**3GPP TSG RAN WG1 #103e R1-** **200xxxx**

**October 26th – November 13th, 2020**

**Agenda item:** 7.2.5

**Source:** Moderator (Qualcomm)

**Title:** Summary of the Remaining Issues on HARQ and Scheduling Enhancements for URLLC

**Document for:** Discussion and Decision

# 1 Introduction

In this document, proposals and remaining issues related to URLLC HARQ and scheduling are summarized. The list of the proposals is as follows:

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| **Topic** | **Companies supporting the discussion in RAN1 #103e** |
| **Issue #1:** CBG-Based Retransmission | HW/HiSi (R1-2007635), Nokia/NSB (R1-2008304) |
| **Issue #2:** Partial cancellation in Rel-15 and Rel-16 | HW/HiSi (R1-02007635) |
| **Issue #3:** DMRS shift and impact on UE processing | HW/HiSi (R1-02007635) |
| **Issue #4: I**ntra-UE prioritization and multiplexing order | Ericsson (R1-2007705), OPPO (R1-2008277), DCM (R1-2008535), Nokia/NSB (2008303) |
| **Issue #5:** Order of multiplexing and prioritization due to conflicts with semi-static DL and SSB symbols | ZTE (R1-2007734), Spreadtrum (R1-2008109), Qualcomm (R1-2008607), vivo (R1-2008672), Nokia/NSB (R1-2008303) |
| **Issue #6:** PUSCH preparation procedure time | ZTE (R1-2007734) |
| **Issue #7:** Modification to intra-UE cancellation timeline | OPPO (R1-2008277) |
| **Issue #8:** Active duration of CSI-RS resources in case of cancellation | Qualcomm (R1-2008607) |
| **Issue #9:** Handling overlapping between high priority PUSCH without UL-SCH and SR | Nokia/NSB (R1-2008303) |

# 2 Issue #1

The issue of determining TB CRC for a CBG-based PUSCH with initial transmission cancelled has been discussed in the past few meetings.

In [1], it is proposed to introduce a new FG based on Option 1a as follows:

***Proposal: Introduce an FG i.e. table 1 for "Out-of-order CBG-based re-transmission(s) with cancelled initial PUSCH transmission" in Rel-16.***

* ***If the UE indicates the support of the FG, the UE can be scheduled for a re-transmission of a CBG #N in a given TB when CBG #N-1 has not been transmitted before and is not scheduled in the same UL grant that includes CBG#N.***
* ***Otherwise, the UE expects to be scheduled for a re-transmission of a CBG #N in a given TB only if CBG #N-1 has been transmitted before or is scheduled in the same UL grant that includes CBG#N.***

In [7], a change to the FG discussed during the RANP meeting is proposed. Further, it is proposed to capture the behavior in TS 38.214.

**Proposal: RAN1 to endorse the FG description for CBG based re-transmission in RP-201877 is to be endorsed by RAN1, except the note which should be captured in 38.214 directly, i.e.**

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| 11.  NR\_L1enh\_URLLC | 11-12 | Out-of-order CBG-based re-transmission(s) with cancelled initial PUSCH transmission | Support CBG-based re-transmission(s) of a TB in case the initial PUSCH transmission was cancelled and the following condition is satisfied: the UE is scheduled for a re-transmission of a CBG #N in a given TB when CBG #N-1 has not been transmitted before and it is not scheduled in the same UL grant that includes CBG#N. | 5-25 | Yes | N/A |  | Per UE | N/A | N/A |  | ~~A UE supporting 5-25 shall support CBG-based retransmission(s) with cancelled initial PUSCH transmission if the following condition is satisfied: the UE is scheduled for a re-transmission of a CBG #N in a given TB only if CBG #N-1 has been transmitted before or it is scheduled in the same UL grant that includes CBG#N.~~ | Optional with capability signaling |

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| *CR-Form-v12.0* | | | | | | | | |
| **[DRAFT] CHANGE REQUEST** | | | | | | | | |
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|  | **38.214** | **CR** | **-** | **rev** | **-** | **Current version:** | **16.3.0** |  |
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| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* | | | | | | | | |
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| 6.1.5 Code block group based PUSCH transmission6.1.5.1 UE procedure for grouping of code blocks to code block groups If a UE is configured to transmit code block group (CBG) based transmissions by receiving the higher layer parameter *codeBlockGroupTransmission* in *PUSCH-ServingCellConfig*, the UE shall determine the number of CBGs for a PUSCH transmission as  ,  where *N* is the maximum number of CBGs per transport block as configured by *maxCodeBlockGroupsPerTransportBlock* in *PUSCH-ServingCellConfig*, and *C* is the number of code blocks in the PUSCH according to the procedure defined in Clause 6.2.3 of [5, TS 38.212].  Define , , and .  If , CBG *m*, , consists of code blocks with indices . CBG *m*, , consists of code blocks with indices . 6.1.5.2 UE procedure for transmitting code block group based transmissions If a UE is configured to transmit code block group based transmissions by receiving the higher layer parameter *codeBlockGroupTransmission* in *PUSCH-ServingCellConfig*,  - For an initial transmission of a TB as indicated by the *New Data Indicator* field of the scheduling DCI, the UE may expect that the *CBGTI* field indicates all the CBGs of the TB are to be transmitted, and the UE shall include all the code block groups of the TB.  - For a retransmission of a TB as indicated by the *New Data Indicator* field of the scheduling DCI, the UE shall include only the CBGs indicated by the *CBGTI* field of the scheduling DCI.  - For a UE not supporting *out-of-order CBG-based PUSCH re-transmission,* the UE is not expected to be scheduled for a retransmission of a CBG *m, m>0,* in a TB as indicated by the *New Data Indicator* field and *CBGTI* field of the scheduling DCI unless CBG *m-1* for that TB has been transmitted before or is scheduled by the same scheduling DCI.  A bit value of 0' in the *CBGTI* field indicates that the corresponding CBG is not to be transmitted and 1' indicates that it is to be transmitted. The order of *CBGTI* field bits is such that the CBGs are mapped in order from CBG#0 onwards starting from the MSB.  <omitted text> |

# 3 Issue #2

During the last few meetings, as part of the UE feature discussions, it was discussed whether a configured UL transmission can be partially cancelled by a PDSCH/CSI-RS/SFI.

In [1], it is observed that the uplink cancellation unit is the whole PUCCH/PUSCH within a slot rather than a partial cancellation of a PUCCH/PUSCH. Hence, it is mentioned that the Rel. 15 specification is not aligned with the Rel. 15 agreement:

RAN1#94 Agreements**:**

Update the #92bis agreement as follows:

For cancellation of RRC configured transmission or reception by SFI or DCI, the cancellation is for a unit of transmission/reception if any OFDM symbol within the unit is cancelled by SFI.

* + For RRC configured CSI-RS resource set, the cancellation unit is the CSI-RS resource set
  + For RRC configured PDSCH and PUSCH with slot aggregation, the cancellation unit is the whole PDSCH or PUSCH within a slot
  + For RRC configured PDSCH, PUCCH, and PUSCH without slot aggregation, the cancellation unit is the whole PDSCH, PUCCH, and PUSCH
  + For RRC configured SRS transmission, the cancellation unit is OFDM symbol

It is therefore proposed in [1] to clarify the Rel. 15 behaviour and to adopt a new FG for Rel. 16:

***Proposal:* *Partial cancellation of uplink transmission is introduced as an optional capability for Rel-16 UEs.***

# 4 Issue #3

HW/HiSi points out the issue of UE timeline with DMRS shift in [1]. In particular, the following observation is made:

***Observation: For the case of additional configured DMRS, the processing time requirement for N1 is relaxed. However, for the case of shifted DMRS, the specification does not relax the processing time requirement even if front-loaded DMRS is shifted to the position of the additional DMRS.***

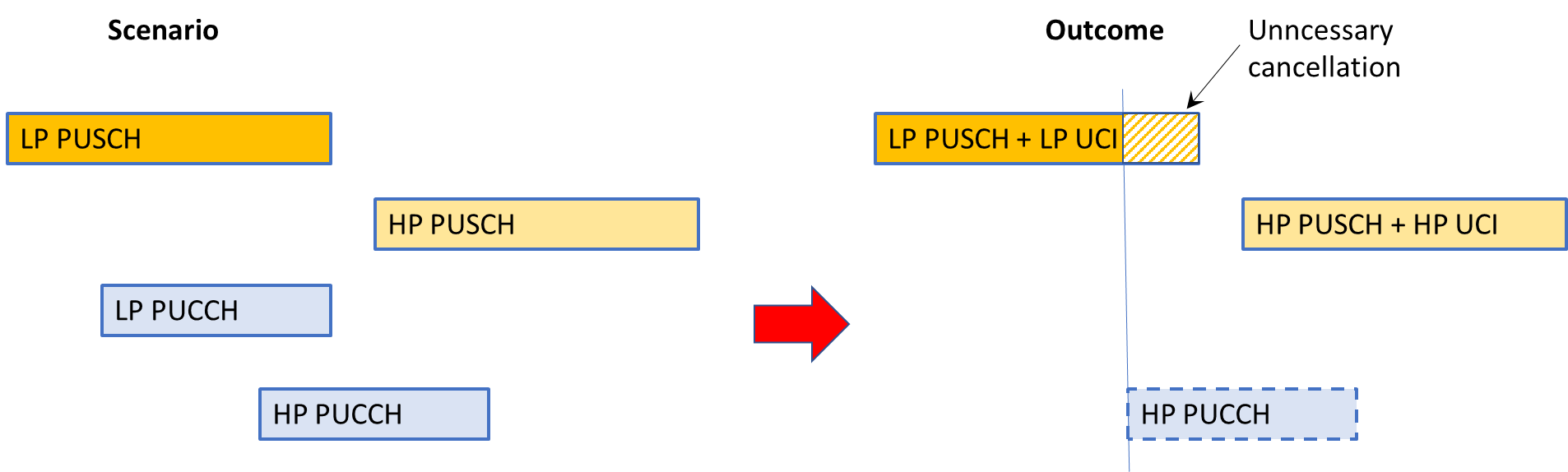
***Proposal: In order to address the issue of a reduced UE processing time budget in case of DMRS shift, RAN1 should consider one of the following options:***

* ***Option 1: Relaxation of the UE processing time requirement in case of DMRS shift***
* ***Option 2: Introduce a Rel-16 UE capability for UEs not supporting DMRS shift due to collisions with search space sets that are associated with a CORESET, e.g.***
  + ***Modify the existing FG 10-8 as follows:***

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| ***Feature Group*** | ***Components*** |
| Type B PDSCH length {3, 5, 6, 8, 9, 10, 11, 12, 13} without DMRS shift ~~due to CRS collision~~ | 1. Type B PDSCH length {3, 5, 6, 8, 9, 10, 11, 12, 13} without DMRS shift ~~due to CRS collision~~ |

# 5 Issue #4

In [2], it is observed that the behavior adopted under the working assumption can lead to excessive cancellations as shown in the figure below. However, due to the lack of time, it is proposed to confirm the working assumption.



An example of unnecessary cancellation when applying the working assumption to resolve the overlap between low-priority channels and high-priority channels.

**Proposal: Confirm the working assumption and no specification change is needed.**

In [7], on the other hand, some changes to the previous working assumption are proposed. In particular, it is mentioned that:

***“****Processing time of cancellation and overriding are different and processing time of overriding, i.e. N3 is shorter than processing time of cancellation, i.e. Tproc,2+d, as shown in Figure 2. So when both cancellation and overriding occur, to ensure enough time to perform cancellation and overriding, UE determines and generates final uplink channel at the deadline of cancellation. However, if there is a DCI indicating a new PUCCH, which overrides the cancelled PUCCH, UE has to look back cancelled PUCCH, it increases UE complexity significantly. To avoid UE complexity, overriding should be avoided after deadline of cancellation.”*

To address the issue, the following TP is proposed:

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| --------------------------------------- Start of TP 38.213V16.3.0 section 9-------------------------------------  <unchanged text omitted>  A UE does not expect to detect a DCI format scheduling a PDSCH reception or a SPS PDSCH release, or a DCI format including a One-shot HARQ-ACK request field with value 1, and indicating a resource for a PUCCH transmission with corresponding HARQ-ACK information in a slot if the UE previously detects a DCI format scheduling a PUSCH transmission in the slot and if the UE multiplexes HARQ-ACK information in the PUSCH transmission, or if the UE previously detects a DCI format scheduling a PUCCH transmission for HARQ-ACK information in the slot and if the UE cancels the HARQ-ACK information in the PUCCH transmission.  <unchanged text omitted>  ------------------------------------------ End of TP 38.213V16.3.0 section 9----------------------------------- |

In [8], a change for the following part of the intra-UE cancellation text from Section 9 of TS 38.213 is proposed:

*“where*

*- the overlapping is applicable before or after resolving overlapping among channels of larger priority index, if any, as described in Clause 9.2.5*

*- the UE expects that the transmission of the first PUCCH or the first PUSCH, respectively, would not start before after a last symbol of the corresponding PDCCH reception”*

The reason for change is as follows:

*“The intention of the description “before or after” here means that the prioritization of different priority UL channels is conducted before the multiplexing of overlapping HP UL channels in Clause 9.2.5 of TS 38.213 if any, and after the multiplexing of overlapping HP UL channels in the Clause 9.2.5 if any when the outcome of the multiplexing would overlap with the LP channel. Although this description comes from the email discussion “[102-e-NR-Editor-NR\_L1enh\_URLLC-38.213],” we think it is still misleading. For example, it could be interpreted that “before or after” means UE conducts the prioritization of different priority UL channels only before the multiplexing of overlapping HP UL channels or only after the multiplexing of overlapping HP UL channels. There is ambiguity of UE behaviour with the interpretation. Therefore, the following TP is proposed to avoid future misunderstanding of the spec.”*

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| ---------------------------------Start of Text Proposal on TS 38.213 v16.3.0----------------------- 9 UE procedure for reporting control information <Unchanged parts are omitted>  When a UE determines overlapping for PUCCH and/or PUSCH transmissions of different priority indexes, the UE first resolves the overlapping for PUCCH and/or PUSCH transmissions of smaller priority index as described in Clause 9.2.5. Then,  - if a transmission of a first PUCCH of larger priority index scheduled by a DCI format in a PDCCH reception would overlap in time with a transmission of a second PUSCH or a second PUCCH of smaller priority index, the UE cancels the transmission of the second PUSCH or the second PUCCH before the first symbol that would overlap with the first PUCCH transmission  - if a transmission of a first PUSCH of larger priority index scheduled by a DCI format in a PDCCH reception would overlap in time with a transmission of a second PUCCH of smaller priority index, the UE cancels the transmission of the second PUCCH before the first symbol that would overlap with the first PUSCH transmission  where  - the overlapping is applicable before resolving overlapping among channels of larger priority index, if any, as described in Clause 9.2.5  - the overlapping is applicable after resolving overlapping among channels of larger priority index, if any, as described in Clause 9.2.5  - the UE expects that the transmission of the first PUCCH or the first PUSCH, respectively, would not start before after a last symbol of the corresponding PDCCH reception  - is the PUSCH preparation time for a corresponding UE processing capability assuming [6, TS 38.214], based on and as subsequently defined in this Clause, and is determined by a reported UE capability  <Unchanged parts are omitted>  --------------------------------------End of Text Proposal on TS 38.213 v16.3.0------------------ |

In [10], it is mentioned that the highlighted part in following text related to intra-UE prioritization and multiplexing is not clear:

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| When a UE determines overlapping for PUCCH and/or PUSCH transmissions of different priority indexes, the UE first resolves the overlapping for PUCCH and/or PUSCH transmissions of smaller priority index as described in Clause 9.2.5. Then,  - if a transmission of a first PUCCH of larger priority index scheduled by a DCI format in a PDCCH reception would overlap in time with a transmission of a second PUSCH or a second PUCCH of smaller priority index, the UE cancels the transmission of the second PUSCH or the second PUCCH before the first symbol that would overlap with the first PUCCH transmission  - if a transmission of a first PUSCH of larger priority index scheduled by a DCI format in a PDCCH reception would overlap in time with a transmission of a second PUCCH of smaller priority index, the UE cancels the transmission of the second PUCCH before the first symbol that would overlap with the first PUSCH transmission  where  - the overlapping is applicable before or after resolving overlapping among channels of larger priority index, if any, as described in Clause 9.2.5  - the UE expects that the transmission of the first PUCCH or the first PUSCH, respectively, would not start before after a last symbol of the corresponding PDCCH reception  - is the PUSCH preparation time for a corresponding UE processing capability assuming [6, TS 38.214], based on and as subsequently defined in this Clause, and is determined by a reported UE capability |

In particular, it is mentioned that *“it is not clear when the UE should perform the cancellation of low-priority channel due to the reception of a PDCCH scheduling a high-priority channel that overlaps with the low-priority channel, i.e. whether the UE should cancel the low-priority channel before or after performing high-priority channels multiplexing triggered by the (newly) scheduled high-priority channel, if any. From the Working Assumption, it is s clear that the UE should perform high-priority channels multiplexing triggered by the newly scheduled high-priority channel, if any, after cancelling the transmission of low-priority channel.”*

To clarify, the following TP is proposed:

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| UE procedure for reporting control information <omitted text>  When a UE determines overlapping for PUCCH and/or PUSCH transmissions of different priority indexes, the UE first resolves the overlapping for PUCCH and/or PUSCH transmissions of smaller priority index as described in Clause 9.2.5. Then,  - if a transmission of a first PUCCH of larger priority index scheduled by a DCI format in a PDCCH reception would overlap in time with a transmission of a second PUSCH or a second PUCCH of smaller priority index, the UE cancels the transmission of the second PUSCH or the second PUCCH before the first symbol that would overlap with the first PUCCH transmission  - if a transmission of a first PUSCH of larger priority index scheduled by a DCI format in a PDCCH reception would overlap in time with a transmission of a second PUCCH of smaller priority index, the UE cancels the transmission of the second PUCCH before the first symbol that would overlap with the first PUSCH transmission  where  - the overlapping is applicable before ~~or~~ and after resolving overlapping among channels of larger priority index, if any, triggered by the first PUCCH or the first PUSCH scheduled by a DCI format in a PDCCH reception, as described in Clause 9.2.5  - the UE expects that the transmission of the first PUCCH or the first PUSCH, respectively, would not start before after a last symbol of the corresponding PDCCH reception  - is the PUSCH preparation time for a corresponding UE processing capability assuming [6, TS 38.214], based on and as subsequently defined in this Clause, and is determined by a reported UE capability  <omitted text> |

# 6 Issue #5

On handling the collisions with semi-static DL and SSB symbols, the following agreement was reached previously:

**Agreement:**

*After the UE determines the overlapping PUCCH or PUSCH for multiplexing/prioritization, the UE cancels the PUCCH or PUSCH that has overlapping with semi-static configured DL symbols or SSB symbols, and then the multiplexing/prioritization is performed among the non-cancelled overlapping transmissions.*

*This means that (as RAN1 common understanding):*

* ***Step 1:*** *A UE follows Rel-15 behaviors for any intermediate procedure to determine the overlapping PUCCH or PUSCH for multiplexing/prioritization*
* ***Step 2:*** *UE cancels the ones that collides with semi-static DL symbols,*
* ***Step 3:*** *UE performs multiplexing/prioritization among the non-cancelled overlapping channels.*

In [3], the following observations are made:

**Observation**: UE performs intra-UE multiplexing/prioritization including all the cases after canceling the candidate transmission colliding with semi-static DL symbols.

**Observation**: UE doesn’t expect that the final PUCCH resource to be used is overlapping with the semi-static DL symbols after performing step 3.

Based on these observations, the following TP is proposed:

**--------------------------------------------Text Proposal for Section 9 in TS38.213[2]---------------------------------**

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| 9 UE procedure for reporting control information <---------------------------Other parts are omitted ------------------------------->  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.  When a UE determines overlapping for PUCCH and/or PUSCH transmissions of the same priority indexes, the UE cancels the PUCCH or the PUSCH transmission if the UE determines a PUCCH or a PUSCH transmissions overlapping with DL symbols indicated by *tdd-UL-DL-ConfigurationCommon* or *tdd-UL-DL-ConfigurationDedicated*. Then the UE resolves the overlapping for PUCCH and/or PUSCH transmissions of a same priority index as defined in Clause 9.2.5.  When a UE determines overlapping for PUCCH and/or PUSCH transmissions of different priority indexes, the UE cancels the PUCCH or the PUSCH transmission if the UE determines a PUCCH or a PUSCH transmissions overlapping with DL symbols indicated by *tdd-UL-DL-ConfigurationCommon* or *tdd-UL-DL-ConfigurationDedicated*, next the UE resolves the overlapping for PUCCH and/or PUSCH transmissions of smaller priority index as described in Clause 9.2.5. Then,  - if a transmission of a first PUCCH of larger priority index scheduled by a DCI format in a PDCCH reception would overlap in time with a transmission of a second PUSCH or a second PUCCH of smaller priority index, the UE cancels the transmission of the second PUSCH or the second PUCCH before the first symbol that would overlap with the first PUCCH transmission  - if a transmission of a first PUSCH of larger priority index scheduled by a DCI format in a PDCCH reception would overlap in time with a transmission of a second PUCCH of smaller priority index, the UE cancels the transmission of the second PUCCH before the first symbol that would overlap with the first PUSCH transmission  <---------------------------Other parts are omitted ------------------------------->  **Reasons for change**  To capture the agreement in the specification.  **Summary of changes**  After the UE determines the overlapping PUCCH or PUSCH for multiplexing/prioritization, the UE cancels the PUCCH or PUSCH that has overlapping with semi-static configured DL symbols or SSB symbols, and then the multiplexing/prioritization is performed among the non-cancelled overlapping transmissions.  **Specs/Sections impacted**  TS 38.213, Section 9  **Consequences if not approved:**  Wrong UE processing order between semi-static TDD configuration and intra-UE prioritization/multiplexing. |

Both [4] and [5] point out that if a group of overlapping channels consists of at least one dynamically granted PUCCH or PUSCH, neither any of the intermediate resources or the final one can overlap with a semi-static DL/SSB symbols. In [4], it is proposed that the UE should remove all the configured PUCCH/PUSCH resources overlapping with semi-static DL symbols/SSBs in step 2. In [5], on the other hand, it is proposed that the UE should drop the final transmission if it is colliding with the semi-static DL/SSB symbols.

The proposal in [4] is as follows:

***Proposal: For processing order between semi-static TDD configuration and intra-UE prioritization***

* ***Step 1: A UE follows Rel-15 behaviours for any intermediate procedure to determine the overlapping PUCCH or PUSCH for multiplexing/prioritization***
* ***Step 2: UE cancels the ones that collides with semi-static DL symbols***
* ***Step 3: UE performs multiplexing/prioritization among the non-cancelled overlapping channels with same or different priorities.***
  + ***If one multi-CSI PUCCH resource is selected, the one should not collided with DL symbols/SSB***
  + ***If there is at least one dynamic PUCCH/PUSCH, neither an intermediate PUCCH resource nor the final PUCCH/PUSCH resource is expected to overlap with semi-static DL symbols/SSB***

The proposal in [5] is as follows:

**Proposal: Update the agreement made for handling collision between PUCCH/PUSCH and semi-static DL/SSB symbols as follows:**

* ***Step 1: A UE follows Rel-15 behaviors for any intermediate procedure to determine the overlapping PUCCH or PUSCH ~~for~~ before multiplexing/prioritization***
* ***Step 2: UE cancels the ones that collides with semi-static DL symbols,***
* ***Step 3: UE performs multiplexing/prioritization among the non-cancelled overlapping channels.***
* ***Step 4: After performing Step 3, any channel colliding with a semi-static DL/SSB symbols gets cancelled by the UE.***

In [8], two additional steps as follows are proposed:

**Proposal:**

* *For processing order of intra-UE UL multiplexing/prioritization and UL cancellation due to TDD configuration, UE follows the steps below:*
  + *Step 1: Multiplexing/overriding/etc. is performed similar to Rel.15 as if HP channels do not exist; this means that LP operations, multiplexing/overriding/etc., are performed before cancellation.*
  + *Step 2: A UE cancels the transmission of a LP channel including any intermediate scheduled LP transmission that does not overlap with any LP channel, if any DCI schedules an overlapping HP transmission with the LP channel, before performing multiplexing/overriding HP channels if any.*
  + *Step 3: Multiplexing/overriding of HP channels is performed as if LP channels do not exist.*
  + *Step 4: A final HP channel is prioritized if it overlaps with a final LP channel, after performing multiplexing of HP channels*
  + *Step 5: UE cancels the HP and/or LP channels which collide with semi-static DL symbols*

In [9], it is proposed to remove all the resources overlapping with semi-static DL/SSB symbols after Step 2. *“Otherwise, final PUCCH/PUSCH may be invalid due to collision with semi-static DL symbols or SSB symbols, which leads to the dropping of UL channel(s). On the other hand, gNB scheduling should guarantee an available final PUCCH/PUSCH resource.”*

The proposed TP is as follows:

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| TS 38.213 9 UE procedure for reporting control information …  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. When a UE determines overlapping for PUCCH and/or PUSCH transmissions of the same priority indexes, the UE cancels the PUCCH or the PUSCH transmission if the UE determines a PUCCH or a PUSCH transmissions overlapping with DL symbols indicated by *tdd-UL-DL-ConfigurationCommon* or *tdd-UL-DL-ConfigurationDedicated*. Then the UE resolves the overlapping for PUCCH and/or PUSCH transmissions of a same priority index as defined in Clause 9.2.5. When a UE determines overlapping for PUCCH and/or PUSCH transmissions of different priority indexes, the UE cancels the PUCCH or the PUSCH transmission if the UE determines a PUCCH or a PUSCH transmissions overlapping with DL symbols indicated by *tdd-UL-DL-ConfigurationCommon* or *tdd-UL-DL-ConfigurationDedicated*, then the UE ~~first~~ resolves the overlapping for PUCCH and/or PUSCH transmissions of a same priority index. Then, if the UE determines to transmit  - a first PUCCH of larger priority index scheduled by a first DCI format in a first PDCCH reception, 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 cancels the transmission of the PUSCH or the second PUCCH before the first symbol overlapping with the first PUCCH transmission. The UE expects that the transmission of the first PUCCH does not start before after a last symbol of the first PDCCH reception  - a PUSCH of larger priority index scheduled by a first DCI format in a first PDCCH reception, a PUCCH of smaller priority index, and a transmission of the PUSCH would overlap in time with a transmission of the PUCCH, the UE cancels the transmission of the PUCCH before the first symbol overlapping with the PUSCH transmission. The UE expects that the transmission of the PUSCH does not start before after a last symbol of the first PDCCH reception  where is the PUSCH preparation time for a corresponding UE processing capability assuming [6, TS 38.214], based on and as subsequently defined in this Clause, and is determined by a reported UE capability  … |

In [10], it is proposed that the UE should cancel/remove all resources colliding with the semi-static DL symbols and SSBs after step 2. The following TP is proposed:

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| UE procedure for reporting control information <omitted text>  When a UE determines overlapping for PUCCH and/or PUSCH transmissions of different priority indexes, the UE first resolves the overlapping for PUCCH and/or PUSCH transmissions of smaller priority index as described in Clause 9.2.5. Then,  - if a transmission of a first PUCCH of larger priority index scheduled by a DCI format in a PDCCH reception would overlap in time with a transmission of a second PUSCH or a second PUCCH of smaller priority index, the UE cancels the transmission of the second PUSCH or the second PUCCH before the first symbol that would overlap with the first PUCCH transmission  - if a transmission of a first PUSCH of larger priority index scheduled by a DCI format in a PDCCH reception would overlap in time with a transmission of a second PUCCH of smaller priority index, the UE cancels the transmission of the second PUCCH before the first symbol that would overlap with the first PUSCH transmission  where  - the overlapping is applicable before or after resolving overlapping among channels of larger priority index, if any, as described in Clause 9.2.5. When the overlapping is applicable after resolving overlapping among channels of larger priority index, before resolving overlapping channels of different priority index, UE determines the valid transmission resource following the procedure as described in Clause 11.1 and Clause 11.1.1.  - the UE expects that the transmission of the first PUCCH or the first PUSCH, respectively, would not start before after a last symbol of the corresponding PDCCH reception  - is the PUSCH preparation time for a corresponding UE processing capability assuming [6, TS 38.214], based on and as subsequently defined in this Clause, and is determined by a reported UE capability  If a UE is scheduled by a DCI format in a first PDCCH reception to transmit a first PUCCH or a first PUSCH of larger priority index that overlaps with a second PUCCH or a second PUSCH transmission of smaller priority index that, if any, is scheduled by a DCI format in a second PDCCH  - is based on a value of corresponding to the smallest SCS configuration of the first PDCCH, the second PDCCHs, the first PUCCH or the first PUSCH, and the second PUCCHs or the second PUSCHs  - if the overlapping group includes the first PUCCH  - if *processingType2Enabled* of *PDSCH-ServingCellConfig* is set to *enable* for the serving cell where the UE receives the first PDCCH and for all serving cells where the UE receives the PDSCHs corresponding to the second PUCCHs, and if *processingType2Enabled* of *PUSCH-ServingCellConfig* is set to *enable* for the serving cells with the second PUSCHs, *N2* is 5 for , 5.5 for  and 11 for  - else, *N2* is 10 for =0*,* 12 for , 23 for , and 36 for ;  - if the overlapping group includes the first PUSCH  - if *processingType2Enabled* of *PUSCH-ServingCellConfig* is set to *enable* for the serving cells with the first PUSCH and the second PUSCHs and if *processingType2Enabled* of *PDSCH-ServingCellConfig* is set to *enable* for all serving cells where the UE receives the PDSCHs corresponding to the second PUCCHs, *N2* is 5 for , 5.5 for  and 11 for  - else, *N2* is 10 for =0*,* 12 for , 23 for , and 36 for ;  If a UE would transmit the following channels that would overlap in time, after determining the valid transmission resource following the procedure as described in Clause 11.1 and Clause 11.1.1,  - a first PUCCH of larger priority index with SR and a second PUCCH or PUSCH of smaller priority index, or  - a configured grant PUSCH of larger priority index and a PUCCH of smaller priority index, or  - a first PUCCH of larger priority index with HARQ-ACK information only in response to a PDSCH reception without a corresponding PDCCH and a second PUCCH of smaller priority index with SR and/or CSI, or a configured grant PUSCH with smaller priority index, or a PUSCH of smaller priority index with SP-CSI report(s) without a corresponding PDCCH, or  - a PUSCH of larger priority index with SP-CSI reports(s) without a corresponding PDCCH and a PUCCH of smaller priority index with SR, or CSI, or HARQ-ACK information only in response to a PDSCH reception without a corresponding PDCCH, or  - a configured grant PUSCH of larger priority index and a configured PUSCH of lower priority index on a same serving cell  the UE is expected to cancel the PUCCH/PUSCH transmissions of smaller priority index before the first symbol overlapping with the PUCCH/PUSCH transmission of larger priority index.  <omitted text> |

# 7 Issue #6

In [3], the following TP is proposed:

***Proposal 2****: Endorse the text proposal in section 6.4 of 38.214:*

**--------------------------------------------Text Proposal for Section 6.4 in TS38.214[3]---------------------------------**

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| 6.4 UE PUSCH preparation procedure time<---------------------------Other parts are omitted -------------------------------> If the first uplink symbol in the PUSCH allocation for a transport block, including the DM-RS, as defined by the slot offset *K2* and the start and length indicator *SLIV*, or the start symbol *S* of the scheduling DCI and including the effect of the timing advance, is no earlier than at symbol *L2*, where *L2* is defined as the next uplink symbol with its CP starting after the end of the reception of the last symbol of the PDCCH carrying the DCI scheduling the PUSCH, then the UE shall transmit the transport block.  <---------------------------Other parts are omitted ------------------------------->  **Reasons for change**  To fix the error of the determination of the first uplink symbol allocation.  **Summary of changes**  Adding the start symbol S indication.  **Specs/Sections impacted**  TS 38.214, Section 6.4  **Consequences if not approved:**  The determination of the first uplink symbol allocation is not complete. |

# 8 Issue #7

In [6], it is mentioned that according to the previous agreement (copied below), for collision between a high priority and a low priority, cancellation for overlapping low priority can start from the first overlapping symbol or the symbol before the first overlapping symbol. However, in current spec, only the latter case is captured. Therefore, we suggest the following TP to include the first overlapping symbol case.

*Agreement:*

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

1. *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.*

The proposed changes are as follows:

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| ------------------------------------ Start of TP 38.213V16.3.0 section 9---------------------------------  <unchanged text omitted>  When a UE determines overlapping for PUCCH and/or PUSCH transmissions of different priority indexes, the UE first resolves the overlapping for PUCCH and/or PUSCH transmissions of smaller priority index as described in Clause 9.2.5. Then,  - if a transmission of a first PUCCH of larger priority index scheduled by a DCI format in a PDCCH reception would overlap in time with a transmission of a second PUSCH or a second PUCCH of smaller priority index, the UE cancels the transmission of the second PUSCH or the second PUCCH ~~before~~ no later than the first symbol that would overlap with the first PUCCH transmission  - if a transmission of a first PUSCH of larger priority index scheduled by a DCI format in a PDCCH reception would overlap in time with a transmission of a second PUCCH of smaller priority index, the UE cancels the transmission of the second PUCCH ~~before~~ no later than the first symbol that would overlap with the first PUSCH transmission  where  - the overlapping is applicable before or after resolving overlapping among channels of larger priority index, if any, as described in Clause 9.2.5  - the UE expects that the transmission of the first PUCCH or the first PUSCH, respectively, would not start before after a last symbol of the corresponding PDCCH reception  - is the PUSCH preparation time for a corresponding UE processing capability assuming [6, TS 38.214], based on and as subsequently defined in this Clause, and is determined by a reported UE capability  If a UE is scheduled by a DCI format in a first PDCCH reception to transmit a first PUCCH or a first PUSCH of larger priority index that overlaps with a second PUCCH or a second PUSCH transmission of smaller priority index that, if any, is scheduled by a DCI format in a second PDCCH  - is based on a value of corresponding to the smallest SCS configuration of the first PDCCH, the second PDCCHs, the first PUCCH or the first PUSCH, and the second PUCCHs or the second PUSCHs  - if the overlapping group includes the first PUCCH  - if *processingType2Enabled* of *PDSCH-ServingCellConfig* is set to *enable* for the serving cell where the UE receives the first PDCCH and for all serving cells where the UE receives the PDSCHs corresponding to the second PUCCHs, and if *processingType2Enabled* of *PUSCH-ServingCellConfig* is set to *enable* for the serving cells with the second PUSCHs, *N2* is 5 for , 5.5 for  and 11 for  - else, *N2* is 10 for =0*,* 12 for , 23 for , and 36 for ;  - if the overlapping group includes the first PUSCH  - if *processingType2Enabled* of *PUSCH-ServingCellConfig* is set to *enable* for the serving cells with the first PUSCH and the second PUSCHs and if *processingType2Enabled* of *PDSCH-ServingCellConfig* is set to *enable* for all serving cells where the UE receives the PDSCHs corresponding to the second PUCCHs, *N2* is 5 for , 5.5 for  and 11 for  - else, *N2* is 10 for =0*,* 12 for , 23 for , and 36 for ;  If a UE would transmit the following channels that would overlap in time  - a first PUCCH of larger priority index with SR and a second PUCCH or PUSCH of smaller priority index, or  - a configured grant PUSCH of larger priority index and a PUCCH of smaller priority index, or  - a first PUCCH of larger priority index with HARQ-ACK information only in response to a PDSCH reception without a corresponding PDCCH and a second PUCCH of smaller priority index with SR and/or CSI, or a configured grant PUSCH with smaller priority index, or a PUSCH of smaller priority index with SP-CSI report(s) without a corresponding PDCCH, or  - a PUSCH of larger priority index with SP-CSI reports(s) without a corresponding PDCCH and a PUCCH of smaller priority index with SR, or CSI, or HARQ-ACK information only in response to a PDSCH reception without a corresponding PDCCH, or  - a configured grant PUSCH of larger priority index and a configured PUSCH of lower priority index on a same serving cell  the UE is expected to cancel the PUCCH/PUSCH transmissions of smaller priority index ~~before~~ no later than the first symbol overlapping with the PUCCH/PUSCH transmission of larger priority index.  <unchanged text omitted>  ------------------------------------ End of TP 38.213V16.3.0 section 9--------------------------------- |

# 9 Issue #8

In RAN1 #101e, RAN1 agreed/concluded that:

**Conclusion: In Rel. 15, if a PUCCH/PUSCH carrying a CSI report is cancelled, the occupied CPUs are remained occupied until the last symbol of “configured/scheduled” PUCCH/PUSCH.**

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| **Modified clause (Section 5.2.1.6 of TS 38.214)**  For a CSI report with *CSI-ReportConfig* with higher layer parameter *reportQuantity* not set to 'none', the CPU(s) are occupied for a number of OFDM symbols as follows:  - A periodic or semi-persistent CSI report (excluding an initial semi-persistent CSI report on PUSCH after the PDCCH triggering the report) occupies CPU(s) from the first symbol of the earliest one of each CSI-RS/CSI-IM/SSB resource for channel or interference measurement, respective latest CSI-RS/CSI-IM/SSB occasion no later than the corresponding CSI reference resource, until the last symbol of the configured PUSCH/PUCCH carrying the report.  - An aperiodic CSI report occupies CPU(s) from the first symbol after the PDCCH triggering the CSI report until the last symbol of the scheduled PUSCH carrying the report.  - An initial semi-persistent CSI report on PUSCH after the PDCCH trigger occupies CPU(s) from the first symbol after the PDCCH until the last symbol of the scheduled PUSCH carrying the report.  **End** |

According to [5], the active time duration of aperiodic CSI-RS should also be clarified in the same way. The related clause is copied below.

*“In any slot, the UE is not expected to have more active CSI-RS ports or active CSI-RS resources in active BWPs than reported as capability. NZP CSI-RS resource is active in a duration of time defined as follows. For aperiodic CSI-RS, starting from the end of the PDCCH containing the request and ending at the end of the PUSCH containing the report associated with this aperiodic CSI-RS. For semi-persistent CSI-RS, starting from the end of when the activation command is applied, and ending at the end of when the deactivation command is applied. For periodic CSI-RS, starting when the periodic CSI-RS is configured by higher layer signalling, and ending when the periodic CSI-RS configuration is released. If a CSI-RS resource is referred N times by one or more CSI Reporting Settings, the CSI-RS resource and the CSI-RS ports within the CSI-RS resource are counted N times.”*

Proposal: If the transmission of the PUSCH containing the report associated with the aperiodic CSI-RS is cancelled, the NZP CSI-RS resource is active from the end of the PDCCH containing the request and ending at the end of the “scheduled” PUSCH containing the report.

# 10 Issue #9

In [10], a possible ambiguity on prioritization between a PUSCH without UL-SCH and SR is pointed out (From Section 0 of TS 38.213):

*“In the remaining of this Clause, a UE multiplexes UCIs with same priority index in a PUCCH or a PUSCH. A PUCCH or a PUSCH is assumed to have a same priority index as a priority index of UCIs a UE multiplexes in the PUCCH or the PUSCH.”*

*“If a UE would transmit on a serving cell a PUSCH without UL-SCH that overlaps with a PUCCH transmission on a serving cell that includes positive SR information, the UE does not transmit the PUSCH.”*

To address the issue, the following TP is proposed:

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| **TP to TS 38.213, Section 9**  9 UE procedure for reporting control information  **<**Unchanged text is omitted>  If a UE would transmit on a serving cell a PUSCH without UL-SCH that overlaps with a PUCCH transmission on a serving cell that includes positive SR information, the UE does not transmit the PUSCH, except when the PUSCH without UL-SCH is of a larger priority index than the positive SR.  **<**Unchanged text is omitted> |

# 11 References

**[1] R1-2007635, “*Corrections on scheduling and HARQ*,” Huawei, HiSilicon**

**[2] R1-2007705, “*Maintenance of scheduling/HARQ for NR URLLC*,” Ericsson**

**[3] R1-2007734, “*Text proposals for intra-UE multiplexing and PUSCH preparation procedure time*,” ZTE**

**[4] R1-2008109, “*Remaining issues of enhancements to scheduling/HARQ*,” Spreadtrum**

**[5] R1-2008607, “*Remaining issues on HARQ and scheduling for URLLC*,” Qualcomm**

**[6] R1-2008277, “*Remaining issues on scheduling and HARQ*,” OPPO**

**[7] R1-2008304, “*Out-of-order CBG based PUSCH re-transmission and PHR/power scaling with UL cancellation*,” Nokia, NSB**

**[8] R1-2008535, “*Corrections on scheduling/HARQ for Rel-16 URLLC*,” NTT DOCOMO**

**[9] R1-2008672, “*Enhancement for scheduling/HARQ*,” vivo**

**[10] R1-2008303, “*Maintenance of Rel-16 URLLC intra-UE prioritization enhancements (incl. draft CRs)*,” Nokia/NSB**