**3GPP TSG-RAN WG2 Meeting #109bis electronic *R2-20xxxxx***

20 April – 30 April 2020

**Agenda item: 6.22.3**

**Source: Huawei, HiSilicon**

**Title: Summary of MAC remaining issues for eURLLC**

**Document for: Discussion and Decision**

# 1 Introduction

This document is used to collect the feedbacks on the remaining MAC issues for eURLLC based on contributions [1] [2], and present the summary of the email discussions.

# 2 Discussion

## 2.1 PUSCH repetition type B

In [1], one misalignment between MAC and RRC is identified on the determination of CG Type 1 occasions for PUSCH repetition type B. For PUSCH repetition type B, the start symbol is indicated independently from the length indication, i.e. startSymbol (for type B) and length are configured as two independent IEs, which is not startSymbolAndLength (SLIV) (for type A and legacy) any more.

***PUSCH-TimeDomainResourceAllocationNew* information element**

-- ASN1START

-- TAG-PUSCH-TIMEDOMAINRESOURCEALLOCATIONLISTNEW-START

PUSCH-TimeDomainResourceAllocationListNew-r16 ::= SEQUENCE (SIZE(1..maxNrofUL-Allocations-r16)) OF PUSCH-TimeDomainResourceAllocationNew-r16

PUSCH-TimeDomainResourceAllocationNew-r16 ::= SEQUENCE {

 k2-r16 INTEGER (0..32) OPTIONAL, -- Need S

 mappingType-r16 ENUMERATED {typeA, typeB} OPTIONAL, -- Cond RepTypeA

 startSymbolAndLength-r16 INTEGER (0..127) OPTIONAL, -- Cond RepTypeA

 startSymbol-r16 INTEGER (0..13) OPTIONAL, -- Cond RepTypeB

 length-r16 INTEGER (1..14) OPTIONAL, -- Cond RepTypeB

 numberOfRepetitions-r16 ENUMERATED {n1, n2, n4, n7, n12, n16},

 ...

}

-- TAG-PUSCH-TIMEDOMAINRESOURCEALLOCATIONLISTNEW-STOP

-- ASN1STOP

However, according to the current MAC specification, in subclause 5.8.2, the determination of CG type 1 occasions is only based on startSymbolAndLength (SLIV). Therefore, [1] proposed to update the MAC spec to align with RRC spec.

**Question 1a. Do you agree that the determination of CG Type 1 occasion is based on the S from indicated startSymbol for** **PUSCH repetition type B?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments (if any)** |
|  Ericsson | Yes | We wonder if it is also calculated from the “length” field. The legacy has both start symbol and length in one field, and the difference is that in Rel-16, these two fields are separate now.Update: Thank Huawei for further clarification below. The starting position of the CG type 1 occasion depends on S. It seems that only the starting position is needed in MAC spec.  |
|  HW | Yes | The determination of CG/SPS occasion is only relevant to the starting point and periodicity, and has no relation with the “length”. As indicated in the current spec, the starting symbol S is derived from SILV and it was true in Rel-15 but cannot applicable to repetition type B where the starting symbol S is separately configured from length, so we think the text should be updated to align with RRC spec.1> initialise or re-initialise the configured uplink grant to start in the symbol according to *timeDomainOffset* and *S* (derived from *SLIV* as specified in TS 38.214 [7]), and to reoccur with *periodicity*. |
|  Qualcomm | Yes | Agree with Huawei |
|  LG |  Yes | In Rel-15, MAC entity initialises configured uplink grant using *timeDomainOffset*, *S* derived from *SLIV* and *periodicity* as mentioned by Huawei. |

**Question 1b. If your answer to Question 1a is “Yes”, do you agree with the TP for section 5.8.2 in the annex?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments (if any)** |
| HW | Yes |  |
| Ericsson | Yes | We are fine with the second change. We have a minor comment related with the first change below:- *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]);However, the field description from RRC is with an integer from 0 to 15:***timeDomainAllocation***Indicates a combination of start symbol and length and PUSCH mapping type, see TS 38.214 [19], clause 6.1.2 and TS 38.212 [17], clause 7.3.1. timeDomainAllocation INTEGER (0..15),We assume that RAN1 spec has captured or would (if has not done so) capture how to derive the start symbol from an integer value of 0 to 15 and so there is no need to update the field description,  |
|  Qualcomm | Yes |   |
|  LG |  Yes, but | The TP needs to be improved as follow: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*. |

## 2.2 Aperiodic CSI Trigger State Subselection MAC CE

As discussed in [1] [2], in the last RAN2#109 e-meeting, the Aperiodic CSI Trigger State Subselection MAC CE was discussed and it was agreed to update the relevant MAC CE as follows.

* Re-use one reserved bit in Rel-15 Aperiodic CSI Trigger State Subselection MAC CE to indicate one of the two lists for CSI aperiodic trigger state.

However, according to the updated RAN1 agreement made in RAN1#100 e-meeting as below, the additional list of aperiodic CSI trigger states for DCI format 0\_2 was removed.

Agreements:

* Introduce independent RRC parameters AntennaPorts-FieldPresence-ForDCIFormat0\_2 for DCI format 0\_2 and AntennaPorts-FieldPresence-ForDCIFormat1\_2 for DCI format 1\_2.
* Remove the RRC parameters CSI-AperiodicTriggerStateList-ForDCIFormat0\_2 and [CSI-SemiPersistentOnPUSCH-TriggerStateList-ForDCIFormat0\_2] from the Rel-16 RRC parameter lists.
* Remove the bracket on formats0-0-And-1-0 in the column of value range for RRC parameter dci-Formats-Rel16.

With this said, there is only one list for CSI Aperiodic Trigger State and it is only applicable for DCI format 0\_1 and ambiguity has been removed regarding which list the MAC CE is referring to. So there is no need to update the MAC CE as agreed in the last RAN2 meeting.

**Question 2a. Do you agree that the updates on section “Aperiodic CSI Trigger State Subselecton MAC CE” can be reverted to the Rel-15 version, due to the updated RAN1 parameter list?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments (if any)** |
|  Ericsson | Yes |   |
|  HW | Yes |   |
|  Qualcomm | Yes |   |
|  LG | Yes |  |

**Question 2b. If your answer to Question 1a is “YES”, do you agree with the TP for section 6.1.3.13 in the annex?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments (if any)** |
|  Ericsson | Yes |   |
|  HW | Yes |   |
|  Qualcomm | Yes |   |
|  LG | Yes |  |

## 2.3 PUCCH Spatial Relation Activation/Deactivation MAC CE

The mapping between PUCCH Resource ID and the corresponding PUCCH Config was discussed in RAN2 which may impact the MAC CE on PUCCH Spatial Relation Activation/Deactivation in the last e-meeting, and have the following agreements.

|  |
| --- |
| * Both PUCCH spatial relation lists can be in-use simultaneously in Rel-16, and Rel-15 MAC CE cannot distinguish which list the MAC CE refers to.
* Wait for RAN1 inputs on the maximum number of PUCCH resource per BWP when two HARQ-ACK codebooks are configured.
* RAN2 to jointly design PUCCH spatial relation activation/de-activation MAC CE for Rel-16 eURLLC WI and Rel-16 eMIMO WI, if both are identified to be needed.
 |

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

If there are two PUCCH spatial relation lists are configured in two different PUCCH Config and both list are corresponding to the same PUCCH Resource ID, it could cause ambiguity for determining the list the MAC CE refers to. However, if the PUCCH Resource ID is unique across two PUCCH config for two HARQ-ACK codebooks, the UE can determine the corresponding PUCCH Spatial Relation Info List (configured in ) based on the indicated PUCCH Resource ID.

[1] indicated that according to the summary of RAN1 discussions in [3], the RAN1 understanding is that

Conclusion 4-1:

It is clarified that different PUCCH resource IDs are configured in different *PUCCH-Config.*Not specification impacts in RAN1.

Due to the reason that some companies suggested to avoid introducing RAN1’s understanding in a field where RAN2 should make a decision and hence the LS of above clarification was not agreed. But according to RAN1’s understandings, the maximum number of PUCCH resource per BWP remain the same and ambiguity can be removed.

[2] suggested to wait for RAN1 to complete the whole discussions relevant to UCI and hence no action is needed for RAN2 in this e-meeting. [To be confirmed by ER]

In general, we have two options on the table to proceed this issue.

* Option 1: RAN2 confirms RAN1 understanding that different PUCCH resource IDs are configured in different PUCCH-Config.
* Option 2: Do nothing in RAN2 in this e-meeting.

**Question 3a. Please indicate your choice/preference between Option 1 and 2.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Option1/2** | **Comments (if any)** |
|  Ericsson | Option 1 | Thank Huawei for indicating the RAN1 email discussion outcome. From the discussion in section 3 in [3], it seems that RAN1’s understanding is option 1. We have some questions for clarification.Can option 1 be understood as “same PUCCH resource ID cannot be configured in different PUCCH-Config”? If yes, can I understand that RAN2 should indicate to RAN1 that the following “if” condition is never satisfied? Agreement:When two PUCCH-Configs are configured, *SchedulingRequestResourceConfig* can be configured in both *PUCCH-Configs** If the same PUCCH resource ID can be configured in different *PUCCH-Config*, a *PUCCH-ResourceId* in a *SchedulingRequestResourceConfig* refers to a PUCCH-Resource in the *PUCCH-Config* containing the *SchedulingRequestResourceConfig*

Update: Thank Huawei for the clarification below. From the discussion in the last meeting, it does not seem like majority companies have preference and either approach should work from signalling point of view. If this understanding is confirmed, further clarifications in the RRC field descriptions are needed and can be discussed in the other email discussion as rapporteur points out in the end of this section.  |
|  HW |  Option 1 | RAN1’understanding is Option 1. Regarding the concerns from Ericsson, I’ve checked internally and would clarify that RAN1 intention is to leave the decision up to RAN2. But I think it is clear from the second half of the agreement that PUCCH resource of SR is mapped to only one PUCCH Config and the same PUCCH resource ID should be avoided within two PUCCH Config when SR resource are configured in both PUCCH Config. I think it is consistent with RAN1 understandings. I agree if RAN1 has not concluded anything in this meeting, we can send LS to RAN1 for clarification. |
|  Qualcomm | Option 1 |   |
| LG | Option 1 |  |

**Question 3b: If you indicated to support Option 1, do you agree that the PUCCH spatial relation info list in the MAC CE of PUCCH spatial relation activation/deactivation corresponds to the indicated PUCCH Resource ID.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments (if any)** |
|  Ericsson |  Yes | We wonder if it is clear from the PUCCH Resource ID, one can find the spatial relation info list directly. If option 1 means that “same PUCCH resource ID cannot be configured in different PUCCH-Config”, then each PUCCH resource “implicitly” indicates the PUCCH config it belongs to. From the PUCCH config, we can find the corresponding spatial relation info list. If the above understanding is shared among the companies, we prefer a clearer and concise text to capture it. Update: Thank Huawei for further clarification, we are fine with a clearer text.  |
|  HW | Yes | Agree with the analysis above, we can have a clearer text to capture our RAN2 understanding on the mapping between PUCCH resource ID and PUCCH Config/spatial relation info list.  |
|  Qualcomm | Yes |  We have the same understanding as Ericsson. |
| LG | Yes |  |

**Question 3c: If your answer to Question 3b is “YES”, do you agree with the TP for section 6.1.3.25 in the annex?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments (if any)** |
|  HW |   |  The text can be further improved in phase 2 discussions |
|  Ericsson |   | To facilitate discussion, we have one proposal below. 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],. |
|   |   |  |

**Question 3d: If you indicated to support Option 1, do you agree that RAN2 should indicate RAN2 understanding on this to RAN1 ?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments (if any)** |
|  HW |  Yes |   |
|  Ericsson |   | RAN1 should be aware the discussion outcome here, but we are not sure if an LS is needed. As this was discussed in the RAN1, RAN2 agreements and further related RRC updates captured by the chair notes would be sufficient in our view. We assume RAN1 would also check the latest RRC spec and endorsed running RRC CR from this meeting. |
|  Qualcomm | - | No strong view. Based on what I learned from our RAN1 colleague, Option 1 is the common understanding of the agreement in RAN1. So a LS may not be necessary. |
| LG |  | If needed, RAN2 can send LS to RAN1 in order to share RAN2’s understanding. |

*Note: The impact of RRC spec can be discussed in [057] based on outcome of above questions.*

# 2 Conclusion

TBD

# 2 Reference

[1] [R2-2003616](file:///D%3A%5CDocuments%5C3GPP%5Ctsg_ran%5CWG2%5CTSGR2_109bis-e%5CDocs%5CR2-2003616.zip) Remaining issues of MAC aspects for eURLLC Huawei, HiSilicon

[2] [R2-2002714](file:///D%3A%5CDocuments%5C3GPP%5Ctsg_ran%5CWG2%5CTSGR2_109bis-e%5CDocs%5CR2-2002714.zip) on MAC CE design for eURLLC Ericsson

[3] R1-2001227 Summary of email thread [100e-NR-L1enh\_URLLC-UCI\_Enh-02], OPPO.

# Annex TP for TS 38.321

*START OF 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 *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* or depending on how D field is set, 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 there is a PUCCH Spatial Relation Info with *PUCCH-SpatialRelationInfoId* corresponding to the indicated PUCCH Resource ID 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* corresponding to the indicated PUCCH Resource ID 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*