**3GPP TSG-RAN WG2 Meeting #110-e *R2-2005924***

**Electronic meeting, 1st – 12th June 2020**

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| *CR-Form-v12.0* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
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|  | **36.321** | **CR** | **1472** | **rev** | **2** | **Current version:** | **16.0.0** |  |
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| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* | | | | | | | | |
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| ***Proposed change affects:*** | | | UICC apps | | | |  | ME | **x** | Radio Access Network | | | | | **x** | Core Network |  |
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| ***Title:*** | Corrections to MAC for Rel-16 NB-IoT | | | | | | | | | | | | | | | | |
|  |  | | | | | | | | | | | | | | | | |
| ***Source to WG:*** | Ericsson | | | | | | | | | | | | | | | | |
| ***Source to TSG:*** | R2 | | | | | | | | | | | | | | | | |
|  |  | | | | | | | | | | | | | | | | |
| ***Work item code:*** | NB\_IOTenh3-Core, LTE\_eMTC5-Core | | | | | | | | |  | ***Date:*** | | | 2020-05-21 | | | |
|  |  | | | | |  | | | | |  | | |  | | | |
| ***Category:*** | F |  | | | | | | | | | ***Release:*** | | | Rel-16 | | | |
|  | *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-12 (Release 12) Rel-13 (Release 13) Rel-14 (Release 14) Rel-15 (Release 15) Rel-16 (Release 16)* | | | | |
|  |  | | | | | | | | | | | | | | | | |
| ***Reason for change:*** | | Capturing agreements and clarifications in MAC to finalize Rel-16 features for NB-IoT. | | | | | | | | | | | | | | | |
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| ***Summary of change:*** | | The following agreements from RAN2#110-e have been captured:   * When repetition adjustment DCI is detected, MAC layer expects the 3-bit index from PHY layer and further provides it to RRC layer. RRC layer updates the PUR configuration with the provided information. * RRC layer calculates the exact PUR timing and provides the information to MAC in the form of UL grant. Details of the timing of providing this information to MAC layer is up to UE implementation. * pur-ResponseWindowSize is provided to MAC when lower layers are configured to use PUR. * If pur-Config is not present in RRC release, pur-TimeAlignmentTimer is kept running. * When configuration of pur-TimeAlignmentTimer is not present in pur-Config, the timer is released and not applicable. * Clarify that pur-TimeAlignmentTimer is not provided to lower layers when configuring lower layers for transmission using PUR as it is provided already earlier in pur-Config.   The following agreements from RAN2#109bis-e have been captured:   * No further MAC-RRC interaction on TA validation is needed. Remove the Editor’s Note “How RRC indicates to MAC that TA is valid or instructs MAC to use PUR” from 36.321. * Remove the references to PUR TA timer validation in section 5.4.7.1 from 36.321. * PUR release due to RACH initiation on a new cell is captured in RRC. * PUR configuration is released when the UE initiates RA procedure on a new cell for all purposes. * Revert the previous working assumption, PUR grant is maintained in RRC. * The handling of ‘m’ counter is moved from MAC to RRC * PUR-RNTI is used as the name of RNTI used for PUR. | | | | | | | | | | | | | | | |
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| ***Consequences if not approved:*** | | Rel-16 corrections and functionality for NB-IoT and eMTC Rel-16 will be missing from MAC. | | | | | | | | | | | | | | | |
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| ***Clauses affected:*** | | 5.4.1, 5.4.2.1, 5.4.7.1, 5.4.7.2, 5.9, 7.1 | | | | | | | | | | | | | | | |
|  | |  | | | | | | | | | | | | | | | |
|  | | **Y** | | **N** |  | | | | | | |  | | | | | |
| ***Other specs*** | | **X** | |  | Other core specifications | | | | | | | TS 36.300 CR 1277  TS 36.306 CR 1746  TS 36.331 CR 4287 | | | | | |
| ***affected:*** | |  | | **X** | Test specifications | | | | | | |  | | | | | |
| ***(show related CRs)*** | |  | | **X** | O&M Specifications | | | | | | |  | | | | | |
|  | |  | | | | | | | | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | | | | | | | | |
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| ***This CR's revision history:*** | |  | | | | | | | | | | | | | | | |

First Change

### 5.4.1 UL Grant reception

In order to transmit on the UL-SCH the MAC entity must have a valid uplink grant (except for non-adaptive HARQ retransmissions) which it may receive dynamically on the PDCCH or in a Random Access Response or which may be configured semi-persistently or preallocated by RRC or provided by RRC for transmission using PUR (see clause 5.4.7). To perform requested transmissions, the MAC layer receives HARQ information from lower layers. When the physical layer is configured for uplink spatial multiplexing, the MAC layer can receive up to two grants (one per HARQ process) for the same TTI from lower layers.

If the MAC entity has a C-RNTI, a Semi-Persistent Scheduling C-RNTI, a UL Semi-Persistent Scheduling V-RNTI, a AUL C-RNTI, or a Temporary C-RNTI, the MAC entity shall for each TTI and for each Serving Cell belonging to a TAG that has a running *timeAlignmentTimer* and for each grant received for this TTI and for each SPS configuration that is indicated by the PDCCH addressed to UL Semi-Persistent Scheduling V-RNTI; or if the MAC entity has Preconfigured Uplink Resource RNTI, the MAC entity shall for each TTI and for each grant received for this TTI:

- if an uplink grant for this TTI and this Serving Cell has been received on the PDCCH for the MAC entity's C-RNTI, Preconfigured Uplink Resource RNTI or Temporary C-RNTI; or

- if an uplink grant for this TTI has been received in a Random Access Response:

- if the uplink grant is for MAC entity's C-RNTI and if the previous uplink grant delivered to the HARQ entity for the same HARQ process was either an uplink grant received for the MAC entity's Semi-Persistent Scheduling C-RNTI, for the MAC entity's UL Semi-Persistent Scheduling V-RNTI, or a configured uplink grant for which the UL HARQ operation was not autonomous:

- consider the NDI to have been toggled for the corresponding HARQ process regardless of the value of the NDI.

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

- else, if an uplink grant for this TTI has been received for this Serving Cell on the PDCCH for the MAC entity's Semi-Persistent Scheduling C-RNTI or for the MAC entity's UL Semi-Persistent Scheduling V-RNTI; or if an uplink grant for this TTI has been received for this Serving Cell on the PDCCH for the MAC entity's AUL C-RNTI:

- if the NDI in the received HARQ information is 1:

- consider the NDI for the corresponding HARQ process not to have been toggled;

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

- else if the NDI in the received HARQ information is 0:

- if PDCCH contents indicate AUL release:

- trigger an AUL confirmation;

- if an uplink grant for this TTI has been configured:

- consider the NDI bit for the corresponding HARQ process to have been toggled;

- deliver the configured uplink grant and the associated HARQ information to the HARQ entity for this TTI;

- else if PDCCH contents indicate AUL activation:

- trigger an AUL confirmation;

- store the uplink grant and the associated HARQ information as configured uplink grant;

- initialise (if not active) or re-initialise (if already active) the configured uplink grant to start in this TTI and to recur according to rules in clause 5.23;

- consider the NDI bit for the corresponding HARQ process to have been toggled;

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

- else if PDCCH contents indicate SPS release:

- if the MAC entity is configured with *skipUplinkTxSPS*:

- trigger an SPS confirmation;

- if an uplink grant for this TTI has been configured:

- consider the NDI bit for the corresponding HARQ process to have been toggled;

- deliver the configured uplink grant and the associated HARQ information to the HARQ entity for this TTI;

- else:

- clear the corresponding configured uplink grant (if any).

- else:

- if the MAC entity is configured with *skipUplinkTxSPS*:

- trigger an SPS confirmation;

- store the uplink grant and the associated HARQ information as configured uplink grant;

- initialise (if not active) or re-initialise (if already active) the configured uplink grant to start in this TTI, or in TTI according to N=0 in clause 5.10.2 for short TTI, and to recur according to rules in clause 5.10.2;

- if UL HARQ operation is asynchronous, set the HARQ Process ID to the HARQ Process ID associated with this TTI;

- consider the NDI bit for the corresponding HARQ process to have been toggled;

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

- else, if an uplink grant for this TTI has been configured for the Serving Cell and if UL HARQ operation is autonomous for the corresponding HARQ process:

- if the HARQ\_FEEDBACK is set to ACK for the corresponding HARQ process or if there is no uplink grant previously delivered to the HARQ entity for the same HARQ process:

- consider the NDI bit for the corresponding HARQ process to have been toggled.

- if the *aul-RetransmissionTimer* is not running:

- if there is no uplink grant previously delivered to the HARQ entity for the same HARQ process; or

- if the previous uplink grant delivered to the HARQ entity for the same HARQ process was not an uplink grant received for the MAC entity's C-RNTI; or

- if the HARQ\_FEEDBACK is set to ACK for the corresponding HARQ process:

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

- else:

- if this Serving Cell is the SpCell and an uplink grant for this TTI has been preallocated for the SpCell; or

- except for preconfigured uplink grant for PUR, if an uplink grant for this TTI has been configured for this Serving Cell:

- if UL HARQ operation is asynchronous, set the HARQ Process ID to the HARQ Process ID associated with this TTI;

- consider the NDI bit for the corresponding HARQ process to have been toggled;

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

NOTE 1: The period of configured uplink grants is expressed in TTIs.

NOTE 2: If the MAC entity receives both a grant in a Random Access Response and a grant for its C-RNTI or Semi persistent scheduling C-RNTI requiring transmissions on the SpCell in the same UL subframe, the MAC entity may choose to continue with either the grant for its RA-RNTI or the grant for its C-RNTI or Semi persistent scheduling C-RNTI.

NOTE 3: When a configured uplink grant is indicated during a measurement gap and indicates an UL-SCH transmission during a measurement gap, the MAC entity processes the grant but does not transmit on UL-SCH. When a configured uplink grant is indicated during a Sidelink Discovery gap for reception and indicates an UL-SCH transmission during a Sidelink Discovery gap for transmission with a SL-DCH transmission, the MAC entity processes the grant but does not transmit on UL-SCH. When a configured uplink grant indicates an UL-SCH transmission during a V2X sidelink communication transmission and transmission of V2X sidelink communication is prioritized as described in clause 5.14.1.2.2, the MAC entity processes the grant but does not transmit on UL-SCH.

NOTE 4: The NDI transmitted in the PDCCH for the MAC entity's AUL C-RNTI is set to '0' (TS 36.212 [5]).

Except for NB-IoT, for configured uplink grants without *harq-ProcID-offset*, if UL HARQ operation is not autonomous, the HARQ Process ID associated with this TTI is derived from the following equation for asynchronous UL HARQ operation:

- if the TTI is a subframe TTI:

- HARQ Process ID = [floor(CURRENT\_TTI/semiPersistSchedIntervalUL)] modulo numberOfConfUlSPS-Processes,

where CURRENT\_TTI=[(SFN \* 10) + subframe number] and it refers to the subframe where the first transmission of a bundle takes place.

- else:

- HARQ Process ID = [floor(CURRENT\_TTI/*semiPersistSchedIntervalUL-sTTI*)] modulo *numberOfConfUlSPS-Processes-sTTI*,

where CURRENT\_TTI = [(SFN \* 10 \* sTTI\_Number\_Per\_Subframe) + subframe number \* sTTI\_Number\_Per\_Subframe + sTTI\_number] and it refers to the short TTI occasion where the first transmission of a bundle takes place. Refer to 5.10.2 for sTTI\_Number\_Per\_Subframe and sTTI\_number.

For preallocated uplink grants the HARQ Process ID associated with this TTI is derived from the following equation for asynchronous UL HARQ operation:

HARQ Process ID = [floor(CURRENT\_TTI/*ul-SchedInterval*)] modulo *numberOfConfUL-Processes*,

where CURRENT\_TTI=subframe number and it refers to the subframe where the first transmission of a bundle takes place.

For configured uplink grants, if UL HARQ operation is autonomous, the HARQ Process ID associated with this TTI for transmission on this Serving Cell is selected by the UE implementation from the HARQ process IDs that are configured for autonomous UL HARQ operation by upper layers in *aul-HARQ-Processes* (TS 36.331 [8]).

For configured uplink grants with *harq-ProcID-offset*, the HARQ Process ID associated with this TTI is derived from the following equation for asynchronous UL HARQ operation:

- if the TTI is a subframe TTI:

- HARQ Process ID = [floor(CURRENT\_TTI/*semiPersistSchedIntervalUL*)] modulo *numberOfConfUlSPS-Processes* + *harq-ProcID-offset*,

where CURRENT\_TTI = [(SFN \* 10) + subframe number] and it refers to the subframe where the first transmission of a bundle takes place.

- else:

- HARQ Process ID = [floor(CURRENT\_TTI/*semiPersistSchedIntervalUL-sTTI*)] modulo *numberOfConfUlSPS-Processes-sTTI* + harq-ProcID-offset,

where CURRENT\_TTI = [(SFN \* 10 \* sTTI\_Number\_Per\_Subframe) + subframe number \* sTTI\_Number\_Per\_Subframe + sTTI\_number] and it refers to the short TTI occasion where the first transmission of a bundle takes place. Refer to 5.10.2 for sTTI\_Number\_Per\_Subframe and sTTI\_number. For NB-IoT, for configured uplink grants for BSR, the HARQ Process ID is set to 0.

If the MAC entity is configured with Short Processing Time or short TTI and if current\_TTI is a subframe TTI, the HARQ Process ID associated with this TTI is derived from the following equation for synchronous UL HARQ operation:

HARQ Process ID = [SFN \* number\_of\_UL\_PUSCH\_SFs\_per\_radio\_frame + index\_of\_UL\_PUSCH\_SF] modulo number\_of\_UL\_HARQ\_processes.

where number\_of\_UL\_PUSCH\_SFs\_per\_radio\_frame is the number of subframes that can be used for PUSCH (UL PUSCH subframe) per radio frame:

- For FDD serving cells and serving cells operating according to Frame structure Type 3, all 10 subframes in a radio frame represent UL PUSCH subframes;

- For TDD serving cells, all uplink subframes of the TDD UL/DL configuration indicated by *tdd-Config*, as specified in TS 36.331 [8] of the cell represent UL PUSCH subframes and additionally the subframes including UpPTS if the cell is configured with *symPUSCH-UpPts-r14*;

and index\_of\_UL\_PUSCH\_SF is the index of a subframe that can be used for PUSCH within the radio frame, and number\_of\_UL\_HARQ\_processes is the number of parallel HARQ processes per HARQ entity for subframe TTI as specified in TS 36.213 [2], clause 8.

Next Change

### 5.4.2 HARQ operation

#### 5.4.2.1 HARQ entity

There is one HARQ entity at the MAC entity for each Serving Cell with configured uplink, which maintains a number of parallel HARQ processes allowing transmissions to take place continuously while waiting for the HARQ feedback on the successful or unsuccessful reception of previous transmissions.

The number of parallel HARQ processes per HARQ entity is specified in TS 36.213 [2], clause 8. NB-IoT has one or two UL HARQ processes.

When the physical layer is configured for uplink spatial multiplexing, as specified in TS 36.213 [2], there are two HARQ processes associated with a given TTI. Otherwise there is one HARQ process associated with a given TTI.

At a given TTI, if an uplink grant is indicated for the TTI, the HARQ entity identifies the HARQ process(es) for which a transmission should take place. It also routes the received HARQ feedback (ACK/NACK information), MCS and resource, relayed by the physical layer, to the appropriate HARQ process(es).

In asynchronous HARQ operation, a HARQ process is associated with a TTI based on the received UL grant except for UL grant in RAR. Except for NB-IoT UE configured with a single HARQ process, each asynchronous HARQ process is associated with a HARQ process identifier. For UL transmission with UL grant in RAR, HARQ process identifier 0 is used. HARQ feedback is not applicable for asynchronous UL HARQ except if *mpdcch-UL-HARQ-ACK-FeedbackConfig* is configured.

In autonomous HARQ operation, HARQ feedback is applicable.

When TTI bundling is configured, the parameter TTI\_BUNDLE\_SIZE provides the number of TTIs of a TTI bundle. TTI bundling operation relies on the HARQ entity for invoking the same HARQ process for each transmission that is part of the same bundle. Within a bundle HARQ retransmissions are non-adaptive and triggered without waiting for feedback from previous transmissions according to TTI\_BUNDLE\_SIZE. The HARQ feedback of a bundle is only received for the last TTI of the bundle (i.e the TTI corresponding to TTI\_BUNDLE\_SIZE), regardless of whether a transmission in that TTI takes place or not (e.g. when a measurement gap occurs). A retransmission of a TTI bundle is also a TTI bundle. TTI bundling is not supported when the MAC entity is configured with one or more SCells with configured uplink.

Uplink HARQ operation is asynchronous for NB-IoT UEs, BL UEs or UEs in enhanced coverage except for the repetitions within a bundle, in serving cells configured with *pusch-EnhancementsConfig*, serving cells operating according to Frame Structure Type 3, for HARQ processes scheduled using short TTI, for HARQ processes scheduled using Short Processing Time, and for HARQ processes associated with an SPS configuration with *totalNumberPUSCH-SPS-STTI-UL-Repetitions* or *totalNumberPUSCH-SPS-UL-Repetitions* exceptfor the repetitions within a bundle.

For serving cells configured with *pusch-EnhancementsConfig*, NB-IoT UEs, BL UEs or UEs in enhanced coverage, the parameter UL\_REPETITION\_NUMBER provides the number of transmission repetitions within a bundle. For each bundle, UL\_REPETITION\_NUMBER is set to a value provided by lower layers. Bundling operation relies on the HARQ entity for invoking the same HARQ process for each transmission that is part of the same bundle. Within a bundle HARQ retransmissions are non-adaptive and are triggered without waiting for feedback from previous transmissions according to UL\_REPETITION\_NUMBER. An uplink grant corresponding to a new transmission of the bundle is only received after the last repetiton of the bundle if *mpdcch-UL-HARQ-ACK-FeedbackConfig* is not configured. An uplink grant corresponding to a retransmission of the bundle is only received after the last repetition of the bundle. For UEs configured with *mpdcch-UL-HARQ-ACK-FeedbackConfig*, repetitions within a bundle are stopped if an UL HARQ-ACK feedback or an uplink grant corresponding to a new transmission of the bundle is received on PDCCH during the bundle transmission. A retransmission of a bundle is also a bundle.

For a SPS configuration with *totalNumberPUSCH-SPS-STTI-UL-Repetitions* or *totalNumberPUSCH-SPS-UL-Repetitions* (TS 36.331 [8]), the parameter *totalNumberPUSCH-SPS-STTI-UL-Repetitions* or *totalNumberPUSCH-SPS-UL-Repetitions* provides the number of transmission repetitions within a configured grant bundle. Bundling operation relies on the HARQ entity invoking the same HARQ process for each transmission that is part of the same bundle. Within a bundle HARQ retransmissions are non-adaptive and are triggered without waiting for feedback from previous transmissions.

TTI bundling is not supported for RN communication with the E-UTRAN in combination with an RN subframe configuration.

For transmission of Msg3 during Random Access (see clause 5.1.5) TTI bundling does not apply. For UEs configured with *pusch-EnhancementsConfig* performing contention free Random Access, NB-IoT UEs, BL UEs or UEs in enhanced coverage, uplink repetition bundling is used for transmission of Msg3.

For each TTI, the HARQ entity shall:

- identify the HARQ process(es) associated with this TTI, and for each identified HARQ process:

- if an uplink grant has been indicated for this process and this TTI:

- if the received grant was addressed neither to a Temporary C-RNTI nor to a PUR-RNTI on PDCCH and if the NDI provided in the associated HARQ information has been toggled compared to the value in the previous transmission of this HARQ process; or

- if the uplink grant was received on PDCCH for the C-RNTI and the HARQ buffer of the identified process is empty; or

- if the uplink grant was provided by RRC for transmission using PUR; or

- if the uplink grant was received in a Random Access Response:

- if there is a MAC PDU in the Msg3 buffer and the uplink grant was received in a Random Access Response:

- if the MAC PDU in the Msg3 buffer contains the Data Volume and Power Headroom Report MAC control element:

- the MAC entity shall update the Data Volume and Power Headroom Report MAC control element in the MAC PDU in the Msg3 buffer.

- if the UE is an NB-IoT UE and *cqi-Reporting* is configured by upper layers:

- the MAC entity shall update the MAC PDU in the Msg3 buffer in accordance with the DL channel quality measurement result.

- obtain the MAC PDU to transmit from the Msg3 buffer.

- else if the uplink grant is a configured grant with *totalNumberPUSCH-SPS-STTI-UL-Repetitions* or *totalNumberPUSCH-SPS-UL-Repetitions* and if a retransmission within a bundle is triggered for another configured grant with *totalNumberPUSCH-SPS-STTI-UL-Repetitions* or *totalNumberPUSCH-SPS-UL-Repetitions* in this TTI:

- ignore the uplink grant.

- else if the MAC entity is configured with *semiPersistSchedIntervalUL* shorter than 10 subframes and if the uplink grant is a configured grant, and if the HARQ buffer of the identified HARQ process is not empty, and if HARQ\_FEEDBACK of the identified HARQ process is NACK; or if the MAC entity is configured with *ul-SchedInterval* shorter than 10 subframes and if the uplink grant is a preallocated uplink grant, and if the HARQ buffer of the identified HARQ process is not empty, and if HARQ\_FEEDBACK of the identified HARQ process is NACK:

- instruct the identified HARQ process to generate a non-adaptive retransmission.

- else:

- if the UL HARQ operation is synchronous, and the uplink grant is a preallocated uplink grant, and a MAC PDU has previously been obtained from the "Multiplexing and assembly" entity during this handover attempt:

- ignore the uplink grant;

- else:

- obtain the MAC PDU to transmit from the "Multiplexing and assembly" entity, if any;

- if a MAC PDU to transmit has been obtained:

- deliver the MAC PDU and the uplink grant and the HARQ information to the identified HARQ process;

- instruct the identified HARQ process to trigger a new transmission.

- else:

- flush the HARQ buffer of the identified HARQ process.

- else:

- if the MAC entity is configured with *skipUplinkTxSPS* and if the uplink grant received on PDCCH was addressed to the Semi-Persistent Scheduling C-RNTI or to the UL Semi-Persistent Scheduling V-RNTI and if the HARQ buffer of the identified process is empty; or

- if UL HARQ operation is autonomous for the identified HARQ process and if the uplink grant is a configured UL grant and if the HARQ buffer of the identified process is empty; or

- if the previous uplink grant delivered to the HARQ entity for the same HARQ process was a configured uplink grant for which the UL HARQ operation was autonomous, and if the corresponding UL grant size was different from the UL grant size indicated by the uplink grant for this TTI:

- ignore the uplink grant;

- else:

- deliver the uplink grant and the HARQ information (redundancy version) to the identified HARQ process;

- if UL HARQ operation is autonomous for the identified HARQ process and if the uplink grant is a configured UL grant:

- instruct the identified HARQ process to generate a non adaptive retransmission.

- else:

- instruct the identified HARQ process to generate an adaptive retransmission.

- else, if the HARQ buffer of this HARQ process is not empty:

- instruct the identified HARQ process to generate a non-adaptive retransmission;

- if the non-adaptive retransmission collides with a transmission of another HARQ process scheduled using Short Processing Time:

- instruct the identified HARQ process to generate a positive acknowledgement (ACK) of the data in the corresponding TB.

When determining if NDI has been toggled compared to the value in the previous transmission the MAC entity shall ignore NDI received in all uplink grants on PDCCH for its Temporary C-RNTI and PUR-RNTI.

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 including information of timing and resources used for transmission using PUR.

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 PDCCH indicates L1 ACK for transmission using PUR; or

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

- stop *pur-ResponseWindowTimer*;

- if PDCCH indicates L1 ACK for transmission using PUR or the MAC PDU contains only Timing Advance Command MAC control element:

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

- if PDCCH includes repetition adjustment for PUR:

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

- discard the PUR-RNTI.

- else if PDCCH indicates fallback for PUR:

- stop *pur-ResponseWindowTimer*;

- indicate to upper layers PUR fallback indication is received.

- if PDCCH includes repetition adjustment for PUR:

- 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.

#### 5.4.7.2 Maintenance of PUR Uplink Time Alignment

MAC entity may have a configurable timer *pur-TimeAlignmentTimer* when upper layers have configured Preconfigured Uplink Resource as specified in TS 36.331 [8], clause 5.3.8.3.

The MAC entity shall:

- when *pur-TimeAlignmentTimer* configuration is received from upper layers:

- start or restart the *pur-TimeAlignmentTimer.*

- when *pur-TimeAlignmentTimer* is configured and is released by upper layers:

- stop the *pur-TimeAlignmentTimer*;

- discard the *pur-TimeAlignmentTimer*.

- when a Timing Advance Command MAC control element is received or PDCCH indicates timing advance adjustment as specified in TS 36.212 [5]:

- apply the Timing Advance Command or the timing advance adjustment;

- start or restart the *pur-TimeAlignmentTimer*, if configured.

Upon request from upper layers, MAC entity shall indicate whether *pur-TimeAlignmentTimer* is running.

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;

- 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.

Next Change

## 7.1 RNTI values

RNTI values are presented in Table 7.1-1 and their usage and associated Transport Channels and Logical Channels are presented in Table 7.1-2.

Table 7.1-1: RNTI values.

|  |  |
| --- | --- |
| Value (hexa-decimal) | RNTI |
| 0000 | N/A |
| 0001-0960  0001-1000 (Note 3) | RA-RNTI, C-RNTI, Semi-Persistent Scheduling C-RNTI, Temporary C-RNTI, eIMTA-RNTI, TPC-PUCCH-RNTI, TPC-PUSCH-RNTI, SL-RNTI (see note), G-RNTI, SL-V-RNTI, UL Semi-Persistent Scheduling V-RNTI, SL Semi-Persistent Scheduling V-RNTI, SRS-TPC-RNTI, AUL C-RNTI, and PUR-RNTI |
| 0961-FFF3  1001-FFF3 (Note 3) | C-RNTI, Semi-Persistent Scheduling C-RNTI, eIMTA-RNTI, Temporary C-RNTI, TPC-PUCCH-RNTI, TPC-PUSCH-RNTI, SL-RNTI, G-RNTI, SL-V-RNTI, UL Semi-Persistent Scheduling V-RNTI, SL Semi-Persistent Scheduling V-RNTI, SRS-TPC-RNTI, AUL C-RNTI, and PUR-RNTI |
| FFF4-FFF8 | Reserved for future use |
| FFF9 | SI-RNTI |
| FFFA | SC-N-RNTI |
| FFFB | SC-RNTI |
| FFFC | CC-RNTI |
| FFFD | M-RNTI |
| FFFE | P-RNTI |
| FFFF | SI-RNTI |

NOTE 1: A MAC entity uses the same C-RNTI on all Serving Cells.

NOTE 2: SI-RNTI value FFFF may be used for MBMS-dedicated carrier. SI-RNTI value FFF9 is only used for MBMS-dedicated carrier.

NOTE 3: Range applicable for NB-IoT. Table 7.1-2: RNTI usage.

|  |  |  |  |
| --- | --- | --- | --- |
| RNTI | Usage | Transport Channel | Logical Channel |
| P-RNTI | Paging and System Information change notification | PCH | PCCH |
| SI-RNTI | Broadcast of System Information | DL-SCH | BCCH, BR-BCCH |
| M-RNTI | MCCH Information change notification | N/A | N/A |
| RA-RNTI | Random Access Response | DL-SCH | N/A |
| eIMTA-RNTI | eIMTA TDD UL/DL configuration notification | N/A | N/A |
| Temporary C-RNTI | Contention Resolution (when no valid C-RNTI is available) | DL-SCH | CCCH, DCCH |
| Temporary C-RNTI | Msg3 transmission | UL-SCH | CCCH, DCCH, DTCH |
| C-RNTI | Dynamically scheduled unicast transmission | UL-SCH | DCCH, DTCH |
| C-RNTI | Dynamically scheduled unicast transmission | DL-SCH | CCCH, DCCH, DTCH |
| C-RNTI | Triggering of PDCCH ordered random access | N/A | N/A |
| Semi-Persistent Scheduling C-RNTI | Semi-Persistently scheduled unicast transmission  (activation, reactivation and retransmission) | DL-SCH, UL-SCH | DCCH, DTCH |
| Semi-Persistent Scheduling C-RNTI | Semi-Persistently scheduled unicast transmission  (deactivation) | N/A | N/A |
| TPC-PUCCH-RNTI | Physical layer Uplink power control | N/A | N/A |
| TPC-PUSCH-RNTI | Physical layer Uplink power control | N/A | N/A |
| SL-RNTI | Dynamically scheduled sidelink transmission for sidelink communication | SL-SCH | STCH |
| SC-RNTI | Dynamically scheduled SC-PTM control information | DL-SCH | SC-MCCH |
| G-RNTI | Dynamically scheduled SC-PTM transmission | DL-SCH | SC-MTCH |
| SC-N-RNTI | SC-MCCH Information change notification | N/A | N/A |
| CC-RNTI | Providing common control PDCCH information | N/A | N/A |
| SL-V-RNTI | Dynamically scheduled sidelink transmission for V2X sidelink communication | SL-SCH | STCH |
| UL Semi-Persistent Scheduling V-RNTI | Semi-Persistently scheduled uplink transmission for V2X communication  (activation, reactivation and retransmission) | UL-SCH | DCCH, DTCH |
| UL Semi-Persistent Scheduling V-RNTI | Semi-Persistently scheduled uplink transmission for V2X communication  (deactivation) | N/A | N/A |
| SL Semi-Persistent Scheduling V-RNTI | Semi-Persistently scheduled sidelink transmission for V2X sidelink communication  (activation, reactivation and retransmission) | SL-SCH | STCH |
| SL Semi-Persistent Scheduling V-RNTI | Semi-Persistently scheduled sidelink transmission for V2X sidelink communication  (deactivation) | N/A | N/A |
| SRS-TPC-RNTI | SRS and TPC for the PUSCH-less SCells | N/A | N/A |
| AUL C-RNTI | Autonomous Uplink C-RNTI unicast transmission (activation and reactivation) | UL-SCH | DCCH, DTCH |
| AUL C-RNTI | Autonomous Uplink C-RNTI unicast transmission (deactivation) | N/A | N/A |
| PUR-RNTI | Transmission using Preconfigured Uplink Resource | DL-SCH, UL-SCH | CCCH, DCCH, DTCH |

End of changes