**3GPP TSG RAN WG1 #101 R1-200xxxx**

**e-Meeting, May 25th – June 5th, 2020**

Source: Email discussion #01 for enhanced configured grant transmission

Title: Moderator (vivo)

Agenda Item: 7.2.5.6

**Document for:** **Discussion and Decision**

# **Introduction**

Based on the phase 1 discussions and suggestions, Chairman allocates following email discussion for eCG for URLLC. It is noted that the deadline for agreements/conclusions is 5/29, in order to have some time to make the acceptable proposals based on companies’ input, **please share your views by 12:00 noon time of UTC on 5/27.**

[101-e-NR-L1enh-URLLC-eCG-01] Possible RAN1 conclusion on per PUSCH repetition cancellation and CG-CG/DG with different priorities by 5/29 – Lihui (vivo)

* Issue#1: Discuss and draw RAN1 conclusion on per PUSCH repetition cancellation. The following proposal for conclusion is to be used as a starting point for discussions but can be revised further
  + In Rel.15, for CG PUSCH configured with repetition factor K>1, in case there is collision between DG PUSCH and CG PUSCH, the timeline is defined by the starting symbol of a CG-PUSCH repetition that overlaps with the DG PUSCH within a bundle (i.e., DG-PUSCH overrides CG-PUSCH is per repetition).
    - If the HARQ process is the same between CG and DG, UE terminates all remaining repetitions.
    - Otherwise, only overlapped repetitions are terminated.
  + In Rel.15, for DG and CG with the same HARQ process and without resource collision, DG overrides CG under the timeline defined in TS 38.214 section 6.1.
* Issue#2: Discussion on CG-CG/DG with different priorities

# **Discussion on per PUSCH repetition cancellation**

Regarding issue 3.3 in R1-2003395, based on the comments received, following was proposed to be captured in chairman notes.

**Conclusion**

In Rel.15, for a DG PUSCH overriding a CG PUSCH configured with repetition factor K>1,

* If the HARQ process is the same between the DG and the CG, DG overrides all remaining repetition occasions after the end of PDCCH reception, under the timeline specified in TS 38.214 section 6.1.
* Otherwise, DG overrides only the CG repetition overlapped with DG, under the timeline specified in TS 38.214 section 6.1.

Any comments?

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| --- | --- |
| Company | View |
| vivo | Support above conclusion. |
| Nokia, NSB | Support the conclusion |
| MediaTek | Support the conclusion. |
| Qualcomm | Support |
| Sharp | Support |
| Samsung | Agree |
| CATT | Agree |
| OPPO | Partially support the conclusion. However, the timeline specified in TS 38.214 section 6.1 is not clear. It needs to further clarification that the timeline is determined by the starting symbol of first overlapping PUSCH repetition.  For the same HARQ process case, support intention of proposal. However, it is a bit different from Rel-15 spec. Rel-15 spec needs to be updated.   1. According to current spec “A UE is not expected to be scheduled by a PDCCH ending in symbol to transmit a PUSCH on a given serving cell for a given HARQ process, if there is a transmission occasion where the UE is allowed to transmit a PUSCH with configured grant according to [10, TS38.321] with the same HARQ process on the same serving cell starting in a symbol after symbol , and if the gap between the end of PDCCH and the beginning of symbol is less than symbols.” In the following figure, the second PUSCH repetition that would transmit is also required to satisfy cancellation timeline. However it is too restrictive to ensure gap between PDCCH and the first repetition after PDCCH satisfy cancellation timeline. It means gap between consecutive PUSCH repetitions is larger than N2. Taking PUSCH decoding and PDCCH preparation time into account, the gap between consecutive PUSCH repetitions approaches to 2\*N2, and then available PUSCH repetition symbol number is very small, e.g. 3-4 symbols for capability 2 with u=0, 1, which is not benefit for reliability. Even it is not feasible for capability 1 and capability 2 with u=2 due to gap between consecutive PUSCH repetition needs to be larger than 14 symbols. So we suggest to clarify that cancelation timeline is applied for cancelled PUSCH repetition.     To be clearer, if necessary, we suggest to correct Rel-15 spec in the following  ----------------------Text proposal for TS38.214----------------------------  A UE is not expected to be scheduled by a PDCCH ending in symbol to transmit a PUSCH on a given serving cell for a given HARQ process, if there is a transmission occasion where the UE is allowed to cancel a PUSCH with configured grant according to [10, TS38.321] with the same HARQ process on the same serving cell starting in a symbol after symbol , and if the gap between the end of PDCCH and the beginning of symbol is less than symbols.  ----------------------End of Text proposal for TS38.214------------------------   1. According to current spec, “For any RV sequence, the repetitions shall be terminated after transmitting *K* repetitions, or at the last transmission occasion among the *K* repetitions within the period *P*, or from the starting symbol of the repetition that overlaps with a PUSCH with the same HARQ process scheduled by DCI format 0\_0, 0\_1 or 0\_2, whichever is reached first.”, The condition that dynamic grant overrides configured grants is that dynamic PUSCH overlaps with configured grant PUSCH. We agree with intention of proposal that it is not necessary restrict dynamic PUSCH and configured grant overlapping. However, if we support this proposal, correction on Rel-15 is required. Or keep the current spec, restriction is kept due to it is not a big issue for gNB scheduling.   ----------------------Text proposal for TS38.214----------------------------  For any RV sequence, the repetitions shall be terminated after transmitting *K* repetitions, or at the last transmission occasion among the *K* repetitions within the period *P*, or from the starting symbol of the repetition that cancelled by a PUSCH with the same HARQ process scheduled by DCI format 0\_0, 0\_1 or 0\_2, whichever is reached first  ----------------------End of Text proposal for TS38.214------------------------ |
| Panasonic | Agree to the conclusion. |
| Apple | Agree with the conclusion |

# **Discussion on CG-CG/DG collisions with different priorities**

Below are the current PHY layer specifications regarding to the collision handling for consideration.

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| TS 38.213 section 9: A PUSCH or a PUCCH, including repetitions if any, can be of priority index 0 or of priority index 1. If a priority index is not provided for a PUSCH or a PUCCH, the priority index is 0. If in an active DL BWP a UE monitors PDCCH either for detection of DCI format 0\_1 and DCI format 1\_1 or for detection of DCI format 0\_2 and DCI format 1\_2, a priority index can be provided by a priority indicator field. If a UE indicates a capability to monitor, in an active DL BWP, PDCCH for detection of DCI format 0\_1 and DCI format 1\_1 and for detection of DCI format 0\_2 and DCI format 1\_2, a DCI format 0\_1 or a DCI format 0\_2 can schedule a PUSCH transmission of any priority and a DCI format 1\_1 or a DCI format 1\_2 can schedule a PDSCH reception and trigger a PUCCH transmission with corresponding HARQ-ACK information of any priority. If, after resolving overlapping for PUCCH and/or PUSCH transmissions of a same priority index, a UE determines to transmit  - a first PUCCH of larger priority index, a PUSCH or a second PUCCH of smaller priority index, and a transmission of the first PUCCH would overlap in time with a transmission of the PUSCH or the second PUCCH, the UE does not transmit the PUSCH or the second PUCCH  - a PUSCH of larger priority index, a PUCCH of smaller priority index, and a transmission of the PUSCH would overlap in time with a transmission of the PUCCH, the UE does not transmit the PUCCH  - a first PUSCH of larger priority index on a serving cell, a second PUSCH of smaller priority index on the serving cell, and a transmission of the first PUSCH would overlap in time with a transmission of the second PUSCH, the UE does not transmit the second PUSCH, where at least one of the two PUSCH is not scheduled by a DCI format  [Irrelevant text is omitted] |

Furthermore, the details of when the UE may interrupt an ongoing transmission PHY-layer prioritization is captured in TS 38.214 in the following way:

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| 38.214 section 6.1 UE procedure for transmitting the physical uplink shared channel [Irrelevant text is omitted]  [If [a UE reports the capability of intra-UE prioritization], and if a PUSCH corresponding to a configured grant and a PUSCH scheduled by a PDCCH on a serving cell are partially or fully overlapping in time,  *-* If the PUSCH corresponding to the configured grant has *priority* in *configuredGrantConfig* set to 1 (i.e., high priority), and the PUSCH scheduled by the PDCCH is indicated as low priority by having the [priority indicator] field in the scheduling DCI set to 0 or by not having the [priority indicator] field present in the scheduling DCI, the UE is expected to transmit the PUSCH corresponding to the configured grant, and cancel the PUSCH transmission scheduled by the PDCCH at latest starting at the first symbol of the PUSCH corresponding to the configured grant.  *-* Otherwise, the UE shall cancel the PUSCH transmission corresponding to the configured grant at latest starting *M* symbols after the end of the last symbol of the PDCCH carrying the DCI scheduling the PUSCH, and transmit the PUSCH scheduled by the PDCCH, where  - *M = Tproc,2 +d1, where Tproc,2* is given by clause 6.4 for the corresponding PUSCH timing capability assuming *d2,1*= 0 and *d1* is determined by the reported UE capability [XXXXX],  - In this case, the UE is not expected to be scheduled for the PUSCH by the PDCCH where the PUSCH starts earlier than *N* symbols after the end of the last symbol of the PDCCH, where  - *N = Tproc,2* + *d2*, where *Tproc,2* is the PUSCH preparation time of the PUSCH scheduled by the PDCCH using the associated PUSCH timing capability according to clause 6.4 and *d2* is determined by the reported UE capability [YYYYY].  *-* In case of PUSCH repetitions, the overlapping handling is performed for each PUSCH repetition separately.  *-* The UE is not expected to be scheduled for another PUSCH by a PDCCH where this PUSCH starts no earlier than the end of the prioritized transmitted PUSCH and before the end of the time domain allocation of the cancelled PUSCH.]  [Irrelevant text is omitted] |

In the following, the 1st CG vs. 2nd CG, 1st CG vs. 2nd DG and 1st DG vs. 2nd CG will be discussed assuming that the MAC PDU corresponding to the second grant delivered from MAC to PHY is later than the MAC PDU corresponding to the first grant and the second grant is with higher priority, in other words, the latest agreed MAC spec R2-2004289 (see appendix) allows MAC to generate two MAC PDUs with resource overlapping where the 1st MAC PDU is with low priority and 2nd MAC PDU is with high priority. (It is reasonable that if the 1st grant is with higher priority and delivered from the MAC to PHY, then MAC shall not generate the 2nd grant with lower priority). Note that this document, the high and low priority is in terms of PHY layer priority.

**In addition, if your answers are different depending on whether the 1st grant has already started transmission or not, please provide your views separately and clearly for them.**

* **Case 1: 1st DG vs. 2nd CG**
  + Q1-1: whether to support the collision case that the 2nd CG with higher priority cancels the 1st DG with lower priority?
    - Option 1: Yes
    - Option 2: No

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| Company | View |
| vivo | Option 1: Yes. The use case for such collision in Rel.16 exists and is valid. For example, to reduce the transmission delay for the URLLC, it is possible that the CG is configured with short periodicity with high priority. Since URLLC could be burst traffic, there may or may not be CG transmission on each configured CG resource. To increase resource utilization, gNB can schedule a DG PUSCH with low priority overlapping with CG resource. In such case, when high priority CG traffic especially aperiodic one comes, high priority CG should be able to override the low priority DG transmission to ensure the high priority traffic transmission. |
| Nokia, NSB | Yes (Option 1) |
| MediaTek | Yes, support the collision case that the 2nd CG with higher priority cancels the 1st DG with lower priority. |
| Qualcomm | No, we do not support. Under the same timelines as in Rel. 16, there is no impact on PHY layer, i.e., cancellation of a transmission at the PHY layer is not expected. |
| Sharp | Yes |
| Samsung | Yes |
| CATT | Yes |
| OPPO | Yes |
| Panasonic | Yes |
| Apple | No to Q1-1. As analyzed in our contribution R1-2004227, supporting high priority CG canceling low priority DG bring serious challenges to UE implementation; cancellation and replacement of PUSCH is not supported in Rel-16. The tentative text under Clause 6.1 38.214 should be removed. |

* + Q1-2: if your answer to Q1-1 is Yes, what is the expected physical layer handling behavior?
    - e.g. as specified in 38.214 that “the UE is expected to transmit the PUSCH corresponding to the configured grant, and cancel the PUSCH transmission scheduled by the PDCCH at latest starting at the first symbol of the PUSCH corresponding to the configured grant”?

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| Company | View |
| vivo | In case of collision between 1st DG with lower priority and 2nd CG with higher priority, the DG transmission can be cancelled at latest starting at the first symbol of the CG PUSCH, according to the cancellation timeline captured with blankets in current 38.214 for Rel.16 UE supporting the capability of *intra-UE prioritization*. |
| Nokia, NSB | Current text in 38.214 is sufficient. |
| MediaTek | The current text seems sufficient. |
| Sharp | The current text is sufficient. |
| Samsung | We are supportive of having the sentence in bracket in current specification. It is note that gNB behavior does not change whether processing time is defined or not. Saying that again, gNB does not know when a UE transmit on CG even if cancellation timeline is defined (for example, timeline between PDCCH scheduling between first symbol of CG), and therefore gNB needs to blindly detect CG and DG when they are overlapped and priority associated with CG is higher than priority associated with DG. In this regards, it should be UE implementation. |
| CATT | Current text in 38.214 is sufficient. |
| OPPO | Configured grant transmission is an UE implementation, In addition, the time for MAC PDU delivered from MAC is also an UE implementation issue, and it is not easy to define transparent timeline for gNB. So collision handling behavior related with configured grant transmission with high priority is left to UE implementation. |
| Panasonic | The expected physical layer handling behavior is as specified in TS38.214. |
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* + Q1-3: if your answer to Q1-1 is No, what is the expected physical layer handling behavior if MAC layer delivers the CG with higher priority?

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| Company | View |
| Qualcomm | There is no impact at the PHY layer. At a time defined by the Rel. 15 timeline, MAC decides whether to generage a PDU for CG or DG. Any grant comes after the this time is invalid. |
| Apple | The Rel-15 timeline allows DG PUSCH to overlap with CG PUSCH’s transmission occasion. The need to cancel the low priority DG PUSCH potentially might arise if the DG PUSCH is ahead of the CG, on the other hand, if the DG PUSCH starts at the same time or starts later than the CG PUSCH transmission occasion, the UE can drop the DG PUSCH, but no cancellation is involved in this case, see the figure below for PUSCH-9. In this case, the MAC does not need to generate a MAC PDU for LP PUSCH-9; A screenshot of a cell phone  Description automatically generated |

* + Q1-4: is there any discrepancy foreseen between PHY and MAC for option 1 and/or option 2, and how to resolve it?

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| Company | View |
| vivo | No discrepancy is foreseen between PHY and MAC for option 1. |
| Nokia, NSB | Option1: No discrepancy foreseen between PHY and MAC since the cancellation decision is made in PHY, i.e. even two MAC PDUs delivered from MAC, only the one with the high PHY priority is transmitted. |
| Qualcomm | No, as explained above in response to Q1-3, there is no discrepancy expected. |
| Sharp | No (for Option 1). |
| CATT | No for option 1 assuming LCH based prioritization would not be configured without PHY based prioritization. |
| OPPO | Considering processing time is not transparent for MAC, indication on whether delivered MAC PDU transmits or not is reported to MAC layer. |
| Apple | We don’t see any discrepancy with Option 2. In the answer to Q1-3, the MAC can decide not to generate a MAC PDU for PUSCH-9. |

[Summary and proposals: to be added based on companies’ views]

* **Case 2: 1st CG vs. 2nd DG**
  + Q2-1: whether to support the collision case that the 2nd DG with higher priority cancels the 1st CG with lower priority?
    - Option 1: Yes
    - Option 2: No

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| Company | View |
| vivo | Option 1: Yes.  In Rel.15, DG overriding CG is already supported. For Rel.16, at least we should support what is Rel.15 already supported. |
| Nokia, NSB | Yes (Option 1)  As vivo pointed out, even within the same priority we supporting overriding of DG over CG in Rel-15, so no need to prevent this. |
| Qualcomm | No, we do not support PHY layer cancellation for CGDG collision. |
| Sharp | Yes. We share the same view with vivo. |
| Samsung | Yes |
| CATT | Yes |
| OPPO | Yes |
| Panasonic | Yes |
| Apple | We support Option 2. |

* + Q2-2: if your answer to Q2-1 is Yes, what is the expected physical layer handling behavior?

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| Company | View |
| vivo | It is better to clarify whether this collision case is supported by re-using Rel.15 timeline ***N2*** restriction or Rel.16 defined new timeline e.g. ***M***.  From our understanding that for the Rel.15 UE and Rel.16 UE not supporting *intra-UE prioritization*, and for DG and CG with same priority i.e., both CG and DG are high priority or both are low priority, Rel.15 timeline applies, which means CG will not start transmit at all and PHY layer does not expect CG MAC PDU will be delivered from MAC layer. Otherwise, it is error case.  While, for Rel.16 UE supporting *intra-UE prioritization*, UE can be scheduled with a DG PUSCH with high priority that is overlapping with an earlier started CG transmission, without satisfying the Rel.15 timeline ***N2*** restriction. In such case, no error case would be defined. The DG PUSCH with high priority will cancel the CG with low priority under the timeline restriction ***M*** even if the earlier CG starts transmission. |
| Nokia, NSB | The expected physical layer behavior should be aligned with the outcome from the first email thread under “Scheduling & HARQ” AI (i.e. [101-e-NR-L1enh-URLLC-HARQ&Scheduling-01]) |
| Sharp | We share the same view with vivo. |
| Samsung | For overlapping CG and DG with same priority and DG overriding CG, Rel-15 specifies UE behavior as follows.  A UE is not expected to be scheduled by a PDCCH ending in symbol 𝑖 to transmit a PUSCH on a given serving cell overlapping in time with a transmission occasion, where the UE is allowed to transmit a PUSCH with configured grant according to [10, TS38.321], starting in a symbol 𝑗 on the same serving cell if the end of symbol 𝑖 is not at least 𝑁2 symbols before the beginning of symbol 𝑗. |
| CATT | We suggest to discuss different priority case only in this email thread. For same priority case (including the timeline), it is being discussed under Others AI.  Then we share the similar view with vivo except for the same priority case, i.e.  For the Rel.15 UE and Rel.16 UE not supporting *intra-UE prioritization*, Rel.15 timeline applies. For Rel.16 UE supporting *intra-UE prioritization*, Rel.15 timeline does not need to be met and Rel.16 timeline applies. |
| OPPO | We share the same view with vivo. Cancellation timeline defined in Rel-16 is required. |
| Panasonic | To keep Rel.15 timeline for the case of dynamic grant overriding configured grant. To judge priority indicator is necessary and then, if it is not possible, to adjust the timeline requirement can be considered. |

* + Q2-3: if your answer to Q2-1 is No, what is the expected physical layer handling behavior if MAC layer delivers the DG with higher priority?

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| Company | View |
| Qualcomm | The same as mentioned before, MAC makes its decision at a time given by the Rel. 15 timeline. |
| Apple | As long as MAC generates MAC PDU following the Rel-15 timeline, there is no issue to handle.  A screenshot of a cell phone  Description automatically generated |

* + Q2-4: is there any discrepancy foreseen between PHY and MAC for option 1 and/or option 2, and how to resolve it?

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| --- | --- |
| Company | View |
| vivo | No discrepancy is foreseen between PHY and MAC for option 1 if Rel.16 newly defined timeline and behavior are used such that it is not problematic when MAC layer delivers the second MAC PDU with high priority after the first MAC PDU with low priority delivered to PHY layer. |
| Nokia, NSB | Option 1: No discrepancy foreseen between PHY and MAC since the cancellation decision is made in PHY, i.e. even two MAC PDUs delivered from MAC, only the one corresponding to the grant with high PHY priority is transmitted. |
| MediaTek | We don’t see any discrepancy between PHY and MAC for option 1. |
| Qualcomm | We do not see any discrepancy under Option 2. |
| Sharp | No (for Option 1) |
| CATT | No for option 1 assuming LCH based prioritization would not be configured without PHY based prioritization. |
| OPPO | No |
| Apple | No discrepancy is seen with Option 2. |

[Summary and proposals: to be added based on companies’ views]

* **Case 3: 1st CG vs. 2ndCG**
  + Q3-1: whether to support the collision case that the 2nd CG with higher priority cancels the 1st CG with lower priority?
    - Option 1: Yes
    - Option 2: No

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| --- | --- |
| Company | View |
| vivo | Option 1: Yes. Multiple CGs can be used for supporting different traffic types and reducing the transmission alignment delay, hence the collision among CGs exists. |
| Nokia, NSB | Yes (Option 1)  Agree with justifications by vivo. |
| MediaTek | Yes, support the collision case that the 2nd CG with higher priority cancels the 1st CG with lower priority. |
| Qualcomm | If this is about allowing a configuration with overlapping CG occasions, then yes. If it means that one CG “has to” cancel the other, then No. |
| Sharp | Yes |
| Samsung | Yes |
| CATT | Yes |
| OPPO | Yes |
| Panasonic | Yes |
| Apple | We don’t support cancellation and replacement between CG vs CG either. |

* + Q3-2: if your answer to Q3-1 is Yes, what is the expected physical layer handling behavior?

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| Company | View |
| vivo | For the case that MAC layer delivers two CGs with different priorities, (first delivered CG is low priority and second delivered CG is high priority), it is preferred that the high priority CG can cancel the low priority CG, but considering the CG does not have corresponding PDCCH, the cancellation timeline can be left to UE implementation. |
| Nokia, NSB | If the MAC delivers two PDUs, up to UE implementation to make sure that the low priority CG PUSCH transmission can be cancelled before the start of the high priority CG PUSCH. |
| MediaTek | We don’t see a need for specific physical layer handling behavior for this case. |
| Qualcomm | With the assumption that Q3 was only about configuration of overlapping occasions, then no specification impact is foreseen. Handling the collision is left to the UE implementation. |
| Sharp | Up to implementation. |
| Samsung | We are not expecting PHY impact and corresponding specification efforts. |
| CATT | If the MAC delivers two PDUs, up to UE implementation to make sure that the low priority CG PUSCH transmission can be cancelled before the start of the high priority CG PUSCH. |
| OPPO | Up to implementation |
| Panasonic | Up to implementation |

* + Q3-3: if your answer to Q3-1 is No, what is the expected physical layer handling behavior if MAC layer delivers the DG with higher priority?

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| Company | View |
| Apple | The handling of overlapping CG configurations is for UE implementation. |

* + Q3-4: is there any discrepancy foreseen between PHY and MAC for option 1 and/or option 2, and how to resolve it?

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| --- | --- |
| Company | View |
| vivo | No for option 1. |
| Nokia, NSB | Option 1: No discrepancy foreseen between PHY and MAC since the cancellation decision is made in PHY, i.e. even two MAC PDUs delivered from MAC, only the one with the high PHY priority is transmitted. |
| MediaTek | We don’t see any discrepancy between PHY and MAC for option 1. |
| Qualcomm | There is no discrepancy; PHY and MAC are in the same UE, and know how to avoid/handle the collision. |
| Sharp | No (for Option 1) |
| CATT | No for option 1 assuming LCH based prioritization would not be configured without PHY based prioritization. |
| OPPO | Considering processing time is not transparent for MAC, indication on whether delivered MAC PDU transmits or not is reported to MAC layer. |
| Apple | We don’t see any discrepancy with Option 2. |

[Summary and proposals: to be added based on companies’ views]

In addition, there is one more issue that deserves discussion. It is noted that in RAN2 #109bis e-meeting, following agreements were made for URLLC/IIoT:

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| --- |
| * R2 assumes that PHY-based prioritization and LCH-based prioritization are configured independently and one can be configured without the other (assumption may be modified when LS reply from R1 is received) |

Based on above agreement, it is implied that RAN2 assumes MAC prioritization can be configured regardless the PHY priority. Companies are encouraged to provide your views on above RAN2 assumptions.

* **Q4: what is your views about the relations between the PHY-based prioritization and LCH-based prioritization?**
  + Option 1: they can be configured independently;
  + Option 2: they should be configured jointly;
  + Option 3: PHY-based prioritization should be the prerequisite UE feature for the LCH-based prioritization.
  + Option 4: LCH-based prioritization should be the prerequisite UE feature for PHY-based prioritization.
  + Other options?

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| --- | --- |
| Company | View |
| vivo | Option 3.  Based on our analysis in [R1-2003347], if UE does not support LCH-based prioritization, UE behaviors are mostly like Rel.15, i.e. in case of collision, only one MAC PDU will be delivered to PHY, then regardless of whether UE supports PHY-based prioritization, PHY only transmits the delivered MAC PDU. However, if UE supports LCH-based prioritization but does not support PHY-based prioritization, there will be inconsistency between MAC and PHY that PHY layer expects one MAC PDU delivered from MAC but MAC layer delivers two MAC PDUs with different priorities (here the priorities is from MAC perspective since only LCH-based prioritization is supported in MAC).  Since intra-UE prioritization configuration for PHY layer is not only used to handle the collision cases between PUSCH and PUSCH, but also PUCCH and PUSCH/PUCCH, there could be the use case of intra-UE prioritization configured for PHY layer but not configured for MAC layer. Therefore, we propose   * UE should not expect to be configured with LCH-based prioritization alone. * PHY-based prioritization should be the prerequisite for the LCH-based prioritization. |
| Nokia, NSB | Option 2 because full advantages of the intra-UE prioritization can be exploited in case PHY-based prioritization and LCH-based prioritization are applied together.  Please note, that Option 2 to our understanding includes Option 3 and Option 4 (i.e. if you are required to configure both, UE of course needs to support both). |
| MediaTek | Option 1: they can be configured independently.  We are not sure why they **should** be configured jointly? Also, which PHY-based prioritization that should be jointly configured LCH-based prioritization? Is it HARQ priority, SR priority, CG-PUSCH priority, etc.?  It should be up to the network to see what priority configuration is needed. |
| Qualcomm | No need to discuss this; it can be decided by the network.  On vivo’s comment about what happens if the MAC based prioritization is configured, but the PHY based prioritization is not, we do not think there is any discrepancy for this case either. Building on the MAC enhancements, e.g., for the case of DGCG collision, MAC can check the data availability and the LCH prioritization and decide whether a PDU should be generated for CG or DG (which was not possible in Rel. 15.) |
| Sharp | Option 1: they can be configured independently.  We share the similar view with MediaTek. |
| Samsung | Option 1, it is unnecessary to be associated one with another, instead, it is better to provide better flexibility between PHY and MAC by allowing independent configurations. But, not sure why this discussion is needed. |
| CATT | Although it can be left to RAN2 to decide, it is beneficial to provide RAN1’s understandings to facilitate RAN2’s decision given that the features involve both MAC and PHY layers.  Our view is that if LCH based prioritization is configured, PHY based prioritization should be configured. Otherwise, there are discrepancies as we discussed above. Basically, MAC delivers two MAC PDUs to PHY but PHY would not prioritize the one with higher L1 priority.  We are open to discuss whether it is allowed to configure PHY based prioritization without LCH based prioritization considering the case when only prioritization for two HARQ-ACK codebooks for DL services is needed. |
| OPPO | Option 1 and 2, they can be configured independently and jointly, which is decided by network.   * If both solution are configured, MAC solution is applied in MAC layer and physical solution for PHY priority feature is applied in physical layer. * If MAC solution is configured and physical solution is not configured, MAC solution is applied in MAC layer and physical solution for no PHY priority feature is applied in physical layer. * If physical solution is configured and MAC solution is not configured, physical solution for PHY priority feature is applied in physical layer.   When PHY priority feature is not configured, The UE behavior to solve PUSCH overlapping in physical layer is up to UE implementation.Typically, Later MAC PDU has higher priority. Similarly, indication on whether overlapped MAC PDU transmits or not is reported to MAC layer. |
| Panasonic | Option 2 seems beneficial, but Option 1 can also work. |
| Apple | It is up to network’s implementation |

[Summary and proposals: to be added based on companies’ views]

# **Appendix**

5.4 UL-SCH data transfer

5.4.1 UL Grant reception

[Irrelevant text is omitted]

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. The priority of an uplink grant for which no data for logical channels is multiplexed or can be multiplexed in the MAC PDU is lower than the priority of an uplink grant for which data for any logical channels is multiplexed or can be multiplexed in the MAC PDU.

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

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 which was not already de-prioritized, 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> consider this uplink grant as a prioritized uplink grant;

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

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

2> if there is no overlapping PUSCH duration of another configured uplink grant which was not already de-prioritized, 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 which was not already de-prioritized, 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> consider this uplink grant as a prioritized uplink grant;

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

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.

5.4.2 HARQ operation

5.4.2.1 HARQ Entity

[Irrelevant text is omitted]

For each uplink grant, the HARQ entity shall:

1> identify the HARQ process associated with this grant, and for each identified HARQ process:

2> if the received grant was not addressed to a Temporary C-RNTI on PDCCH, and the NDI provided in the associated HARQ information has been toggled compared to the value in the previous transmission of this TB of this HARQ process; or

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

2> if the uplink grant was received in a Random Access Response (i.e. in a MAC RAR or a fallback RAR); or

2> if the uplink grant was determined as specified in clause 5.1.2a for the transmission of the MSGA payload; or

2> if the uplink grant was received on PDCCH for the C-RNTI in *ra-ResponseWindow* and this PDCCH successfully completed the Random Access procedure initiated for beam failure recovery; or

2> if the uplink grant is part of a bundle of the configured uplink grant, and may be used for initial transmission according to clause 6.1.2.3 of TS 38.214 [7], and if no MAC PDU has been obtained for this bundle:

3> if there is a MAC PDU in the MSGA buffer and the uplink grant determined as specified in clause 5.1.2a for the transmission of the MSGA payload was selected:

4> obtain the MAC PDU to transmit from the MsgA buffer.

3> else if there is a MAC PDU in the Msg3 buffer and the uplink grant was received in a fallbackRAR:

4> obtain the MAC PDU to transmit from the Msg3 buffer.

3> else if there is a MAC PDU in the Msg3 buffer and the uplink grant was received in a MAC RAR; or:

3> if there is a MAC PDU in the Msg3 buffer and the uplink grant was received on PDCCH for the C-RNTI in *ra-ResponseWindow* and this PDCCH successfully completed the Random Access procedure initiated for beam failure recovery:

4> obtain the MAC PDU to transmit from the Msg3 buffer.

4> if the uplink grant size does not match with size of the obtained MAC PDU; and

4> if the Random Access procedure was successfully completed upon receiving the uplink grant:

5> indicate to the Multiplexing and assembly entity to include MAC subPDU(s) carrying MAC SDU from the obtained MAC PDU in the subsequent uplink transmission;

5> obtain the MAC PDU to transmit from the Multiplexing and assembly entity.

3> else if this uplink grant is a configured grant configured with *autonomousTx*; and

3> if the previous configured uplink grant for this HARQ process was de-prioritized; and

3> if a MAC PDU had already been obtained for this HARQ process; and

3> if the uplink grant size matches with size of the obtained MAC PDU; and

3> if a transmission of the obtained MAC PDU has not been performed:

4> consider the MAC PDU has been obtained.

3> else if the MAC entity is not configured with *lch-basedPrioritization*; or

3> if this uplink grant is a prioritized uplink grant:

4> obtain the MAC PDU to transmit from the Multiplexing and assembly entity, if any;

3> if a MAC PDU to transmit has been obtained:

4> if the uplink grant is not a configured grant configured with *autonomousTx*; or

4> if the uplink grant is a prioritized uplink grant:

5> deliver the MAC PDU and the uplink grant and the HARQ information of the TB to the identified HARQ process;

5> instruct the identified HARQ process to trigger a new transmission;

5> if the uplink grant is a configured uplink grant:

6> start or restart the *configuredGrantTimer*, if configured, for the corresponding HARQ process when the transmission is performed;

6> start or restart the *cg-RetransmissionTimer*, if configured, for the corresponding HARQ process when the transmission is performed.

5> if the uplink grant is addressed to C-RNTI, and the identified HARQ process is configured for a configured uplink grant:

6> start or restart the *configuredGrantTimer*, if configured, for the corresponding HARQ process when the transmission is performed.

5> if *cg-RetransmissionTimer* is configured for the identified HARQ process:

6> if the transmission is performed:

7> consider the identified HARQ process as not pending.

6> else:

7> consider the identified HARQ process as pending.

3> else:

4> flush the HARQ buffer of the identified HARQ process.

2> else (i.e. retransmission):

3> if the uplink grant received on PDCCH was addressed to CS-RNTI and if the HARQ buffer of the identified process is empty; or

3> if the uplink grant is part of a bundle and if no MAC PDU has been obtained for this bundle; or

3> if the uplink grant is part of a bundle of the configured uplink grant, and the PUSCH duration of the uplink grant overlaps with a PUSCH duration of another uplink grant received on the PDCCH or an uplink grant received in a Random Access Response (i.e. MAC RAR or fallbackRAR) or an uplink grant determined as specified in clause 5.1.2a for MSGA payload for this Serving Cell; or:

3> if the MAC entity is configured with *lch-basedPrioritization* and this uplink grant is not a prioritized uplink grant:

4> ignore the uplink grant.

3> else:

4> deliver the uplink grant and the HARQ information (redundancy version) of the TB to the identified HARQ process;

4> instruct the identified HARQ process to trigger a retransmission;

4> if the uplink grant is addressed to CS-RNTI; or

4> if the uplink grant is addressed to C-RNTI, and the identified HARQ process is configured for a configured uplink grant:

5> start or restart the *configuredGrantTimer*, if configured, for the corresponding HARQ process when the transmission is performed.

4> if the uplink grant is a configured uplink grant:

5> if the identified HARQ process is pending:

6> start or restart the *configuredGrantTimer* for the corresponding HARQ process when the transmission is performed;

5> start or restart the *cg-RetransmissionTimer*, if configured, for the corresponding HARQ process when the transmission is performed.

4> if the identified HARQ process is pending and the transmission is performed:

5> consider the identified HARQ process as not pending.

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.