6.2 Formats and parameters

6.2.1 MAC subheader for DL-SCH and UL-SCH

(*omitted text*)

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

|  |  |  |
| --- | --- | --- |
| Codepoint | Index | LCID values |
| 0 to 21x | 64 to 27x | Reserved |
| Xxx | xxx | SP CLI Measurement Resource Set Activation/Deactivation |
| 216 | 280 | Aggregated SP Positioning SRS Activation/Deactivation |
| 217 | 281 | Enhanced SP CSI reporting on PUCCH Activation/Deactivation |
| 218 | 282 | Cross-RRH TCI State Indication for UE-specific PDCCH |
| 219 | 283 | LTM Cell Switch Command |
| 220 | 284 | Candidate Cell TCI States Activation/Deactivation |
| 221 | 285 | PSI-Based SDU Discard Activation/Deactivation |
| 222 | 286 | Enhanced Unified TCI states Activation/Deactivation MAC CE for Joint TCI States |
| 223 | 287 | Enhanced Unified TCI states Activation/Deactivation MAC CE for Separate TCI States |
| 224 | 288 | NCR Access Link Beam Indication |
| 225 | 289 | NCR Downlink Backhaul Link Beam Indication |
| 226 | 290 | NCR Uplink Backhaul Link Beam Indication |
| 227 | 291 | Serving Cell Set based SRS TCI State Indication |
| 228 | 292 | SP/AP SRS TCI State Indication |
| 229 | 293 | BFD-RS Indication |
| 230 | 294 | Differential Koffset |
| 231 | 295 | Enhanced SCell Activation/Deactivation (one octet Ci field) |
| 232 | 296 | Enhanced SCell Activation/Deactivation (four octet Ci field) |
| 233 | 297 | Unified TCI States Activation/Deactivation |
| 234 | 298 | PUCCH Power Control Set Update for multiple TRP PUCCH repetition |
| 235 | 299 | PUCCH spatial relation Activation/Deactivation for multiple TRP PUCCH repetition |
| 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 |

(*omitted text*)

# Annex A - Collection of RAN2 agreements

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| --- |
| **RAN2#127:**8.11.2 Random access in SBFD  * Working assumption: Random access procedure in SBFD symbols is supported for all the existing RACH trigger events. * RAN2 assume RACH configuration for SBFD via SIB and/or dedicated RRC signalling is supported. Detailed signalling FFS. * RAN2 to strive for a common SBFD CBRA framework independent of RRC state. * FFS whether/how early indication is used during a SBFD RA procedure. * RAN2 focus on 4-step RACH for SBFD RA, FFS on 2-step if needed.  8.11.3 Other aspects  * Cell-specific SBFD time/frequency configuration is provided by SIB1 (or via dedicated signalling to covey cell specific configuration). FFS on UE specific dedicated RRC configuration if needed, pending on RAN1 progress.  **RAN2#127bis:**8.11.2 Random access in SBFD  * RAN2 understand that if additional RO is selected by SBFD-aware UE, early identification via Msg1 is possible from NW point of view for this UE without specification impact. * From R2 point of view, there is no need to introduce SBFD as a new feature combination in the current PRACH preamble partitioning framework. * Upon initiation of CBRA RACH procedure for a SBFD-aware UE, UE selects one type of ROs between legacy-ROs and additional-ROs based on certain specified/configured conditions/prioritizations, if no additional indication (FFS if there needs to be any) is from network. * For the PRACH transmission re-attempt in one RACH procedure, after certain (configured) number of times of RACH attempt in SBFD RACH occasions, UE is allowed to switch to legacy RACH occasions. FFS about the case when UE select legacy ROs first. * The following two RACH configuration options are considered for SBFD based random access:   + - Option 1: Use one single RACH configuration based on the existing parameters of the single RACH configuration. Can extend the existing parameters if needed.     - Option 2: Use two separate RACH configurations, including one legacy RACH configuration and one additional RACH configuration * For RACH configuration Option 2, RAN2 needs to specify RRC signalling for the new SBFD based RACH configuration with a new set of parameters. * The RACH configuration for SBFD is transmitted via SIB1. * FFS dedicated RRC signalling detail. FFS whether NW can provide both configurations.  8.11.3 Other aspects  * For UL resource muting for PUSCH, the configuration of time and frequency location for UL resource muting should be introduced based on R1 agreement. * For L1 based UE-to-UE CLI measurement mechanism, the configuration of periodic, semi-persistent or aperiodic UE-to-UE CLI measurement resource (set) should be introduced based on R1 agreement. * For L1 based UE-to-UE CLI reporting mechanism, the configuration of report quantities should be introduced based on R1 agreement. |

|  |
| --- |
| **RAN2#128:**8.11.2 Random access in SBFD  * The RO type is indicated by NW for CFRA. FFS on signaling (can FFS for the SI request case if needed). * FFS on the following options   **Option 1**  Upon initiation of RACH procedure for a SBFD-aware UE, network provides the indication on the prioritization of the additional ROs over legacy RO.  **If there is no such indication from the NW, FFS on the following mechanism**   * **UE select legacy RO or SBFD RO based on SSB RSRP, or** * **UE select the legacy RO, or** * **UE select the SBFD RO, or** * **Other metrics than SSB RSRP.**   **Option 2**  **UE select legacy RO or SBFD RO based on SSB RSRP if such condition is configured, and if not configured, then UE can prioritize one type of the ROs, FFS which one.**   * Only one RACH configuration option (i.e., either RACH configuration Option 1 with Alt 1-1 or RACH configuration Option 2) is supported in a cell.  8.11.3 Other aspects  * Prioritization of SBFD cells / frequencies during cell reselection is not considered. * RAN2 wait for input from the other WGs regarding whether for inter-cell CSI-RS measurements, UE needs to be provided with information of the SBFD configuration of neighbouring cells.  **RAN2#129:**8.11.2 Random access in SBFD  * When a SBFD aware UE supporting one or both SBFD RACH configuration options accesses a cell, the UE can apply the supported SBFD RACH configuration option in the cell. * When a SBFD aware UE supporting a SBFD RACH configuration option accesses a cell configured with a different SBFD RACH configuration option, the UE applies the legacy RA operation, and does not apply the SBFD RACH configuration. * For initial RA transmission, the network can indicate the RO type (legacy RO or additional RO) to the SBFD-aware UE for the case of CBRA. Detailed signalling is FFS. * If no RO type indication is provided by the NW, a UE selects RO type based on a SSB RSRP threshold. FFS whether NW can further indicate whether to select the additional RO type below or above this SSB RSRP threshold. * FFS whether RO type selection is performed before or after the RA type selection. * FFS if switching from the PRACH resources in non-SBFD symbols to the PRACH resources in SBFD symbols is supported.  8.11.3 Other aspects  * A new SP CLI measurement resource set activation/deactivation MAC CE is introduced to activate/deactivate the SP CLI measurement resource.  **RAN2#129bis:**8.11.2 Random access in SBFD  * On RO type signaling for CFRA   1. For CFRA triggered by BFR, the RO type is indicated in BeamFailureRecoveryConfig.  2. For CFRA triggered by ReconfigurationwithSync, the RO type is indicated in RACH-ConfigDedicated.   * When both NW indication on RO type and RSRP threshold are absent, it is up to UE implementation to select the RO type. * Random access procedure in SBFD symbols is supported for all the existing RACH trigger events except for SI request. FFS for LTM. * NW indicate via explicit signaling whether the SBFD RO is selected when SSB RSRP are 'below' or 'above' the configured threshold. * Working assumption: For SBFD-aware UE, the selection of RO type is suggested to be performed before the selection of the set of Random Access resources. * RO-Type change procedure on RO type selection from legacy RO to additional RO in SBFD symbols is supported when the number of PRACH transmission attempts exceed a threshold (we assume it is the same threshold with the fallback from additional RO to legacy RO). If fallback from legacy RO to additional RO occurs, no further fallback to legacy RO is supported.  8.11.3 Other aspects  * Send an LS to RAN1 (CC RAN3 and RAN4) on whether SBFD and DC can be configured simultaneously, and whether there is any issue for such configuration. * Working assumption: The configured SP CLI measurement resource sets are initially deactivated upon (re-) configuration by upper layers and after reconfiguration with sync. * SP CLI measurement resource set activation/deactivation MAC CE includes following fields: A/D, Serving Cell ID, BWP ID, CLI measurement resource set ID (for CLI-RSSI or SRS-RSRP measurement), TCI State IDs. |