**3GPP TSG-RAN WG2 Meeting #110 electronic** ***R2-2005474***

**1 June – 12 June 2020**

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| *CR-Form-v12.0* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
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|  | **38.321** | **CR** | **0734** | **rev** | **1** | **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:*** | Correction to MAC spec for eURLLC | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Huawei, HiSilicon | | | | | | | | | |
| ***Source to TSG:*** | R2 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_L1enh\_URLLC | | | | |  | ***Date:*** | | | 2020-06-01 |
|  |  | | | |  | |  | | |  |
| ***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:*** | | In RAN2#109bis-e meeting, RAN2 discussed the MAC remaining issues for eURLLC and have reached the following agreements that should be captured in MAC spec. More specifically,   * Regarding PUSCH repetition type B, RAN2 agreed that The determination of CG Type 1 occasion is based on the S from indicated startSymbol for PUSCH repetition type B. * Regarding Aperiodic CSI Trigger State Subselection MAC CE, RAN2 agreed that the updates on section “Aperiodic CSI Trigger State Subselecton MAC CE” can be reverted to the Rel-15 version. * Regarding PUCCH Spatial Relation Activation/Deactivation MAC CE, RAN2 agreed that RAN2 confirms that different PUCCH resource IDs are configured in different PUCCH-Config when two PUCCH-Configs are simultaneously configured for URLLC WI.   In RAN2#110-e meeting, RAN2 discussed the CG auto transmission in inter-UE prioritization and reached the following agreements that should be captured in MAC spec.   * A CG cancelled by Cancellation Indicator (CI) is considered as a de-prioritized uplink grant and the MAC entity autonomous transmit the MAC PDU in the subsequent CG | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | 1. In Subclause 5.8.2, update S can be provided by startSymbol 2. In Subclause 6.1.3.13, revert the text to the Rel-15 version 3. In Subclause 6.1.3.18, clafify that the PUCCH Spation Relation Info refers to that in PUCCH-Config in which the PUCCH Resource ID is configured. 4. In Subclause 6.1.3.25, clafify that the PUCCH Spation Relation Info refers to that in PUCCH-Config in which the PUCCH Resource ID is configured. 5. In Subclause 5.4.1, add a Note to clarify that a CG cancelled by CI-RNTI is considered as a deprioritized grant. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | The MAC spec remains unaligned with the RRC spec and not consistent with the updated RAN1 agreements.  The CG autonomous transmission is not supported in inter-UE prioritization. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 5.4.1, 5.8.2, 6.1.3.13, 6.1.3.18, 6.1.3.25 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **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*

5.4 UL-SCH data transfer

5.4.1 UL Grant reception

Uplink grant is either received dynamically on the PDCCH, in a Random Access Response, configured semi-persistently by RRC or determined to be associated with the PUSCH resource of MSGA as specified in clause 5.1.2a. The MAC entity shall have an uplink grant to transmit on the UL-SCH. To perform the requested transmissions, the MAC layer receives HARQ information from lower layers. An uplink grant addressed to CS-RNTI with NDI = 0 is considered as a configured uplink grant. An uplink grant addressed to CS-RNTI with NDI = 1 is considered as a dynamic uplink grant.

If the MAC entity has a C-RNTI, a Temporary C-RNTI, or CS-RNTI, the MAC entity shall for each PDCCH occasion and for each Serving Cell belonging to a TAG that has a running *timeAlignmentTimer* and for each grant received for this PDCCH occasion:

1> if an uplink grant for this Serving Cell has been received on the PDCCH for the MAC entity's C-RNTI or Temporary C-RNTI; or

1> if an uplink grant has been received in a Random Access Response:

2> 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 CS-RNTI or a configured uplink grant:

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

2> if the uplink grant is for MAC entity's C-RNTI, and the identified HARQ process is configured for a configured uplink grant:

3> start or restart the *configuredGrantTimer* for the correponding HARQ process, if configured.

3> stop the *cg-RetransmissionTimer* for the correponding HARQ process, if running.

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

1> else if an uplink grant for this PDCCH occasion has been received for this Serving Cell on the PDCCH for the MAC entity's CS-RNTI:

2> if the NDI in the received HARQ information is 1:

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

3> start or restart the *configuredGrantTimer* for the corresponding HARQ process, if configured;

3> stop the *cg-RetransmissionTimer* for the correponding HARQ process, if running;

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

2> else if the NDI in the received HARQ information is 0:

3> if PDCCH contents indicate configured grant Type 2 deactivation:

4> trigger configured uplink grant confirmation.

3> else if PDCCH contents indicate configured grant Type 2 activation:

4> trigger configured uplink grant confirmation;

4> store the uplink grant for this Serving Cell and the associated HARQ information as configured uplink grant;

4> initialise or re-initialise the configured uplink grant for this Serving Cell to start in the associated PUSCH duration and to recur according to rules in clause 5.8.2;

4> stop the *configuredGrantTimer* for the corresponding HARQ process, if running;

4> stop the *cg-RetransmissionTimer* for the correponding HARQ process, if running.

For each Serving Cell and each configured uplink grant, if configured and activated, the MAC entity shall:

1> if the MAC entity is configured with *lch-basedPrioritization*; or

1> if the PUSCH duration of the configured uplink grant does not overlap with the PUSCH duration of an uplink grant received on the PDCCH or in a Random Access Response for this Serving Cell or with a transmission of MSGA payload:

2> set the HARQ Process ID to the HARQ Process ID associated with this PUSCH duration;

2> if, for the corresponding HARQ process, the *configuredGrantTimer* is not running and *cg-RetransmissionTimer* is not configured (i.e. new transmission):

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

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

2> else if the *cg-RetransmissionTimer* for the corresponding HARQ process is configured and not running, then for the corresponding HARQ process:

3> if the *configuredGrantTimer* is not running, and the HARQ process is not pending (i.e. new transmission):

4> consider the NDI bit to have been toggled;

4> deliver the configured uplink grant and the associated HARQ information to the HARQ entity.

3> else if the previous uplink grant delivered to the HARQ entity for the same HARQ process was a configured uplink grant (i.e. retransmission on configured grant):

4> deliver the configured uplink grant and the associated HARQ information to the HARQ entity.

Editor's Note: It is FFS whether SR/data prioritization can be a separate configurable parameter from data/data prioritization.

For configured uplink grants neither configured with *harq-ProcID-Offset2* nor with *cg-RetransmissionTimer*, the HARQ Process ID associated with the first symbol of a UL transmission is derived from the following equation:

HARQ Process ID = [floor(CURRENT\_symbol/*periodicity*)] modulo *nrofHARQ-Processes*

For configured uplink grants with *harq-ProcID-Offset2*, the HARQ Process ID associated with the first symbol of a UL transmission is derived from the following equation:

HARQ Process ID = [floor(CURRENT\_symbol / *periodicity*)] modulo *nrofHARQ-Processes* + *harq-ProcID-Offset2*

where CURRENT\_symbol = (SFN × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot* + slot number in the frame × *numberOfSymbolsPerSlot* + symbol number in the slot), and *numberOfSlotsPerFrame* and *numberOfSymbolsPerSlot* refer to the number of consecutive slots per frame and the number of consecutive symbols per slot, respectively as specified in TS 38.211 [8].

For configured uplink grants configured with *cg-RetransmissionTimer*, the UE implementation select an HARQ Process ID among the HARQ process IDs available for the configured grant configuration. The UE shall prioritize retransmissions before initial transmissions. The UE shall toggle the NDI in the CG-UCI for new transmissions and not toggle the NDI in the CG-UCI in retransmissions.

NOTE 1: CURRENT\_symbol refers to the symbol index of the first transmission occasion of a repetition bundle that takes place.

NOTE 2: A HARQ process is configured for a configured uplink grant where *harq-ProcID-Offset2* is not configured, if the configured uplink grant is activated and the associated HARQ process ID is less than *nrofHARQ-Processes*. A HARQ process is configured for a configured uplink grant where *harq-ProcID-Offset2* is configured, if the configured uplink grant is activated and the associated HARQ process ID is greater than or equal to *harq-ProcID-Offset2* and less than sum of *harq-ProcID-Offset2* and *nrofHARQ-Processes* for the configured grant configuration.

NOTE 3: If the MAC entity receives a grant in a Random Access Response (i.e. MAC RAR or fallbackRAR) or determines a grant as specified in clause 5.1.2a for MSGA payload and if the MAC entity also receives an overlapping grant for its C-RNTI or CS-RNTI, requiring concurrent transmissions on the SpCell, the MAC entity may choose to continue with either the grant for its RA-RNTI/MSGB-RNTI/the MSGA payload transmission or the grant for its C-RNTI or CS-RNTI.

NOTE 4: In case of unaligned SFN across carriers in a cell group, the SFN of the concerned Serving Cell is used to calculate the HARQ Process ID used for configured uplink grants.

NOTE 5: A HARQ process is not shared between different configured grant configurations.

For the MAC entity configured with *lch-basedPrioritization,* priority of an uplink grant is determined by the highest priority among priorities of the logical channels with data available that are multiplexed or can be multiplexed in the MAC PDU, according to the mapping restrictions as described in clause 5.4.3.1.2.

Editor's Note: Priority determination considering MAC CE is FFS.

When the MAC entity is configured, with *lch-basedPrioritization,* for each uplink grant which is not already a de-prioritized uplink grant:

1> if this uplink grant is addressed to CS-RNTI with NDI = 1 or C-RNTI:

2> if there is no overlapping PUSCH duration of a configured uplink grant, in the same BWP whose priority is higher than the priority of the uplink grant; and

2> if there is no overlapping PUCCH resource with an SR transmission where the priority of the logical channel that triggered the SR is higher than the priority of the uplink grant:

3> this uplink grant is a prioritized uplink grant;

3> the other overlapping uplink grant(s), if any, is a de-prioritized uplink grant.

1> else if this uplink grant is a configured uplink grant:

2> if there is no overlapping PUSCH duration of another configured uplink grant, in the same BWP, whose priority is higher than the priority of the uplink grant; and

2> if there is no overlapping PUSCH duration of an uplink grant addressed to CS-RNTI with NDI = 1 or C-RNTI, in the same BWP, whose priority is higher than or equal to the priority of the uplink grant; and

2> if there is no overlapping PUCCH resource with an SR transmission where the priority of the logical channel that triggered the SR is higher than the priority of the uplink grant:

3> this uplink grant is a prioritized uplink grant;

3> the other overlapping uplink grant(s), if any, is a de-prioritized uplink grant.

NOTE 6: If there is overlapping PUSCH duration of at least two configured uplink grants whose priorities are equal, the prioritized uplink grant is determined by UE implementation.

NOTE 7: If the corresponding PUSCH transmission of a configured uplink grant is cancelled by CI-RNTI, this uplink grant is a de-prioritized uplink grant.

*NEXT CHANGES*

5.8.2 Uplink

There are three types of transmission without dynamic grant:

- configured grant Type 1 where an uplink grant is provided by RRC, and stored as configured uplink grant;

- configured grant Type 2 where an uplink grant is provided by PDCCH, and stored or cleared as configured uplink grant based on L1 signalling indicating configured uplink grant activation or deactivation;

- retransmissions on a stored configured uplink grant of Type 1 or Type 2 configured with *cg-RetransmissionTimer*.

Type 1 and Type 2 are configured by RRC per Serving Cell and per BWP. Multiple configurations can be active simultaneously in the same BWP. For Type 2, activation and deactivation are independent among the Serving Cells. For the same BWP, the MAC entity can be configured with both Type 1 and Type 2.

RRC configures the following parameters when the configured grant Type 1 is configured:

- *cs-RNTI*: CS-RNTI for retransmission;

- *periodicity*: periodicity of the configured grant Type 1;

- *timeDomainOffset*: Offset of a resource with respect to SFN = *timeReferenceSFN* in time domain;

- *timeDomainAllocation*: Allocation of configured uplink grant in time domain which contains *startSymbolAndLength* (i.e. *SLIV* in TS 38.214 [7]) or *startSymbol* (i.e. *S* in TS 38.214 [7]);

- *nrofHARQ-Processes*: the number of HARQ processes for configured grant;

- *harq-procID-offset*: offset of HARQ process for configured grant;

- *timeReferenceSFN*: SFN used for determination of the offset of a resource in time domain. The UE uses the closest SFN with the indicated number preceding the reception of the configured grant configuration.

RRC configures the following parameters when the configured grant Type 2 is configured:

- *cs-RNTI*: CS-RNTI for activation, deactivation, and retransmission;

- *periodicity*: periodicity of the configured grant Type 2;

- *nrofHARQ-Processes*: the number of HARQ processes for configured grant;

- *harq-procID-offset*: offset of HARQ process for configured grant.

RRC configures the following parameters when retransmissions on configured uplink grant is configured:

- *cg-RetransmissionTimer*: the duration after a configured grant (re)transmission of a HARQ process when the UE shall not autonomously retransmit that HARQ process.

Upon configuration of a configured grant Type 1 for a Serving Cell by upper layers, the MAC entity shall:

1> store the uplink grant provided by upper layers as a configured uplink grant for the indicated Serving Cell;

1> initialise or re-initialise the configured uplink grant to start in the symbol according to *timeDomainOffset* and *S* (derived from *SLIV* or provided by *startSymbol* as specified in TS 38.214 [7]), and to reoccur with *periodicity*.

After an uplink grant is configured for a configured grant Type 1, the MAC entity shall consider sequentially that the Nth uplink grant occurs in the symbol for which:

[(SFN × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*) + (slot number in the frame × *numberOfSymbolsPerSlot*) + symbol number in the slot] =  
 (*timeReferenceSFN* × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot + timeDomainOffset* × *numberOfSymbolsPerSlot* + *S* + N × *periodicity*) modulo (1024 × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*).

Editor’s Note: The step of determining the closest N needs to be added.

After an uplink grant is configured for a configured grant Type 2, the MAC entity shall consider sequentially that the Nth uplink grant occurs in the symbol for which:

[(SFN × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*) + (slot number in the frame × *numberOfSymbolsPerSlot*) + symbol number in the slot] =  
[(SFNstart time × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot* + slotstart time × *numberOfSymbolsPerSlot* + symbolstart time) + N × *periodicity*] modulo (1024 × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*).

where SFNstart time, slotstart time, and symbolstart time are the SFN, slot, and symbol, respectively, of the first transmission opportunity of PUSCH where the configured uplink grant was (re-)initialised.

NOTE: In case of unaligned SFN across carriers in a cell group, the SFN of the concerned serving cell is used to calculate the occurrences of configured uplink grants.

When the configured uplink grant is released by upper layers, all the corresponding configurations shall be released and all corresponding uplink grants shall be cleared.

The MAC entity shall:

1> if at least one configured uplink grant confirmation has been triggered and not cancelled; and

1> if the MAC entity has UL resources allocated for new transmission:

2> if the MAC entity is configured with *configuredGrantConfigList*:

3> instruct the Multiplexing and Assembly procedure to generate a Multiple Entry Configured Grant Confirmation MAC CE as defined in clause 6.1.3.31.

2> else:

3> instruct the Multiplexing and Assembly procedure to generate a Configured Grant Confirmation MAC CE as defined in clause 6.1.3.7.

2> cancel the triggered configured uplink grant confirmation.

For a configured grant Type 2, the MAC entity shall clear the configured uplink grant(s) immediately after first transmission of Configured Grant Confirmation MAC CE or Multiple Entry Configured Grant Confirmation MAC CE which confirms the configured uplink grant deactivation.

Retransmissions are done by:

- repetition of configured uplink grants; or

- receiving uplink grants addressed to CS-RNTI; or

- retransmission on configured uplink grants.

*NEXT CHANGES*

6.1.3.13 Aperiodic CSI Trigger State Subselection MAC CE

The Aperiodic CSI Trigger State Subselection MAC CE is identified by a MAC subheader with LCID as specified in Table 6.2.1-1. It has a variable size consisting of following fields:

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

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

- Ti: This field indicates the selection status of the Aperiodic Trigger States configured within *aperiodicTriggerStateList* , as specified in TS 38.331 [5]. T0 refers to the first trigger state within the list, T1 to the second one and so on. If the list does not contain entry with index i, MAC entity shall ignore the Ti field. The Ti field is set to 1 to indicate that the Aperiodic Trigger State i shall be mapped to the codepoint of the DCI *CSI request* field, as specified in TS 38.214 [7]. The codepoint to which the Aperiodic Trigger State is mapped is determined by its ordinal position among all the Aperiodic Trigger States with Ti field set to 1, i.e. the first Aperiodic Trigger State with Ti field set to 1 shall be mapped to the codepoint value 1, second Aperiodic Trigger State with Ti field set to 1 shall be mapped to the codepoint value 2 and so on. The maximum number of mapped Aperiodic Trigger States is 63;

- R: Reserved bit, set to 0.



Figure 6.1.3.13-1: Aperiodic CSI Trigger State Subselection MAC CE

*NEXT CHANGES*

#### 6.1.3.18 PUCCH spatial relation Activation/Deactivation MAC CE

The PUCCH spatial relation Activation/Deactivation MAC CE is identified by a MAC subheader with LCID as specified in Table 6.2.1-1. It has a fixed size of 24 bits with following fields:

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

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

- PUCCH Resource ID: This field contains an identifier of the PUCCH resource ID identified by *PUCCH-ResourceId* as specified in TS 38.331 [5]. The length of the field is 7 bits;

- Si: If, in *PUCCH-Config* in which the PUCCH Resource ID is configured, there is a PUCCH Spatial Relation Info with *PUCCH-SpatialRelationInfoId* as specified in TS 38.331 [5], configured for the uplink bandwidth part indicated by BWP ID field, Si indicates the activation status of PUCCH Spatial Relation Info with *PUCCH-SpatialRelationInfoId* equal to i + 1, otherwise MAC entity shall ignore this field. The Si field is set to 1 to indicate PUCCH Spatial Relation Info with *PUCCH-SpatialRelationInfoId* equal to i + 1 shall be activated. The Si field is set to 0 to indicate PUCCH Spatial Relation Info with *PUCCH-SpatialRelationInfoId* equal to i + 1 shall be deactivated. Only a single PUCCH Spatial Relation Info can be active for a PUCCH Resource at a time;

- R: Reserved bit, set to 0.



Figure 6.1.3.18-1: PUCCH spatial relation Activation/Deactivation MAC CE

*NEXT CHANGES*

6.1.3.25 Enhanced PUCCH spatial relation Activation/Deactivation MAC CE

The Enhanced PUCCH spatial relation Activation/Deactivation MAC CE is identified by a MAC subheader with LCID as specified in Table 6.2.1-1. It has a variable size with following fields:

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

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

- PUCCH Resource ID: This field contains an identifier of the PUCCH resource ID identified by *PUCCH-ResourceId* as specified in TS 38.331 [5]. The length of the field is 7 bits. If the indicated PUCCH Resource is configured as part of a PUCCH Group as specified in TS 38.331 [5], no other PUCCH Resources within the same PUCCH group are indicated in the MAC CE, and this MAC CE applies to all the PUCCH Resources in the PUCCH group

- Spatial Relation Info ID: This field contains an identifier of the PUCCH Spatial Relation Info ID identified by *PUCCH-SpatialRelationInfoId*,in *PUCCH-Config* in which the PUCCH Resource IDis configured, as specified in TS 38.331 [5]. The length of the field is 6 bits;

- R: Reserved bit, set to 0.



**Figure 6.1.3.25-1: Enhanced PUCCH spatial relation Activation/Deactivation MAC CE**

Editor’s note: Whether to allow multiple PUCCH resources in a MAC CE.

*END OF CHANGES*