**3GPP TSG RAN WG1 #104e R1-** **200xxxx**

**January 25th – February 5th, 2021**

**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 #104e** |
| Issue #1: Correction on intra-UE prioritization timeline by replacing “before the first overlapping symbol” with “no later than the first overlapping symbol” | OPPO (R1-2100178) |
| Issue #2: Prioritization due to collision with semi-static DL and SSB symbols  | OPPO (R1-2100179), Ericsson (R1-2100267), CATT (R1-2100338), vivo (R1-2100414), Nokia/NSB (R1-2100826), Qualcomm (R1-2101439), NTT DOCOMO (R1-2101585) |
| Issue #3: PDSCH SCS for defining prioritization timeline | CATT (R1-2100338) |
| Issue #4: Active duration of CSI-RS resources in case of cancellation  | Qualcomm (R1-2101439) |
| Issue #5: Including the agreement that any HP DCI can cancel a LP transmission | Qualcomm (R1-2101439) |

# 2 Issue #1

In [1], it is mentioned that the current specification does not capture the correct UE behavior for intra-UE prioritization. In particular, the current spec. states that the LP channel should be cancelled before the first overlapping symbol, while cancellation starting at the first overlapping symbol is also allowed. Hence, the proposal is to replace “before the first symbol” by “no later than the first symbol”.

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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 transmissionwhere - 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 $T\_{proc,2}+d\_{1}$ after a last symbol of the corresponding PDCCH reception- $T\_{proc,2} $is the PUSCH preparation time for a corresponding UE processing capability assuming $d\_{2,1}=0$ [6, TS 38.214], based on $μ$ and $N\_{2}$ as subsequently defined in this Clause, and $d\_{1}$ is determined by a reported UE capabilityIf 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- $T\_{proc,2}$ is based on a value of $μ$ 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 $μ=0$, 5.5 for $μ=1$ and 11 for $μ=2$ - else, *N2* is 10 for $μ$=0*,* 12 for $μ=1$, 23 for $μ=2$, and 36 for $μ=3$;- 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 $μ=0$, 5.5 for $μ=1$ and 11 for $μ=2$- else, *N2* is 10 for $μ$=0*,* 12 for $μ=1$, 23 for $μ=2$, and 36 for $μ=3$;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 cellthe 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--------------------------------- |

# 3 Issue #2

During RAN1 #103e, the following question and answer were discussed; however, no conclusion was drawn:

**Question: Can the following steps be considered for handling the collisions with semi-static DL and SSB? Is Step 3 consistent with the earlier decision on ordering of multiplexing and prioritization involving dynamically granted channels?**

* **Step 1: Overlapping PUCCH/PUSCHs are determined (No multiplexing)**
* **Step 2: Overlapping PUCCH/PUSCHs collied with semi-static DL symbols are cancelled.**
* **Step 3: UE performs multiplexing/prioritization among the non-cancelled overlapping channels.**
	+ **Step 3.1: Remaining PUCCH/PUSCHs of low priority after step 2 are multiplexed**
	+ **Step 3.2: If there is collision between high and low priority PUCCH/PUSCHs, low priority channels are dropped.**
	+ **Step 3.3: Remaining PUCCH/PUSCHs of high priority are multiplexed**
	+ **Step 3.4: If there is collision between high and low priority PUCCH/PUSCHs, low priority channels are dropped.**
* **Step 4 If there is collision between high and/or low priority PUCCH/PUSCHs and semi-static DL symbols, it/they will be dropped.**

3.1-3.4 are consistent with our earlier decisions on the order of multiplexing and prioritization.

The following solutions are proposed by the companies and submitted to RAN1 #104e:

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| **OPPO [2]*****Proposal 1: To address collision with semi-static DL symbols and SSB, the following easy way is suggested:**** ***Step1: Perform intra UE prioritization (including multiplexing, overriding) according to related working assumption in 102 e-meeting if confirmed and produce final PUCCHs/PUSCHs.***
* ***Step 2: Final PUCCHs/PUSCHs is cancelled by semi-static DL symbols and SSB symbols.***
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| Ericsson [3]For the purpose of collision resolution of PUCCH/PUSCH resources with semi-static DL and/or SSBs or with other PUCCH/PUSCH resources in a slot, the following steps are applied:* + When PUCCH/PUSCH resources in a slot are determined, apply the following steps:
	+ Step 1: Any PUCCH/PUSCH resource that overlaps with semi-static DL symbols or SSB in the slot is cancelled
	+ Step 2: Any overlapping among PUCCH/PUSCH resources is resolved as the following:
		- Step 2.1: Overlapping among LP PUCCH/PUSCH channels, if any, is resolved similar to Rel-15 as if HP channels do not exist.
		- Step 2.2: Any LP PUCCH/PUSCH that overlaps with a HP PUCCH/PUSCH channel is cancelled.
		- Step 2.3: Overlapping among HP PUCCH/PUSCH channels, if any, is resolved similar to Rel-15 as if LP channels do not exist.
		- Step 2.4: Any LP PUCCH/PUSCH that overlaps with a HP PUCCH/PUSCH channel is cancelled.
	+ Step 3: Any PUCCH/PUSCH resource that overlaps with semi-static DL symbols or SSB is cancelled.
	+ Note: In steps 2.1 or 2.3, for a scheduled LP or HP PUCCH resource carrying HARQ-ACK, respectively, the corresponding overriding procedure if applicable, is performed prior to any multiplexing procedures involving the PUCCH resource.

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| ---------------------------------Start of Text Proposal on TS 38.213 v16.4.0-----------------------9 UE procedure for reporting control information <Unchanged texts are omitted>When a UE determines overlapping for PUCCH and/or PUSCH transmissions of different priority indexes, including repetitions if any, where each transmission is subject to the limitations for UE transmissions described in Clause 11.1, the UE first resolves the overlapping for PUCCH and/or PUSCH transmissions of smaller priority index as described in Clauses 9.2.5 and 9.2.6. 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 repetition of a transmission of a second PUSCH or a second PUCCH of smaller priority index, the UE cancels the repetition of a 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 repetition of the transmission of a second PUCCH of smaller priority index, the UE cancels the repetition of the transmission of the second PUCCH before the first symbol that would overlap with the first PUSCH transmissionwhere - the overlapping is applicable before or after resolving overlapping among channels of larger priority index, if any, as described in Clauses 9.2.5 and 9.2.6- any remaining PUCCH and/or PUSCH transmission after overlapping resolution is subject to the limitations for UE transmission s described in Clause 11.1- the UE expects that the transmission of the first PUCCH or the first PUSCH, respectively, would not start before $T\_{proc,2}+d\_{1}$ after a last symbol of the corresponding PDCCH reception- $T\_{proc,2} $is the PUSCH preparation time for a corresponding UE processing capability assuming $d\_{2,1}=0$ [6, TS 38.214], based on $μ$ and $N\_{2}$ as subsequently defined in this Clause, and $d\_{1}$ is determined by a reported UE capability<Unchanged texts are omitted>---------------------------------End of Text Proposal on TS 38.213 v16.4.0----------------------- |

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| CATT [4]***Proposal 1: For intra-UE multiplexing and prioritization, the following steps are proposed:**** ***Step 1: Determine all individual LP PUCCH/PUSCH in a slot, the individual LP PUCCH/PUSCHs are determined before any multiplexing and after PUCCH overriding procedure;(LP PUCCH overriding is performed in this step)***
* ***Step 2: Each individual LP PUCCH/PUSCH that collides with semi-static DL symbols and/or SSB symbols is cancelled;***
* ***Step 3: Multiplexing between LP PUCCH/PUSCHs are performed; (Multiplexing between multiple CSIs is also included in this step;*** ***the intermediate LP PUCCH/PUSCHs in the middle of multiplexing are not cancelled when collides with semi-static DL symbols and/or SSB symbols)***
* ***Step 4: Determine all individual HP PUCCH/PUSCH in a slot, the individual HP PUCCH/PUSCHs are determined before any multiplexing procedure (The PUCCH resources*** ***associated with PUCCH overriding procedure are not included in this step), each individual HP PUCCH/PUSCH that collides with semi-static DL symbols and/or SSB symbols is cancelled;***
* ***Step 5: If there is collision between HP PUCCHs/PUSCHs obtained in step 4 and LP PUCCHs/PUSCHs obtained in step 3, LP channels are cancelled;***
* ***Step 6: For HP PUCCHs/PUSCHs obtained in step 4 and HP PUCCH resources associated with PUCCH overriding procedure, multiplexing or PUCCH overriding between HP channels are performed. (The intermediate HP PUCCH/PUSCHs in multiplexing and PUCCH overriding are not cancelled when colliding with semi-static DL symbols and/or SSB symbols);***
* ***Step 7: For each of the intermediate and final HP PUCCH/PUSCHs obtained in step 6, if it does not collides with semi-static DL symbols and/or SSB symbols and overlaps with LP PUCCH/PUSCHs obtained in step 5, the LP channels are cancelled;***
* ***Step 8: For LP PUCCHs/PUSCHs obtained in step 7 and final HP PUCCHs/PUSCHs obtained in step 6, if there is collision with semi-static DL symbols and/or SSB symbols, it/they will be dropped.***

A text proposal is provided below for intra-UE multiplexing and prioritization in section 9 of 38.213.-------------------------------------------------- Start of text proposal ------------------------------------------------------**9 UE procedure for reporting control information**<Unchanged text omitted>When a UE determines overlapping for PUCCH and/or PUSCH transmissions of same priority indexes, including repetitions if any, the UE cancels the PUCCH and/or PUSCH transmissions if a set of symbols of PUCCH and/or PUSCH transmissions are indicated to a UE as downlink by *tdd-UL-DL-ConfigurationCommon*, or *tdd-UL-DL-ConfigurationDedicated*, or indicated to the UE by *ssb-PositionsInBurst* in *SIB1* or *ssb-PositionsInBurst* in *ServingCellConfigCommon*, for reception of SS/PBCH blocks, and then resolves the overlapping for PUCCH and/or PUSCH transmissions of same priority indexes, as described in Clauses 9.2.5 and 9.2.6.When a UE determines overlapping for PUCCH and/or PUSCH transmissions of different priority indexes, including repetitions if any, the UE first resolves the overlapping for PUCCH and/or PUSCH transmissions of smaller priority index as described in Clauses 9.2.5 and 9.2.6. 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 repetition of a transmission of a second PUSCH or a second PUCCH of smaller priority index, the UE cancels the repetition of a 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 repetition of the transmission of a second PUCCH of smaller priority index, the UE cancels the repetition of the transmission of the second PUCCH before the first symbol that would overlap with the first PUSCH transmissionwhere - the overlapping is applicable before or after resolving overlapping among channels of larger priority index, and during the multiplexing among channels of larger priority index, if any, as described in Clauses 9.2.5 and 9.2.6; and the overlapping is applicable during PUCCH resource overriding procedure , if any, as described in Clauses 9.2.3- if a set of symbols of the channels with larger priority index are indicated to a UE as downlink by *tdd-UL-DL-ConfigurationCommon*, or *tdd-UL-DL-ConfigurationDedicated*, or indicated to the UE by *ssb-PositionsInBurst* in *SIB1* or *ssb-PositionsInBurst* in *ServingCellConfigCommon*, for reception of SS/PBCH blocks, the PUCCH or PUSCH of low priority index which overlaps with the channels with larger priority index would not be cancelled- before resolving overlapping among channels of larger priority index, if any, the UE cancels the PUCCH and/or PUSCH transmissions of larger priority index which does not include the PUCCH transmissions associated with PUCCH overriding procedure if a set of symbols of the PUCCH and/or PUSCH transmissions are indicated to a UE as downlink by *tdd-UL-DL-ConfigurationCommon*, or *tdd-UL-DL-ConfigurationDedicated*, or indicated to the UE by *ssb-PositionsInBurst* in *SIB1* or *ssb-PositionsInBurst* in *ServingCellConfigCommon*, for reception of SS/PBCH blocks- after resolving overlapping among channels of different priority indexes, the UE cancels the PUCCH and/or PUSCH transmissions if a set of symbols of PUCCH and/or PUSCH transmissions are indicated to a UE as downlink by *tdd-UL-DL-ConfigurationCommon*, or *tdd-UL-DL-ConfigurationDedicated*, or indicated to the UE by *ssb-PositionsInBurst* in *SIB1* or *ssb-PositionsInBurst* in *ServingCellConfigCommon*, for reception of SS/PBCH blocks- the UE expects that the transmission of the first PUCCH or the first PUSCH, respectively, would not start before $T\_{proc,2}+d\_{1}$ after a last symbol of the corresponding PDCCH reception- $T\_{proc,2} $is the PUSCH preparation time for a corresponding UE processing capability assuming $d\_{2,1}=0$ [6, TS 38.214], based on $μ$ and $N\_{2}$ as subsequently defined in this Clause, and $d\_{1}$ is determined by a reported UE capability<Unchanged text omitted>----------------------------------------------------- End of text proposal ------------------------------------------------------ |

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| vivo [5]***Proposal 1: Take the following behavior as common understanding.**** ***Step 1: Overlapping PUCCH/PUSCHs are determined (No multiplexing, for both HP and LP channel)***
* ***Step 2: PUCCH/PUSCHs collided with semi-static DL symbols are cancelled. (including intermediate PUCCH(s) and final PUCCH(s) for HARQ-ACK and non-overlapping channel for both HP and LP PUCCH)***
* ***Step 3: UE performs multiplexing/prioritization among the non-cancelled overlapping channels.***
	+ ***Step 3.1: Remaining PUCCH/PUSCHs of low priority after step 2 are multiplexed***
	+ ***Step 3.2: If there is collision between high and low priority PUCCH/PUSCHs, low priority channels are dropped. (including intermediate HP PUCCHs)***
	+ ***Step 3.3: Remaining PUCCH/PUSCHs of high priority are multiplexed***
	+ ***Step 3.4: If there is collision between high and low priority PUCCH/PUSCHs, low priority channels are dropped.***
* ***Step 4 If there is collision between high and/or low priority PUCCH/PUSCHs and semi-static DL symbols, it/they will be dropped.***

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| TS 38.213---------------------------------------- Start of text proposal ----------------------------------------------9 UE procedure for reporting control information\*\*\* Unchanged text is 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 different priority indexes, the UE cancels the PUCCH or the PUSCH transmission if the UE determines a PUCCH and/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 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 transmissionwhere - 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 $T\_{proc,2}+d\_{1}$ after a last symbol of the corresponding PDCCH reception- $T\_{proc,2} $is the PUSCH preparation time for a corresponding UE processing capability assuming $d\_{2,1}=0$ [6, TS 38.214], based on $μ$ and $N\_{2}$ as subsequently defined in this Clause, and $d\_{1}$ is determined by a reported UE capabilityAfter resolving the overlapping for PUCCH and/or PUSCH with different priority index, if UE determines a PUCCH and/or a PUSCH transmissions overlapping with DL symbols indicated by *tdd-UL-DL-ConfigurationCommon* or *tdd-UL-DL-ConfigurationDedicated*, the UE cancels the PUCCH and/or the PUSCH transmissions.---------------------------------------- End of text proposal --------------------------------------------- |

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| Nokia/NSB [6]**Proposal: Agree the following operational steps on intra-UE multiplexing/prioritization when the overlapping between UL channels and semi-static configured DL symbols/SSB symbols:*** ***Step 1 (Same as Step 1 proposed by Apple): For LP channels, final PUCCH resource for HARQ-ACK is determined based on the overriding procedure (i.e. identifying overlapping channels and no multiplexing).***
* ***Step 2 (Same as Step 2 proposed by Apple): Each individual LP PUCCH/PUSCH (before any multiplexing) that collides with semi-static DL symbols and/or SSB symbols is cancelled.***
* ***Step 3 (Same as Step 3 proposed by Apple): Multiplexing LP overlapping PUCCH/PUSCH, if any.***
* ***Step 4 (Same as Step 6 proposed by Apple): For HP channels, final PUCCH resource for HARQ-ACK is determined based on the overriding procedure (i.e. identifying overlapping channels and no multiplexing) - Same handling as for LP channels in Step 1.***
* ***Step 5 (Same as Step 4 proposed by Apple): For HP, each individual HP PUCCH/PUSCH (before any multiplexing) that collides with semi-static DL symbols and SSB symbols is cancelled. - Same handling as for LP channels in Step 2.***
* ***Step 6 (Same as Step 5 proposed by Apple): If there is collision between HP and LP PUCCHs/PUSCHs, the overlapped LP PUCCH/PUSCHs are cancelled.***
* ***Step 7 (Same as Step 7 proposed by Apple): Multiplexing HP overlapping PUCCH/PUSCH, if any.***
* ***Step 8 (Same as Step 9 proposed by Apple): If there is collision between high and/or low priority PUCCH/PUSCHs and semi-static DL symbols/SSB symbols, it/they will be dropped.***
* ***Step 9 (Same as Step 8 proposed by Apple): If there is collision between HP and LP PUCCHs/PUSCHs, LP channels are cancelled.***

9 UE procedure for reporting control information<omitted text>When a UE determines overlapping for PUCCH and/or PUSCH transmissions of different priority indexes, including repetitions if any, after determining the valid transmission resource for PUCCH and/or PUSCH transmissions of smaller priority index as described in Clause 11.1 and Clause 11.1.1, the UE first resolves the overlapping for PUCCH and/or PUSCH transmissions of smaller priority index as described in Clauses 9.2.5 and 9.2.6. Then, - the UE determines the valid transmission resource for PUCCH and/or PUSCH transmissions as described in Clause 11.1 and Clause 11.1.1 for PUCCH and/or PUSCH transmissions of larger priority index- 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 repetition of a transmission of a second PUSCH or a second PUCCH of smaller priority index, the UE cancels the repetition of a 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 repetition of the transmission of a second PUCCH of smaller priority index, the UE cancels the repetition of the transmission of the second PUCCH before the first symbol that would overlap with the first PUSCH transmissionwhere - the overlapping is applicable before or after resolving overlapping among channels of larger priority index, if any, as described in Clauses 9.2.5 and 9.2.6. - the UE expects that the transmission of the first PUCCH or the first PUSCH, respectively, would not start before $T\_{proc,2}+d\_{1}$ after a last symbol of the corresponding PDCCH reception- $T\_{proc,2} $is the PUSCH preparation time for a corresponding UE processing capability assuming $d\_{2,1}=0$ [6, TS 38.214], based on $μ$ and $N\_{2}$ as subsequently defined in this Clause, and $d\_{1}$ is determined by a reported UE capabilityIf 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- $T\_{proc,2}$ is based on a value of $μ$ 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, $N\_{2} $is 5 for $μ=0$, 5.5 for $μ=1$ and 11 for $μ=2$ - else, $N\_{2} $is 10 for $μ$=0*,* 12 for $μ=1$, 23 for $μ=2$, and 36 for $μ=3$;- 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, $N\_{2} $is 5 for $μ=0$, 5.5 for $μ=1$ and 11 for $μ=2$- else, $N\_{2} $is 10 for $μ$=0*,* 12 for $μ=1$, 23 for $μ=2$, and 36 for $μ=3$;If a UE would transmit the following channels, including repetitions if any, 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 cellthe UE is expected to cancel a repetition of the PUCCH/PUSCH transmissions of smaller priority index before the first symbol overlapping with the PUCCH/PUSCH transmission of larger priority index if the repetition of the PUCCH/PUSCH transmissions of smaller priority index overlaps in time with the PUCCH/PUSCH transmissions of larger priority index.<omitted text> |

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| Qualcomm [7]**Proposal: To handle the collisions with the semi-static DL and SSB symbols, the following steps should be considered:** * **Step 1: Overlapping PUCCHs/PUSCHs are determined (without performing multiplexing)**
	+ **Since any HP DCI can trigger the cancellation of any LP channel, including the intermediate ones, any LP channel that overlaps with any dynamically indicated HP channel is cancelled as part of this step.**
* **Step 2: Overlapping PUCCH/PUSCHs that are colliding with semi-static DL symbols are cancelled.**
* **Step 3: UE performs multiplexing/prioritization among the non-cancelled overlapping channels.**
	+ **Step 3.1: Remaining PUCCH/PUSCHs of low priority after step 2 are multiplexed.**
	+ **Step 3.1: Remaining PUCCH/PUSCHs of high priority after step 2 are multiplexed.**
	+ **Step 3.2: If there is collision between high and low priority PUCCH/PUSCHs, low priority channels are dropped.**
		- **Note: This step includes any configured HP transmission too.**
* **Step 4: If there is collision between high and/or low priority PUCCH/PUSCHs and semi-static DL symbols, it/they will be dropped.**
* **Step 5: Transmissions that are impacted by ULCI/dynamic SFI/PDSCH/CSI-RS are dropped.**
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| NTT DOCOMO [8]---------------------------------Start of Text Proposal on TS 38.213 v16.4.0-----------------------11.1 Slot configuration<Unchanged parts are omitted>For a set of symbols of a slot that are indicated to a UE as downlink by *tdd-UL-DL-ConfigurationCommon*, or *tdd-UL-DL-ConfigurationDedicated*, the UE does not transmit PUSCH, PUCCH, determined from Caluses 9 and 9.2.5, PRACH, or SRS when the PUSCH, PUCCH, PRACH, or SRS overlaps, even partially, with the set of symbols of the slot.For a set of symbols of a slot that are indicated to a UE as flexible by *tdd-UL-DL-ConfigurationCommon*, and *tdd-UL-DL-ConfigurationDedicated* if provided, the UE does not expect to receive both dedicated higher layer parameters configuring transmission from the UE in the set of symbols of the slot and dedicated higher layer parameters configuring reception by the UE in the set of symbols of the slot. For operation on a single carrier in unpaired spectrum, for a set of symbols of a slot indicated to a UE by *ssb-PositionsInBurst* in *SIB1* or *ssb-PositionsInBurst* in *ServingCellConfigCommon*, for reception of SS/PBCH blocks, the UE does not transmit PUSCH, PUCCH, determined from Clauses 9 and 9.2.5, PRACH in the slot if a transmission would overlap with any symbol from the set of symbols and the UE does not transmit SRS in the set of symbols of the slot. The UE does not expect the set of symbols of the slot to be indicated as uplink by *tdd-UL-DL-ConfigurationCommon*, or *tdd-UL-DL-ConfigurationDedicated*, when provided to the UE.If a UE - is configured with multiple serving cells and is provided *half-duplex-behavior* = 'enable', and- is not capable of simultaneous transmission and reception on any of the multiple serving cells, and- indicates support of capability for half-duplex operation in CA with unpaired spectrum, and - is not configured to monitor PDCCH for detection of DCI format 2\_0 on any of the multiple serving cells,for a set of symbols of a slot that are indicated to the UE for reception of SS/PBCH blocks in any of multiple serving cells by *ssb-PositionsInBurst* in *SystemInformationBlockType1* or by *ssb-PositionsInBurst* in *ServingCellConfigCommon*, when provided to the UE, the UE does not transmit PUSCH, PUCCH, determined from Clauses 9 and 9.2.5, or PRACH in the slot if a transmission would overlap with any symbol from the set of symbols, and the UE does not transmit SRS in the set of symbols of the slot in any of multiple serving cells.<Unchanged parts are omitted>--------------------------------------End of Text Proposal on TS 38.213 v16.4.0------------------ |

# 4 Issue #3

In [4], it is proposed that:

***Proposal: The SCS configuration of the PDSCH corresponding to the overlapping PUCCH should be considered in cancellation time.***

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| A text proposal is provided below for cancellation timeline in section 9 of 38.213.-------------------------------------------------- Start of text proposal ------------------------------------------------------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 at least 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- $T\_{proc,2}$ is based on a value of $μ$ corresponding to the smallest SCS configuration of the first PDCCH, the second PDCCHs, the PDSCHs corresponding to the first PUCCH, the PDSCHs corresponding to the second PUCCHs, 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, $N\_{2} $is 5 for $μ=0$, 5.5 for $μ=1$ and 11 for $μ=2$ - else, $N\_{2} $is 10 for $μ$=0*,* 12 for $μ=1$, 23 for $μ=2$, and 36 for $μ=3$;- 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, $N\_{2} $is 5 for $μ=0$, 5.5 for $μ=1$ and 11 for $μ=2$- else, $N\_{2} $is 10 for $μ$=0*,* 12 for $μ=1$, 23 for $μ=2$, and 36 for $μ=3$;----------------------------------------------------- End of text proposal ------------------------------------------------------ |

Furthermore, for determining the value of *N2* for Tproc,2, it is not clear whether PDSCH processing capability of a serving cell with a PDSCH transmission is the same as the PUSCH processing capability of a serving cell with a PUCCH transmission which carries HARQ-ACK for the PDSCH transmission.

***Proposal : It should be clarified which is the correct understanding below and the corresponding text proposal should be adopted:***

* ***Understanding 1: PDSCH processing capability of a serving cell with a PDSCH transmission should be the same as the PUSCH processing capability of a serving cell with a PUCCH transmission corresponding to the PDSCH transmission***
* ***Understanding 2: PDSCH processing capability of a serving cell with a PDSCH transmission can be different with the PUSCH processing capability of a PUCCH transmission corresponding to the PDSCH transmission***

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| -------------------------------------------------- Start of text proposal ------------------------------------------------------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- $T\_{proc,2}$ is based on a value of $μ$ 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 if *processingType2Enabled* of *PUSCH-ServingCellConfig* is set to *enable* for the serving cells with the second PUSCHs, $N\_{2} $is 5 for $μ=0$, 5.5 for $μ=1$ and 11 for $μ=2$ - else, $N\_{2} $is 10 for $μ$=0*,* 12 for $μ=1$, 23 for $μ=2$, and 36 for $μ=3$;- 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, $N\_{2} $is 5 for $μ=0$, 5.5 for $μ=1$ and 11 for $μ=2$- else, $N\_{2} $is 10 for $μ$=0*,* 12 for $μ=1$, 23 for $μ=2$, and 36 for $μ=3$;----------------------------------------------------- End of text proposal ------------------------------------------------------ |

It is also proposed that the following text proposal corresponding to understanding 2 should be considered in 38.213.

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| -------------------------------------------------- Start of text proposal ------------------------------------------------------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- $T\_{proc,2}$ is based on a value of $μ$ 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 and for the serving cell with the first PUCCH, $N\_{2} $is 5 for $μ=0$, 5.5 for $μ=1$ and 11 for $μ=2$ - else, $N\_{2} $is 10 for $μ$=0*,* 12 for $μ=1$, 23 for $μ=2$, and 36 for $μ=3$;- 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 for the serving cell with the second PUCCHs 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, $N\_{2} $is 5 for $μ=0$, 5.5 for $μ=1$ and 11 for $μ=2$- else, $N\_{2} $is 10 for $μ$=0*,* 12 for $μ=1$, 23 for $μ=2$, and 36 for $μ=3$;----------------------------------------------------- End of text proposal ------------------------------------------------------ |

# 5 Issue #4

In RAN1 #101e, the following conclusion was made:

**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.**

The active time duration of aperiodic CSI-RS should also be clarified in the same way. From Section 5.2.1.6 of TS 38.214, we have:

*“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.”*

Hence, [7] proposes the following:

**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.**

# 6 Issue #5

Previously, the following clause was included in Section 9 TS 38.213 and was removed by the Editor later:

*“If a UE detects a first DCI format scheduling a PUCCH or PUSCH transmission of larger priority index that would overlap with a PUCCH or PUSCH transmission of smaller priority index, the UE does not expect to transmit the PUCCHs or PUSCHs of the smaller priority index due to a detection of a second DCI format after the detection of the first DCI format.”*

In the last meeting, it was discussed that for more clarity and to avoid any ambiguity, this clause should be added back. Hence, [7] proposes to adopt the following CR:

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|  **Modified clause (Section 9 of TS 38.213)**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 transmissionwhere - 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 $T\_{proc,2}+d\_{1}$ after a last symbol of the corresponding PDCCH reception- $T\_{proc,2} $is the PUSCH preparation time for a corresponding UE processing capability assuming $d\_{2,1}=0$ [6, TS 38.214], based on $μ$ and $N\_{2}$ as subsequently defined in this Clause, and $d\_{1}$ is determined by a reported UE capabilityIf a UE detects a first DCI format scheduling a PUCCH or PUSCH transmission of larger priority index that would overlap with a PUCCH or PUSCH transmission of smaller priority index, the UE does not expect to transmit the PUCCHs or PUSCHs of the smaller priority index due to a detection of a second DCI format after the detection of the first DCI format. **End** |

# 7 References

**[1] R1-2100178, “*Text proposal for intra UE prioritization timeline*,” OPPO**

**[2] R1-2100179, “*Remaining issues on scheduling and HARQ,*” OPPO**

**[3] R1-2100267, “*Maintenance of scheduling/HARQ for NR URLLC,*” Ericsson**

**[4] R1-2100338, “Remaining issues on intra-UE prioritization,” CATT**

**[5] R1-2100414, “Maintenance on scheduling/HARQ,” vivo**

**[6] R1-2100826, “Maintenance of Rel. 16 URLLC Intra-UE and inter-UE prioritization/multiplexing enhancements,” Nokia, NSB**

**[7] R1-2101439, “Remaining issues on HARQ and scheduling for URLLC,” Qualcomm**

**[8] R1-2101585, “Corrections on scheduling/HARQ for Rel. 16 URLLC,” NTT DOCOMO**