3GPP RAN WG2 Meeting #116e R2-21xxxxx

eMeeting November 1st – 12th, 2021

|  |
| --- |
| *CR-Form-v12.1* |
| **CHANGE REQUEST** |
|  |
|  | **36.321** | **CR** | **draft** | **rev** | **-** | **Current version:** | **16.5.0** |  |
|  |
| *For* [*HE**LP*](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* |
|  |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***Proposed change affects:*** | UICC apps |  | ME | **X** | Radio Access Network | **x** | Core Network |  |

|  |
| --- |
|  |
| ***Title:***  | Stage-3 running CR for TS 36.321 for Rel-17 IoT-NTN |
|  |  |
| ***Source to WG:*** | MediaTek |
| ***Source to TSG:*** | R2 |
|  |  |
| ***Work item code:*** | LTE\_NBIOT\_eMTC\_NTN |  | ***Date:*** | 2021-09-02 |
|  |  |  |  |  |
| ***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 canbe found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | *Use one of the following releases:Rel-8 (Release 8)Rel-9 (Release 9)Rel-10 (Release 10)Rel-11 (Release 11)…Rel-15 (Release 15)Rel-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)* |
|  |  |
| ***Reason for change:*** | Introduction of 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 115e. |
|  |  |
| ***Consequences if not approved:*** | No support for Release-17 enhancements for NTN in IoT |
|  |  |
| ***Clauses affected:*** | 5.1.4, 5.1.5, 5.2, 5.4.4, 5.4.7, 7.7, Annex C |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  |  |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** |  |  |  Test specifications | TS/TR ... CR ...  |
| ***(show related CRs)*** |  |  |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***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 network:** [to be provided by the RAN3 stg2 CR].

***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-gNB RTT: For non-terrestrial networks, the sum of the UEs Timing Advance value and K\_mac, see TS 36.2XX [Y] clause X.X.

**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.

Start of changes

### 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, 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, 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.

If the UE is an NTN-NB-IoT UE, RA Response window starts at the subframe that contains the end of the last preamble repetition plus X + UE-eNB RTT subframes, as specified in TS 36.2XX [6] clause X.X 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.

.

Editor’s Note: If the start of the RA Response window is accurately compensated by UE-eNB RTT and no extension of repetition is required, there is no need to extend the *ra-ResponseWindowSize* for IoT NTN.

Editor’s Note: FFS if applicable to NB-IoT 41ms offset.

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, as specified in TS 36.2XX [6] clause X.X.

 - 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, as specified in TS 36.2XX [6] clause X.X.

- 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.

Editor’s Note: If the start of *mac-contentionResolutionTimer* is accurately compensated by UE-eNB RTT and no extension of repetition is required, there is no need to extend the *mac-Cont entionResolutionTimer* for IoT NTN.

 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

## 5.2 Maintenance of Uplink Time Alignment

The MAC entity has a configurable timer *timeAlignmentTimer* per TAG. The *timeAlignmentTimer* is used to control how long the MAC entity considers the Serving Cells belonging to the associated TAG to be uplink time aligned, as specified in TS 36.331 [8].

The MAC entity shall:

- when a Timing Advance Command MAC control element is received and if a NTA has been stored or maintained with the indicated TAG:

- except when the received Timing Advance Command MAC control element is addressed with a PUR-RNTI:

- apply the Timing Advance Command for the indicated TAG;

- start or restart the *timeAlignmentTimer* associated with the indicated TAG.

- when a Timing Advance Command is received in a Random Access Response message for a serving cell belonging to a TAG:

- if the UE is configured with *pur-Config* (see TS 36.331 [8]) and if a NTA has been stored or maintained and no temporary NTA has been stored:

- store current NTA as temporary NTA (see clause 5.4.7.2).

- if the Random Access Preamble was not selected by the MAC entity:

- apply the Timing Advance Command for this TAG;

- start or restart the *timeAlignmentTimer* associated with this TAG.

- else, if the *timeAlignmentTimer* associated with this TAG is not running:

- apply the Timing Advance Command for this TAG;

- start the *timeAlignmentTimer* associated with this TAG;

- when the contention resolution is considered not successful as described in clause 5.1.5, stop *timeAlignmentTimer* associated with this TAG*.*

- else:

- ignore the received Timing Advance Command.

- when the MAC entity is configured with *rach-Skip* or *rach-SkipSCG*:

- apply timing advance value indicated by *targetTA* in *rach-Skip* or *rach-SkipSCG* for the pTAG;

- start the *timeAlignmentTimer* associated with this TAG.

- when a *timeAlignmentTimer* expires:

- if the *timeAlignmentTimer* is associated with the pTAG:

- flush all HARQ buffers for all serving cells;

- notify RRC to release PUCCH/SPUCCH for all serving cells;

- notify RRC to release SRS for all serving cells;

- for NB-IoT, notify RRC to release all dedicated resources for SR;

- clear any configured downlink assignments and uplink grants;

- consider all running *timeAlignmentTimer*s as expired;

- else if the *timeAlignmentTimer* isassociated with an sTAG, then for all Serving Cells belonging to this TAG*:*

- flush all HARQ buffers;

- notify RRC to release SRS;

- notify RRC to release PUCCH/SPUCCH, if configured;

- clear any configured downlink assignments and uplink grants.

- upon indication from upper layers to start *timeAlignmentTimer*, if a NTA has been stored or maintained with the indicated TAG:

- start or restart the *timeAlignmentTimer* associated with the indicated TAG.

When the MAC entity stops uplink transmissions for an SCell due to the fact that the maximum uplink transmission timing difference (as described in clause 7.9.2 of TS 36.133 [9]) or the maximum uplink transmission timing difference the UE can handle between TAGs of any MAC entity of the UE is exceeded, the MAC entity considers the *timeAlignmentTimer* associated with the SCell as expired.

The MAC entity shall not perform any uplink transmission on a Serving Cell, except the Random Access Preamble transmission and transmissions corresponding to a PUR-RNTI, when the *timeAlignmentTimer* associated with the TAG to which this Serving Cell belongs is not running. Furthermore, when the *timeAlignmentTimer* associated with the pTAG is not running, the MAC entity shall not perform any uplink transmission on any Serving Cell except the Random Access Preamble transmission on the SpCell.

The MAC entity shall not perform any sidelink transmission which is performed based on UL timing of the corresponding serving cell and any associated SCI transmissions when the corresponding *timeAlignmentTimer* is not running.

NOTE: A MAC entity stores or maintains NTA upon expiry of associated *timeAlignmentTimer*, where NTA is defined in TS 36.211 [7]. The MAC entity applies a received Timing Advance Command MAC control element and starts associated *timeAlignmentTimer* also when the *timeAlignmentTimer* is not running.

Editor’s Note: RAN2 assumes that TA information (FFS what) reporting by the UE on network enabling will be needed in IoT NTN. RAN2 expects that RAN1 needs to progress on this, and can maybe reuse NR NTN progress. Which message this is provided will be determined later.

Next change

### 5.4.4 Scheduling Request

The Scheduling Request (SR) is used for requesting UL-SCH resources for new transmission.

When an SR is triggered, it shall be considered as pending until it is cancelled. All pending SR(s) shall be cancelled and *sr-ProhibitTimer* and *ssr-ProhibitTimer* shall be stopped when a MAC PDU is assembled and this PDU includes a BSR which contains buffer status up to (and including) the last event that triggered a BSR (see clause 5.4.5), or, if all pending SR(s) are triggered by Sidelink BSR, when a MAC PDU is assembled and this PDU includes a Sidelink BSR which contains buffer status up to (and including) the last event that triggered a Sidelink BSR (see clause 5.14.1.4), or, if all pending SR(s) are triggered by Sidelink BSR, when upper layers configure autonomous resource selection, or when the UL grant(s) can accommodate all pending data available for transmission.

If the MAC entity has resources for SR configured on only one of SPUCCH and PUCCH, that SR resource is valid for all logical channels. If the MAC entity has resources for SR configured on both PUCCH and SPUCCH, MAC entity shall consider all logical channels that have triggered an SR (and at *retxBSR-Timer* expiry, MAC entity shall consider all logical channels, belonging to a LCG, with data available for transmission):

- PUCCH resources for SR are valid if *logicalChannelSr-Restriction* is not configured, or if *logicalChannelSr-Restriction* allows SR on PUCCH, for any of the logical channels;

- SPUCCH resources for SR are valid if *logicalChannelSr-Restriction* is not configured, or if *logicalChannelSr-Restriction* allows SR on SPUCCH, for any of the logical channels.

If an SR is triggered and there is no other SR pending, the MAC entity shall set the SR\_COUNTER and the SSR\_COUNTER to 0.

As long as one SR is pending, the MAC entity shall for each TTI:

- if no UL-SCH resources are available for a transmission in this TTI:

- Except for NB-IoT:

- if the MAC entity has no valid PUCCH nor valid SPUCCH resource for SR configured in any TTI:

- if the MAC entity is a MCG MAC entity and *rach-Skip* is not configured; or

- if the MAC entity is a SCG MAC entity and *rach-SkipSCG* is not configured:

- initiate a Random Access procedure (see clause 5.1) on the corresponding SpCell and cancel all pending SRs;

- else if this TTI is not part of a measurement gap or Sidelink Discovery Gap for Transmission, and if transmission of V2X sidelink communication is not prioritized in this TTI as described in clause 5.14.1.2.2:

- if the MAC entity has at least one valid SPUCCH resource for SR configured for this TTI and if *ssr-ProhibitTimer* is not running:

- if SSR\_COUNTER < *dssr-TransMax*:

- increment SSR\_COUNTER by 1;

- instruct the physical layer to signal the SR on one valid SPUCCH resource for SR;

- start the *ssr-ProhibitTimer*.

- else:

- notify RRC to release SPUCCH for all serving cells;

- if the MAC entity has no valid PUCCH resource for SR configured in any TTI:

- notify RRC to release PUCCH for all serving cells;

- notify RRC to release SRS for all serving cells;

- clear any configured downlink assignments and uplink grants;

- initiate a Random Access procedure (see clause 5.1) on the SpCell and cancel all pending SRs.

- if the MAC entity has at least one valid PUCCH resource for SR configured for this TTI and if *sr-ProhibitTimer* is not running:

- if SR\_COUNTER < *dsr-TransMax*:

- increment SR\_COUNTER by 1;

- instruct the physical layer to signal the SR on one valid PUCCH resource for SR;

- start the *sr-ProhibitTimer*.

Editor’s Note: RAN2 assumes that *sr-ProhibitTimer* needs to be extended. The treatment of *sr-ProhibitTimer* values is postponed until the NR NTN details have been decided.

- else:

- notify RRC to release PUCCH and SPUCCH for all serving cells;

- notify RRC to release SRS for all serving cells;

- clear any configured downlink assignments and uplink grants;

- initiate a Random Access procedure (see clause 5.1) on the SpCell and cancel all pending SRs.

- For NB-IoT:

- if the MAC entity has no valid resource for SR together with acknowledgement of the data in this TTI and no valid PRACH resource for SR configured in any TTI:

- initiate a Random Access Procedure (see clause 5.1), and cancel all pending SRs in the first subframe containing PRACH for preamble transmission.

- else:

- if the MAC entity has valid resource for SR together with acknowledgement of the data in this TTI:

- instruct the physical layer to signal the SR together with acknowledgement of the data.

- cancel, if any, initiated Random Access Procedure for SR.

- else:

- if the MAC entity has valid PRACH resource for SR configured in this TTI and *sr-ProhibitTimer* is not running:

- instruct the physical layer to signal the SR on one valid PRACH resource for SR.

- start the *sr-ProhibitTimer* in the subframe containing the last repetition of the corresponding SR transmission.

Editor’s Note: RAN2 assumes that *sr-ProhibitTimer* needs to be extended. The treatment of *sr-ProhibitTimer* values is postponed until the NR NTN details have been decided.

NOTE 1: The selection of which valid PUCCH/SPUCCH resource for SR to signal SR on when the MAC entity has more than one valid PUCCH/SPUCCH resource for SR in one TTI or overlapping TTIs is left to UE implementation.

NOTE 2: SR\_COUNTER is incremented for each SR bundle. *sr-ProhibitTimer* is started in the first TTI of an SR bundle.

Next change

### 5.4.7 Preconfigured Uplink Resource

#### 5.4.7.1 Transmission using PUR

Transmission using PUR is initiated by the RRC layer. When transmission using PUR is initiated, RRC layer provides MAC with the following information:

- PUR-RNTI;

- Duration of PUR response window *pur-ResponseWindowSize*;

- UL grant information.

If the MAC entity has a PUR-RNTI, the MAC entity shall for each TTI for which RRC layer has provided uplink grant for transmission using PUR:

- deliver the uplink grant, and the associated HARQ information to the HARQ entity for this TTI.

After transmission using PUR, the MAC entity shall monitor PDCCH identified by PUR-RNTI in the PUR response window using timer *pur-ResponseWindowTimer*, which starts at the subframe that contains the end of the corresponding PUSCH transmission plus 4 subframes, and has the length *pur-ResponseWindowSize.* While *pur-ResponseWindowTimer* is running, the MAC entity shall:

- if the PDCCH transmission is addressed to the PUR-RNTI and contains an UL grant for a retransmission:

- restart *pur-ResponseWindowTimer* at the last subframe of a PUSCH transmission corresponding to the retransmission indicated by the UL grant plus 4 subframes.

- if L1 ACK for transmission using PUR is received from lower layers; or

- if PDCCH transmission is addressed to the PUR-RNTI and the MAC PDU is successfully decoded:

- stop *pur-ResponseWindowTimer*;

- if L1 ACK for transmission using PUR is received from lower layers or the MAC PDU contains only Timing Advance Command MAC control element:

- indicate to upper layers the transmission using PUR was successful;

- if repetition adjustment for transmission using PUR is received from lower layers:

- indicate the value of the repetition adjustment to upper layers.

- discard the PUR-RNTI.

- else if fallback indication for PUR is received from lower layers:

- stop *pur-ResponseWindowTimer*;

- indicate to upper layers PUR fallback indication is received;

- if repetition adjustment for transmission using PUR is received from lower layers:

- indicate the value of the repetition adjustment to upper layers.

- discard the PUR-RNTI.

- if the *pur-ResponseWindowTimer* expires:

- indicate to upper layers the transmission using PUR has failed;

- discard the PUR-RNTI.

Editor’s Note: From RAN2’s perspective, delayed start of *pur-ResponseWindowTimer* with UE-eNB RTT can be supported.

Next change

## 5.X UE-Specific TA Reporting

The UE may be configured to report information about UE specific timing advance during a Random Access procedure not due to SI request and/or when in RRC\_CONNECTED.

Editor’s Note: Support UE-specific TA reporting using MAC CE in Msg3/Msg5 for IoT NTN.

Editor’s Note: For IoT NTN, UE specific TA reporting during RACH procedure (MSG3/MSG5) in RRC IDLE is enabled/disabled by SI, similar with NR NTN

Editor’s Note: Support TA reporting in RRC connected mode in IoT NTN

Editor’s Note: UE-specific TA report uses MAC CE.

Editor’s Note: Support event-triggered for TA reporting in connected mode. Wait for NR NTN agreements for other triggers

Next change

### 6.2 Formats and Parameters

### 6.2.1 MAC header for DL-SCH, UL-SCH and MCH

The MAC header is of variable size and 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 control element or padding as described in tables 6.2.1-1, 6.2.1-2 and 6.2.1-4 for the DL-SCH, UL-SCH and MCH respectively. There is one LCID field for each MAC SDU, MAC control element or padding included in the MAC PDU. In addition to that, one or two additional LCID fields are included in the MAC PDU, when single-byte or two-byte padding is required but cannot be achieved by padding at the end of the MAC PDU. If the LCID field is set to "10000", an additional octet is present in the MAC PDU subheader containing the eLCID field and this additional octet follows the octet containing LCID field. A UE of Category 0, as specified in TS 36.306 [12], except when in enhanced coverage, and *unicastFreqHoppingInd-r13* is indicated in the BR version of SI message carrying *SystemInformationBlockType2*, and UE supports frequency hopping for unicast, as specified in TS 36.306 [12], shall indicate CCCH using LCID "01011", a BL UE with support for frequency hopping for unicast, as specified in TS 36.306 [12], and a UE in enhanced coverage with support for frequency hopping for unicast, as specified in TS 36.306 [12], shall if *unicastFreqHoppingInd-r13* is indicated in the BR version of SI message carrying *SystemInformationBlockType2* indicate CCCH using LCID "01100", otherwise the UE shall indicate CCCH using LCID "00000". A short DCQR may be included in the MAC PDU subheader with LCID set to "00000", "01011", "01100" or "01101". The LCID field size is 5 bits;

- eLCID: The extended Logical Channel ID field identifies the logical channel instance of the corresponding MAC SDU or the type of the corresponding MAC control element as described in tables 6.2.1-1a and 6.2.1-2a for the DL-SCH and UL-SCH respectively. The size of the eLCID field is 6 bits.

- L: The Length field indicates the length of the corresponding MAC SDU or variable-sized MAC control element in bytes. There is one L field per MAC PDU subheader except for the last subheader and subheaders corresponding to fixed-sized MAC control elements. The size of the L field is indicated by the F field and F2 field;

- F: The Format field indicates the size of the Length field as indicated in table 6.2.1-3. There is one F field per MAC PDU subheader except for the last subheader and subheaders corresponding to fixed-sized MAC control elements and except for when F2 is set to 1. The size of the F field is 1 bit. If the F field is included; if the size of the MAC SDU or variable-sized MAC control element is less than 128 bytes, the value of the F field is set to 0, otherwise it is set to 1;

- F2: Except when this field is used for short DCQR, the Format2 field indicates the size of the Length field as indicated in table 6.2.1-3. For short DCQR, the mapping of F2 field to short DCQR value is described in table 6.2.1-5. There is one F2 field per MAC PDU subheader. The size of the F2 field is 1 bit. Except when this field is used for short DCQR, if the size of the MAC SDU or variable-sized MAC control element is larger than 32767 bytes, and if the corresponding subheader is not the last subheader, the value of the F2 field is set to 1, otherwise it is set to 0;

- E: The Extension field is a flag indicating if more fields are present in the MAC header or not. The E field is set to "1" to indicate another set of at least R/F2/E/LCID fields. The E field is set to "0" to indicate that either a MAC SDU, a MAC control element or padding starts at the next byte;

- R: Except when this field is used for short DCQR, reserved bit, set to "0". For short DCQR, the mapping of R field to short DCQR value is described in table 6.2.1-5.

The MAC header and subheaders are octet aligned.

Table 6.2.1-1 Values of LCID for DL-SCH

|  |  |
| --- | --- |
| Codepoint/Index | LCID values |
| 00000 | CCCH |
| 00001-01010 | Identity of the logical channel |
| 01011-01111 | Reserved |
| 10000 | Extended logical channel ID field |
| 10001 | DCQR Command |
| 10010 | Activation/Deactivation of PDCP Duplication |
| 10011 | Hibernation (1 octet) |
| 10100 | Hibernation (4 octets) |
| 10101 | Activation/Deactivation of CSI-RS |
| 10110 | Recommended bit rate |
| 10111 | SC-PTM Stop Indication |
| 11000 | Activation/Deactivation (4 octets) |
| 11001 | SC-MCCH, SC-MTCH (see note) |
| 11010 | Long DRX Command |
| 11011 | Activation/Deactivation (1 octet) |
| 11100 | UE Contention Resolution Identity |
| 11101 | Timing Advance Command |
| 11110 | DRX Command |
| 11111 | Padding |
| NOTE: Both SC-MCCH and SC-MTCH cannot be multiplexed with other logical channels in the same MAC PDU except for Padding and SC-PTM Stop Indication |

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

|  |  |  |
| --- | --- | --- |
| Codepoint | Index | LCID values |
| 000000-000110 | 32-38 | Identity of the logical channel |
| 000111-111111 | 39-95 | Reserved |

For NB-IoT only the following LCID values for DL-SCH are applicable: CCCH, Identity of the logical channel, DCQR Command, SC-PTM Stop Indication, SC-MCCH/SC-MTCH, UE Contention Resolution Identity, Timing Advance Command, DRX Command and Padding.

Table 6.2.1-2 Values of LCID for UL-SCH

|  |  |
| --- | --- |
| Codepoint/Index | LCID values |
| 00000 | CCCH |
| 00001-01010 | Identity of the logical channel |
| 01011 | CCCH |
| 01100 | CCCH |
| 01101 | CCCH and Extended Power Headroom Report |
| 01110-01111 | Reserved |
| XX | UE-specific TA Report |
| 10000 | Extended logical channel ID field |
| 10001 | DCQR and AS RAI |
| 10010 | AUL confirmation (4 octets) |
| 10011 | AUL confirmation (1 octet) |
| 10100 | Recommended bit rate query |
| 10101 | SPS confirmation |
| 10110 | Truncated Sidelink BSR |
| 10111 | Sidelink BSR |
| 11000 | Dual Connectivity Power Headroom Report |
| 11001 | Extended Power Headroom Report |
| 11010 | Power Headroom Report |
| 11011 | C-RNTI |
| 11100 | Truncated BSR |
| 11101 | Short BSR |
| 11110 | Long BSR |
| 11111 | Padding |

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

|  |  |  |
| --- | --- | --- |
| Codepoint | Index | LCID values |
| 000000-000110 | 32-38 | Identity of the logical channel |
| 000111-111111 | 39-95 | Reserved |

For NB-IoT only the following LCID values for UL-SCH are applicable: CCCH (LCID "00000"), Identity of the logical channel, CCCH and Extended Power Headroom Report, DCQR and AS RAI, SPS confirmation, C-RNTI, Short BSR and Padding.

Table 6.2.1-3 Values of F and F2 fields:

|  |  |  |
| --- | --- | --- |
| Index of F2 | Index of F | Size of Length field (in bits) |
| 0 | 0 | 7 |
| 1 | 15 |
| 1 | - | 16 |

Table 6.2.1-4 Values of LCID for MCH

|  |  |
| --- | --- |
| Index | LCID values |
| 00000 | MCCH (see note) |
| 00001-11100 | MTCH |
| 11101 | Reserved |
| 11110 | MCH Scheduling Information or Extended MCH Scheduling Information |
| 11111 | Padding |
| NOTE: If there is no MCCH on MCH, an MTCH could use this value. |

Table 6.2.1-5: Values of R and F2 fields for short DCQR

|  |  |  |
| --- | --- | --- |
| Index of R | Index of F2 | Short DCQR value |
| 0 | 0 | No short DCQR |
| 0 | 1 | Short DCQR 1 |
| 1 | 0 | Short DCQR 2 |
| 1 | 1 | Short DCQR 3 |

Next change

## 7.7 HARQ RTT Timers

For each serving cell, in case of FDD configuration not configured with *subframeAssignment-r15* and in case of Frame Structure Type 3 configuration on the serving cell which carries the HARQ feedback for this serving cell the HARQ RTT Timer is set to 8 subframes. For each serving cell, in case of TDD configuration or FDD with *subframeAssignment-r15* configured on the serving cell which carries the HARQ feedback for this serving cell the HARQ RTT Timer is set to k + 4 subframes, where k is the interval between the downlink transmission and the transmission of associated HARQ feedback, as indicated in clauses 10.1 and 10.2 of TS 36.213 [2], and for an RN configured with *rn-SubframeConfig*, as specified in TS 36.331 [8] and not suspended, as indicated in Table 7.5.1-1 of TS 36.216 [11].

For each serving cell, for HARQ processes scheduled using Short Processing Time (TS 36.331 [8]) the HARQ RTT is set to 6 subframes for FDD and Frame Structure Type 3 and set to k + 3 subframes for TDD, where k is the interval between the downlink transmission and the transmission of associated HARQ feedback, as indicated in clauses 10.1 and 10.2 of TS 36.213 [2].

For each serving cell, for HARQ processes scheduled using short TTI (TS 36.331 [8]) the HARQ RTT is set to 8 TTIs if the TTI length is one slot or if *proc-Timeline* is set to n+4 set1, to 12 TTIs if *proc-Timeline* is set to n+6 set1 or n+6 set2 and to 16 TTIs if *proc-Timeline* is set to n+8 set2 for FDD and Frame Structure Type 3.

For TDD short TTI the HARQ RTT is set to k + 4 TTIs, where k is the interval between the downlink transmission and the transmission of associated HARQ feedback, as indicated in clauses 10.1 and 10.2 of TS 36.213 [2].

For BL UEs and UEs in enhanced coverage, when single TB is scheduled by PDCCH the HARQ RTT Timer corresponds to 7 + N where N is the used PUCCH repetition factor, where only valid (configured) UL subframes as configured by upper layers in *fdd-UplinkSubframeBitmapBR* are counted. In case of TDD, HARQ RTT Timer corresponds to 3 + k + N, where k is the interval between the last repetition of downlink transmission and the first repetition of the transmission of associated HARQ feedback, and N is the used PUCCH repetition factor, where only valid UL subframes are counted as indicated in clauses 10.1 and 10.2 of TS 36.213 [2].

For BL UEs and UEs in enhanced coverage, when multiple TBs are scheduled by PDCCH and HARQ-ACK bundling is not configured, the HARQ RTT Timer corresponds to 7 + m \* N where N is the used PUCCH repetition factor and m is the number of scheduled TBs as indicated in PDCCH, where only valid (configured) UL subframes as configured by upper layers in *fdd-UplinkSubframeBitmapBR* are counted.

For BL UEs and UEs in enhanced coverage, when multiple TBs are scheduled by PDCCH and HARQ-ACK bundling is configured the HARQ RTT Timer corresponds to 7 + k \* N where N is the used PUCCH repetition factor and k is the number of HARQ feedback bundles, k = ceiling(NTB/M), where NTB is the number of scheduled TBs as indicated in PDCCH and M is the Multi-TB HARQ-ACK bundling size indicated in the corresponding PDCCH as specified in clause 7.3 of TS 36.213 [2], where only valid (configured) UL subframes as configured by upper layers in *fdd-UplinkSubframeBitmapBR* are counted.

For NB-IoT, when single TB is scheduled by PDCCH or when multiple TBs are scheduled for the interleaved case when HARQ-ACK bundling is configured the HARQ RTT Timer is set to k+3+N+deltaPDCCH subframes, where k is the interval between the last subframe of the downlink transmission and the first subframe of the associated HARQ feedback transmission and N is the transmission duration in subframes of the associated HARQ feedback, and deltaPDCCH is the interval starting from the subframe following the last subframe of the associated HARQ feedback transmission plus 3 subframes to the first subframe of the next PDCCH occasion.

For NB-IoT, when multiple TBs are scheduled by PDCCH for the non-interleaved case or for the interleaved case when HARQ-ACK bundling is not configured, the HARQ RTT Timer is set to k+2\*N+1+deltaPDCCH subframes where k is the interval between the last subframe of the downlink transmission and the first subframe of the first HARQ feedback transmission and N is the transmission duration in subframes of the associated HARQ feedback, and deltaPDCCH is the interval starting from the subframe following the last subframe of the last HARQ feedback transmission plus 1 subframe to the first subframe of the next PDCCH occasion.

Except for NB-IoT and for HARQ processes scheduled using Short Processing Time and for short TTI, UL HARQ RTT Timer length is set to 4 subframes for FDD and Frame Structure Type 3, and set to kULHARQRTT subframes for TDD, where kULHARQRTT equals to the kPHICH value indicated in Table 9.1.2-1 of TS 36.213 [2] if the UE is not configured with upper layer parameter *symPUSCH-UpPts* for the serving cell, otherwise the kPHICH value is indicated in Table 9.1.2-3.

For NB-IoT, when single TB is scheduled by PDCCH the UL HARQ RTT timer length is set to 4+deltaPDCCH subframes, where deltaPDCCH is the interval starting from the subframe following the last subframe of the PUSCH transmission plus 3 subframes to the first subframe of the next PDCCH occasion.

For NB-IoT, when multiple TBs are scheduled by PDCCH the UL HARQ RTT timer length is set to 1+deltaPDCCH subframes, where deltaPDCCH is the interval starting from the subframe following the last subframe of the PUSCH transmission plus 1 subframe to the first subframe of the next PDCCH occasion.

For UE’s operating in NTN, UE-eNB RTT is added to the HARQ RTT Timer and the UL HARQ RTT Timer values as calculated above.For HARQ processes scheduled using Short Processing Time (TS 36.331  [8]), the UL HARQ RTT Timer length is set to 3 subframes for FDD and for Frame Structure Type 3, and set to kULHARQRTT subframes for TDD, where kULHARQRTT equals the value indicated in Table 7.7-1 and Table 7.7-2.

For HARQ processes scheduled using short TTI (TS 36.331 [8]), the UL HARQ RTT Timer length is set to 8 TTIs if the TTI length is one slot or if *proc-Timeline* is set to n+4 set1, to 12 TTIs if *proc-Timeline* is set to n+6 set1 or n+6 set2 and to 16 TTIs if *proc-Timeline* is set to n+8 set2 for FDD and Frame Structure Type 3. For TDD short TTI the UL HARQ RTT is set to kULHARQRTT TTIs, where kULHARQRTT equals the value indicated in Table 7.7-3, Table 7.7-4 and Table 7.7-5.

Table 7.7-1: kULHARQRTT for TDD Short Processing Time when special subframe configurations 0~9 is configured

|  |  |
| --- | --- |
| **TDD UL/DLConfiguration** | **subframe index *n*** |
| **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| 0 |  |  | 3 | 3 | 6 |  |  | 3 | 3 | 6 |
| 1 |  |  | 3 | 3 |  |  |  | 3 | 3 |  |
| 2 |  |  | 3 |  |  |  |  | 3 |  |  |
| 3 |  |  | 3 | 3 | 3 |  |  |  |  |  |
| 4 |  |  | 3 | 3 |  |  |  |  |  |  |
| 5 |  |  | 3 |  |  |  |  |  |  |  |
| 6 |  |  | 3 | 3 | 5 |  |  | 3 | 3 |  |

Table 7.7-2: kULHARQRTT for TDD Short Processing Time applied when special subframe configuration 10 is configured

|  |  |
| --- | --- |
| **TDD UL/DLConfiguration** | **subframe index n** |
| **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| 0 |  | 4 | 3 | 3 | 6 |   | 4 | 3 | 3 | 6 |
| 1 |  | 3 | 3 | 3 |   |   | 3 | 3 | 3 |   |
| 2 |  | 3 | 3 |  |  |  | 3 | 3 |  |   |
| 3 |  | 4 | 3 | 3 | 3 |  |  |  |  |   |
| 4 |  | 3 | 3 | 3 |  |  |  |  |  |   |
| 5 |  | 3 | 3 |  |  |  |  |  |  |   |
| 6 |  | 4 | 3 | 3 | 5 |  | 3 | 3 | 3 |   |

Table 7.7-3: kULHARQRTT for TDD short TTI applied when special subframe configurations 1, 2, 3, 4, 6, 7 and 8 are configured

|  |  |
| --- | --- |
| **TDD UL/DLConfiguration** | **sTTI index *n*** |
| **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** |
| 0 |  |  |  |  | 6 | 5 | 4 | 4 | 4 | 4 |  |  |  |  | 6 | 5 | 4 | 4 | 4 | 4 |
| 1 |  |  |  |  | 4 | 4 | 4 | 4 |  |  |  |  |  |  | 4 | 4 | 4 | 4 |  |  |
| 2 |  |  |  |  | 4 | 4 |  |  |  |  |  |  |  |  | 4 | 4 |  |  |  |  |
| 3 |  |  |  |  | 6 | 5 | 4 | 4 | 4 | 4 |  |  |  |  |  |  |  |  |  |  |
| 4 |  |  |  |  | 4 | 4 | 4 | 4 |  |  |  |  |  |  |  |  |  |  |  |  |
| 5 |  |  |  |  | 4 | 4 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 6 |  |  |  |  | 6 | 5 | 4 | 4 | 4 | 4 |  |  |  |  | 4 | 4 | 4 | 4 |  |  |

Table 7.7-4: kULHARQRTT for TDD short TTI applied when special subframe configurations 0, 5 and 9 are configured

|  |  |
| --- | --- |
| **TDD UL/DLConfiguration** | **sTTI index *n*** |
| **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** |
| 0 |  |  |  |  | 6 | 5 | 4 | 4 | 4 | 11 |  |  |  |  | 6 | 5 | 4 | 4 | 4 | 11 |
| 1 |  |  |  |  | 4 | 4 | 4 | 4 |  |  |  |  |  |  | 4 | 4 | 4 | 4 |  |  |
| 2 |  |  |  |  | 4 | 4 |  |  |  |  |  |  |  |  | 4 | 4 |  |  |  |  |
| 3 |  |  |  |  | 6 | 5 | 4 | 4 | 4 | 4 |  |  |  |  |  |  |  |  |  |  |
| 4 |  |  |  |  | 4 | 4 | 4 | 4 |  |  |  |  |  |  |  |  |  |  |  |  |
| 5 |  |  |  |  | 4 | 4 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 6 |  |  |  |  | 6 | 5 | 4 | 4 | 4 | 9 |  |  |  |  | 4 | 4 | 4 | 4 |  |  |

Table 7.7-5: kULHARQRTT for TDD short TTI applied when special subframe configuration 10 is configured

|  |  |
| --- | --- |
| **TDD UL/DLConfiguration** | **sTTI index *n*** |
| **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** |
| 0 |  |  |  | 7 | 6 | 5 | 4 | 4 | 4 | 11 |  |  |  | 7 | 6 | 5 | 4 | 4 | 4 | 11 |
| 1 |  |  |  | 5 | 4 | 4 | 4 | 4 |  |  |  |  |  | 5 | 4 | 4 | 4 | 4 |  |  |
| 2 |  |  |  | 4 | 4 | 4 |  |  |  |  |  |  |  | 4 | 4 | 4 |  |  |  |  |
| 3 |  |  |  | 7 | 6 | 5 | 4 | 4 | 4 | 4 |  |  |  |  |  |  |  |  |  |  |
| 4 |  |  |  | 5 | 4 | 4 | 4 | 4 |  |  |  |  |  |  |  |  |  |  |  |  |
| 5 |  |  |  | 4 | 4 | 4 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 6 |  |  |  | 7 | 6 | 5 | 4 | 4 | 4 | 9 |  |  |  | 5 | 4 | 4 | 4 | 4 |  |  |

Next change

Annex C (informative):
Intended UE behaviour for DRX Timers

When a DRX timer is set to a value of X, and n denotes the subframe in which the related event is triggered according to the clause 5.7, the intended behaviours of each DRX timer are presented in the Table C-1 below:

Table C-1: Intended UE behaviour for DRX timers

|  |  |
| --- | --- |
| DRX Timers | Intended UE behaviour ([x, y] means including subframe x and y) |
| drx-InactivityTimer | The MAC entity monitors PDCCH in PDCCH-subframes during the subframes [n+1, n+m].The MAC entity starts or restarts drxShortCycleTimer, and uses Short DRX Cycle in the subframe n+m+1, if configured. |
| drx-InactivityTimerSCPTM | The MAC entity monitors PDCCH in PDCCH-subframes during the subframes [n+1, n+m]. |
| mac-ContentionResolutionTimer or mac-ContentionResolutionTimer for the corresponding enhanced coverage level, if it exists | The MAC entity monitors PDCCH in PDCCH-subframes during the subframes [n+1, n+X]. |
| drx-RetransmissionTimer or drx-ULRetransmissionTimer | The MAC entity monitors PDCCH in PDCCH-subframes during the subframes [n, n+m-1]. |
| onDurationTimer or onDurationTimerSCPTM | The MAC entity monitors PDCCH in PDCCH-subframes during the subframes [n, n+m-1]. |
| drxShortCycleTimer | The MAC entity uses the Short DRX Cycle during the subframes [n, n+X-1].The MAC entity starts to use the Long DRX Cycle in the subframe n+X. |
| HARQ RTT Timer | The MAC entity starts drx-RetransmissionTimer in the subframe n+X, if needed. |
| UL HARQ RTT Timer | The MAC entity starts drx-ULRetransmissionTimer in the subframe n+X, if needed. |
| NOTE 1: For FDD, m is equal to X; for TDD, m is equal to the minimum number of subframes so that X PDCCH-subframes are included during the subframes [x, y].NOTE 2: A MAC entity configured with eIMTA monitors PDCCH in some subframe(s) in addition to PDCCH-subframes, as specified in clause 5.7.NOTE 3: For BL UE or UE in enhanced coverage, m is equal to the minimum number of subframes so that X PDCCH-subframes are included during the subframes [x, y]. |

For drx-InactivityTimerSCPTM, drx-InactivityTimer, drx-RetransmissionTimer and drx-ULRetransmissionTimer, if X=0, the timer does not make the MAC entity to monitor the PDCCH.

The intended UE behaviours in Table C-1 are not applicable for NB-IoT.

For NB-IoT, the intended UE behaviour regarding setting the HARQ RTT Timer is shown in Figure C-1 and for the UL HARQ RTT Timer is shown in Figure C-2.



Figure C-1: Setting the HARQ RTT Timer for NB-IoT



Figure C-2: Setting the UL HARQ RTT Timer for NB-IoT

Editor’s Note: UE-eNB RTT is taken into account when calculating the *(UL) HARQ RTT timer*.

End of changes

# Annex – Agreements

### RAN2#115-e Agreements

* Start of ra-ResponseWindow is delayed by an offset. Postpone discussion on the offset value until further agreements regarding RACH are made in RAN1.
* If the start of the RA Response window is accurately compensated by UE-eNB RTT and no extension of repetition is required, there is no need to extend the ra-ResponseWindowSize for IoT NTN.
* Start of mac-ContentionResolutionTimer is delayed by an offset, (assumed equal to UE-eNB RTT). This can be revisited if RAN1 decides something that requires to change this.
* If the start of mac-ContentionResolutionTimer is accurately compensated by UE-eNB RTT and no extension of repetition is required, there is no need to extend the mac-ContentionResolutionTimer for IoT NTN.
* From RAN2 perspective, for UE with UE-specific pre-compensation as a baseline it is up to eNB implementation to ensure sufficient time on UE side for the Msg3 transmission for IoT NTN.
* RAN2 assumes that TA information (FFS what) reporting by the UE on network enabling will be needed in IoT NTN. Expect RAN1 need to progress on this, and can maybe reuse NR NTN progress. FFS in which message this is provided.
* UE-eNB RTT is taken into account when calculating the (UL) HARQ RTT timer.
* RAN2 assumes that sr-ProhibitTimer need to be extended. Postpone treatment of sr-ProhibitTimer values until the NR NTN details have been decided.
* From RAN2’s perspective, delayed start of pur-ResponseWindowTimer with UE-eNB RTT can be supported. This can be revised if RAN1 finds issues to support PUR that are not small.
* pur-ResponseWindowSize is not extended for IoT NTN. SPS is supported without modification for IoT NTN.

### RAN2#116-e Agreements

* The estimate of UE-eNB RTT is equal to the sum of UE’s TA and K\_mac, where the UE’s TA is given by, and K\_mac value is broadcasted by network.
* RAN2 confirm that the start of mac-ContentionResolutionTimer is delayed by UE-eNB RTT in IoT NTN.
* Any enhancements on (N)PRACH resource selection in IoT NTN will not be pursued in Rel-17.
* An offset equal to UE-eNB RTT is added to the formula used for calculating the (UL) HARQ RTT timer in IoT NTN.The ra window start offset is defined as sum (current offset, UE-eNB RTT) and current offset is defined in TS36.321 (FFS if applicable to NB-IoT 41ms offset)
* Support UE-specific TA reporting using MAC CE in Msg3/Msg5 for IoT NTN.
* For IoT NTN, UE specific TA reporting during RACH procedure (MSG3/MSG5) in RRC IDLE is enabled/disabled by SI, similar with NR NTN.
* Support TA reporting in RRC connected mode in IoT NTN.
* UE-specific TA report uses MAC CE.
* Support event-triggered for TA reporting in connected mode. Wait for NR NTN agreements for other triggers.