**3GPP TSG RAN WG1 #108-e**  **R1-22xxxxx**

**e-Meeting, February 21st – March 3rd, 2022**

**Agenda item:** 7.2.5

**Source:** Moderator (vivo)

**Title:** Summary of [108-e-NR-L1enh-URLLC-04] Discussion on remaining issues on UL prioritization and UL skipping

**Document for:** Discussion and Decision

# 1 Introduction

This document is to kick-off the following email discussion:

* [108-e-R16-URLLC-02] Issue#2: Discussion on remaining issues on UL prioritization and UL skipping by February 25 – Lihui (vivo)

The Questions/proposals that in the focus of the discussion are tagged as FL1. Please provide your 1st round feedback by UTC 23:59 PM, Feb. 22ed.

# 2 Background

Following agreements and conclusion was made in RAN1#107-e meeting.

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| **Agreements:**RAN1 confirms RAN2’s following working assumption.* When *lch-BasedPrioritization* is not configured and Rel-16 CG/DG PUSCH skipping is enabled, DG always overrides CG.

In response to RAN2 LSs (R1-2106409, R1-2110755), the following RAN1 responses are agreed.* RAN1 cannot confirm RAN2’s WA on LCH based prio has higher priority than UL skipping, and RAN1 inform RAN2 that when *lch-basedPrioritization* is configured, Rel-16 UL skipping cannot be enabled in Rel-16.
* RAN1 confirms that the following intended UE behavior can be supported:
	+ Given the understanding in RAN1 that when *lch-basedPrioritization* is configured and Rel-16 UL skipping cannot be enabled in Rel-16, for the case of overlapping PUSCH and SR with equal L1 priority and MAC has not yet delivered MAC PDU for the PUSCH to PHY, if SR is prioritized in MAC, MAC shall not deliver the MAC PDU for the PUSCH and shall instruct PHY for SR transmission.

**LS is endorsed in R1-2112862.****Conclusion****In the Rel-16 multiplexing/prioritization procedures described in TS 38.213 section 9, the UE is expected to apply the procedures to the PUSCH(s) for which a transport block is delivered by MAC, while the PUSCH(s) for which a transport block is not delivered is ignored.** |

Following Table 1 from [3] summarize the current status about the interaction between the UL skipping and Rel-16 MAC/PHY intra-UE prioritization features.

**Table 1: UL skipping cases considering lch-basedPrioritization and PHY priority**

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|  | **lch-basedPrioritization** | **PHY priority** | **UL skipping** |
| **Case 1** | Configured | SINGLE | Can NOT be enabled |
| **Case 2** | Configured | TWO | Can NOT be enabled |
| **Case 3** | NOT Configured | SINGLE | Can be enabled and agreements/conclusions were achieved in RAN1 #101e~RAN1 #104e |
| **Case 4** | NOT Configured | TWO | FFS, without any agreement/conclusion |

For Case 4, no agreement or conclusion has been reached. [2], [3] and [4] discussed the UE behavior for Case 4, details can be found in following section.

# 3 Discussion

For Case 4 that when *lch-basedPrioritization* is not configured, UL skipping is enabled and PHY is configured with two L1 priorities, [3] and [4] proposed that based on the following agreements made in RAN1#107-e meeting, it is suggested that firstly DG should override CG regardless of the PHY priority and after that the UL skipping is performed per PHY priority. For simplicity, above procedure is called option 1.

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| Agreement: RAN1 confirms RAN2’s following working assumption.* When *lch-BasedPrioritization* is not configured and Rel-16 CG/DG PUSCH skipping is enabled, DG always overrides CG.
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While [2] proposed that firstly if there is a LP PUSCH that overlaps with a HP PUCCH or a HP PUSCH, the LP PUSCH is dropped; Then for a given PHY priority, the same procedure agreed for single PHY priority is applied, so that MAC generates a PDU for a PUSCH which is expected to multiplex with UCI of same priority. For simplicity, this procedure is called option 2.

Take following figure as an example to elaborate the difference between Option 1 and Option 2.



Figure 1 - LP DG overlaps with HP CG, and LP PUCCH overlaps with LP DG, HP PUCCH overlaps with HP CG

By using Figure 1,

* For Option 1, LP DG will override HP CG firstly. Then for the LP, since LP DG PUSCH overlaps with LP PUCCH, the LP DG PUSCH cannot be skipped. For the HP, HP PUCCH is transmitted since the HP CG PUSCH has already been overridden by DG PUSCH.
* For Option 2, HP CG is expected to have UCI multiplexing with PUCCH (HP), thus MAC will generate a PDU for HP CG. Similarly, MAC would generate a PDU for LP DG as well, if LP DG does not overlap with a HP channel. However, considering that LP DG overlaps with a HP channel (i.e., HP CG PUSCH #1) in the example, LP DG does not receive a TB, and is omitted in the PHY multiplexing/prioritization procedure.

## 1st Round

FL1 Question 1: Which option is your understanding for the following?

* When both Rel-16 PUSCH skipping and Rel-16 PHY priorities are configured, *lch-basedPrioritization* is not configured,
	+ Option 1: DG overrides CG regardless of the PHY priority if overlapping in the same cell, after that the UL skipping rules are performed per PHY priority.
	+ Option 2: LP PUSCH is dropped if HP and LP PUSCH are overlapping in the same cell, after that the UL skipping rules are performed per PHY priority.

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| Company | View |
| HW/HiSi | Option 1For the DG overlapping with CG regardless of the PHY priority, only one PDU delivery from MAC to PHY is allowed. DG overriding the CG is specified in 321 as shown below. Option 2 would require the MAC to deliver a PDU corresponding to the HP PUSCH, even if the HP PUSCH is a HP CG PUSCH, which would have impact on the RAN2 specification.From 321: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*, and the PUSCH duration of the configured uplink grant does not overlap with the PUSCH duration of an uplink grant received in a Random Access Response or with the PUSCH duration of an uplink grant addressed to Temporary C-RNTI or the PUSCH duration of a MSGA payload for this Serving Cell; or1> if the MAC entity is not configured with *lch-basedPrioritization*, and 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 or the PUSCH duration of a MSGA payload for this Serving Cell: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. |
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In addition, it is noted that Rel-16 UL skipping procedure for single PHY priority has been defined for the case where PUSCH repetition (both type A and type B) is not enabled, see conclusion below.

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| **Conclusion (RAN1#105e)**UE is not expected that Rel-16 PUSCH skipping (including both *enhancedSkipUplinkTxDynamic-r16* and *enhancedSkipUplinkTxConfigured-r16*) and PUSCH repetitions (including both type A and type B) are enabled together when Rel-16 LCH based prioritization is not configured and there is a single PHY priority for UL transmissions. |

Therefore, [2] and [4] proposed that similar conclusion can be drawn for the case of two PHY priorities. It is also noted by [4] that according to the part of the 38.331 specification copied below, clearly, they cannot be enabled together.

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| ***skipUplinkTxDynamic, enhancedSkipUplinkTxDynamic, enhancedSkipUplinkTxConfigured***If set to *true*, the UE skips UL transmissions as described in TS 38.321 [3]. If the UE is configured with *enhancedSkipUplinkTxDynamic* or *enhancedSkipUplinkTxConfigured* with value *true*, REPETITION\_NUMBER (as specified in TS 38.321 [3], clause 5.4.2.1) of the corresponding PUSCH transmission of the uplink grant shall be equal to 1. |

**FL1 Question 2: Do you agree to following conclusion?**

* Conclusion: The UE does not expect that Rel-16 PUSCH skipping (including both enhancedSkipUplinkTxDynamic-r16 and enhancedSkipUplinkTxConfigured-r16) and PUSCH repetitions (including both type A and type B) are enabled together when Rel-16 LCH based prioritization is not configured and there are two PHY priorities for UL transmissions. No spec update is needed.

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| HW/HiSi | Agree |
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In addition, [1] proposed that for the following LSs, RAN1 needs to provide feedback to RAN2.

* For the following RAN2 LS (R1-2106409 (R2-2106746)), RAN1 need to respond to RAN2 whether this WA can be confirmed.

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| For case 2-2 and case 3, RAN2 has made the following working assumption in RAN2#113-e:

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| **Working assumption: The MAC entity does not generate a MAC PDU for a deprioritized uplink grant even when its associated PUSCH is overlapping with PUCCH. This working assumption is not agreed until confirmed by RAN1.** |

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Figure 2. R1-2102244 (reply LS), Case 2-2: the final PUCCH resource after UCI multiplexing overlaps with PUSCH



Figure 3. R1-2102244 (reply LS), Case 3: other UCI(s) overlaps with a PUSCH, SR overlaps with the PUSCH, SR does not overlap with other UCI(s)

The relevant scenario as configured by RRC parameters is: Rel-16 UL skipping is disabled, *lch-basedPrioritization* is configured. For both Case 2-2 and Case 3, RAN2 WA describes that no transport block is generated for a deprioritized uplink grant even when its associated PUSCH is overlapping with PUCCH. In this case, the PUSCH disappears from physical layer intra-UE multiplexing/prioritization procedure. Thus the PUCCH(s) is transmitted, and PUSCH is not transmitted. Thus the RAN2 WA above can be confirmed by RAN1.

**FL1 Question 3: Do you agree following proposal and provide feedback to RAN2?**

* Proposal 3: RAN1 confirm RAN2’s WA that MAC entity does not generate a MAC PDU for a deprioritized uplink grant even when its associated PUSCH is overlapping with PUCCH.

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| HW/HiSi | Agree |
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* In RAN1#103-e meeting, RAN1 received LS from RAN2 to confirm the intended UE behavior as below:

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| **RAN2 LS on Intra UE Prioritization Scenario (R1-2007523)**

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| RAN2 has agreed in RAN2#107 that For the case when no PDU has been generated at all yet, and there are two grants where one will be de-prioritized (and there is data available for both grants), one PDU is generated by MAC.This agreement means that in the collision scenario between CG and DG with same/different PHY-priority index, and only one transport block is delivered to PHY, PHY transmit on the grant for which a transport block is delivered and skip the transmission on the other grant.It is not clear from the wording in the LS R1-2005078 if the PHY behavior described above is consistent with RAN1 understanding.RAN2 respectfully asks RAN1 to clarify if the mentioned scenario is supported or not. |

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In RAN1#103e, RAN1 made the following agreement, and replied to RAN2 in LS R1-2009680.

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| **Agreement*** For the collision scenario between CG and DG with same/different PHY-priority index, if there is no collision between PUCCH and the CG and there is no collision between PUCCH and the DG, the behaviour mentioned in the LS is consistent with RAN1’s understanding if taking into account the TP to Rel-16 TS 38.214, i.e., revision CR in R1-2008655.
* When the MAC entity is configured with *lch-basedPrioritization*, for the collision scenario between CG and DG with same/different PHY-priority index, and when there is collision between PUCCH and the CG with the same priority and/or there is collision between PUCCH and the DG with the same priority, RAN1 is still discussing the related PHY layer behaviour.
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Therefore, RAN1 need to finish the response to RAN2 about the scenarios in the second bullet. Considering the RAN1 conclusion in RAN1#107-e, the relevant RRC configuration is: *lch-basedPrioritization* is configured, and Rel-16 UL skipping is not enabled. Thus there is no concern to confirm RAN2’s WA for the 2nd bullet LS R1-2009680.

**FL1 Question 4: Do you agree following proposal and provide feedback to RAN2?**

* Proposal 4: When the MAC entity is configured with *lch-basedPrioritization*, for the collision scenario between CG and DG with same/different PHY-priority index, and when there is collision between PUCCH and the CG with the same priority and/or there is collision between PUCCH and the DG with the same priority, the behavior described in the LS R2-2008599 is also consistent with RAN1’s understanding for Rel-16.

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| HW/HiSi | Agree |
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**Any other comments?**

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## Summary for the 1st Round

TBU

# 4 Email Discussion Outcome

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# References

1. [R1-2200999](file:///D%3A%5CDocuments%5C3GPP%20documents%5CRAN1%5CTSGR1_108-e%5CDocs%5CR1-2200999.zip) Interaction of MAC and PHY for Intra-UE Multiplexing/Prioritization Ericsson
2. [R1-2201000](file:///D%3A%5CDocuments%5C3GPP%20documents%5CRAN1%5CTSGR1_108-e%5CDocs%5CR1-2201000.zip) Physical Layer Intra-UE Multiplexing/Prioritization and UL Skipping Ericsson
3. [R1-2201294](file:///D%3A%5CDocuments%5C3GPP%20documents%5CRAN1%5CTSGR1_108-e%5CDocs%5CR1-2201294.zip) Remaining issues on intra-UE prioritization and multiplexing OPPO
4. [R1-2201625](file:///D%3A%5CDocuments%5C3GPP%20documents%5CRAN1%5CTSGR1_108-e%5CDocs%5CR1-2201625.zip) Remaining issues on UL prioritization and UL skipping Huawei, HiSilicon