**3GPP TSG-RAN/WG2 Meeting #118-e *R2-22xxxxx***

**, May 09 - May 20, 2022**

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

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| ***Title:*** | Introducing Non-Terrestrial Network in NB-IoT and eMTC | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | MediaTek | | | | | | | | | |
| ***Source to TSG:*** | R2 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | LTE\_NBIOT\_eMTC\_NTN | | | | |  | ***Date:*** | | | 2022-05-20 |
|  |  | | | |  | |  | | |  |
| ***Category:*** |  |  | | | | | ***Release:*** | | |  |
|  | *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:*** | | Release-17 support for IoT-Non-Terrestrial Networks (NTN) | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | This running CR captures agreements made for LTE eMTC and NB-IoT to support Non-Terrestrial Networks (NTN) for Release-17 up to RAN2 118-e. It includes any correction provided to 36.321 specifications in R2 118-e. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | Support for Release-17 enhancements for NTN in IoT is not complete and incorrect. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 3.1, 5.1.4, 5.1.5, 5.4.9, 5.9 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | | **X** |  | Other core specifications | | | | TS 36.331 CR | | |
| ***affected:*** | |  | **X** | Test specifications | | | |  | | |
| ***(show related CRs)*** | |  | **X** | O&M Specifications | | | |  | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

Start of changes

## 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].

**Active Time:** Time related to DRX operation, as defined in clause 5.7, during which the MAC entity monitors the PDCCH.

***mac-ContentionResolutionTimer***: Specifies the number of consecutive subframe(s) during which the MAC entity shall monitor the PDCCH after Msg3 is transmitted.

**DRX Cycle:** Specifies the periodic repetition of the On Duration followed by a possible period of inactivity (see figure 3.1-1 below).



Figure 3.1-1: DRX Cycle

***drx-InactivityTimer***: Except for NB-IoT UEs, BL UEs or UEs in enhanced coverage, it specifies the number of consecutive PDCCH-subframe(s) after the subframe in which a PDCCH indicates an initial UL, DL or SL user data transmission for this MAC entity. For NB-IoT UEs, it specifies the number of consecutive PDCCH-subframe(s) after the subframe in which the HARQ RTT timer or UL HARQ RTT timer expires. For BL UEs or UEs in enhanced coverage, it specifies the number of consecutive PDCCH-subframe(s) following the subframe containing the last repetition of the PDCCH reception that indicates an initial UL or DL user data transmission for this MAC entity.

***drx-RetransmissionTimer***: Specifies the maximum number of consecutive PDCCH-subframe(s) until a DL retransmission is received.

***drx-RetransmissionTimerShortTTI***: Specifies the maximum number of consecutive TTI(s) until a DL retransmission is received for HARQ processes scheduled using short TTI.

***drxShortCycleTimer***: Specifies the number of consecutive subframe(s) the MAC entity shall follow the Short DRX cycle.

***drxStartOffset***: Specifies the subframe where the DRX Cycle starts.

***drx-ULRetransmissionTimer***: Specifies the maximum number of consecutive PDCCH-subframe(s) until a grant for UL retransmission or the HARQ feedback is received.

***drx-ULRetransmissionTimeShortTTI***: Specifies the maximum number of consecutive TTI(s) until a grant for UL retransmission is received for HARQ processes scheduled using short TTI.

**Early Data Transmission**: Allows one uplink data transmission optionally followed by one downlink data transmission during the random access procedure as specified in TS 36.300 [20]. The S1 connection is established or resumed upon reception of the uplink data and may be released or suspended along with the transmission of the downlink data. Early data transmission refers to both CP-EDT and UP-EDT.

**HARQ information**: HARQ information for DL-SCH or for UL-SCH transmissions consists of New Data Indicator (NDI), Transport Block (TB) size. For DL-SCH transmissions and for asynchronous UL HARQ and for autonomous UL HARQ, the HARQ information also includes HARQ process ID, except for UEs in NB-IoT configured with a single HARQ process for which this information is not present. For UL-SCH transmission the HARQ information also includes Redundancy Version (RV). In case of spatial multiplexing on DL-SCH the HARQ information comprises a set of NDI and TB size for each transport block. HARQ information for SL-SCH and SL-DCH transmissions consists of TB size only.

**HARQ RTT Timer**: This parameter specifies the minimum amount of subframe(s) before a DL assignment for HARQ retransmission is expected by the MAC entity.

**Msg3**:Message transmitted on UL-SCH containing a C-RNTI MAC CE or a CCCH SDU optionally multiplexed with DTCH for the UP-EDT, submitted from upper layer and associated with the UE Contention Resolution Identity, as part of a random access procedure.

**NB-IoT**:NB-IoT allows access to network services via E-UTRA with a channel bandwidth limited to 200 kHz.

**NB-IoT UE**:A UE that uses NB-IoT.

**NR sidelink communication**: AS functionality enabling at least V2X Communication as defined in TS 23.287 [23], between two or more nearby UEs, using NR technology but not traversing any network node.

**Non-terrestrial networks:** An E-UTRAN consisting of eNBs, which provide non-terrestrial LTE access to UEs by means of an NTN payload embarked on a space-borne NTN vehicle and an NTN Gateway.

***onDurationTimer***: Specifies the number of consecutive PDCCH-subframe(s) at the beginning of a DRX Cycle.

**PDCCH:** Refers to the PDCCH (see TS 36.211 [7]), EPDCCH (in subframes when configured), MPDCCH (see TS 36.213 [2]), for an RN with R-PDCCH configured and not suspended, to the R-PDCCH, for NB-IoT to the NPDCCH or for short TTI to SPDCCH.

**PDCCH period (pp):** Refers to the interval between the start of two consecutive PDCCH occasions and depends on the currently used PDCCH search space, as specified in TS 36.213 [2]. A PDCCH occasion is the start of a search space and is defined by subframe k0 as specified in clause 16.6 of TS 36.213 [2]. The calculation of number of PDCCH-subframes for the timer configured in units of a PDCCH period is done by multiplying the number of PDCCH periods with *npdcch-NumRepetitions-RA* when the UE uses the common search space or by *npdcch-NumRepetitions* when the UE uses the UE specific search space. When counting a timer whose length is calculated in PDCCH-subframes, the UE shall include PDCCH-subframes that will be dropped or not required to be monitored as specified in clause 16.6 of TS 36.213 [2]. The calculation of number of subframes for the timer configured in units of a PDCCH period is done by multiplying the number of PDCCH periods with duration between two consecutive PDCCH occasions.

**PDCCH-subframe:** Refers to a subframe with PDCCH. This represents the union over PDCCH-subframes for all serving cells excluding cells configured with cross carrier scheduling for both uplink and downlink, as specified in TS 36.331 [8]; except if the UE is not capable of simultaneous reception and transmission in the aggregated cells where this instead represents the PDCCH-subframes of the SpCell.

- For FDD serving cells, all subframes represent PDCCH-subframes, unless specified otherwise in this clause.

- For TDD serving cells, all downlink subframes and subframes including DwPTS of the TDD UL/DL configuration indicated by *tdd-Config*, as specified in TS 36.331 [8] of the cell represent PDCCH-subframes, unless specified otherwise in this clause.

- For serving cells operating according to Frame structure Type 3, all subframes represent PDCCH-subframes.

- For RNs with an RN subframe configuration configured and not suspended, in its communication with the E-UTRAN, all downlink subframes configured for RN communication with the E-UTRAN represent PDCCH-subframes.

- For SC-PTM reception on an FDD cell, all subframes except MBSFN subframes represent PDCCH-subframes, unless specified otherwise in this clause.

- For SC-PTM reception on a TDD cell, all downlink subframes and subframes including DwPTS of the TDD UL/DL configuration indicated by *tdd-Config*, as specified in TS 36.331 [8] of the cell except MBSFN subframes represent PDCCH-subframes, unless specified otherwise in this clause.

- For BL UE or UE in enhanced coverage, all subframes in which the UE is required to monitor MPDCCH represent PDCCH-subframes among all valid subframes regardless of whether the subframe is dropped, see clause 9.1.5 of TS 36.213 [2].

- For NB-IoT UE, all subframes that are part of the NPDCCH search space represent PDCCH-subframes among all NB-IoT downlink subframes, including those which the UE is not required to monitor as specified in clause 16.6 of TS 36.213 [2].

**PDSCH**: Refers to subframe-PDSCH/slot-PDSCH/subslot-PDSCH or for NB-IoT to NPDSCH.

**PRACH**: Refers to PRACH or for NB-IoT to NPRACH.

**PRACH Resource Index**: The index of a PRACH within a system frame, see TS 36.211 [7]

**Primary Timing Advance Group:** Timing Advance Group containing the SpCell.

**PUCCH SCell:** An SCell configured with PUCCH/SPUCCH.

**PUSCH**: Refers to subframe-PUSCH/slot-PUSCH/subslot-PUSCH or for NB-IoT to NPUSCH.

***ra-PRACH-MaskIndex*:** Defines in which PRACHs within a system frame the MAC entity can transmit a Random Access Preamble (see clause 7.3).

**RA-RNTI:** The Random Access RNTI is used on the PDCCH when Random Access Response messages are transmitted. It unambiguously identifies which time-frequency resource was utilized by the MAC entity to transmit the Random Access preamble.

**SC Period:** Sidelink Control period, the time period consisting of transmission of SCI and its corresponding data.

**SCI:** The Sidelink Control Information contains the sidelink scheduling information such as resource block assignment, modulation and coding scheme, Group Destination ID (for sidelink communication) and PPPP (for V2X sidelink communication), see TS 36.212 [5].

**Secondary Timing Advance Group:** Timing Advance Group not containing the SpCell. A Secondary Timing Advance Group contains at least one Serving Cell with an UL configured.

**Serving Cell:** A Primary or a Secondary Cell, see TS 36.331 [8].

**Short Processing Time**: For 1 ms TTI length, the operation with short processing time in UL data transmission and DL data reception.

**Short TTI**: TTI length based on a slot or a subslot.

**Sidelink:** UE to UE interface for sidelink communication, sidelink discovery and V2X sidelink communication. The sidelink corresponds to the PC5 interface as defined in TS 23.303 [13] for sidelink communication and sidelink discovery, and as defined in TS 23.285 [14] for V2X sidelink communication.

**Sidelink communication**: AS functionality enabling ProSe Direct Communication as defined in TS 23.303 [13], between two or more nearby UEs, using E-UTRA technology but not traversing any network node.

**Sidelink Discovery Gap for Reception:** Time period during which the UE does not receive any channels in DL from any serving cell, except during random access procedure.

**Sidelink Discovery Gap for Transmission:** Time period during which the UE prioritizes transmission of sidelink discovery and associated procedures e.g. re-tuning and synchronisation over transmission of channels in UL, if they occur in the same subframe, except during random access procedure.

**Special Cell:** For Dual Connectivity operation the term Special Cell refers to the PCell of the MCG or the PSCell of the SCG, otherwise the term Special Cell refers to the PCell.

**Timing Advance Group:** A group of Serving Cells that is configured by RRC and that, for the cells with an UL configured, using the same timing reference cell and the same Timing Advance value.

**Transmission using PUR:** Allows one uplink data transmission using preconfigured uplink resource from RRC\_IDLE mode as specified in TS 36.300 [9]. Transmission using PUR refers to both CP transmission using PUR and UP transmission using PUR.

**UE-eNB RTT:** For non-terrestrial networks, the sum of the UE's Timing Advance value (see TS 36.211[7] clause 8.1) and *k\_Mac.*

**UL HARQ RTT Timer**: This parameter specifies the minimum amount of subframe(s) before a UL HARQ retransmission grant is expected by the MAC entity.

**V2X sidelink communication**: AS functionality enabling V2X Communication as defined in TS 23.285 [14], 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.

Next change

### 5.1.4 Random Access Response reception

Once the Random Access Preamble is transmitted and regardless of the possible occurrence of a measurement gap or a Sidelink Discovery Gap for Transmission or a Sidelink Discovery Gap for Reception, and regardless of the prioritization of V2X sidelink communication described in clause 5.14.1.2.2, the MAC entity shall monitor the PDCCH of the SpCell for Random Access Response(s) identified by the RA-RNTI defined below, in the RA Response window which starts at the subframe that contains the end of the preamble transmission,as specified in TS 36.211 [7], plus three subframes and has length *ra-ResponseWindowSize*.

If the UE is a BL UE or a UE in enhanced coverage:

- if the random access preamble was transmitted in a non-terrestrial network:

- RA Response window starts at the subframe that contains the end of the last preamble repetition plus 3 + UE-eNB RTT subframes, and has length *ra-ResponseWindowSize* for the corresponding enhanced coverage level;

- else:

- RA Response window starts at the subframe that contains the end of the last preamble repetition plus three subframes and has length *ra-ResponseWindowSize* for the corresponding enhanced coverage level.

If the UE is an NB-IoT UE:

- if the random access preamble was transmitted in a non-terrestrial network:

- RA Response window starts at the subframe that contains the end of the last preamble repetition plus X + UE-eNB RTT subframes, has length *ra-ResponseWindowSize* for the corresponding enhanced coverage level, where value X is determined from Table 5.1.4-1 based on the used preamble format and the number of NPRACH repetitions;

- else:

- RA Response window starts at the subframe that contains the end of the last preamble repetition plus X subframes and has length *ra-ResponseWindowSize* for the corresponding enhanced coverage level, where value X is determined from Table 5.1.4-1 based on the used preamble format and the number of NPRACH repetitions.

Table 5.1.4-1: Subframes between preamble transmission and RA Response Window in NB-IoT

|  |  |  |  |
| --- | --- | --- | --- |
| TDD/FDD mode | Preamble format | Number of NPRACH repetitions | X |
| FDD | 0 or 1 | >= 64 | 41 |
| FDD | 0 or 1 | < 64 | 4 |
| FDD | 2 | >= 16 | 41 |
| FDD | 2 | < 16 | 4 |
| TDD | Any | Any | 4 |

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

RA-RNTI= 1 + t\_id + 10\*f\_id

where t\_id is the index of the first subframe of the specified PRACH (0≤ t\_id <10), and f\_id is the index of the specified PRACH within that subframe, in ascending order of frequency domain (0≤ f\_id< 6) except for NB-IoT UEs, BL UEs or UEs in enhanced coverage. If the PRACH resource is on a TDD carrier, the f\_id is set to , where  is defined in clause 5.7.1 of TS 36.211 [7].

For BL UEs and UEs in enhanced coverage, RA-RNTI associated with the PRACH in which the Random Access Preamble is transmitted, is computed as:

RA-RNTI=1+t\_id + 10\*f\_id + 60\*(SFN\_id mod (Wmax/10))

where t\_id is the index of the first subframe of the specified PRACH (0≤ t\_id <10), f\_id is the index of the specified PRACH within that subframe, in ascending order of frequency domain (0≤ f\_id< 6), SFN\_id is the index of the first radio frame of the specified PRACH, and Wmax is 400, maximum possible RAR window size in subframes for BL UEs or UEs in enhanced coverage. If the PRACH resource is on a TDD carrier, the f\_id is set to , where  is defined in clause 5.7.1 of TS 36.211 [7].

For NB-IoT UEs, the RA-RNTI associated with the PRACH in which the Random Access Preamble is transmitted, is computed as:

RA-RNTI=1 + floor(SFN\_id/4) + 256\*carrier\_id

where SFN\_id is the index of the first radio frame of the specified PRACH and carrier\_id is the index of the UL carrier associated with the specified PRACH. The carrier\_id of the anchor carrier is 0.

For NB-IoT UEs operating in TDD mode, the RA-RNTI associated with the PRACH in which the Random Access Preamble is transmitted, is computed as:

RA-RNTI = 1 + floor(SFN\_id/4) + 256\*(H-SFN mod 2)

where SFN\_id is the index of the first radio frame of the specified PRACH and H-SFN is the index of the first hyper frame of the specified PRACH. The PDCCH transmission and the PRACH resource are on the same carrier.

The MAC entity may stop monitoring for Random Access Response(s) after successful reception of a Random Access Response containing Random Access Preamble identifiers that matches the transmitted Random Access Preamble.

- If a downlink assignment for this TTI has been received on the PDCCH for the RA-RNTI and the received TB is successfully decoded, the MAC entity shall regardless of the possible occurrence of a measurement gap or a Sidelink Discovery Gap for Transmission or a Sidelink Discovery Gap for Reception, and regardless of the prioritization of V2X sidelink communication described in clause 5.14.1.2.2:

- if the Random Access Response contains a Backoff Indicator subheader:

- set the backoff parameter value as indicated by the BI field of the Backoff Indicator subheader and Table 7.2-1, except for NB-IoT where the value from Table 7.2-2 is used.

- else, set the backoff parameter value to 0 ms.

- if the Random Access Response contains a Random Access Preamble identifier corresponding to the transmitted Random Access Preamble (see clause 5.1.3), the MAC entity shall:

- consider this Random Access Response reception successful and apply the following actions for the serving cell where the Random Access Preamble was transmitted:

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

- indicate the *preambleInitialReceivedTargetPower* and the amount of power ramping applied to the latest preamble transmission to lower layers (i.e., (PREAMBLE\_TRANSMISSION\_COUNTER – 1) \* *powerRampingStep*);

- if the SCell is configured with *ul-Configuration-r14*, ignore the received UL grant otherwise process the received UL grant value and indicate it to the lower layers;

- if, except for NB-IoT, *ra-PreambleIndex* was explicitly signalled and it was not 000000 (i.e., not selected by MAC):

- consider the Random Access procedure successfully completed.

- else if, the UE is an NB-IoT UE, *ra-PreambleIndex* was explicitly signalled and it was not 000000 (i.e., not selected by MAC) and *ra-CFRA-Config* is configured:

- consider the Random Access procedure successfully completed.

- the UL grant provided in the Random Access Response message is valid only for the configured carrier (i.e. UL carrier used prior to this Random Access procedure).

- else:

- if the Random Access Preamble was selected by the MAC entity; or

- if the UE is an NB-IoT UE, the *ra-PreambleIndex* was explicitly signalled and it was not 000000 and *ra-CFRA-Config* is not configured:

- set the Temporary C-RNTI to the value received in the Random Access Response message no later than at the time of the first transmission corresponding to the UL grant provided in the Random Access Response message;

- if the Random Access Preamble associated with EDT was transmitted and UL grant provided in the Random Access Response message is not for EDT:

- indicate to upper layers that EDT is cancelled due to UL grant not being for EDT;

- for CP-EDT, flush the Msg3 buffer.

- for UP-EDT, update the MAC PDU in the Msg3 buffer in accordance with the uplink grant received in the Random Access Response.

- if the Random Access Preamble associated with EDT was transmitted, the UL grant was received in a Random Access Response for EDT, and there is a MAC PDU in the Msg3 buffer:

- if the TB size according to *edt-SmallTBS-Enabled* and as described in clause 8.6.2 and 16.3.3 of TS 36.213 [2] does not match the size of the MAC PDU in the Msg3 buffer:

- the MAC entity shall update the MAC PDU in the Msg3 buffer in accordance with the TB size.

- if this is the first successfully received Random Access Response within this Random Access procedure; or

- if CP-EDT is cancelled due to the UL grant provided in the Random Access Response message not being for EDT:

- if the transmission is not being made for the CCCH logical channel, indicate to the Multiplexing and assembly entity to include a C-RNTI MAC control element in the subsequent uplink transmission;

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

NOTE 1: When an uplink transmission is required, e.g., for contention resolution, the eNB should not provide a grant smaller than 56 bits (or 88 bits for NB-IoT) in the Random Access Response.

NOTE 2: If within a Random Access procedure, an uplink grant provided in the Random Access Response for the same group of Random Access Preambles has a different size than the first uplink grant allocated during that Random Access procedure, the UE behavior is not defined except for EDT.

If no Random Access Response or, for NB-IoT UEs, BL UEs or UEs in enhanced coverage for mode B operation, no PDCCH scheduling Random Access Response is received within the RA Response window, or if none of all received Random Access Responses contains a Random Access Preamble identifier corresponding to the transmitted Random Access Preamble, the Random Access Response reception is considered not successful and the MAC entity shall:

- if the notification of power ramping suspension has not been received from lower layers:

- increment PREAMBLE\_TRANSMISSION\_COUNTER by 1;

- if the UE is an NB-IoT UE, a BL UE or a UE in enhanced coverage:

- if PREAMBLE\_TRANSMISSION\_COUNTER = *preambleTransMax-CE* + 1:

- if the Random Access Preamble is transmitted on the SpCell:

- indicate a Random Access problem to upper layers;

- if NB-IoT:

- consider the Random Access procedure unsuccessfully completed;

- else:

- if PREAMBLE\_TRANSMISSION\_COUNTER = *preambleTransMax* + 1:

- if the Random Access Preamble is transmitted on the SpCell:

- indicate a Random Access problem to upper layers;

- if the Random Access Preamble is transmitted on an SCell:

- consider the Random Access procedure unsuccessfully completed.

- if in this Random Access procedure, the Random Access Preamble was selected by MAC:

- based on the backoff parameter, select a random backoff time according to a uniform distribution between 0 and the Backoff Parameter Value;

- delay the subsequent Random Access transmission by the backoff time;

- else if the SCell where the Random Access Preamble was transmitted is configured with *ul-Configuration-r14*:

- delay the subsequent Random Access transmission until the Random Access Procedure is initiated by a PDCCH order with the same *ra-PreambleIndex and ra-PRACH-MaskIndex*;

- if the UE is an NB-IoT UE, a BL UE or a UE in enhanced coverage:

- increment PREAMBLE\_TRANSMISSION\_COUNTER\_CE by 1;

- if PREAMBLE\_TRANSMISSION\_COUNTER\_CE = *maxNumPreambleAttemptCE* for the corresponding enhanced coverage level+ 1:

- reset PREAMBLE\_TRANSMISSION\_COUNTER\_CE;

- consider to be in the next enhanced coverage level, if it is supported by the Serving Cell and the UE, otherwise stay in the current enhanced coverage level;

- if the UE is an NB-IoT UE:

- if the Random Access Procedure was initiated by a PDCCH order:

- select the PRACH resource in the list of UL carriers providing a PRACH resource for the selected enhanced coverage level for which the carrier index is equal to ((*Carrier Indication* from the PDCCH order) modulo (Number of PRACH resources in the selected enhanced coverage));

- consider the selected PRACH resource as explicitly signalled;

- proceed to the selection of a Random Access Resource (see clause 5.1.2).

### 5.1.5 Contention Resolution

Contention Resolution is based on either C-RNTI on PDCCH of the SpCell or UE Contention Resolution Identity on DL-SCH.

Once Msg3 is transmitted, the MAC entity shall:

- if the UE is an NB-IoT UE, a BL UE or a UE in enhanced coverage:

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

- if, for EDT, *edt-SmallTBS-Enabled* is set to *TRUE* for the corresponding PRACH resource:

- start *mac-ContentionResolutionTimer* and restart *mac-ContentionResolutionTimer* at each HARQ retransmission of the bundle in the subframe corresponding to the last subframe of a PUSCH transmission corresponding to the largest TBS indicated by the UL grant plus UE-eNB RTT subframes.

- else:

- start *mac-ContentionResolutionTimer* and restart *mac-ContentionResolutionTimer* at each HARQ retransmission of the bundle in the subframe containing the last repetition of the corresponding PUSCH transmission plus UE-eNB RTT subframes.

- else:

- if, for EDT, *edt-SmallTBS-Enabled* is set to *TRUE* for the corresponding PRACH resource:

- start *mac-ContentionResolutionTimer* and restart *mac-ContentionResolutionTimer* at each HARQ retransmission of the bundle in the subframe corresponding to the last subframe of a PUSCH transmission corresponding to the largest TBS indicated by the UL grant.

- else:

- start *mac-ContentionResolutionTimer* and restart *mac-ContentionResolutionTimer* at each HARQ retransmission of the bundle in the subframe containing the last repetition of the corresponding PUSCH transmission.

- else:

- start *mac-ContentionResolutionTimer* and restart *mac-ContentionResolutionTimer* at each HARQ retransmission.

- regardless of the possible occurrence of a measurement gap or Sidelink Discovery Gap for Reception, monitor the PDCCH until *mac-ContentionResolutionTimer* expires or is stopped;

- if notification of a reception of a PDCCH transmission is received from lower layers, the MAC entity shall:

- if the C-RNTI MAC control element was included in Msg3:

- 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 an UL grant for a new transmission; or

- if the Random Access procedure was initiated by a PDCCH order and the PDCCH transmission is addressed to the C-RNTI:

- consider this Contention Resolution successful;

- stop *mac-ContentionResolutionTimer*;

- discard the Temporary C-RNTI;

- if the UE is an NB-IoT UE:

- the UL grant or DL assignment contained in the PDCCH transmission is valid only for the configured carrier (i.e. UL/DL carrier used prior to this Random Access procedure).

- consider this Random Access procedure successfully completed.

- else if the CCCH SDU was included in Msg3 and the PDCCH transmission is addressed to its Temporary C-RNTI:

- if the MAC PDU is successfully decoded:

- stop *mac-ContentionResolutionTimer*;

- if the MAC PDU contains a UE Contention Resolution Identity MAC control element; and

- if the UE Contention Resolution Identity included in the MAC control element matches the 48 first bits of the CCCH SDU transmitted in Msg3:

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

- set the C-RNTI to the value of the Temporary C-RNTI;

- discard the Temporary C-RNTI;

- consider this Random Access procedure successfully completed.

- else:

- discard the Temporary C-RNTI;

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

- if *mac-ContentionResolutionTimer* expires:

- for BL UEs or UEs in CE or NB-IoT UEs:

- if notification of a reception of a PDCCH transmission has been received from lower layers before *mac-ContentionResolutionTimer* expired; and

- if the MAC PDU received until the subframe that contains the last repetition of the corresponding PDSCH transmission is successfully decoded; and

- if the MAC PDU contains a UE Contention Resolution Identity MAC control element; and

- if the UE Contention Resolution Identity included in the MAC control element matches the 48 first bits of the CCCH SDU transmitted in Msg3:

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

- set the C-RNTI to the value of the Temporary C-RNTI;

- discard the Temporary C-RNTI;

- consider this Random Access procedure successfully completed.

- else:

- discard the Temporary C-RNTI;

- consider this Contention Resolution not successful.

- except for BL UEs or UEs in CE or NB-IoT UEs:

- discard the Temporary C-RNTI;

- consider the Contention Resolution not successful.

- if the Contention Resolution is considered not successful the MAC entity shall:

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

- if the notification of power ramping suspension has not been received from lower layers:

- increment PREAMBLE\_TRANSMISSION\_COUNTER by 1;

- if the UE is an NB-IoT UE, a BL UE or a UE in enhanced coverage:

- if PREAMBLE\_TRANSMISSION\_COUNTER = *preambleTransMax-CE* + 1:

- indicate a Random Access problem to upper layers;

- if NB-IoT:

- consider the Random Access procedure unsuccessfully completed.

- else:

- if PREAMBLE\_TRANSMISSION\_COUNTER = *preambleTransMax* + 1:

- indicate a Random Access problem to upper layers.

- based on the backoff parameter, select a random backoff time according to a uniform distribution between 0 and the Backoff Parameter Value;

- delay the subsequent Random Access transmission by the backoff time;

- proceed to the selection of a Random Access Resource (see clause 5.1.2).

Next change

## 5.2a Maintenance of UL Synchronization

If upper layer informs that the UL synchronization is lost according to the clause 5.3.3.Y of TS 36.331 [8], the MAC entity shall:

- flush all HARQ buffers;

- not perform any uplink transmission.

If upper layer informs that the UL synchronization is restored for the SpCell according to the clause 5.2.2.22 of TS36.331 [8], uplink transmissions can be performed

Next change

### 5.4.9 Timing Advance Reporting

The UE may be configured to report information about UE specific timing advance during a Random Access procedure and in RRC\_CONNECTED Mode.

The Timing Advance reporting procedure is used in a non-terrestrial network to provide the eNB with an estimate of the UEs Timing Advance, see TTA in TS 36.211 [7] clause 8.1.

RRC controls Timing Advance reporting by configuring the following parameters:

- *ta-Report*;

- *offsetThresholdTA*.

If configured, Timing Advance reporting may be triggered if any of the following events occur:

- if triggered by upper layers;

- upon configuration or reconfiguration of *offsetThresholdTA*, by upper layers, if the UE has not previously reported Timing Advance value to current Serving Cell;

- if the variation between current information about Timing Advance and the last successfully reported information about Timing Advance is equal to or larger than *offsetThresholdTA*, if configured.

If the Timing Advance reporting procedure determines that at least one Timing Advance Report has been triggered and not cancelled:

- if the MAC entity has UL resources allocated for new transmission for this TTI, and;

- if the allocated UL resources can accommodate the Timing Advance Report MAC plus its subheader, as a result of logical channel prioritization:

- instruct the Multiplexing and Assembly procedure to generate the Timing Advance report MAC control element as defined in clause 6.1.3.20.

A MAC PDU shall contain at most one Timing Advance Report MAC CE, even when multiple events have triggered a Timing Advance report.

All triggered Timing Advance reports shall be cancelled when a Timing Advance Report MAC CE is included in a MAC PDU for transmission.

Next change

## 5.9 MAC Reset

If a reset of the MAC entity is requested by upper layers, the MAC entity shall:

- initialize Bj for each logical channel to zero;

- except for *pur-TimeAlignmentTimer,* if configured*,* stop (if running) all timers;

- except for *pur-TimeAlignmentTimer,* if configured*,* consider all *timeAlignmentTimer*sas expired and perform the corresponding actions in clause 5.2;

- set the NDIs for all uplink HARQ processes to the value 0;

- stop, if any, ongoing RACH procedure;

- discard explicitly signalled *ra-PreambleIndex* and *ra-PRACH-MaskIndex*, if any;

- flush Msg3 buffer;

- cancel, if any, triggered Scheduling Request procedure;

- cancel, if any, triggered Buffer Status Reporting procedure;

- cancel, if any, triggered Power Headroom Reporting procedure;

- cancel, if any, triggered Recommended bit rate query procedure;

- cancel, if any, triggered Timing Advance Reporting procedure;

- flush the soft buffers for all DL HARQ processes;

- for each DL HARQ process, consider the next received transmission for a TB as the very first transmission;

- release, if any, Temporary C-RNTI.

If a partial reset of the MAC entity is requested by upper layers, for a serving cell, the MAC entity shall for the serving cell:

- set the NDIs for all uplink HARQ processes to the value 0;

- flush all UL HARQ buffers;

- stop all running *drx-ULRetransmissionTimers*;

- stop all running UL HARQ RTT timers;

- stop, if any, ongoing RACH procedure;

- discard explicitly signalled *ra-PreambleIndex* and *ra-PRACH-MaskIndex*, if any;

- flush Msg3 buffer;

- release, if any, Temporary C-RNTI.