**3GPP TSG-RAN WG2 Meeting #117-e R2-220xxxx**

**Electronic, 21st Feb. – 3rd Mar. 2022**

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| *CR-Form-v12.2* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **38.321** | **CR** | **1186** | **rev** | **1** | **Current version:** | **16.7.0** |  |
|  | | | | | | | | |
| *For* [***HELP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* | | | | | | | | |
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| ***Proposed change affects:*** | UICC apps |  | ME | **X** | Radio Access Network | **X** | Core Network |  |

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| ***Title:*** | Introduction of RedCap in TS 38.321 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | vivo (Rapporteur) | | | | | | | | | |
| ***Source to TSG:*** | R2 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_redcap-Core | | | | |  | ***Date:*** | | | 2022-03-06 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **B** |  | | | | | ***Release:*** | | | Rel-17 |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) … Rel-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18) Rel-19 (Release 19)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | To capture agreements for RedCap into MAC specification. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | Introduction of RedCap.  This CR captures the MAC aspects of RedCap and it is based on RAN2 and RAN1 agreements made so far, which could be found in Annex at the end of this document. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | RedCap is not supported in MAC specification TS 38.321. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 3.1, 3.2, 5.1, 5.15, 6.2 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | | **X** |  | Other core specifications | | | | TS/TR 38.331 CR TBD  TS/TR 38.306 CR TBD  TS/TR 38.304 CR TBD  TS/TR 38.300 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:*** | | This is the updated version of running CR for TS 38.321 for RedCap WI considering conclusions from RAN2#117-e. | | | | | | | | |

Start of change

# 2 References

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

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

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

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

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

[2] 3GPP TS 38.300: "NR; Overall description; Stage 2".

[3] 3GPP TS 38.322: "NR; Radio Link Control (RLC) protocol specification".

[4] 3GPP TS 38.323: "NR; Packet Data Convergence Protocol (PDCP) protocol specification".

[5] 3GPP TS 38.331: "NR; Radio Resource Control (RRC); Protocol specification".

[6] 3GPP TS 38.213: "NR; Physical Layer Procedures for control".

[7] 3GPP TS 38.214: "NR; Physical Layer Procedures for data".

[8] 3GPP TS 38.211: "NR; Physical channels and modulation".

[9] 3GPP TS 38.212: "NR; Multiplexing and channel coding".

[10] Void.

[11] 3GPP TS 38.133: "NR; Requirements for support of radio resource management".

[12] 3GPP TS 36.133: "Evolved Universal Terrestrial Radio Access (E-UTRA); Requirements for support of radio resource management".

[13] 3GPP TS 26.114: "Technical Specification Group Services and System Aspects; IP Multimedia Subsystem (IMS); Multimedia Telephony; Media handling and interaction".

[14] 3GPP TS 38.101-1: "NR; User Equipment (UE) radio transmission and reception; Part 1: Range 1 Standalone".

[15] 3GPP TS 38.101-2: "NR; User Equipment (UE) radio transmission and reception; Part 2: Range 2 Standalone".

[16] 3GPP TS 38.101-3: "NR; User Equipment (UE) radio transmission and reception; Part 3: Range 1 and Range 2 Interworking operation with other radios".

[17] 3GPP TS 36.213: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Layer Procedures".

[18] 3GPP TS 37.213: "Physical layer procedures for shared spectrum channel access".

[19] 3GPP TS 23.287: "Architecture enhancements for 5G System (5GS) to support Vehicle-to-Everything (V2X) services ".

[20] 3GPP TS 23.285: "Architecture enhancements for V2X services".

[21] 3GPP TS 36.331: "Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification".

[22] 3GPP TS 36.321: "Evolved Universal Terrestrial Radio Access (E-UTRA); Medium Access Control (MAC); Protocol specification".

[23] 3GPP TS 37.355: "Evolved Universal Terrestrial Radio Access (E-UTRA); LTE Positioning Protocol (LPP)".

[24] 3GPP TS 38.215: "NR; Physical layer measurements".

[x] 3GPP TS 38.306: "NR; User Equipment (UE) radio access capabilities".

# 3 Definitions, symbols and abbreviations

## 3.1 Definitions

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

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

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

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

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

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

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

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

**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], between two or more nearby UEs, using NR technology but not traversing any network node.

**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.

**RedCap UE:** A UE with reduced capabilities as specified in sub-clause 4.2.x.x.1 in TS 38.306 [x].

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

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

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

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

**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: 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.

## 3.2 Abbreviations

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

AP Aperiodic

BFR Beam Failure Recovery

BSR Buffer Status Report

BWP Bandwidth Part

CE Control Element

CG Cell Group

CI-RNTI Cancellation Indication RNTI

CSI Channel State Information

CSI-IM CSI Interference Measurement

CSI-RS CSI Reference Signal

CS-RNTI Configured Scheduling RNTI

DAPS Dual Active Protocol Stack

DCP DCI with CRC scrambled by PS-RNTI

DL-PRS DownLink-Positioning Reference Signal

IAB Integrated Access and Backhaul

INT-RNTI Interruption RNTI

LBT Listen Before Talk

LCG Logical Channel Group

LCP Logical Channel Prioritization

MCG Master Cell Group

MPE Maximum Permissible Exposure

NUL Normal Uplink

NZP CSI-RS Non-Zero Power CSI-RS

PDB Packet Delay Budget

PHR Power Headroom Report

PS-RNTI Power Saving RNTI

PTAG Primary Timing Advance Group

QCL Quasi-colocation

RS Reference Signal

SCG Secondary Cell Group

SFI-RNTI Slot Format Indication RNTI

SI System Information

SL-RNTI Sidelink RNTI

SLCS-RNTI Sidelink Configured Scheduling RNTI

SpCell Special Cell

SP Semi-Persistent

SP-CSI-RNTI Semi-Persistent CSI RNTI

SPS Semi-Persistent Scheduling

SR Scheduling Request

SS Synchronization Signals

SSB Synchronization Signal Block

STAG Secondary Timing Advance Group

SUL Supplementary Uplink

TAG Timing Advance Group

TCI Transmission Configuration Indicator

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

UCI Uplink Control Information

V2X Vehicle-to-Everything

ZP CSI-RS Zero Power CSI-RS

Next change

# 5 MAC procedures

## 5.1 Random Access procedure

Editor’s NOTE: Msg.1 based early identification captured in 5.1.1 and 5.1.1a part will be handled together with other features (e.g. coverage, slicing, SDT, etc.) in common MAC running CR for RACH indication and partitioning.

### 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 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.

RRC configures the following parameters for the Random Access procedure:

- *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;

- *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;

- *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);

- *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;

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

- *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;

- *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*.

When the Random Access procedure is initiated on a Serving Cell, the MAC entity shall:

1> flush the Msg3 buffer;

1> flush the MSGA buffer;

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

1> 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.

1> perform the BWP operation as specified in clause 5.15;

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 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:

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 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 (i.e. no 4-step RACH RA type resources configured); or

1> if the Random Access procedure was initiated for reconfiguration with sync 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 handover; 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 handover; 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 *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*.

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 handover; 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 *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*).

### 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 the 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 the 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

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> determine the next available PRACH occasion from the PRACH occasions corresponding to the selected SSB permitted by the restrictions given by the *ra-ssb-OccasionMaskIndex* if configured or indicated by PDCCH (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; the MAC entity may take into account the possible occurrence of measurement gaps when determining the next available PRACH occasion 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, 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 according to clause 8.1 of TS 38.213 [6], 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 when determining the next available PRACH occasion 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 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 occurring simultaneously but on different subcarriers, corresponding to the selected CSI-RS; the MAC entity may take into account the possible occurrence of measurement gaps when determining the next available PRACH occasion corresponding to the selected CSI-RS).

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 X1: If a 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*.

Editor’s NOTE: Postpone the discussion on whether and how to capture the agreement: *From RAN2 perspective, if a RedCap UE in idle/inactive mode is configured with a separate initial BWP associated with no SSB (CD or NCD) for RACH, it is up to UE implementation to perform new RSRP measurement in a DL BWP associated with CD-SSB before Msg1/A retransmission.*

### 5.1.2a Random Access Resource selection for 2-step RA type

If the selected *RA\_TYPE* is set to *2-stepRA*, the MAC entity shall:

1> if the contention-free 2-step RA type Resources associated with SSBs have been explicitly provided in *rach-ConfigDedicated* and at least one SSB with SS-RSRP above *msgA-RSRP-ThresholdSSB* amongst the associated SSBs is available:

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

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

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

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

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

2> else:

3> select any SSB.

2> if contention-free Random Access Resources for 2-step RA type have not been configured and if Random Access Preambles group has not yet been selected during the current Random Access procedure:

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

4> if the potential MSGA payload size (UL data available for transmission plus MAC subheader and, where required, MAC CEs) is greater than the *ra-MsgA-SizeGroupA* and the pathloss is less than *PCMAX* (of the Serving Cell performing the Random Access Procedure) – *msgA-PreambleReceivedTargetPower* – *msgA-DeltaPreamble* – *messagePowerOffsetGroupB*; or

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-MsgA-SizeGroupA*:

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 if contention-free Random Access Resources for 2-step RA type have been configured and if Random Access Preambles group has not yet been selected during the current Random Access procedure:

3> if Random Access Preambles group B for 2-step RA type is configured; and

3> 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:

4> select the Random Access Preambles group B.

3> else:

4> select the Random Access Preambles group A.

2> else (i.e. Random Access preambles group has been selected during the current Random Access procedure):

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

2> select a Random Access Preamble randomly with equal probability from the 2-step RA type 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> determine the next available PRACH occasion from the PRACH occasions corresponding to the selected SSB permitted by the restrictions given by the *msgA-SSB-SharedRO-MaskIndex* if configured and *ra-ssb-OccasionMaskIndex* if configured (the MAC entity shall select a PRACH occasion randomly with equal probability among the consecutive PRACH occasions allocated for 2-step RA type according to clause 8.1 of TS 38.213 [6], corresponding to the selected SSB; the MAC entity may take into account the possible occurrence of measurement gaps when determining the next available PRACH occasion corresponding to the selected SSB);

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

2> select a PUSCH occasion from the PUSCH occasions configured in *msgA-CFRA-PUSCH* corresponding to the PRACH slot of the selected PRACH occasion, according to *msgA-PUSCH-resource-Index* corresponding to the selected SSB;

2> determine the UL grant and the associated HARQ information for the MSGA payload in the selected PUSCH occasion;

2> deliver the UL grant and the associated HARQ information to the HARQ entity.

1> else:

2> select a PUSCH occasion corresponding to the selected preamble and PRACH occasion according to clause 8.1A of TS 38.213 [6];

2> determine the UL grant for the MSGA payload according to the PUSCH configuration associated with the selected Random Access Preambles group and determine the associated HARQ information;

2> if the selected preamble and PRACH occasion is mapped to a valid PUSCH occasion as specified in clause 8.1A of TS 38.213 [6]:

3> deliver the UL grant and the associated HARQ information to the HARQ entity.

1> perform the MSGA transmission procedure (see clause 5.1.3a).

NOTE: To determine if there is an SSB with *SS-RSRP* above *msgA-RSRP-ThresholdSSB*, the UE uses the latest unfiltered *L1-RSRP* measurement.

NOTE X2: If a 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*.

### 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:

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*;

1> except for contention-free Random Access Preamble for beam failure recovery request, 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 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, 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], 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).

### 5.1.3a MSGA transmission

The MAC entity shall, for each MSGA:

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 MSGA Random Access Preamble transmission; and

1> if SSB selected is not changed from the selection in 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 *msgA-PreambleReceivedTargetPower* + *DELTA\_PREAMBLE* + (*PREAMBLE\_POWER\_RAMPING\_COUNTER* – 1) × *PREAMBLE\_POWER\_RAMPING\_STEP*;

1> if this is the first MSGA transmission within this Random Access procedure:

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

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

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

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

2> obtain the MAC PDU to transmit from the Multiplexing and assembly entity according to the HARQ information determined for the MSGA payload (see clause 5.1.2a) and store it in the MSGA buffer.

1> compute the MSGB-RNTI associated with the PRACH occasion in which the Random Access Preamble is transmitted;

1> instruct the physical layer to transmit the MSGA using the selected PRACH occasion and the associated PUSCH resource of MSGA (if the selected preamble and PRACH occasion is mapped to a valid PUSCH occasion), using the corresponding RA-RNTI, MSGB-RNTI, *PREAMBLE\_INDEX*, *PREAMBLE\_RECEIVED\_TARGET\_POWER*, *msgA-PreambleReceivedTargetPower*, and the amount of power ramping applied to the latest MSGA preamble transmission (i.e. (*PREAMBLE\_POWER\_RAMPING\_COUNTER* – 1) × *PREAMBLE\_POWER\_RAMPING\_STEP*);

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

2> instruct the physical layer to cancel the transmission of the MSGA payload on the associated PUSCH resource;

2> if *lbt-FailureRecoveryConfig* is configured:

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

2> else:

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

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

4> indicate a Random Access problem to upper layers;

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

5> consider this Random Access procedure unsuccessfully completed.

3> if the Random Access procedure is not completed:

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> if the Msg3 buffer is empty:

6> obtain the MAC PDU to transmit from the MSGA buffer and store it in the Msg3 buffer;

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 procedure as specified in clause 5.1.2.

4> else:

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

NOTE: The MSGA transmission includes the transmission of the PRACH Preamble as well as the contents of the MSGA buffer in the PUSCH resource corresponding to the selected PRACH occasion and *PREAMBLE\_INDEX* (see TS 38.213 [6])

The MSGB-RNTI associated with the PRACH occasion in which the Random Access Preamble is transmitted, is computed as:

MSGB-RNTI = 1 + s\_id + 14 × t\_id + 14 × 80 × f\_id + 14 × 80 × 8 × ul\_carrier\_id + 14 × 80 × 8 × 2

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], 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). The RA-RNTI is calculated as specified in clause 5.1.3.

### 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> 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> 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*);

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

NOTE: 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> 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.

### 5.1.4a MSGB reception and contention resolution for 2-step RA type

Once the MSGA preamble is transmitted, regardless of the possible occurrence of a measurement gap, the MAC entity shall:

1> start the *msgB-ResponseWindow* at the PDCCH occasion as specified in TS 38.213 [6], clause 8.2A;

1> monitor the PDCCH of the SpCell for a Random Access Response identified by MSGB-RNTI while the *msgB-ResponseWindow* is running;

1> if C-RNTI MAC CE was included in the MSGA:

2> monitor the PDCCH of the SpCell for Random Access Response identified by the C-RNTI while the *msgB-ResponseWindow* is running.

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 MSGA:

3> if the Random Access procedure was initiated for SpCell beam failure recovery (as specified in clause 5.17) and the PDCCH transmission is addressed to the C-RNTI:

4> consider this Random Access Response reception successful;

4> stop the *msgB-ResponseWindow*;

4> consider this Random Access procedure successfully completed.

3> else if the *timeAlignmentTimer* associated with the PTAG is running:

4> if the PDCCH transmission is addressed to the C-RNTI and contains a UL grant for a new transmission:

5> consider this Random Access Response reception successful;

5> stop the *msgB-ResponseWindow*;

5> consider this Random Access procedure successfully completed.

3> else:

4> if a downlink assignment has been received on the PDCCH for the C-RNTI and the received TB is successfully decoded:

5> if the MAC PDU contains the Absolute Timing Advance Command MAC CE:

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

6> consider this Random Access Response reception successful;

6> stop the *msgB-ResponseWindow*;

6> consider this Random Access procedure successfully completed and finish the disassembly and demultiplexing of the MAC PDU.

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

3> if the MSGB contains a MAC subPDU with Backoff Indicator:

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

3> else:

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

3> if the MSGB contains a fallbackRAR MAC subPDU; and

3> if the Random Access Preamble identifier in the MAC subPDU matches the transmitted *PREAMBLE\_INDEX* (see clause 5.1.3a):

4> consider this Random Access Response reception successful;

4> apply the following actions for the SpCell:

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

5> indicate the *msgA-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*);

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

6> consider the Random Access procedure successfully completed;

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

5> else:

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

6> if the Msg3 buffer is empty:

7> obtain the MAC PDU to transmit from the MSGA buffer and store it in the Msg3 buffer;

6> process the received UL grant value and indicate it to the lower layers and proceed with Msg3 transmission.

NOTE: If within a 2-step RA type procedure, an uplink grant provided in the fallback RAR has a different size than the MSGA payload, the UE behavior is not defined.

3> else if the MSGB contains a successRAR MAC subPDU; and

3> if the CCCH SDU was included in the MSGA and the UE Contention Resolution Identity in the MAC subPDU matches the CCCH SDU:

4> stop *msgB-ResponseWindow*;

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

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

4> else:

5> set the C-RNTI to the value received in the *successRAR*;

5> apply the following actions for the SpCell:

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

6> indicate the *msgA-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*).

4> deliver the *TPC*, *PUCCH resource Indicator*, *ChannelAccess-CPext* (if indicated), and *HARQ feedback Timing Indicator* received in successRAR to lower layers.

4> consider this Random Access Response reception successful;

4> consider this Random Access procedure successfully completed;

4> finish the disassembly and demultiplexing of the MAC PDU.

1> if *msgB-ResponseWindow* expires, and the Random Access Response Reception has not been considered as successful based on descriptions above:

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

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

3> indicate a Random Access problem to upper layers;

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

4> consider this Random Access procedure unsuccessfully completed.

2> if the Random Access procedure is not completed:

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

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

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

4> if the Msg3 buffer is empty:

5> obtain the MAC PDU to transmit from the MSGA buffer and store it in the Msg3 buffer;

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

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

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

3> else:

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 5.1.2a) to select contention-free Random Access Resources is met during the backoff time:

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

4> else:

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

Upon receiving a fallbackRAR, the MAC entity may stop *msgB-ResponseWindow* once the Random Access Response reception is considered as successful.

### 5.1.5 Contention Resolution

Once Msg3 is transmitted the MAC entity shall:

1> start the *ra-ContentionResolutionTimer* and restart the *ra-ContentionResolutionTimer* at each HARQ retransmission 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 (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 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.

1> if *ra-ContentionResolutionTimer* expires:

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

2> 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> 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.

### 5.1.6 Completion of the Random Access procedure

Upon completion of the Random Access procedure, the MAC entity shall:

1> discard any explicitly signalled contention-free Random Access Resources for 2-step RA type and 4-step RA type except the 4-step RA type contention-free Random Access Resources for beam failure recovery request, if any;

1> flush the HARQ buffer used for transmission of the MAC PDU in the Msg3 buffer and the MSGA buffer.

Upon successful completion of the Random Access procedure initiated for DAPS handover, the target MAC entity shall:

1> indicate the successful completion of the Random Access procedure to the upper layers.

Next change

## 5.15 Bandwidth Part (BWP) operation

### 5.15.1 Downlink and Uplink

In addition to clause 12 of TS 38.213 [6], this clause specifies requirements on BWP operation.

A Serving Cell may be configured with one or multiple BWPs, and the maximum number of BWP per Serving Cell is specified in TS 38.213 [6].

The BWP switching for a Serving Cell is used to activate an inactive BWP and deactivate an active BWP at a time. The BWP switching is controlled by the PDCCH indicating a downlink assignment or an uplink grant, by the *bwp-InactivityTimer*, by RRC signalling, or by the MAC entity itself upon initiation of Random Access procedure or upon detection of consistent LBT failure on SpCell. Upon RRC (re-)configuration of *firstActiveDownlinkBWP-Id* and/or *firstActiveUplinkBWP-Id* for SpCell or activation of an SCell, the DL BWP and/or UL BWP indicated by *firstActiveDownlinkBWP-Id* and/or *firstActiveUplinkBWP-Id* respectively (as specified in TS 38.331 [5]) is active without receiving PDCCH indicating a downlink assignment or an uplink grant. The active BWP for a Serving Cell is indicated by either RRC or PDCCH (as specified in TS 38.213 [6]). For unpaired spectrum, a DL BWP is paired with a UL BWP, and BWP switching is common for both UL and DL.

For each SCell a dormant BWP may be configured with *dormantBWP-Id* by RRC signalling as described in TS 38.331 [5]. Entering or leaving dormant BWP for SCells is done by BWP switching per SCell or per dormancy SCell group based on instruction from PDCCH (as specified in TS 38.213 [6]). The dormancy SCell group configurations are configured by RRC signalling as described in TS 38.331 [5]. Upon reception of the PDCCH indicating leaving dormant BWP, the DL BWP indicated by *firstOutsideActiveTimeBWP-Id* or by *firstWithinActiveTimeBWP-Id* (as specified in TS 38.331 [5] and TS 38.213 [6]) is activated. Upon reception of the PDCCH indicating entering dormant BWP, the DL BWP indicated by *dormantBWP-Id* (as specified in TS 38.331 [5]) is activated. The dormant BWP configuration for SpCell or PUCCH SCell is not supported.

For each activated Serving Cell configured with a BWP, the MAC entity shall:

1> if a BWP is activated and the active DL BWP for the Serving Cell is not the dormant BWP:

2> transmit on UL-SCH on the BWP;

2> transmit on RACH on the BWP, if PRACH occasions are configured;

2> monitor the PDCCH on the BWP;

2> transmit PUCCH on the BWP, if configured;

2> report CSI for the BWP;

2> transmit SRS on the BWP, if configured;

2> receive DL-SCH on the BWP;

2> (re-)initialize any suspended configured uplink grants of configured grant Type 1 on the active BWP according to the stored configuration, if any, and to start in the symbol according to rules in clause 5.8.2;

2> if *lbt-FailureRecoveryConfig* is configured:

3> stop the *lbt-FailureDetectionTimer*, if running;

3> set *LBT\_COUNTER* to 0;

3> monitor LBT failure indications from lower layers as specified in clause 5.21.2.

1> if a BWP is activated and the active DL BWP for the Serving Cell is dormant BWP:

2> stop the *bwp-InactivityTimer* of this Serving Cell, if running.

2> not monitor the PDCCH on the BWP;

2> not monitor the PDCCH for the BWP;

2> not receive DL-SCH on the BWP;

2> not report CSI on the BWP, report CSI except aperiodic CSI for the BWP;

2> not transmit SRS on the BWP;

2> not transmit on UL-SCH on the BWP;

2> not transmit on RACH on the BWP;

2> not transmit PUCCH on the BWP;

2> clear any configured downlink assignment and any configured uplink grant Type 2 associated with the SCell respectively;

2> suspend any configured uplink grant Type 1 associated with the SCell;

2> if configured, perform beam failure detection and beam failure recovery for the SCell if beam failure is detected.

1> if a BWP is deactivated:

2> not transmit on UL-SCH on the BWP;

2> not transmit on RACH on the BWP;

2> not monitor the PDCCH on the BWP;

2> not transmit PUCCH on the BWP;

2> not report CSI for the BWP;

2> not transmit SRS on the BWP;

2> not receive DL-SCH on the BWP;

2> clear any configured downlink assignment and configured uplink grant of configured grant Type 2 on the BWP;

2> suspend any configured uplink grant of configured grant Type 1 on the inactive BWP.

Upon initiation of the Random Access procedure on a Serving Cell, after the selection of carrier for performing Random Access procedure as specified in clause 5.1.1, the MAC entity shall for the selected carrier of this Serving Cell:

1> if PRACH occasions are not configured for the active UL BWP:

2> if UE is a RedCap UE; and

2> if *initialUplinkBWP-RedCap* is configured:

3> switch the active UL BWP to BWP configured by *initialUplinkBWP-RedCap*.

2> else:

3> switch the active UL BWP to BWP indicated by *initialUplinkBWP*;

2> if the Serving Cell is an SpCell:

3> if the UE is a RedCap UE; and

3> if *initialDownlinkBWP-RedCap* is configured:

4> switch the active DL BWP to BWP configured by *initialDownlinkBWP-RedCap*.

3> else:

3> switch the active DL BWP to BWP indicated by *initialDownlinkBWP*.

1> else:

2> if the Serving Cell is an SpCell:

3> if the active DL BWP does not have the same *bwp-Id* as the active UL BWP:

4> switch the active DL BWP to the DL BWP with the same *bwp-Id* as the active UL BWP.

1> stop the *bwp-InactivityTimer* associated with the active DL BWP of this Serving Cell, if running.

1> if the Serving Cell is SCell:

2> stop the *bwp-InactivityTimer* associated with the active DL BWP of SpCell, if running.

1> perform the Random Access procedure on the active DL BWP of SpCell and active UL BWP of this Serving Cell.

If the MAC entity receives a PDCCH for BWP switching of a Serving Cell, the MAC entity shall:

1> if there is no ongoing Random Access procedure associated with this Serving Cell; or

1> if the ongoing Random Access procedure associated with this Serving Cell is successfully completed upon reception of this PDCCH addressed to C-RNTI (as specified in clauses 5.1.4, 5.1.4a, and 5.1.5):

2> cancel, if any, triggered consistent LBT failure for this Serving Cell;

2> perform BWP switching to a BWP indicated by the PDCCH.

If the MAC entity receives a PDCCH for BWP switching for a Serving Cell(s) or a dormancy SCell group(s) while a Random Access procedure associated with that Serving Cell is ongoing in the MAC entity, it is up to UE implementation whether to switch BWP or ignore the PDCCH for BWP switching, except for the PDCCH reception for BWP switching addressed to the C-RNTI for successful Random Access procedure completion (as specified in clauses 5.1.4, 5.1.4a, and 5.1.5) in which case the UE shall perform BWP switching to a BWP indicated by the PDCCH. Upon reception of the PDCCH for BWP switching other than successful contention resolution, if the MAC entity decides to perform BWP switching, the MAC entity shall stop the ongoing Random Access procedure and initiate a Random Access procedure after performing the BWP switching; if the MAC decides to ignore the PDCCH for BWP switching, the MAC entity shall continue with the ongoing Random Access procedure on the Serving Cell.

Upon reception of RRC (re-)configuration for BWP switching for a Serving Cell while a Random Access procedure associated with that Serving Cell is ongoing in the MAC entity, the MAC entity shall stop the ongoing Random Access procedure and initiate a Random Access procedure after performing the BWP switching.

Upon reception of RRC (re-)configuration for BWP switching for a Serving Cell, cancel any triggered LBT failure in this Serving Cell.

The MAC entity shall for each activated Serving Cell configured with *bwp-InactivityTimer*:

1> if the *defaultDownlinkBWP-Id* is configured, and the active DL BWP is not the BWP indicated by the *defaultDownlinkBWP-Id*, and the active DL BWP is not the BWP indicated by the *dormantBWP-Id* if configured; or

1> if the *defaultDownlinkBWP-Id* is not configured, and the active DL BWP is not the *initialDownlinkBWP*, and the active DL BWP is not the BWP indicated by the *dormantBWP-Id* if configured:

2> if a PDCCH addressed to C-RNTI or CS-RNTI indicating downlink assignment or uplink grant is received on the active BWP; or

2> if a PDCCH addressed to C-RNTI or CS-RNTI indicating downlink assignment or uplink grant is received for the active BWP; or

2> if a MAC PDU is transmitted in a configured uplink grant and LBT failure indication is not received from lower layers; or

2> if a MAC PDU is received in a configured downlink assignment:

3> if there is no ongoing Random Access procedure associated with this Serving Cell; or

3> if the ongoing Random Access procedure associated with this Serving Cell is successfully completed upon reception of this PDCCH addressed to C-RNTI (as specified in clauses 5.1.4, 5.1.4a and 5.1.5):

4> start or restart the *bwp-InactivityTimer* associated with the active DL BWP.

2> if the *bwp-InactivityTimer* associated with the active DL BWP expires:

3> if the *defaultDownlinkBWP-Id* is configured:

4> perform BWP switching to a BWP indicated by the *defaultDownlinkBWP-Id*.

3> else:

4> perform BWP switching to the *initialDownlinkBWP*.

NOTE: If a Random Access procedure is initiated on an SCell, both this SCell and the SpCell are associated with this Random Access procedure.

1> if a PDCCH for BWP switching is received, and the MAC entity switches the active DL BWP:

2> if the *defaultDownlinkBWP-Id* is configured, and the MAC entity switches to the DL BWP which is not indicated by the *defaultDownlinkBWP-Id* and is not indicated by the *dormantBWP-Id* if configured; or

2> if the *defaultDownlinkBWP-Id* is not configured, and the MAC entity switches to the DL BWP which is not the *initialDownlinkBWP* and is not indicated by the *dormantBWP-Id* if configured:

3> start or restart the *bwp-InactivityTimer* associated with the active DL BWP.

A RedCap UE in RRC\_IDLE or RRC\_INACTIVE mode may be configured with a RedCap-specific initial UL BWP in *initialUplinkBWP-RedCap*, as specified in TS 38.331 [5].

Upon initiation of the Random Access procedure, after selection of the carrier for performing Random Access procedure as specified in clause 5.1.1, if the UE is a RedCap UE in RRC\_IDLE or RRC\_INACTIVE mode, the MAC entity shall:

1> if *initialUplinkBWP-RedCap* is configured:

2> perform the Random Access procedure as specified in clause 5.1 by using the BWP configured by *initialUplinkBWP-RedCap*;

2> if *initialDownlinkBWP-RedCap* is configured:

3> monitor the PDCCH on the BWP configured by *initialDownlinkBWP-RedCap*.

Editor’s NOTE: The behaviour on RedCap specific initial BWP need to be updated based on further progress in RAN2 and RACH partitioning session discussion because feature-priority based BWP selection is still under discussion.

Next change

## 6.2 Formats and parameters

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

The MAC subheader consists of the following fields:

- LCID: The Logical Channel ID field identifies the logical channel instance of the corresponding MAC SDU or the type of the corresponding MAC CE or padding as described in Tables 6.2.1-1 and 6.2.1-2 for the DL-SCH and UL-SCH respectively. There is one LCID field per MAC subheader. The size of the LCID field is 6 bits. If the LCID field is set to 34, one additional octet is present in the MAC subheader containing the eLCID field and follow the octet containing LCID field. If the LCID field is set to 33, two additional octets are present in the MAC subheader containing the eLCID field and these two additional octets follow the octet containing LCID field;

- eLCID: The extended Logical Channel ID field identifies the logical channel instance of the corresponding MAC SDU or the type of the corresponding MAC CE as described in tables 6.2.1-1a, 6.2.1-1b, 6.2.1-2a and 6.2.1-2b for the DL-SCH and UL-SCH respectively. The size of the eLCID field is either 8 bits or 16 bits.

NOTE: The extended Logical Channel ID space using two-octet eLCID and the relevant MAC subheader format is used, only when configured, on the NR backhaul links between IAB nodes or between IAB node and IAB Donor.

- L: The Length field indicates the length of the corresponding MAC SDU or variable-sized MAC CE in bytes. There is one L field per MAC subheader except for subheaders corresponding to fixed-sized MAC CEs, padding, and MAC SDUs containing UL CCCH. The size of the L field is indicated by the F field;

- F: The Format field indicates the size of the Length field. There is one F field per MAC subheader except for subheaders corresponding to fixed-sized MAC CEs, padding, and MAC SDUs containing UL CCCH. The size of the F field is 1 bit. The value 0 indicates 8 bits of the Length field. The value 1 indicates 16 bits of the Length field;

- R: Reserved bit, set to 0.

The MAC subheader is octet aligned.

Table 6.2.1-1 Values of LCID for DL-SCH

|  |  |
| --- | --- |
| Codepoint/Index | LCID values |
| 0 | CCCH |
| 1–32 | Identity of the logical channel |
| 33 | Extended logical channel ID field (two-octet eLCID field) |
| 34 | Extended logical channel ID field (one-octet eLCID field) |
| 35–46 | Reserved |
| 47 | Recommended bit rate |
| 48 | SP ZP CSI-RS Resource Set Activation/Deactivation |
| 49 | PUCCH spatial relation Activation/Deactivation |
| 50 | SP SRS Activation/Deactivation |
| 51 | SP CSI reporting on PUCCH Activation/Deactivation |
| 52 | TCI State Indication for UE-specific PDCCH |
| 53 | TCI States Activation/Deactivation for UE-specific PDSCH |
| 54 | Aperiodic CSI Trigger State Subselection |
| 55 | SP CSI-RS/CSI-IM Resource Set Activation/Deactivation |
| 56 | Duplication Activation/Deactivation |
| 57 | SCell Activation/Deactivation (four octets) |
| 58 | SCell Activation/Deactivation (one octet) |
| 59 | Long DRX Command |
| 60 | DRX Command |
| 61 | Timing Advance Command |
| 62 | UE Contention Resolution Identity |
| 63 | Padding |

Table 6.2.1-1a Values of two-octet eLCID for DL-SCH

|  |  |  |
| --- | --- | --- |
| Codepoint | Index | LCID values |
| 0 to (216 – 1) | 320 to (216 + 319) | Identity of the logical channel |

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

|  |  |  |
| --- | --- | --- |
| Codepoint | Index | LCID values |
| 0 to 244 | 64 to 308 | Reserved |
| 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 |

Table 6.2.1-2 Values of LCID for UL-SCH

|  |  |
| --- | --- |
| Codepoint/Index | LCID values |
| 0 | CCCH of size 64 bits (referred to as "CCCH1" in TS 38.331 [5]), except for a RedCap UE |
| 1–32 | Identity of the logical channel |
| 33 | Extended logical channel ID field (two-octet eLCID field) |
| 34 | Extended logical channel ID field (one-octet eLCID field) |
| 35 | CCCH of size 48 bits (referred to as “CCCH” in TS 38.331 [5]) for a RedCap UE |
| 36 | CCCH1 of size 64 bits (referred to as “CCCH1” in TS 38.331 [5]) for a RedCap UE |
| 37–44 | Reserved |
| 45 | Truncated Sidelink BSR |
| 46 | Sidelink BSR |
| 47 | Reserved |
| 48 | LBT failure (four octets) |
| 49 | LBT failure (one octet) |
| 50 | BFR (one octet Ci) |
| 51 | Truncated BFR (one octet Ci) |
| 52 | CCCH of size 48 bits (referred to as "CCCH" in TS 38.331 [5]), except for a RedCap UE |
| 53 | Recommended bit rate query |
| 54 | Multiple Entry PHR (four octets Ci) |
| 55 | Configured Grant Confirmation |
| 56 | Multiple Entry PHR (one octet Ci) |
| 57 | Single Entry PHR |
| 58 | C-RNTI |
| 59 | Short Truncated BSR |
| 60 | Long Truncated BSR |
| 61 | Short BSR |
| 62 | Long BSR |
| 63 | Padding |

Table 6.2.1-2a Values of two-octet eLCID for UL-SCH

|  |  |  |
| --- | --- | --- |
| Codepoint | Index | LCID values |
| 0 to (216 – 1) | 320 to (216 + 319) | Identity of the logical channel |

Table 6.2.1-2b Values of one-octet eLCID for UL-SCH

|  |  |  |
| --- | --- | --- |
| Codepoint | Index | LCID values |
| 0 to 249 | 64 to 313 | Reserved |
| 250 | 314 | BFR (four octets Ci) |
| 251 | 315 | Truncated BFR (four octets Ci) |
| 252 | 316 | Multiple Entry Configured Grant Confirmation |
| 253 | 317 | Sidelink Configured Grant Confirmation |
| 254 | 318 | Desired Guard Symbols |
| 255 | 319 | Pre-emptive BSR |

End of change

Annex A– RAN2 agreements

### Agreements on identification, access restriction in RAN2

|  |  |  |
| --- | --- | --- |
| **RAN2 agreements** | **Impacted specification** | **Comments, if any** |
| **RAN2#114e** | | |
| 1. SIB1 (not MIB) indicates cell barring for 1 Rx branch and 2 Rx branches separately for RedCap UEs. Further details of the solution are FFS  2. The cell barring for RedCap UE is per cell (not per PLMN).  3. RedCap UE supports the Intra Frequency Reselection Indicator. | No impact |  |
| 4. Either Msg1 and/or Msg3 early identification will be supported | Not yet captured to wait for further progress. |  |
| 1. There is no need to support Rx branches specific early identification from RAN2 perceptive (final decision up to RAN1). | Not yet captured to wait for further progress. |  |
| 2. Send LS to ask RAN3 to consider the coordination between gNBs on whether a neighbour/target gNB supports RedCap UEs, if needed, to avoid handover RedCap to a target cell that it can’t access. We can come back in the next meeting with discussions on other restrictions, e.g. related to number of RX | Not yet captured |  |
| **RAN2#115e** | | |
| 1. Msg1 identification which can be configured to be enabled/disabled can be specified from RAN2 point of view. | Captured in 5.1, which will be handled together with other features in common MAC running CR. |  |
| 2. Solution for early identification for 2-step RACH will be specified. | Not yet captured to wait for further progress. |  |
| 3. Specify separate indications in SIB1 for barring RedCap UEs with 1 Rx chain and 2 Rx chains.  4. Specify a RedCap specific IFRI in SIB1. | No impact |  |
| 1. IFRI for RedCap UEs in SIB1 is common for UEs with 1 Rx or 2 Rx branches.  2. If RedCap-specific IFRI is absent from broadcast SI, the UE considers the cell does not support RedCap. | No impact |  |
| 1. A Msg3 early identification based on dedicated LCID is supported (if SA3 confirms there is no problem) | Partly captured in 6.2.1, further details to be discussed and agreed. |  |
| 1. RedCap UE applies the existing cellBarred field in MIB | No impact |  |
| **RAN2#116e** | | |
| 1. In MAC perspective, a RedCap UE uses Msg1 early identification whenever transmitting preamble for CBRA, as long as the Msg1 early identification is configured for RedCap by NW.  2. For Msg1 early identification, RAN2 confirm both dedicated ROs and dedicated PRACH preamble can be supported from signalling point of view  3. For RedCap, Msg1 early identification is enabled/disabled implicitly by the presence of dedicate RACH configuration for Msg1 early identification. | Captured in 5.1, which will be handled together with other features in common MAC running CR. |  |
| 4. At least the dedicated LCID (i.e. the Msg3 early identification solution) can be supported for MsgA early identification. It is up to RAN1 on the need of dedicated preamble and/or dedicated PUSCH resource configuration. | Captured in 6.2.1, |  |
| 5. Do not support the RedCap specific UAC parameters. | No impact |  |
| 1. In MAC perspective, RedCap UE uses the dedicated LCID for Msg3 early identification, when the Msg3 includes the CCCH data. FFS on whether it requires no other precondition, or precondition as “when Msg1 early identification is not configured”, or precondition as “when Msg3 early identification is enabled by NW”. | Captured in 6.2.1 |  |
| 2. Two reserved LCIDs are used for CCCH and CCCH1 cases respectively for Msg3 early identification | Captured in 6.2.1 |  |
| FFSs:  1. In case the cell is barred due to not supporting RedCap, UE behaviour for intra-frequency cell reselection is FFS  2. FFS whether system information should provide information on which cells accept RedCap UE access, and if, what this information should include (e¸g. support, barring?) and in which form (e.g. NCell, allow-list, exclude-list) | No impact |  |
| **RAN2#116bis-e** | | |
| 1. In MAC perspective, a RedCap UE uses MsgA PRACH early identification when it transmits preamble for CBRA if MsgA PRACH early identification is configured for RedCap by NW.  2. For MsgA PRACH early identification, RAN2 confirms both dedicated ROs and dedicated PRACH preamble can be supported from signalling point of view.  3. For RedCap, MsgA PRACH early identification is enabled/disabled implicitly by the presence of dedicated RACH configuration for MsgA PRACH early identification. | Captured in 5.1, which will be handled together with other features in common MAC running CR. |  |
| 1. In MAC perspective, RedCap UE uses the dedicated LCID for Msg3 early identification, when the Msg3 includes the CCCH data (no other precondition)  2. Also when msg1 early identification is configured, new dedicated LCID is used for CCCH identification | Captured in 6.2.1 |  |
| Working assumption:  1. Msg3 early identification is mandatorily supported by RedCap UE | Not yet captured to wait for further progress. |  |
| **RAN2#117-e** | | |
| 1. Dedicated LCID for RedCap is always indicated when CCCH is sent in MsgA by a RedCap UE (i.e. no other precondition). | Captured in 6.2.1 |  |
| The WA that Msg3 early identification is mandatorily supported by RedCap UE is confirmed | Captured in 6.2.1 |  |
|  |  |  |

### Agreements on NCD-SSB

|  |  |  |
| --- | --- | --- |
| **RAN2 agreements** | **Impacted specification** | **Comments, if any** |
| **RAN2#116-e** | | |
| 1. For idle/inactive UEs, the concept of non-cell-defining SSB (NCD-SSB) and the corresponding procedures, i.e., measurements, cell (re-)selection, do not exist in the current RAN2 specifications.  2. For idle/inactive UEs, using NCD-SSB for measurements and cell (re-)selection would still require the UE to re-tune to the CORESET#0 for reading SIBs.  3. In connected mode, current RRC signalling allows configuring SSB-based RRM measurements on any (CD- or NCD-) SSB, but it does not allow using an NCD-SSB for RLM, BFD, link recovery, RO selection, mobility (mobility here refers to the frequency indicated in FreqDLInfo in HO command), in TCI-states or for any other functionality (other than RRM measurements).  4. It would be feasible to inform IDLE, INACTIVE and CONNECTED UEs about a NCD-SSB, however it is up to RAN1 and RAN4 to decide whether it is possible to use a NCD-SSB as QCL source.  5. According to the current RRC specification, PCIs indicated by other SSB and CD-SSB may be either the same or different if both other SSB and CD-SSB are transmitted on the serving cell.  6. PCIs indicated by the NCD-SSB and CD-SSB should be configured as same if both NCD-SSB and CD-SSB are transmitted on the serving cell.  7. According to the current RRC specification, periodicities and/or TX power and/or block indexes (provided by ssb-PositionsInBurst in SIB1 or in ServingCellConfigCommon) and/or QCL sources of other SSB may be either the same or different from those of CD-SSB, if both other SSB and CD-SSB are transmitted on the serving cell.  8. Use of CSI-RS for cell and beam RLM and measurements is already supported from RAN2 signaling standpoint. | No impact |  |
| **RAN2#116bis-e** | | |
| 1. A RedCap UE in idle/inactive mode monitors paging only in an initial BWP (default or RedCap specific) associated with CD-SSB and performs cell (re-)selection and measurements on the CD-SSB | No impact |  |
| 2. If a RedCap-specific initial UL BWP is configured for RACH, RedCap UEs shall use only the RedCap-specific initial UL BWP to perform RACH. | Captured in 5.15 |  |
| 1. If a RedCap UE in idle/inactive mode is configured with a separate initial BWP associated with no SSB (CD or NCD) for RACH, measurements are based on CD-SSB for initial RACH resource selection. | Captured in 5.1.2/5.1.2a |  |
| 2. If a RedCap UE in idle/inactive mode is configured with a separate initial BWP associated with no SSB (CD or NCD) for RACH, PDCCH-ConfigCommon of the separate initial DL BWP includes common search space configuration for RAR. | Assuming this should be captured in RAN1 specification and/or RRC, no impact to MAC specification |  |
| 3. From RAN2 perspective, if a RedCap UE in idle/inactive mode is configured with a separate initial BWP associated with no SSB (CD or NCD) for RACH, it is up to UE implementation to perform new RSRP measurement in a DL BWP associated with CD-SSB before Msg1/A retransmission. | Captured in 5.1.2/5.1.2a |  |
| 4. RedCap-specific two-step RACH, if configured, and four-step RACH are always configured in the same BWP. | Assuming this should be captured in RRC, and it is already reflected by existing text in 5.1.1 |  |
| 5. In RRC connected mode NCD-SSB may be configured for a RedCap UE in dedicated DL BWP.  6. For connected mode operation NCD-SSB has the same properties (e.g., ssb-PositionsInBurst, PCI, ssb-periodicity, ssb-PBCH-BlockPower) as the corresponding CD-SSB. FFS if an additional property needs to be specified.  7. For connected mode operation if NCD-SSB is configured in a dedicated DL BWP, RedCap UE assumes that “SSB” in QCL-Info IE and “ssb-Index” in RadioLinkMonitoringRS IE refer to the beam with the same index in the NCD-SSB configured in that BWP. | No impact |  |
| 8. For connected mode operation if NCD-SSB is configured in a dedicated DL BWP whose paired UL BWP is configured with RACH-ConfigDedicated, RACH-ConfigCommon or BeamFailureRecovery Config, SSB in that RACH configuration (e.g., in CFRA-SSB-Resource IE or in PRACH-ResourceDedicatedBFR IE) refers to the NCD-SSB configured in that DL BWP. | Assuming this should be captured in RAN1 specification and/or RRC, whether any impact on MAC specification  Captured in 5.1.1/5.1.1a by now. |  |
| 1. The network may provide absoluteFrequencySSB and ssb-periodicity explicitly for NCD-SSB, i.e., other properties such as PCI, ssb-PBCH-BlockPower, ssb-PositionsInBurst are configured with the same values from serving cell's CD-SSB. FFS for the time offset (feedback from RAN1 might also be received)  2. Send a reply LS to RAN1 (cc: RAN4) indicating that "The use of CSI-RS for cell/beam RLM and measurements is supported from RAN2 signaling standpoint as indicated earlier. RAN4 has informed RAN2 and RAN1 that CSI-RS cannot be used as a standalone mechanism for RRM measurements and existing requirements rely on the presence of SSB signals. RAN2 does not intend to introduce a new mechanism that would enable a RedCap UE to perform CSI-RS based RRM measurements and think that it is up to RAN4 to decide whether RAN1 working assumption regarding the use of CSI-RS in connected mode is acceptable based on the information provided above."  3. Send a LS to RAN4 (Cc: RAN1) to inform that "it is up to UE implementation to perform new RSRP measurement in a DL BWP associated with CD-SSB before Msg1/A retransmission if a RedCap UE in idle/inactive mode is configured with a separate initial BWP associated with no SSB (CD or NCD) for RACH." and ask them to check if they need to do anything in their specs.  Working Assumption:  1. The periodicity of NCD-SSB shall be not less than the periodicity of serving cell’s CD-SSB | No impact |  |
| **RAN2#117-e** | | |
| 1. Capture the below Note in RACH section in MAC specification as the starting point:   NOTE X1: If a 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. | Captured in 5.1.2/5.1.2a |  |
| 3. There is no new UE behaviour (i.e. no specification impact) for the case where the UE uses the RedCap-specific initial DL/UL BWP for RACH, if the number of preamble transmission is reached to the maximum value and a random access problem is indicated to the upper layer. | No impact |  |
| 8. RAN2 confirms that it is up to network implementation, but it is expected that the network configures a MO on the NCD-SSB frequency if it wants the UE to use it only for serving cell measurements when some neighbor cells do not send an SSB on UE’s NCD-SSB frequency.  9. For neighbour cell measurements, it is up to network to configure MO on CD-SSB or NCD-SSB or both (same in legacy, no spec impact)  10. servingCellMO is configured to the MO on the CD-SSB when RedCap specific BWP of a UE contains neither CD-SSB nor NCD-SSB.  11. A RedCap UE may be configured with multiple NCD-SSBs, but only one per BWP (FFS on what "only one per BWP" means).  12. The working assumption “The periodicity of NCD-SSB shall be not less than the periodicity of serving cell’s CD-SSB.” is confirmed.  13. NCD-SSB should not be indicated in the handover command, i.e., network sets ServingCellConfigCommon => downlinkConfigCommon => frequencyInfoDL => absoluteFrequencySSB to the frequency of the CD-SSB (not the NCD-SSB) | No impact |  |
| 14. The discussion on whether a non-RedCap UE should be able to use NCD-SSB instead of CD-SSB is deprioritized in Rel-17. | Not yet captured to wait for further progress. |  |
| 16. For RedCap-specific BWP, both common and dedicated configurations are provided using full configuration, i.e., delta configuration is not supported.  17. RAN2 confirms that upon failure of RRC connection setup/resume, UE operates in the initial BWP in which it has been configured to monitor paging (no spec impact) | No impact |  |
| 1. In case a notification for system information update or ETWS and/or CMAS is transmitted, RAN2 confirms that system information can be provided via dedicated signaling to a RedCap UE in an active DL BWP that does not contain CD-SSB.  2. RAN2 confirms that SIB1 can be provided via dedicated signaling to a RedCap UE in an active DL BWP that does not contain CD-SSB after an handover in which dedicatedSIB1-Delivery IE is not included in the handover command | No impact |  |
| 1. A RedCap UE may be configured with multiple NCD-SSBs provided that each BWP is configured with at most one SSB | No impact |  |
| 2. In connected mode if RA occasions are not configured on the active BWP, RedCap UEs should use the RedCap-specific initial UL BWP, if configured, or else legacy BWP#0 | Captured in 5.15 |  |
| 3. In case RedCap-specific initial DL BWP contains CD-SSB and CORESET#0, PDCCH-ConfigCommon is included in the configuration of RedCap-specific initial DL BWP. RedCap UEs don't need to read the PDCCH-ConfigCommon configuration from legacy initial BWP if RedCap-specific initial BWP is signalled | No impact |  |
| 4. The network may configure a dedicated BWP associated with NCD-SSB in an RRCReconfiguration which includes reconfigurationWithSync. | No impact |  |

Annex B– RAN1 agreements

### Agreements on early identification and access control in other WG(s)

|  |  |  |
| --- | --- | --- |
| **RAN1 agreements** | **Impacted specification** | **Comments, if any** |
| **RAN1#105e** | | |
| Working assumption: (replaced by later agreement)   * For 4-step RACH, support the early indication of RedCap UEs at least in Msg1.   + The early indication in Msg1 can be configured to be enabled/disabled     - FFS How to support enable/disable the early indication   + FFS details e.g.:     - separate initial UL BWP     - separate PRACH resource     - PRACH preamble partitioning   + FFS the possibility of supporting Msg3 for the early indication   Agreements: (if the above working assumption is confirmed)   * Early indication of RedCap UEs in Msg1 can be enabled/disabled via SIB   Send an LS to RAN2 informing them the above working assumption and the agreement for early indication, possibly also RAN2-related agreements. Draft LS in [R1-2106216](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_105-e/Docs/R1-2106216.zip) which is approved, with final LS in [R1-2106329](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_105-e/Docs/R1-2106329.zip). | Not yet captured to wait for further progress. |  |
| Agreements:   * Support 2-step RACH for RedCap UEs as an optional feature   + FFS details of early indication in MsgA, e.g.:     - Separation of 2-step RACH resources or MsgA preambles     - Separation of initial UL BWP     - Using a new indication in MsgA PUSCH part   + Note: Discussion on 4-step RACH for early indication should be prioritised | Not yet captured to wait for further progress. |  |
|  |  |  |
| **RAN1#106e** | | |
| Agreements:  Confirm the following working assumption with the modifications in red:   * For 4-step RACH, support the early indication of RedCap UEs at least in Msg1.   + The early indication in Msg1 can be configured to be enabled/disabled via SIB     - ~~FFS how to support enable/disable the early indication~~   + ~~FFS details e.g.:~~ From RAN1 perspective, the following methods can be used for early indication both for shared initial UL BWP and separate initial UL BWP (if supported)     - separate PRACH resource     - PRACH preamble partitioning     - ~~FFS: whether/how to address RA-RNTI overlapping issue~~   + ~~FFS the possibility of supporting Msg3 for the early indication~~   Whether/how to support early indication of RedCap UEs in Msg3 in Rel-17 is up to RAN2.  Conclusion   * Whether there is RA-RNTI overlapping issue and how to address RA-RNTI overlapping issue in the early indication of RedCap UEs in Msg1 in Rel-17 is up to RAN2.   Conclusion   * There is no consensus in RAN1 on whether to have the access barring indication in DCI scheduling SIB1, and RAN1 can come back if triggered by RAN2. | Not yet captured to wait for further progress. |  |
|  |  |  |

### Agreements on separate initial BWP in other WG(s)

|  |  |  |
| --- | --- | --- |
| **RAN1 agreements** | **Impacted specification** | **Comments, if any** |
| **RAN1#104e** | | |
| Agreements:   * Study further how to enable/support that a RACH occasion associated with the best SSB falls within the RedCap UE bandwidth, with the following options:   + Option 1: Proper RF-retuning for RedCap * Option 2: Separate initial UL BWP(s) for RedCap UEs * Option 3: gNB configuration (e.g., restrictions on existing PRACH configurations, or FDM-ed ROs, or always restricting the initial UL BWP to within RedCap UE bandwidth) * Option 4: Dedicated PRACH configurations (e.g., ROs) for RedCap UEs * Other options are not precluded   Agreements:   * Study further whether and how to enable/support that PUCCH (for Msg4/[MsgB] HARQ feedback) and/or PUSCH (for Msg3/[MsgA]) transmissions fall within the RedCap UE bandwidth during initial access, with the following options:   + Option 1: Proper RF-retuning for RedCap (if feasible)   + Option 2: Separate initial UL BWP(s) for RedCap     - FFS more than one starting PRB position   + Option 3: Separate PUCCH/Msg3/[MsgA] PUSCH configuration/indication or a different interpretation for the same configuration/indication for RedCap (e.g., disabled frequency hopping or different frequency hopping)   + Option 4: gNB configuration (e.g., always restricting the initial UL BWP to within RedCap UE bandwidth, or restrictions on the frequency location and the amount of scheduled resource for Msg4/[MsgB] HARQ feedback and Msg3/[MsgA] PUSCH)     - As an example, with restrictions on the frequency location and the amount of scheduled resource for Msg4/[MsgB] HARQ feedback and Msg3/[MsgA] PUSCH, when the initial UL BWP is the same for RedCap and non-RedCap UEs, the PUCCH (for Msg4/[MsgB] HARQ feedback) and PUSCH (for Msg3/[MsgA]) are within the RedCap UE bandwidth   + Other options are not precluded | No impact by now |  |
|  |  |  |
| **RAN1#104bis-e** | | |
| Agreements:   * During initial access, for the scenario where the initial UL BWP for non-RedCap UEs is configured to be wider than the RedCap UE bandwidth, down select among the following options in RAN1#105-e   + Option 1: The scenario is allowed, and a RedCap UE can use the same UL BWP.   + Option 2: The scenario is allowed, but a separate initial UL BWP no wider than the RedCap UE maximum bandwidth is configured/defined for RedCap UEs.   + Option 3: The scenario is not allowed, and a RedCap UE is not expected to operate in an initial UL BWP wider than the RedCap UE maximum bandwidth.   Agreements:   * After initial access, for the scenario where the initial UL BWP for non-RedCap UEs is configured to be wider than the RedCap UE bandwidth, down select among the following options in RAN1#105-e:   + Option 1: The scenario is allowed, and a RedCap UE can use the same UL BWP.   + Option 2: The scenario is allowed, but a separate initial UL BWP no wider than the RedCap UE maximum bandwidth is configured/defined for RedCap UEs.   + Option 3: The scenario is not allowed, and a RedCap UE is not expected to operate in an initial UL BWP wider than the RedCap UE maximum bandwidth. | No impact by now |  |
|  |  |  |
| **RAN1#105e** | | |
| Agreements:   * Both during and after initial access, the scenario where the initial UL BWP for non-RedCap UEs is configured to be wider than the maximum RedCap UE bandwidth is allowed. * Working assumption: Both during and after initial access, for the scenario where the initial UL BWP for non-RedCap UEs is configured to be wider than the RedCap UE bandwidth, a separate initial UL BWP no wider than the RedCap UE maximum bandwidth is configured/defined for RedCap UEs.   + FFS: whether/how to avoid or minimize PUSCH resource fragmentation due to PUCCH transmission for the above case   + Support the case when the centre frequency is assumed to be the same for the initial DL and UL BWPs in TDD.     - FFS whether or not to additionally support the case when the centre frequency is different; if so, how to minimize centre frequency retuning | No impact by now |  |
| **RAN1#106e** | | |
| Agreements:  Replace the RAN1#104bis-e working assumption with the following agreement:   * During initial access, the bandwidth of the initial DL BWP for RedCap UEs is not expected to exceed the maximum RedCap UE bandwidth.   + RedCap UEs and non-RedCap UEs can share the same MIB-configured initial DL BWP (including the bandwidth and location).   + This does not preclude a SIB-configured initial DL BWP for non-RedCap UEs only with a wider bandwidth than the maximum RedCap UE bandwidth.   + This does not preclude separate or additional bandwidth and location for initial DL BWP for RedCap UEs.     Agreements:  Confirm the following working assumptions from RAN1#105-e:   * After initial access (i.e., after RRC Setup, RRC Resume, or RRC Reestablishment), for BWP#0 configuration option 1 (as in 38.331, Appendix B2), a RedCap UE is not expected to operate with an initial DL BWP wider than the maximum RedCap UE bandwidth. * After initial access (i.e., after RRC Setup, RRC Resume, or RRC Reestablishment), for BWP#0 configuration option 2 (as in 38.331, Appendix B2), a RedCap UE is not expected to operate with an initial DL BWP wider than the maximum RedCap UE bandwidth.     Agreements:  Confirm the following working assumption from RAN1#105-e regarding RACH occasions.   * For enabling/supporting that the RACH occasion (RO) associated with the best SSB falls within the RedCap UE bandwidth, support separate initial UL BWP for RedCap UEs (which is not expected to exceed the maximum RedCap UE bandwidth), and this separate initial UL BWP for RedCap includes ROs for RedCap UEs.   + Note: these ROs can be dedicated for RedCap UEs or shared with non-RedCap UEs.     Agreements:   * In case a separate initial UL BWP is configured for RedCap UEs, it is supported that the network can enable/disable intra-slot PUCCH frequency hopping within the separate initial UL BWP in the PUCCH resource for HARQ feedback for Msg4/MsgB for RedCap UEs.   + Working assumption: The frequency hopping is enabled/disabled at least via SIB. | No impact by now |  |
| **RAN1#** | | |
|  |  |  |