**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 $i$ 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 $j$ after symbol $i$, and if the gap between the end of PDCCH and the beginning of symbol $j$ is less than $N\_{2}$ 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 $i$ 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 $j$ after symbol $i$, and if the gap between the end of PDCCH and the beginning of symbol $j$ is less than $N\_{2}$ 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 |
| Spreadtrum | Agree with the conclusion |
| Ericsson | Support the conclusion |
| LG | Agree with the conclusion and one clarification is need. It should be common understanding that he yellow part in below spec is not applied to configured grant case.TS 38.214 section 6.1.For any HARQ process ID(s) in a given scheduled cell, the UE is not expected to transmit a PUSCH that overlaps in time with another PUSCH. For any two HARQ process IDs in a given scheduled cell, if the UE is scheduled to start a first PUSCH transmission starting in symbol *j* by a PDCCH ending in symbol *i*, the UE is not expected to be scheduled to transmit a PUSCH starting earlier than the end of the first PUSCH by a PDCCH that ends later than symbol *i*. The UE is not expected to be scheduled to transmit another PUSCH by DCI format 0\_0, 0\_1 or 0\_2 scrambled by C-RNTI or MCS-C-RNTI for a given HARQ process until after the end of the expected transmission of the last PUSCH for that HARQ process. |
| ZTE | Agree.  |
| Huawei/HiSilicon | Support the conclusion. |
| Intel | We support the proposed conclusion. Also, agree with the clarification from LGE. |

# **Summary:**

Based on the received views, almost all companies support the conclusion. In addition, LG’s clarification is correct and can be clearly seen from the spec that no CS-RNTI is included in the description for the yellow highlighted part cited by LG. Regarding to OPPO’s update for the Rel.15 spec, it is not necessary to use the wording “cancel” and TP is not necessary (otherwise it should be proposed in session 7.1 Rel.15 maintenance). Therefore, following is proposed:

**Proposal 1: capture following conclusion in chairman’s 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.

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| Company | View |
| CATT | We realized that the proposed conclusion covers the case that a PUSCH scheduled by RAR UL grant overrides a CG PUSCH. In this case, the timeline in 38.214 section 6.1 does not apply since there is no associated DCI and the timeline in this case is under discussion without conclusion yet. Therefore, we propose the following updates to the proposed conclusion. For CG PUSCH overridden by PUSCH scheduled by RAR UL grant, we think only the overlapped repetition(s) is(are) overridden.**Conclusion**In Rel.15, for a DG PUSCH scheduled by a DCI 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.

In Rel.15, for a DG PUSCH scheduled by RAR UL grant overriding a CG PUSCH configured with repetition factor K>1, DG overrides only the CG repetition overlapped with DG. |
| LG | Though we agree with the conclusion, we would like to clarify what yellow part means. The UE is not expected to be scheduled to transmit another PUSCH by DCI format 0\_0, 0\_1 or 0\_2 scrambled by C-RNTI or MCS-C-RNTI for a given HARQ process until after the end of the expected transmission of the last PUSCH for that HARQ process.In the yellow part, the description for “another PUSCH” has no CS-RNTI, however, the description for “the last PUSCH” has no any RNTI. What it means, if a HARQ process is used for the configured grant and it has not start yet, a UE is not expected to be scheduled to transmit dynamic PUSCH for the HARQ process. This is totally opposite with the first bullet in this conclusion. That’s our concern. |
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# **Email discussion Outcome**

**Following Conclusion was endorsed @ 2020/5/30**

In Rel.15, for a DG PUSCH scheduled by a DCI 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.

# **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. |
| Spreadtrum | Option 1: Yes |
| Ericsson | Yes |
| LG | I assume the cancel means the cancellation by 2nd MAC PDU. If the timeline is sufficiently satisfied, UE can prioritization HP CG without cancelation.  |
| ZTE | Yes |
| Huawei/HiSilicon | Yes |
| Intel | * If the prioritization between LP DG and HP CG is done in MAC, then such CG-DG overlaps can be supported.
	+ For this, it is necessary that the MAC PDU for the HP CG PUSCH is available from the multiplexing and assembly entity at least Tproc,2 before the start of the LP DG PUSCH, and thus MAC will ignore the LP DG PUSCH UL grant.
* If the prioritization between LP DG and HP CG is done in PHY, it may not be feasible with timelines we have agreed so far since the triggering of the transmission of the HP CG PUSCH would be dependent on when the MAC delivers the corresponding MAC PDU to PHY for the HP CG PUSCH. However, establishing a timeline for such a trigger in PHY specs may not be feasible. On the other hand, the UE would still need some minimum time to cancel the LP DG PUSCH.

In summary, for 1st DG – 2nd CG case with low and high priority respectively, the answer for PHY prioritization is “No”, but for MAC prioritization is “Yes”. |

* + 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. |
| Spreadtrum | As same as other HP UL transmission without PDCCH overlapping with LP UL transmission in [101-e-NR-L1enh-URLLC-HARQ&Scheduling-02], it is up to UE implementation.  |
| Ericsson | While we believe the relevant behaviors have been specified in 38.214, it’s worthwhile to clarify that the DG-CG collision handling occurs after determining if MAC has sent a TB to the physical layer for the CG. As stated in TS 38.214 Section 6.1.2.3:“**The UE shall not transmit anything on the resources configured by *configuredGrantConfig*** if the higher layers did not deliver a transport block to transmit on the resources allocated for uplink transmission without grant.”Thus, there are two cases:* If MAC has sent a TB to be transmitted over CG: the CG PUSCH is prioritized, the DG PUSCH is cancelled. This corresponds to the 38.214 section 6.1 intra-UE prioritization text cited by FL.
* If MAC has not sent a TB to be transmitted over CG: the CG PUSCH is absent from the PHY intra-UE prioritization procedure (i.e., no collision visible at PHY), and the DG PUSCH is transmitted.
 |
| ZTE | Current text is sufficient. |
| Huawei/HiSilicon | Current text in 38.214 is sufficient. |

* + 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 |
| LG | At least it is up to MAC behavior whether to transmit CG. In that case, UE may not know whether UE can transmit LP PUSCH before when MAC PDU for HP CG comes. But we cannot specify a moment when MAC deliver PDU during PUSCH processing time N2. One possible thinking is to schedule with sufficient time line, as like HP CG and LP PUSCH-9 as like Apple’s figure, and ensure MAC generate only one PDU. There is only one PHY impact related to scheduling timeline. |
| Intel | In this case, MAC should not deliver a 2nd PDU for a HP CG PUSCH if it has already delivered a PDU to PHY for a 1st DG PUSCH. |

* + 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.  |
| Spreadtrum | No (for Option 1). |
| Ericsson | No |
| LG | MAC de-prioritizes all other grant if one grant is prioritized. There would be no discrepancy with Option 2 if MAC acquire both grant before processing configured grant.  |
| ZTE | No (for Option 1). |
| Huawei/HiSilicon | No discrepancy foreseen for Option1. |
| Intel | No discrepancy if prioritization performed @ MAC. Otherwise, there can be processing timeline issues for PHY prioritization as there may not be sufficient time for the UE to cancel the DG PUSCH if the MAC PDU for the CG PUSCH is delivered to PHY “quite late” (e.g, Tproc,2 instead of Tproc,2 + d1 even when considering support of partial cancelation of the DG PUSCH).  |

# **Summary for Case 1: 1st DG vs. 2nd CG**

* Assuming MAC layer delivers a high priority (HP) CG after it has already delivered a low priority (LP) DG,
	+ (13) vivo, Nokia, NSB, MediaTek, Sharp, Samsung, CATT, OPPO, Panasonic, Ericsson, ZTE, Huawei/HiSilicon support above assumed collision case and support the 2nd HP CG can partially cancel the ongoing 1st LP DG with the timeline currently captured in TS 38.214 with brackets [], as shown in Fig.1 (a).
		- e.g., 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.
	+ (4) Qualcomm, Apple, LG, Intel do not support above assumed collision case because of following:
		- Serious challenges to UE implementation in PHY: cancellation and replacement of HP CG
		- Infeasible to define proper cancellation timeline since it is not sure when the MAC delivers the corresponding MAC PDU to PHY for the HP CG.
	+ Qualcomm, Apple, LG, Intel proposed that to keep consistency between PHY and MAC, MAC should make the prioritization and only one MAC PDU is delivered to PHY layer as shown in Fig.1 (b).



Fig. 1(a): PHY layer makes the prioritization and cancels the LP DG



Fig. 1(b) MAC layer makes the prioritization and only delivers the HP CG

Based on above, on one hand, the majority companies would like to support the case that PHY layer can handle the collision case and the HP CG can partially cancel the LP DG since it is aligned with RAN2’s assumptions and there seems not much difference from the case that HP CG cancels the LP PUCCH which was already agreed, this is option 3. On the other hand, other companies mainly the chipset vendors having concerns on the complexity at the UE implementation side and the difficulty to define feasible timeline to cancel the LP DG by HP CG, we should also take into account, this is option 2. Therefore, one compromised proposal was made, that is option 1 by introducing the UE capability.

following are proposed, please share your views and suggestions on how to move forward.

**Let me quickly summarize current status. First case is HP CG collide with LP DG**

# **Proposal 2:**

* For collision handling between high priority CG and low priority DG, down-select following options.
	+ Option 1: define a UE capability for collision handling between the CG and DG with different priorities in PHY layer.
		- If UE supports the capability, PHY layer can make the prioritization so 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.
		- Otherwise, MAC layer should make the prioritization so that only one MAC PDU is delivered to PHY layer.
			* Supported by Samsung, vivo
	+ Option 2: re-use Rel.15 timeline, MAC layer should make the prioritization so that only one MAC PDU (e.g. the one with higher priority) is delivered to PHY layer.
		- Supported by QC, Intel, LG, Apple
	+ Option 3: PHY layer can make the prioritization so that the UE is expected to transmit the PUSCH corresponding to the configured grant, and cancel the overlapping low priority PUSCH scheduled by the PDCCH at latest starting at the first symbol of the PUSCH corresponding to the configured grant.
		- Supported by Nokia, NSB, Huawei/HiSilicon, CATT, NEC, MTK, ZTE, Ericsson
	+ No PHY collision handling necessary if MAC does not generate a PDU for the CG.
	+ PHY does not expect MAC to generate a PDU for a later, lower-priority, CG PUSCH, which overlaps with an earlier, higher-priority, DG PUSCH.

Any comments or suggestions?

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| Company | View |
| Qualcomm | Option 2. As mentioned earlier, the MAC timeline is not specified and it is not clear when the PDU is sent to PHY whether the DG-PUSCH can be cancelled on time. From the use case point of view, we think the enhancements done by RAN2, i.e., the UE’s MAC layer can ignore the DG, is sufficient.  |
| Nokia, NSB | We are not really fond of different subsets of UE capabilities here and do not see a real need here.So we would prefer Option 1 without UE capability (and MAC should try to only deliver a single MAC PDU if possible, so that the need for cancelation would only be the last resort).  |
| Huawei/HiSilicon | Same view with Nokia, Option 1 with no new UE capability. |
| CATT | Same view as Nokia and Huawei, Option 1 without UE capability.For the UE complexity issue brought up by some companies, we would like to understand the issue better especially on the difference from intra-UE prioritization between PUCCH/PUCCH and PUCCH/PUSCH.We think it would be very unfortunate if in the end we in RAN1 agree that for all the three cases under discussion, only one MAC PDU is delivered to PHY. The feature is led by RAN2 and RAN2 has spent a lot of time discussing LCH based prioritization. However, if we require MAC to deliver only one MAC PDU in all cases, the whole LCH based prioritization becomes useless and UL traffic with higher priority cannot be prioritized which contradicts with the whole idea in Rel-16 eURLLC/IIoT WIs to prioritize the traffic with higher priority. |
| Intel | We are still not sure how to specify Option 1.For Option 1, it would be good to understand how we can define the timeline for the UE to cancel the LP DG PUSCH by HP CG PUSCH if the prioritization is to be at PHY and based on relative timing between when the corresponding MAC PDUs are delivered from MAC to PHY of the UE. Can the PHY specs guarantee that the UE can perform the cancelation of the DG PUSCH if the PHY in the UE (although it is aware of the CG PUSCH occasion a priori) receives the transport block from MAC such that it still has Tproc,2+d1 time to cancel the DG PUSCH at least latest from the first overlapping symbol? |
| LG | For the case of two MAC PDU, One thing we could say is “leave it to UE implementation”. If MAC delivers two MAC PDU, we cannot specify which PDU would be transmitted.At least exampled figure, only one MAC PDU is generated in the current specification. Once MAC PDU is generated for a grant, all other grant are de-prioritized. Thus, Two PDU can be generated only when HP grant is received after first MAC PDU is generated. We cannot sure that it is practical use case considering T\_proc,2 in RAN1. As Intel mentioned, we cannot expect and specify when the first MAC PDU can be delivered. PHY-MAC operation is UE’s logical behavior. We don’t know how to specify “end of first MAC PDU delivery” and what it is. If we don’t know that, needless to say, we cannot know whether UE is able to do and how to guarantee as well. |
| Samsung | Main issue is how MAC know timeline to transmit MAC PUCH on a prioritized grant on time. Actually, for handling prioritization, MAC entity uses time domain resource allocation information for each grant to check whether or not it is overlapped with others. In this sense, MAC already know where each grant(s) is/are in time domain. Hence, we think that MAC makes sure that PHY is able to cancel LP DG, and transmit HP CG. That is, MAC should not transfer to MAC PDU to PHY if PHY cannot do cancellation even if HP CG is selected as prioritized grant by MAC. Why MAC transfers MAC PDU that could not be transmitted properly by PHY? For the sake of progress, we are fine with option 1 as providing UE capability. |
| Ericsson | It’s strange that the section title is “1st DG vs 2nd CG”, while the opening of Proposal 2 is “high priority CG and low priority DG”. It is not always true that 1st DG=low priority, 2nd CG = high priority. It is also possible that 1st DG = high priority, 2nd CG = low priority, in terms of UL grant.I assume Proposal 2 is for: 1st DG (high priority/low priority) vs 2nd CG collision (low priority/high priority).Need to revise Proposal 2 (regardless of options) by adding the following:* No PHY collision handling necessary if MAC does not generate a PDU for the CG.
* For 1st DG vs 2nd CG collision, PHY does not expect MAC to generate a PDU for a later, lower-priority, CG PUSCH, which overlaps with an earlier, higher-priority, DG PUSH.

For DG-CG collision, we support Option 3 in principle, and we do not support introduction of UE capability for it.  |

* **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

|  |  |
| --- | --- |
| 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. |
| Spreadtrum | Option 1: Yes |
| Ericsson | Yes |
| LG | Support Option 1 to retain CG-DG overriding.  |
| ZTE | Yes |
| Huawei/HiSilicon | Yes. |
| Intel | **Option 1: Yes**. It is possible to define PHY prioritization between 1st CG and 2nd DG PUSCH with low and high priorities respectively. At least, Rel-15 CG-DG overriding behavior should be preserved when CG is LP and DG is HP. More details in response to Q2-2. |

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

|  |  |
| --- | --- |
| 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. |
| Spreadtrum | We share the same view with vivo. Cancellation timeline defined in Rel-16 is required. |
| Ericsson | For this case, regardless of whether MAC has sent a TB to be transmitted over CG, DG PUSCH is always transmitted and CG PUSCH is either absent or dropped. In terms of timeline, the existing Rel-16 spec text in 38.214 section 6.1 applies. |
| LG | Supporting *intra-UE prioritization* and supporting Rel-16 timeline doesn’t mean same things. Supporting *intra-UE prioritization* means we can have different priority and prioritize higher. Rel-16 timeline means that UE can cancel LP transmission in the middle of the transmission if UE acquire higher priority transmission with enough time. If MAC ensures MAC PDU for DG, there is no issue with Rel-16 timeline. If MAC cannot ensure MAC PDU for DG(i.e., MAC entity is configured with *skipUplinkTxDynamic*), Rel-15 timeline should be used.  |
| ZTE | Share with vivo. |
| Huawei/HiSilicon | We share a similar view with vivo. But want to emphasize that for a Rel-16 UE that is capable of intra-UE prioritization, the discussion of collisions with the same priority should be handled in AI 7.2.5.7.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***. Case 1: 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.Case 2: For Rel.16 UE supporting *intra-UE prioritization*, * Case 2-1: 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.
* Case 2-2: the DG and CG of the same priority, then leave up to the discussion in the AI 7.2.5.7
 |
| Intel | The end of the PDCCH carrying the UL grant can be used as the cancelation triggering point. Thus, as long as the Rel-16 timeline for the time between end of the PDCCH with the UL grant and start of the DG PUSCH (HP) is at least Tproc,2 +d2 and time between end of the PDCCH with the UL grant and start of the CG PUSCH (LP) is Tproc,2 + d1, PHY prioritization can be performed.However, it should also be noted that this procedure of replacing one PUSCH with another in case of partial cancelation of the CG PUSCH would likely demand high UE complexity. In this regard, we are also open to applying the same timeline as in Rel-15 (instead of the Rel-16 timeline) such that **the end of the PDCCH carrying the UL grant for HP DG PUSCH is at least Tproc,2 before start of the LP CG PUSCH**. |

* + 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?

|  |  |
| --- | --- |
| 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?

|  |  |
| --- | --- |
| 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. |
| Spreadtrum | No (for Option 1) |
| Ericsson | No |
| LG | No |
| ZTE | No (for Option 1) |
| Huawei/HiSilicon | No discrepancy foreseen for Option 1. |
| Intel | No discrepancy. |

# **Summary for Case 2: 1stCG vs. 2nd DG**

* It seems all companies are fine to support the Rel.15 DG overriding CG behavior when CG is LP and DG is HP as shown in Fig. 2 (a) below.



Fig. 2(a) Rel.15 DG overriding CG when CG is LP and DG is HP

* + Noted that Rel.15 does not support partial CG cancellation as shown in Fig. 2(b), so NW should ensure UL grant sending timing if gNB prefers the DG override CG.



Fig. 2 (b)

* For Rel.16, (12) vivo, Nokia, NSB, Sharp, Samsung, CATT, OPPO, Panasonic, Ericsson, ZTE, Huawei/HiSilicon support the collision case and support the 2nd HP DG can partially cancel the ongoing 1st LP CG with the timeline currently captured in TS 38.214 with brackets [], as shown in Fig.2 (c). (in other word, by defining proper cancellation timeline, case shown in Fig. 2(b) can be supported)
	+ e.g., 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]
* For Rel.16, (4) Qualcomm, Apple, LG, Intel prefer to support Rel.15 cancellation timeline and do not support the partial cancellation of the LP CG because of high complexity for UE implementation by partial cancellation and replacement of HP DG.
* As long as the cancellation timeline is defined (regardless in the end partial cancellation or full cancellation is supported), there is no inconsistency between MAC and PHY.



Fig. 2(c)

Based on companies’ views, this case is HP DG collides with LP CG. For this case, proper timeline can be defined in RAN1 to support the cancellation of the LP CG since the time when receiving the UL grant for HP DG is clear in PHY layer and we can just borrow the timeline defined in scheduling and HARQ session. Still other companies mainly the chipset vendors having concerns on the complexity at the UE implementation side. So Following are proposed, please share your views and suggestions on how to move forward.

#  **Proposal 3:**

* For collision handling between high priority DG and low priority CG, down-select following options:
	+ Option 1: Define a UE capability for collision handling between the CG and DG with different priorities in PHY layer.
		- If a UE supports the capability, the UE is expected to cancel the overlapping low priority CG by the first overlapping symbol at the latest. Further, a UE expects that the first [overlapping] symbol of the high priority DG is not earlier than Tproc,2+d1 after the last symbol of the PDCCH with the DCI format scheduling the high priority DG.
		- Otherwise, the UE can only cancel the entire PUSCH transmission corresponding to the configured grant starting in a symbol 𝑗, if the end of symbol 𝑖 for PDCCH scheduling the PUSCH is at least 𝑁2 symbols before the beginning of symbol 𝑗.
			* Accepted by: Intel, LG, vivo
	+ Option 2: Rel.15 timeline is reused to support cancellation of the low priority CG PUSCH.
		- A UE is not expected to be scheduled by a PDCCH ending in symbol *i* to transmit a high priority DG PUSCH on a given serving cell overlapping in time with a transmission occasion, where the UE is allowed to transmit a CG PUSCH with low priority, 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*.
			* Supported by: QC, Apple
	+ Option 3: PHY layer can make the prioritization so that the UE is expected to cancel the overlapping low priority CG PUSCH by the first overlapping symbol at the latest. Further, a UE expects that the first [overlapping] symbol of the high priority DG PUSCH is not earlier than Tproc,2+d1 after the last symbol of the PDCCH with the DCI format scheduling the high priority channel.
		- * Supported by: Nokia, NSB, Huawei/HiSilicon, CATT, NEC, MTK, ZTE, Samsung, Ericsson
	+ No PHY collision handling necessary if MAC does not generate a PDU for the CG.

Any comments and suggestions?

|  |  |
| --- | --- |
| Company | View |
| Qualcomm | The same timeline as in Rel. 15 in addition to the MAC enhancements are sufficient. If the latency, i.e., an addition of a number of symbols, is not desirable for a given use case, then the UE probably needs to support cap#2 in general. Under cap#2, the N2 value is small. Also, the gNB can choose to configure shorter LP CG configurations. Overall, with the significant UE implementation burden that this proposal imposes on the UE, and the negligible benefit that it may bring, we cannot support the proposal.  |
| Nokia, NSB | Same comment as above, is there really a UE capability needed here (specifically as we agreed today the Option 4 in scheduling / HARQ already)?? |
| Huawei/HiSilicon | Same view with Nokia. |
| CATT | We also do not think the UE capability is required. We can follow the timeline (option 4) defined in scheduling / HARQ.  |
| Intel | Considering relatively high demands on UE implementation for the “capability” of partial cancelation of PUSCH in case of PUSCH-PUSCH overlaps, we are open to defining a UE capability for this, i.e., can support the proposal (although, looking at the comments so far, it may still not help with the progress 😊). |
| LG | We don’t have strong view on defining UE capabilities.  |
| Samsung | It looks like the proposal is to support Rel-16 timeline (first sub-bullet) and Rel-15 timeline (second sub-bullet). We think that Rel-16 timeline should be baseline for handling intra-UE prioritization. But, if some companies still hope to have Rel-15 timeline, we are open to support the proposal by having UE capability.  |
| Ericsson | It’s strange that the section title is “1st CG vs 2nd DG”, while the opening of Proposal 3 is “high priority DG and low priority CG”. It is not always true that 1st CG=low priority, 2nd DG = high priority. It is also possible that 1st CG = high priority, 2nd DG = low priority, in terms of UL grant.I assume Proposal 3 is for: 1st CG (high priority/low priority) vs 2nd DG collision (low priority/high priority).Need to revise Proposal 3 (regardless of options) by adding the following:* No PHY collision handling necessary if MAC does not generate a PDU for the CG.

For DG, PHY spec always assumes that the DG PUSCH exists and participates in UL intra-UE prioritization. We are not aware of PHY spec text that says that the DG PUSCH may or may not exist, depending on if MAC has generated a PDU for it. If there is any misunderstanding in RAN1, this issue needs to be clarified. |

* **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

|  |  |
| --- | --- |
| 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.  |
| Spreadtrum | Option 1: Yes |
| Ericsson | Yes |
| LG | Yes, we can allow to configure two overlapped grant with different priority. If I assume “cancel” means the cancelation in PHY, the answer is No by same reason in Q1-1.  |
| ZTE | Yes |
| Huawei/HiSilicon | Yes  |
| Intel | Similar situation as for Q1-1. * If the prioritization between LP CG1 and HP CG2 is done in MAC, then such CG-CG overlaps can be supported.
	+ For this, it is necessary that the MAC PDU for the HP CG PUSCH is available from the multiplexing and assembly entity at least Tproc,2 before the start of the LP CG PUSCH, and thus MAC will ignore the LP CG PUSCH UL grant.
* If the prioritization between LP CG and HP CG is done in PHY, it may not be feasible with timelines we have agreed so far since the triggering of the transmission of the HP CG PUSCH would be dependent on when the MAC delivers the corresponding MAC PDU to PHY for the HP CG PUSCH. However, establishing a timeline for such a trigger in PHY specs may not be feasible. On the other hand, the UE would still need some minimum time to cancel the LP CG1 PUSCH.

In summary, for 1st CG – 2nd CG case with low and high priority respectively, the answer for PHY prioritization is “No”, but for MAC prioritization is “Yes”. |

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

|  |  |
| --- | --- |
| 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 |
| Spreadtrum | Up to implementation |
| Ericsson | While we believe the relevant behaviors have been specified in 38.214, it’s worthwhile to clarify that the CG-CG collision handling occurs after determining if MAC has sent a TB to the physical layer for the CG. As stated in TS 38.214 Section 6.1.2.3:“**The UE shall not transmit anything on the resources configured by *configuredGrantConfig*** if the higher layers did not deliver a transport block to transmit on the resources allocated for uplink transmission without grant.”Thus, there are three cases:* If MAC didn’t send a TB to either of the CG: then no PUSCH transmission for either of the CG.
* If MAC has sent a TB to be transmitted over only one of the CG: then the CG PUSCH carrying the TB is transmitted regardless of priority. The CG without a TB is absent from the PHY intra-UE prioritization procedure (i.e., no collision visible at PHY).
* If MAC has sent TB to be transmitted over both of the CG: then the CG PUSCH with higher priority is prioritized, and the CG PUSCH with lower priority is cancelled.
 |
| LG | Up to implementation |
| ZTE | We are fine to leave to UE implementation or specify in the spec something like‘ If a first PUSCH corresponding to a configured grant of priority index 0 on a serving cell are partially or fully overlapping in time with a second PUSCH corresponding to a configured grant of priority index 1, a UE is expected to transmit the the second PUSCH, and cancel the first PUSCH transmission at latest starting at the first symbol of the second PUSCH.’ |
| Huawei/HiSilicon | 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?

|  |  |
| --- | --- |
| Company | View |
| Apple | The handling of overlapping CG configurations is for UE implementation. |
| LG | Same as Q3-1, Up to implementation |
| Intel | Similar to Q1-3, in this case, MAC should not deliver a 2nd PDU for a HP CG PUSCH if it has already delivered a PDU to PHY for a 1st CG PUSCH as there may not be sufficient time available from when the UE PHY receives the MAC PDU for the HP CG PUSCH to be able to cancel the LP CG PUSCH at least by the start of the HP CG PUSCH (e.g., available time may be Tproc,2 instead of Tproc,2 +d1 even when considering support of partial cancelation). |

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

|  |  |
| --- | --- |
| 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.  |
| Spreadtrum | No (for Option 1) |
| Ericsson | No |
| LG | With any option, the prioritization in PHY should be up to UE implementation. There seems no discrepancy.  |
| ZTE | No (for Option 1) |
| Huawei/HiSilicon | No discrepancy for Option 1. |
| Intel | No discrepancy if prioritization performed @ MAC. Otherwise, there can be processing timeline issues for PHY prioritization as there may not be sufficient time for the UE to cancel the CG1 PUSCH if the MAC PDU for the CG2 PUSCH is delivered to PHY “quite late” (e.g, Tproc,2 instead of Tproc,2 + d1 even when considering support of partial cancelation of the CG1 PUSCH). |

# **Summary for Case 3: 1stCG vs. 2nd CG**

* Assuming MAC layer delivers a high priority (HP) CG after it has already delivered a low priority (LP) CG,
	+ (6) vivo, Nokia, NSB, CATT, Ericsson, ZTE, support above assumed collision case and support it is 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.
	+ (12) MediaTek, Sharp, Samsung, OPPO, Panasonic, Spreadtrum, LG, ZTE, Huawei/HiSilicon, QC, Apple support this collision case handling is left to UE implementation.
	+ (1) Intel prefers such collision case should be handled in MAC layer, to keep consistency between PHY and MAC, MAC should make the prioritization and only one MAC PDU is delivered to PHY layer.

Based on above, following is proposed:

# **Proposal 4:**

* For collision handling between CG and CG with different priorities, select following options:

~~Option 1: if MAC delivers two MAC PDUs, it is up to UE implementation which CG will be transmitted.~~

~~Supported by:~~

Option 2: MAC layer should make the prioritization so that only one MAC PDU (e.g. the one with higher priority) is delivered to PHY layer.

Supported by:  QC, Intel, Apple, LG

Option 3: if MAC delivers two MAC PDUs, it is 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.

Supported by:  Nokia, NSB, Huawei/HiSilicon, CATT, Samsung, NEC, MTK, ZTE, Ericsson, vivo

No PHY collision handling necessary if MAC does not generate a PDU for one or both of the CGs.

For CG-CG collision, PHY does not expect MAC to generate two PDUs where an earlier, higher-priority, CG PUSCH overlaps with a later, lower-priority, CG PUSCH.

Any comments and suggestions?

|  |  |
| --- | --- |
| Company | View |
| Qualcomm | We initially thought that “left to UE implementation” here means that we leave it to the MAC layer to perform the prioritization; but, it seems not to be the intention. Hence, in our view, the option proposed by Intel is reasonable. The prioritization should be done at the MAC layer, as RAN2 has specified, and one PDU to be passed to PHY. |
| Nokia, NSB | First, we agree with Qualcomm & Intel, that MAC should try to only deliver a single PDU (if possible). But if MAC delivers two MAC PDU’s, and we leave it fully up to UE implementation if to transmit the LP or HP CG PUSCH – we may have an issue with HP HARQ-Ack overlapping here: If the UE chooses the LP CG PUSCH actually this one would according to the PHY rules be canceled by HP PUSCH – right? i.e. in the end both PUSCHs would be dropped and HP PUCCH would be transmitted. Therefore, we think that it would be better if the UE would transmit the HP CG PUSCH then (which prevents the PUSCH dropping of both PDUs on PHY in case of overlap with HP PUCCH).  |
| Huawei/HiSilicon | After a further thinking, now we have a same view with Nokia that it may not be good to completely leave it to UE implementation for such collision case. The HP CG PUSCH should be prioritized over the LP CG PUSCH. |
| CATT | We should not leave it to UE implementation. HP PUSCH should be prioritized. |
| Intel | Similar to Case 1, our concern here is again on how to guarantee the timeline for PHY prioritization since the exact time for the corresponding trigger for the HP CG PUSCH occasion at PHY (which is marked by the time when MAC delivers the TB to PHY) cannot be identified precisely from specifications’ perspective? How can the UE guarantee cancelation of the LP CG PUSCH if the UE PHY receives the TB from its MAC layer for the HP CG PUSCH less than Tproc,2 + d1 time from the first overlapping symbol?  |
| LG | We share Nokia’ s view. MAC should try to only deliver a single PDU (if possible) but if MAC delivers two MAC PDU’s, and we leave it fully up to UE implementationand we think it can be applied to other case (CG-DG/DG-CG) |
| Samsung | In our understanding, MAC know at least time domain information for each grant. So, MAC should not transfer MAC PDU to PHY which is dropped due to not enough timeline. So, it is up to UE implementation in view of RAN2 perspective. MAC cannot always make sure that HP CG PUSCH is always used for actual transmission. So, only one MAC PDU generation is not correct. It is possible to deliver two MAC PDU, but, MAC makes sure second MAC PDU to be transmitted on HP CG PUSCH. It is unreasonable that second delivered MAC PDU is dropped by PHY. That is bad UE implementation in my understanding. In this sense, it is more correct to say as follows. * For collision handling between CG and CG with different priorities, it is up to UE implementation in view of MAC. PHY does not expect that second MAC PDU is dropped due to limited timeline if two MAC PDU is transferred from MAC to PHY.
 |
| Ericsson | Option 3.Need to revise Proposal 4 (regardless of options) by adding the following: * No PHY collision handling necessary if MAC does not generate a PDU for one or both of the CGs.
* For CG-CG collision, PHY does not expect MAC to generate two PDUs where an earlier, higher-priority, CG PUSCH overlaps with a later, lower-priority, CG PUSCH.
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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)
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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.
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| 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 |
| Spreadtrum | We support Option 1 and share the same reason as MTK. |
| Ericsson | Option 1: they can be configured independently;Note that reasonable gNB implementation will make sure that wrong configuration (i.e., contradictory PHY-priority and LCH-priority) will not occur. There is no need to explicitly state any restriction in the spec. |
| LG | Up to network. As Nokia mentioned, it would be nice if UE can support both. However, it doesn’t mean it is necessary to support both. In our view, LCH-based prioritization can work if there is sufficient time line. PHY priority also could be meaningful at least for different HARQ-ACK codebook. gNB can choose proper behavior depending on UE capabilities.  |
| ZTE | Option 1. The possible inconsistency between MAC and PHY can be up to network if network can avoid or up to UE implementation for CG-CG collision.  |
| Huawei/HiSilicon | Option 2, and we share a similar view with Nokia. |
| Intel | As a baseline, they can be configured independently, but as such it should be noted that currently, FG 12-1 indicates that a UE supporting PHY prioritization should also support LCH prioritization as well.  |

# **Summary for relations between the PHY-based prioritization and LCH-based prioritization**

* (10) MTK, QC, Sharp, Samsung, OPPO, Panasonic, Apple, Spreadtrum, LG, Intel think PHY-based prioritization and LCH-based prioritization can be configured independently.
	+ MTK raised the issue that it is unclear what the PHY-based prioritization intends for, e.g. control vs. control and/or data vs. control and/or data vs data.
* (5) Nokia, NSB, Panasonic, Huawei/HiSilicon think option 2 is beneficial because full advantages of the intra-UE prioritization can be exploited by option 2.
* (2) vivo, CATT thinks PHY-based prioritization should be the prerequisite for the LCH-based prioritization (if LCH based prioritization is configured, PHY based prioritization should be configured) since PHY-based prioritization can also be used for prioritization between PUCCH and PUSCH/PUCCH.

Intel noted that currently, FG 12-1 indicates that a UE supporting PHY prioritization should also support LCH prioritization as well.

It seems the relations between the PHY-based prioritization and LCH-based prioritization highly depends on the collision handling decision we made in section 3. Therefore, it is better to first make decision on collision cases. In addition, to avoid duplicated comments and discussions, is it better to discuss this issue in UE feature session?

Any comments and suggestions?

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| Company | View |
| LG | Fine with FL’s suggestion |

# **Appendix**

Agreements made in scheduling and HARQ session

**Agreement**

In case of collision between a high priority channel and low priority channels, adopt one of the following options:

* A UE is expected to cancel the overlapping low priority channel by the first overlapping symbol at the latest. Further, a UE expects that the first [overlapping] symbol of the high priority channel is not earlier than Tproc,2+d1 after the last symbol of the PDCCH with the DCI format scheduling the high priority channel.

**Agreement**

If a UE is configured with a single UL carrier and in case a dynamically scheduled high priority channel overlaps with a low priority channel, the SCS for Tproc,2 calculation is determined as the smallest SCS configuration of the PDCCH providing the DCI for the low priority channel (if any), the SCS configuration for the PDCCH providing the DCI for the high priority channel, the SCS configuration of the low priority channels to be cancelled and the SCS configuration of the high priority channel.

**Agreement**

At least for handling collision between a high priority configured UL transmission and low priority channels in the following cases, it is up to UE implementation to ensure that the low priority UL transmission is cancelled, at the latest, from the first symbol that is overlapping with the high priority UL transmission:

* Case 1: Collision between a high priority SR PUCCH and any low priority channels
* Case 2: Collision between a high priority CG-PUSCH and a low priority PUCCH
* Case 3: Collision between a high priority PUCCH carrying only HARQ-ACK corresponding to PDSCH without corresponding PDCCH and any low priority configured uplink transmission.
* Case 4: Collision between a high priority PUSCH carrying SP-CSI, except the first PUSCH after the activation DCI, and a low priority PUCCH

RAN2 chairman notes in RAN2 109bis-e meeting

R2-2003226 Summary of e-mail discussion: [Post109e#50][IIOT] Remaining issues intra-UE prioritization

* MAC CE is not considered for grant prioritization in Rel-16.
* On P3, it seems no company have strong reasons that we need to do either Option 1 or 2, can be resolved later (TS rapporteur to choose what is simplest)
* On P5, we send an LS to R1 informing on R2 agreements and the current gap, we explain the solutions on the table and we ask R1 for feedback (quick). LS to R1: Nokia (in email discussion above). LS approval 24h after stable.

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| 2.4 Intra-UE prioritization of PDUs with the same L1 priorityPHY-layer prioritization is captured in TS 38.213 based on the CR agreed in [3] in the following way[omit]Furthermore, the details of when the UE may interrupt an ongoing transmission PHY-layer prioritization is captured in TS 38.214 based on the CR agreed in [1] in the following way:[omit]Therefore, the following summarizes how the physical layer deals with various kinds of grants when doing prioritization:1. In case CG with high PHY priority collides with DG with low PHY priority 🡪 CG is prioritized at PHY, if transmission related to DG was ongoing, it is cancelled
2. In case CG with high PHY priority collides with CG with low PHY priority 🡪 CG with high priority is prioritized, PHY layer does not consider the case where there would be ongoing CG transmission to be interrupted
3. In case CG with low PHY priority collides with DG with high PHY priority 🡪 DG is prioritized at PHY and if CG transmission was ongoing, it is cancelled (considering the timeline restrictions)
4. In case CG collides with DG of the same PHY priority 🡪 DG is prioritized at PHY and if CG transmission was ongoing, it is cancelled (considering the timeline restrictions)
5. The case of CG colliding with another CG of the same PHY priority is not addressed by PHY layer prioritization.
6. The case of DG colliding with another DG is not considered by PHY layer prioritization.

It seems clear that the expected behavior agreed in RAN2 is different than the one specified by RAN1:* RAN1: in case grants have the same PHY priority, DG is always prioritized regardless of its LCH-based priority and regardless of when it was delivered from MAC to PHY (two overlapping DGs are not allowed)
* RAN2: in case grants have the same PHY priority, the grant with higher LCH-based priority is always prioritized and PHY should prioritize the grant associated with a MAC PDU, which was delivered to PHY later (the second MAC PDU)
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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.