3GPP TSG RAN WG1 #100bis R1-200xxxx

e-Meeting, April 20th – 30th, 2020

Source: vivo

Title: Summary of [100b-e-NR-L1enh-URLLC-InterUE-01]

Agenda Item: 7.2.5.5

Document for: Discussion and Decision

# Introduction

The document provides a summary for RAN1#100bis-e email discussion thread [100b-e-NR-L1enh-URLLC-InterUE-01].

Interaction between intra-UE prioritization/ multiplexing and inter-UE cancellation is the focus of in this email thread, including the following issues

* **Issue 1: A UL channel with which priority level can be cancelled by UL CI?**
* **Issue 2: UE application ordering for intra-UE prioritization/multiplexing and inter-UE cancellation**
* **Issue 3: Whether another UL transmission can be scheduled in the cancelled symbols that do not overlap with the resource indicated by UL CI**
* **Issue 4: Scheduling and cancellation at the same time**

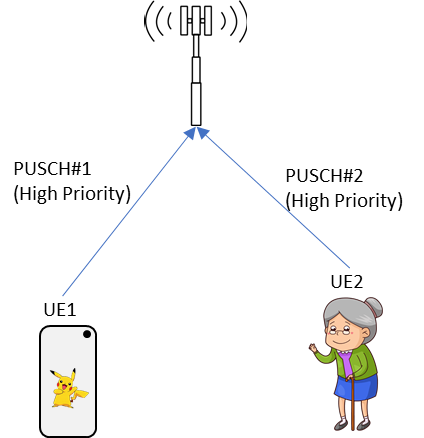
# Email discussion outcome

# Discussions

Interaction between intra-UE prioritization/multiplexing and inter-UE cancellation

## **Issue 1: A UL channel with which priority level can be cancelled by UL CI?**

* + Option1: For a given UE, UL CI is only applicable to the UL transmissions indicated/configured as low priority level
    - Huawei, Nokia (2nd preference), CATT, ETRI, Ericsson, OPPO(1st preference) , InterDigital(2nd preference), Panasonic (2nd preference)
  + Option 2: For a given UE, UL CI is applicable to UL transmission irrespective of its priority level. (no spec change needed)
    - ZTE, vivo (1st preference), OPPO(?), Intel (1st preference), Samsung
  + Option 3 (compromised proposal)
    - If both UL CI and intra-UE priority indicator are configured for a given UE, support a new RRC parameter to configure between following behaviours
      * Behaviour #1: For the given UE, UL CI is only applicable to the UL transmissions indicated/configured as low priority level
      * Behaviour #2: For the given UE, UL CI is applicable to UL transmission irrespective of its priority level
    - When the RRC parameter is not provided to the UE, behaviour #2 is used
    - vivo (2nd preference), Nokia (1st preference), Panasonic (1st preference), Intel (2nd preference), Spreadtrum, Apple, Qualcomm, OPPO(2nd preference) , InterDigital(1st preference)



[4] Provided text proposal for option 1 and option 3 as following. It is noted option 2 is the default which does not require any spec change, if option 1 or 3 cannot be agreed.

|  |
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| **TP to TS 38.213, Sec. 11.2A: RRC parameter to configure UE behaviour (red & green) or alternatively, cancel low priority UL transmissions (in red only)** 11.2A Cancellation indication **<**Unchanged text is omitted>  An indication by a DCI format 2\_4 for a serving cell is applicable to a PUSCH transmission of priority index 0 (according to clause 9), a PUSCH transmission of priority index 1 (according to clause 9) if not configured with [*UplinkCancellationPriority*] or a SRS transmission on the serving cell. For the serving cell, the UE determines the first symbol of the symbols to be the first symbol that is after from the end of a PDCCH reception where the UE detects the DCI format 2\_4, where is provided by *XXX*. corresponds to the PUSCH processing capability 2 [6, TS 38.214] assuming with being the smallest SCS configuration between the SCS configurations of the PDCCH and of a PUSCH transmission or of an SRS transmission on the serving cell. The UE does not expect to cancel the PUSCH transmission or the SRS transmission before a corresponding symbol that is after a last symbol of a CORESET where the UE detects the DCI format 2\_4.  A UE that detects a DCI format 2\_4 for a serving cell cancels an applicable PUSCH transmission, or a repetition of an applicable PUSCH transmission [6, TS 38.214] if the PUSCH transmission is with repetitions, or an SRS transmission on the serving cell if, respectively,  - a group of symbols, from the symbols, has a corresponding bit value of '1' in the DCI format 2\_4 and includes a symbol of the (repetition of the) PUSCH transmission or of the SRS transmission, and  - a group of PRBs, from the PRBs, has a corresponding bit value of '1' in the DCI format 2\_4 and includes a PRB of the (repetition of the) PUSCH transmission or of the SRS transmission,  where  - the cancellation of the (repetition of the) PUSCH transmission includes all symbols from the earliest symbol of the (repetition of the) PUSCH transmission that are in one or more groups of symbols having corresponding bit values of '1' in the DCI format 2\_4;  - the cancellation of the SRS transmission includes only symbols that are in one or more groups of symbols having corresponding bit values of '1' in the DCI format 2\_4.  **<**Unchanged text is omitted> |

**Please share your views on the following aspects using the table format**

* Which option(s) do you support and the key justification/reason for that
* What is your comment on the above text proposals
* Any other comments?

We will then see how to move forward on this topic

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| Company | comments |
| Nokia, NSB | We support the intention of Option 3 – but think we should just configure by RRC the ‘new added behaviour #1. Please note that with the TP is not fully aligned with the alternative proposal of Optiomn 3 above – as the RRC parameter would only configure behaviour #1 (whereas the alternative proposal has two ways to get the behaviour #2 – not configure or set by RRC parameter).  Meaning – we think Option 3 should read as:   * + - If both UL CI and intra-UE priority indicator are configured for a given UE, support a new RRC parameter to configure Behavior #1~~between following behaviours~~       * Behaviour #1: For the given UE, UL CI is only applicable to the UL transmissions indicated/configured as low priority level       * ~~Behaviour #2: For the given UE, UL CI is applicable to UL transmission irrespective of its priority level~~     - When the RRC parameter is not provided to the UE, behaviour #2 is used       * Behaviour #2: For the given UE, UL CI is applicable to UL transmission irrespective of its priority level |
| Sony | We think that Issue#4 worded properly can solve Issue#1. To remind everyone of the scenario illustrated in the Figure above we have:   * PUSCH#1 triggered by a real time game (Pokemon-Go) which therefore is indicated as High Priority for UE1 (because the user gaming experience is important) * PUSCH#2 triggered by a grandma falling down and so is also indicated as High Priority for UE2 (because grandma’s life is important)   PUSCH#1 and PUSCH#2 are both High Priority at the *INTRA-UE level*. However, it should be obvious that PUSCH#2 should have higher priority than PUSCH#1 and so the intended outcome is for PUSCH#1 to be cancelled and PUSCH#2 to go through. The following are the consequences of each option:   * *Option 1:* Both PUSCHs are marked as High Priority so but are transmitted and PUSCH#2 gets interfered (putting grandma’s life at risk). The problem with this option **is INTRA-UE priority CANNOT be applied at the INTER-UE level.** * *Option 2:* Status quo and so BOTH PUSCHs are cancelled (putting grandma’s life at risk). * *Option 3:* This may solve the issue by configuring UE1 with Option 2 and UE2 with Option 1. However, this assumes that UE2 (grandma) will never play real time game and that UE1’s user will never fall down. It also assumes that there will not be a UE3 who has a High Priority PUSCH (e.g. PUSCH#3) that is lower priority than PUSCH#2 at the INTER-UE level. Basically, this option limits the Inter-UE priority level to only 3 levels but at the logical level we have 16 priority levels and so this is a significant reduction. We should also avoid additional RRC parameters.   **None of these options** solve the issue if we do not also consider a solution in Issue#4. One solution is that the UL CI is NOT applicable for UL Grants that arrives at or after that UL CI. In other words, the UE can ignore that UL-CI if it arrives at the same time or before its UL Grant (the wordings in Issue#4 of “not expected” is very limiting which I will elaborate in Issue#4). Using the same example, the scenario is drawn in the figure below.    Here UG1 (Uplink Grant 1) and UG2 (Uplink Grant 2) schedule PUSCH#1 and PUSCH#2 respectively. Using the proposal for Issue#4, the PUSCH#1 vs PUSCH#2 (Pokemon vs Grandma) example can be solved. Here, UE1 will obey the UL-CI since its UG1 is transmitted BEFORE the UL CI and therefore cancels PUSCH#1 whilst UE2 will ignore the UL-CI since its UG2 is transmitted at the same time or after the UL CI and therefore transmits PUSCH#2.  If Issue#4 is worded correctly, i.e. the UL CI is NOT applicable for UL Grant transmitted (rather than the limiting words of “UE not expect”) at or after that UL CI then we can accept Option 2 for Issue#1, since there really isn’t anything more to do in Issue#1 if we sort out Issue#4 ***properly***. |
| Panasonic | We support Option 3 as 1st preference and Option 1 as 2nd preference.  Option 2 does not provide the mechanism to allow URLLC or high priority transmission. Some adjustment is needed for a UE that is configured to monitor UL CI to allow that the URLLC is not cancelled, but only the low priority traffic is cancelled. Therefore, at least Option 1 should be specified. In addition, there is only two-level UE-specific priority while there are more than two level priority/QoS levels in the cell level. The high priority for UE A is not required to be same for UE B in the same cell. This more than two level priority/QoS levels is supported in the upper layer and gNB know it. Then, UE-specific behaviour through RRC provides more flexibility for network operation which accommodates mixed UEs in a cell.  We are fine with TP. |
| HW/HiSi | We support Option 1.  Option 2, as discussed during the last meeting, does not solve the problem of self-cancellation where the pre-empting UE is cancelling its own URLLC transmission.  Option 3, as it has been argued last meeting by some companies, could be used when > 2 priorities levels in the cell shall be supported. However, Option 3 requires a new RRC parameter, which is very late at this stage and only should be done for essential issues.  If multiple priority levels across UEs shall be supported, the straight forward way is to support Option 1 and to use power boosting in case colliding high priority transmissions. As explained below, Option 3 still leaves too many open issues to justify its introduction.  As example, consider the scenario where 3 services (#0 to #2) with ascending priorities are supported in the cell:    Services {#0, #1} are supported by some UEs (UE-A), and the services {#1, #2} are supported by some other UEs (UE-B), If the UE-As are configured with Option 1, they would not cancel their own HP transmission. This could be overcome with power-boosting UE-B in case service #1 from an UE-A would collide with service #2 from an UE-B.  If configuring the UE-As with Option 2, it will lead to problems. For example, a UE-A2 might cancel itself, when another UE-A1 is transmitting service#0 and UE-A2 wants to transmit service #1. Another example is that a service #1 from UE-A might be cancelled by the same service of UE-B. But services with the same priority level should not cancel each other in our view.  Overall, there are too many open issues related to Option 3. If something else in addition to Option 1 and power boosting shall be used, then we need a more generic that also is solving the problems mentioned above. One way could be to convey the priority level in the DCI that is carrying UL CI. |

## **Issue 2: UE application ordering for intra-UE prioritization/multiplexing and inter-UE cancellation**

Several papers discussed the UE behaviour in case of simultaneous UL prioritization/multiplexing for intra-UE and inter-UE cancellation, and observed ambiguous operation if the UE behaviour is not specified. Following options can be discussed

* Option 1: Handling of intra-UE prioritization/multiplexing for overlapping UL transmissions is performed firstly and handling of inter-UE cancellation for UL transmission overlapping with resources by UL CI is performed secondly
  + Huawei, vivo, Nokia, OPPO, Ericsson, Panasonic, CATT, Samsung (UL CI case to be treated the same as SFI case), Spreadtrum, Apple, Qualcommm, LG, InterDigital
* Option 2: Handling of inter-UE cancellation for UL transmission overlapping with resources by UL CI is performed firstly and handling of intra-UE prioritization/multiplexing for overlapping UL transmissions is performed secondly
  + ETRI
* Option 3: UE performs intra-UE prioritization/multiplexing or inter-UE cancellation for the overlapped UL channels according to the time order which is determined by the receiving time order of PDCCH carrying DCI scheduling high priority transmission or DCI for UL CI.
  + Sony, Intel, CMCC
* Option 4: A UE should perform simultaneous UL prioritization/multiplexing for intra-UE and inter-UE according to the timeline between the end of last symbol of CORESET containing UL CI and the start of the earliest UL transmission among a group overlapping UL transmissions.
  + If the timeline is satisfied, handling of inter-UE prioritization for UL transmission according to UL CI firstly and handling of intra-UE prioritization/multiplexing for overlapping UL transmissions secondly.
  + If the timeline is not satisfied, handling of intra-UE prioritization/multiplexing for overlapping UL transmissions firstly and handling of inter-UE prioritization for UL transmission according to UL CI secondly.
  + ZTE

[19] proposed the following TP reflecting option 1.

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| --- |
| A UE that detects a DCI format 2\_4 for a serving cell cancels a PUSCH transmission, or a repetition of a PUSCH transmission [6, TS 38.214] if the PUSCH transmission is with repetitions, or an SRS transmission on the serving cell if, respectively,  - a group of symbols, from the symbols, has a corresponding bit value of '1' in the DCI format 2\_4 and includes a symbol of the (repetition of the) PUSCH transmission or of the SRS transmission, and  - a group of PRBs, from the PRBs, has a corresponding bit value of '1' in the DCI format 2\_4 and includes a PRB of the (repetition of the) PUSCH transmission or of the SRS transmission,  where  - the cancellation of the (repetition of the) PUSCH transmission includes all symbols from the earliest symbol of the (repetition of the) PUSCH transmission that are in one or more groups of symbols having corresponding bit values of '1' in the DCI format 2\_4;  - the cancellation of the SRS transmission includes only symbols that are in one or more groups of symbols having corresponding bit values of '1' in the DCI format 2\_4.  If a UE would transmit multiple overlapping PUCCHs and PUSCHs or SRSs or multiple overlapping PUSCHs and SRSs, and if the UE detects a DCI format 2\_4 to cancel at least one of the PUSCH transmissions or SRS transmissions, the UE behavior to resolve the overlapping among the multiple overlapping PUCCHs, PUSCHs and SRSs is not changed due to detection of DCI format 2\_4. |

Given the clear majority view expressed, suggest to go with option 1 with above TP.

**Please share your views on the following aspects using the table format**

* Is option 1 agreeable?
* Any comment to the text proposal for option 1 above?
* Any other comments?

|  |  |
| --- | --- |
| Company | comments |
| Nokia, NSB | We are OK with Option 1.  We are fine with the intention of the TP. I am just wondering if we could refer to the relevant section where the prioritization is discussed. |
| Sony | We would prefer Option 3 but we can live with Option 1. |
| Panasonic | We agree to Option 1, OK to the TP. |
| HW/HiSi | We support Option 1.  Similar to Nokia, we are also fine with the intention of the TP.  We propose to postpone the careful check of the TP until we have agreed which option to support. |

## **Issue 3: Whether another UL transmission can be scheduled in the cancelled symbols that do not overlap with the resource indicated by UL CI**

In case of inter-UE prioritization, when a UE is scheduled with a transmission on a resource that is overlapping with URLLC transmission, the UE cancels the scheduled transmission on the overlapped resource according to the indication by UL CI, together with the non-overlapping parts afterwards due to “cancellation without resuming”. Can the UE expect another UL transmission to be scheduled on the non-overlapping cancelled resource? Note that similar issue has been discussed in the intra-UE prioritization with following agreement:

Agreement:

When a high-priority UL transmission overlaps with a low-priority UL transmission in a slot,

* + The UE is not expected to be scheduled to transmit in the non-overlapping cancelled symbols

Following the same principle as intra-UE prioritization, the following options has been proposed.

It should be noted that if another UL transmission can be scheduled in the cancelled symbols, it is actually very similar to the OoO UL scheduling case where there can be two UL PUSCH scheduled overlapping in time, which was decided to not support [6].

* Option 1: In case of UL inter-UE prioritization, when a UL transmission from a UE is cancelled by UL CI, the UE **is not expected to be scheduled with UL transmission** in the cancelled symbols that do not overlap with the resource indicated by UL CI.
  + Vivo, Sony, MediaTek, Samsung, Spreadtrum, Apple
* Option 2: In case of UL inter-UE prioritization, when a UL transmission from a UE is cancelled by UL CI, the UE **is not expected to be scheduled with low priority UL transmission** in the cancelled symbols that do not overlap with the resource indicated by UL CI.
  + Qualcomm, Ericsson
* Option 3: In case of UL inter-UE prioritization, when a UL transmission from a UE is cancelled by UL CI, the UE **can be scheduled UL transmission** in the cancelled symbols that do not overlap with the resource indicated by UL CI.
  + Nokia, Intel, CATT

[18] further proposed the following

*When a scheduled UL transmission from a UE is cancelled by UL CI, the UE treats the symbols in the non-overlapped cancelled resource as uplink.*

**Please share your views on the following aspects using the table format**

* Which option(s) do you support and the key justification/reason for that
* Any comments regarding the following proposal made by Apple in [18]
  + When a scheduled UL transmission from a UE is cancelled by UL CI, the UE treats the symbols in the non-overlapped cancelled resource as uplink.
* Any other comments?

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| Company | comments |
| Nokia, NSB | We support Option 3 (1st choice) and Option 2 (2nd choice) – as we do not see a need to restrict the scheduling by specification. Please note, that the difference between Option 2 and Option 3 may be depending on the outcome of what is to be cancelled in the first issue (all UL or possible by RRC to only cancel low priority). |
| Sony | We stick with Option 1. |
| Panasonic | We support Option 1 as it is simple and sufficient. |
| HW/HiSi | We support Option 1. The reason is implementation simplicity. |

## **Issue 4: Scheduling and cancellation at the same time**

It was proposed that UE should not expected to receive a scheduling DCI and UL CI which cancels the scheduled transmission at the same time, propose the following text

* Option 1:
  + UE does not expect to detect a DCI format 2\_4 at a first PDCCH monitoring occasion indicating a set of time-frequency resources and detect a DCI format at a second PDCCH monitoring occasion scheduling a PUSCH/SRS transmission include resources indicated by the DCI format 2\_4 if the second monitoring occasion does not start earlier than the first PDCCH monitoring occasion.
  + Supported by: Huawei, vivo, Sony, Intel, Samsung, Spreadtrum, Qualcomm, Apple
* Option 2:
  + UE does not expect to detect a DCI format 2\_4 at a first PDCCH monitoring occasion indicating a set of time-frequency resources and detect a DCI format at a second PDCCH monitoring occasion scheduling a PUSCH/SRS transmission **with low priority** include resources indicated by the DCI format 2\_4 if the second monitoring occasion does not start earlier than the first PDCCH monitoring occasion.
  + Supported by: Ericsson

Nokia [4] proposed that this issue shall be decided after the issue about “which PUSCH (low or low&high priority PUSCH) is to be cancelled” is finalized.

It is true there is relation with issue 1, however, it seems possible to decouple it with issue 1 if we make an alternative proposal.

* Alternative proposal
  + UE does not expect to detect a DCI format 2\_4 at a first PDCCH monitoring occasion indicating a set of time-frequency resources and detect a DCI format at a second PDCCH monitoring occasion scheduling a PUSCH/SRS transmission **to be cancelled by** the DCI format 2\_4 if the second monitoring occasion does not start earlier than the first PDCCH monitoring occasion

**Please share your views on the following aspects using the table format**

* Which option(s) do you support and the key justification/reason for that
* Is the above alternative proposal trying to decouple this issue from issue #1 reasonable and agreeable?
* Any other comments?

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| --- | --- |
| Company | comments |
| Nokia, NSB | We still think the alternative proposal does not solve the problem we are raising in our contribution. In case all (incl. high priority PUSCH) is canceled then the alternative proposal would still mean there is not option to really have the high priority PUSCH transmitted over the air. Maybe FL could check – comment here if my understanding is maybe wrong here. |
| Sony | Firstly, we think the words “*UE does not expect to detect a DCI Format 2\_4*” VERY limiting as this implies that the gNB CANNOT send an UL CI to OTHER UEs or even the same UE for UL Grants that arrives BEFORE the UL CI.  Secondly, I believe everyone agrees that there is no point in sending an UL CI and then send an UL Grant where its PUSCH needs to be cancelled since the gNB can simply NOT transmit that UL Grant if it wants to cancel that PUSCH.  Consider scenarios in the figure below:    In the example above, UG1 schedules UE1 with a PUSCH#1 and then later UG2 schedules UE2 with PUSCH#2. The gNB decides that it needs to schedule UE2 with an urgent PUSCH#3 which will pre-empt PUSCH#2 and so it transmits UG3 to schedule PUSCH#3 at the same time as the UL-CI (at time *t*4 and *t*5). Now if we use the words “*UE is not expected to detect DCI Format 2\_4*” then the gNB is PREVENTED from transmitting the UL CI. That is:   * **gNB is PREVENTED** to transmit an UL CI for other UEs, e.g. UE2 * **gNB is PREVENTED** to transmit an UL CI for the same UE but for a previous Uplink Grant, e.g. for UG1 of UE1. There is no reason why the gNB cannot cancel PUSCH#1 from UE2 in the scenario above.   I simply cannot understand why we need to deliberately impose such restriction. Hence, I would like to propose to change the wordings of Option 1 to (which we will support):   * + UE ~~does not expect to detect~~ ignores a DCI format 2\_4 at a first PDCCH monitoring occasion indicating a set of time-frequency resources ~~and~~ for a detected ~~a~~ DCI format at a second PDCCH monitoring occasion scheduling a PUSCH/SRS transmission include resources indicated by the DCI format 2\_4 if the second monitoring occasion does not start earlier than the first PDCCH monitoring occasion.   This therefore still allows the gNB to transmit an UL CI for other UEs and also the same UE but for different Uplink Grant. NOTE: We will then solve Issue#1 with the above modification with even need to address Issue#1 further. |
| Panasonic | We support Option 1. Since the reception of a scheduling DCI and UL CI is the same time, just Option 1 can work without conclusion of Issue #1. |
| HW/HiSi | Before supporting on any of the options, I have a question for clarification on the original Option 1and on the alternative proposal.    For the case of a hybrid UE that is monitoring UL CI and has URLLC data to transmit, it could happen that the gNB is transmitting the UL CI and the scheduling grant at the same time.    In order to decouple issue #1 from issue #4, would it be possible to say that a “*scheduled uplink transmission* ***can*** *only be cancelled by UL CI, if the start of the UL CI is later than the scheduling grant*”? Then, any transmission for which the scheduling grant has started earlier, could possibly be cancelled. Which one (only LP or HP/LP) would depend on the outcome of issue #1. And any transmission, regardless the priority, for which the scheduling DCI and the UL CI are transmitted at the same time will not be cancelled.  @Nokia: I think the above could address your concern, right? The gNB can decide how to do. In case of a high priority transmission, it can send UL CI and the grant at the same time the UL transmission will not be cancelled. And in case of low priority transmission, the gNB should avoid transmitting them at the same time. Please let me know if I am missing something here.  I think the above intention is captured by the alternative proposal given by the FL, but I am not so comfortable with the wording that implies that a second monitoring occasion should start before a first occasion. Maybe the following wording reflects the above intention better:?  “*A UE does only expect to detect a DCI format 2\_4 at a second PDCCH monitoring occasion indicating a set of time-frequency resources and detect a DCI format at a first PDCCH monitoring occasion scheduling a PUSCH/SRS transmission* ***to be cancelled by*** *the DCI format 2\_4 if the second monitoring occasion starts later than the first PDCCH monitoring occasion*”? |

# Previous agreements

## **RAN1#96bis**

Working assumption:

* PDCCH is used for UL cancelation indication
  + The Working assumption can be revisited if the DCI for cancelation indication only carry very small number of information bits, e.g. 1 bit.

Agreements:

* Upon detecting an UL cancelation indication, at least stop without resuming is supported
  + FFS whether and how to support stop with resume

Agreements:

* Further discuss which UL transmissions that can potentially be cancelled by the UL cancelation indication, including
  + Dynamic scheduled UL transmissions, including PUSCH, PUCCH, SRS
  + Semi-persistent UL transmissions, including PUSCH, PUCCH, SRS
  + Periodic UL transmissions, including configured grant PUSCH, PUCCH, SRS
  + PRACH

Agreements:

* Further discuss, aiming for down-selection, the group common DCI and UE-specific DCI for UL cancelation indication
  + For group common DCI (different from Rel-15 SFI)
    - UE is configured to monitor a group common DCI which indicates the time/frequency region on which the UL cancellation indication applies
  + For UE specific-DCI
    - When applicable, UE is configured to monitor a second UL grant for the same TB as an earlier PUSCH indicating UL cancellation before the end of the earlier PUSCH transmission. In this case, the UE follows the UL cancellation indication.

**Conclusion**:

* Further discuss the following power control enhancements
  + Increased TPC range
    - FFS details, e.g. supported value range, number of TPC bits, accumulated and/or absolute TPC, configurability of the TPC tables, applicability to SRS/PUCCH.
  + Indication of open-loop parameter sets based on scheduling DCI without using SRI
  + Indication of open-loop parameter sets based on GC-PDCCH

## **RAN1#97**

Agreements:

* Support at least group common DCI for cancelation indication
  + FFS whether or not to additionally support UE-specific DCI for cancelation indication

**Conclusion:**

To down-select from the following options for enhanced power control

* Option 1: Indication of open-loop parameter sets by DCI
* For DG-PUSCH, an open-loop parameter set indicated to the UE by scheduling DCI without using SRI is applied to the scheduled transmission
* FFS At least for single active CG-PUSCH, an open-loop parameter set is indicated to the UE by a UE-specific field in group common DCI
  + - FFS for the case of multiple active CG-PUSCH
* FFS For a UE, the open-loop parameter sets for DG-PUSCH and CG-PUSCH may be same or different
* Option 2: Indication of TPC with increased range by DCI
* For DG-PUSCH, a TPC with increased range is indicated to the UE by the TPC field in scheduling DCI
* FFS At least for single active CG-PUSCH (and potentially also for DG-PUSCH), a TPC with increased range is indicated to the UE by a UE-specific TPC field in group common DCI
  + - FFS for the case of multiple active CG-PUSCH
* At least for DG-PUSCH, for a UE, the number of TPC entries (4 or 8) and power adjustment value for each entry is higher layer configured
* FFS For a UE, the TPC configuration for DG-PUSCH and CG-PUSCH may be same or different
* Option 3:
* For DG-PUSCH, use either the solution from option 1 or option 2 for DG-PUSCH as above
  + - To down-select from option 1 and 2
* FFS At least for single active CG-PUSCH, UE derives the transmissions power based on the time/frequency resource indicated by a group common DCI
  + - If a CG-PUSCH transmission overlaps with the indicated time/frequency resource, UE use one open-loop parameter set with higher power for the transmission
    - If a CG-PUSCH transmission does NOT overlap with the indicated time/frequency resource, UE use another open-loop parameter set with lower power for the transmission
    - FFS for the case of multiple active CG-PUSCH
    - Note: some companies have concern that this was not captured in the TR as one potential solutions

## **RAN1#98**

Agreements:

* Reuse the existing methods for search space configuration to support UL CI monitoring
  + FFS possible restrictions
  + Note: this means both symbol level and slot level monitoring periodicities are possible from specification perspective

Agreements:

* The UE DCI size budget is not increased by UL CI monitoring
* Further discuss methods to reduce the UE monitoring for UL CI, e.g.
  + The number of aggregation levels and/or candidates for the UL CI monitoring should be limited
  + Conditions for eMBB UE UL CI monitoring:
    - For UL transmission with associated PDCCH,
      * Option 1: UE starts UL CI monitoring after the PDCCH is decoded
      * Option 2: UE monitors UL CI at least at the latest monitoring occasion ending no later than X symbols before the start of the UL transmission, and X is related to UL CI processing time.
    - For UL transmission without associated PDCCH, UE monitors UL CI at least at the latest monitoring occasion that ends no later than X symbols before the start of the UL transmission, and X is related to UL CI processing time.
    - Other conditions?
  + Others?
* FFS the enhancement of UE capability (number of non-overlapping CCE and/or blind decodes) for UL CI monitoring

Agreements:

* Upon detecting an UL cancelation indication, for the transmission of UL signal/channels, “stop with resuming” is not supported
  + Except:
    - SRS can still be transmitted on the non-cancelled symbols (conditioned on if SRS can be pre-empted)
    - FFS for the PUSCH repetition (Rel-15 & Rel-16) case
    - FFS for the PUCCH repetition case (conditioned on if PUCCH can be pre-empted)
  + FFS whether another PUSCH can be scheduled in non-pre-empted resource
  + FFS impact (e.g. phase continuity issue) to a different carrier due to UL cancelation

[**R1-1909774**](file:///E:\3GPP%20meetings\WG1_RL1\2019\RAN1%2398bis\R1-1909774.zip)

Agreements:

* The following UL channel/signals can be cancelled by UL cancelation indication
  + PUSCH (including DG-, CG- and SP-)
  + FFS for SRS
  + FFS for PUCCH
    - Option 1: PUCCH (all types) can be cancelled
    - Option 2: Some PUCCH can be cancelled, e.g. PUCCH carrying CSI
    - Option 3: PUCCH cannot be cancelled
  + FFS for PRACH (preamble and/or MSG 3 PUSCH)

Agreements:

* The UE processing time requirement for UL cancelation indication based on N2 defined in Rel-15 UE cap#2 is supported
  + FFS whether the processing time requirement for UL cancelation indication larger than N2 as defined in Rel-15 UE cap#2 can also be supported as an UE capability
  + FFS whether the processing time requirement for UL cancelation indication shorter than N2 as defined in Rel-15 UE cap#2 as can also be supported an UE capability

Agreements:

* For a DG-PUSCH, an open-loop parameter set indicated to the UE by scheduling DCI using a separate field than SRI is supported.
  + FFS number of bits for the indication

## **RAN1#98bis**

Agreements:

* Regarding UL CI monitoring, support the following:
  + A new RNTI (e.g. CI-RNTI) is used for UL CI
  + FFS: Monitoring periodicity larger than [5] slot is not supported for UL CI
  + The aggregation level(s) and the number of PDCCH candidates configured by RRC
    - FFS possible restrictions, e.g., the ones associated with SFI
  + The DCI payload size for UL CI is configured by RRC
    - FFS possible values

Agreements:

* SRS can be cancelled by UL CI
* PUCCH cannot be cancelled by UL CI
* RACH related UL transmissions cannot be cancelled by UL CI, including MSG 1/3 in case of 4-step RACH, MSG A in case of 2-step RACH.

Agreements:

* Cross-carrier UL cancelation indication is supported using the same way as Rel-15 SFI/DL PI
  + The indication field position in DCI for each cross-carrier indicated serving cell is configured by RRC

Agreements:

* Different UE processing time capability for UL CI (i.e. shorter or longer than T\_proc2 for cap#2 UE) is not considered in Rel-16
  + d2,1=0 also when DMRS and UL-SCH (for the PUSCH to be cancelled) are multiplexed in the 1st symbol

Agreements:

* In case of PUSCH repetitions, UL CI is applied to each repetition individually (actual repetition in case of Rel-16 PUSCH repetition) that overlaps with the resource (in time and frequency) indicated by UL CI.

Agreements:

* + The reference time region where a detected UL CI is applicable is determined by the following:
    - * The reference time region starts from X symbols after the ending symbol of the PDCCH CORESET carrying the UL CI, where X is at least equal to the minimum processing time for UL cancelation
        + FFS X can be configured to be larger than the minimum processing time for UL cancelation
      * The duration of the reference time region is configured by RRC
        + FFS Possible values (e.g. 2OS, 4OS, 7OS, 14OS, 28OS?)
      * FFS DL symbols are excluded from the reference time region

Agreements:

* + - The reference frequency region where a detected UL CI is applicable is configured by RRC

Agreements:

Support the following for UL CI

* + Each UL cancelation indicator per serving cell has a RRC configurable field size of X bits
    - * One value of X is 14
      * FFS other values (e.g. X can be N (N>0) times of 7)
  + The time domain granularity for the reference time region is configured by RRC
    - * FFS the possible values (e.g. the time region can be divided into [1],[2],[4],[7],[14],…portions)
      * FFS valid configurations according to the duration of the time reference region
  + The frequency domain granularity is determined based on the configured time domain granularity and the configured bit field size of each indicator
  + The time and frequency resource for cancellation is jointly indicated by a 2D-bitmap (i.e. similar as DL PI) over the time and frequency partitions within the reference region
    - * FFS dynamic 2D-bitmap

Agreements:

* For DG-PUSCH, one bit (separately from SRI) in UL grant is used to indicate the open loop power control parameter set
  + Introduce one new RRC parameter that contains one additional P0-PUSCH-Set per SRI
  + The one bit indication is present in the UL grant when the above new RRC parameter is configured
  + If present, the one bit in the DCI is used to switch between the P0 value from the existing P0-PUSCH-AlphaSet and the P0 value from the newly configured P0-PUSCH-Set

**Conclusion**:

No enhancement for CG-PUSCH power control in Rel-16 for inter-UE multiplexing

## **RAN1#99**

Agreements:

* There is no enhancement to PDCCH monitoring capability (number of BD and non-overlapping CCEs) specifically for UL CI monitoring purpose

Agreements:

* The maximum monitoring periodicity for UL CI is [5] slots

Agreements:

* Up to X BDs can be configured for UL CI
  + FFS per UL CI monitoring occasion or per span
  + The value of X is to be concluded during this week
  + Note: UE is not expected to be configured with search space configuration for UL CI with AL and number of candidates exceeding X BDs

Agreements:

* The maximum size for *dci-PayloadSize-forCI* is 126

Agreements:

* Possible values for RRC parameter *timedurationforCI* can be:
  + If the configured UL CI monitoring periodicity is >1 slot or 1-slot with only one monitoring occasion
    - At least the same as the configured UL CI monitoring periodicity
      * FFS whether or not to additionally support multiple of UL CI monitoring periodicity
  + Otherwise (i.e., >1 monitoring occasion within 1 slot when 1-slot is the configured UL CI monitoring periodicity)
    - {2, 4, 7, [14]} OS, which SCS is used when determine the time duration
      * SCS for the DL BWP carrying UL CI
    - FFS The UE is not expected to be configured with a time duration for CI less than the time different (in symbols) between any adjacent monitoring occasions in a slot

Agreements**:**

* + Possible values (16 values) for RRC parameter *CI-PayloadSize are* 
    - *{[1],2,4,[5],7,8,[10],14,16,[20],[25],28,32,[35],56,112}*
  + *timeGranularityforCI* is defined as number of partitions within the time region, and possible values are
    - *{1,2,4,7,14,28}*
  + The configured value of *CI-PayloadSize* shall be a multiple integer of the configured value of *timeGranularityforCI*

Agreements:

* + The frequency region for UL CI is derived by the following
    - A RIV indication configured by RRC within value range of (0..37949) (i.e. the same way as IE “locationAndBandwidth” for BWP configuration ), the configuration is per serving cell specific
      * The reference point is derived based on the RRC parameter *offsetToCarrier* (existing parameter, same way as BWP configuration)
    - A reference SCS (no RRC configuration) for a serving cell (to handle the case where a UE is configured with multiple BWPs using different SCSs on the serving cell),
      * Use the SCS for the DL BWP carrying UL CI as the reference SCS

Agreements:

* Support per serving cell configuration for the following parameters
* *CI-PayloadSize*
* *timedurationforCI*
* *timeGranularityforCI*
* *frequencyRegionforCI*

Agreements:

* If a serving cell is configured with SUL, each UL carrier (SUL and non-SUL) can be configured with different *positionInDCI.*

Agreements:

* The DL symbols indicated by *tdd-UL-DL-ConfigurationCommon* are excluded from the reference time region for UL CI
  + The partition of reference time region is done after excluding the DL symbols
  + The symbols used for SSB are also excluded

Agreements:

* Clarification of 2D-bitmap
  + 2D-bitmap is to use *X* bits for bitmap indication over a time/frequency region with M partitions in time and N partitions in frequency, and X=M x N

Agreements:

Regarding “FFS whether or not to additionally support multiple of UL CI monitoring periodicity”

* If the configured UL CI monitoring periodicity is >1 slot or 1-slot with only one monitoring occasion, no additionally support that the time duration to be multiple of UL CI monitoring periodicity

Agreement

To determine the P0 value in case SRI is not configured in the DCI

* Option 1A: The open-loop power control parameter set indication field in the DCI can be configurable to be 1 or 2bits
  + *P0-PUSCH-Set can* provide up to two P0 value*s*
    - UE uses the P0 values according to open loop power control indication field in DCI
    - UE use P0 from *P0-PUSCH-AlphaSet* when
      * open-loop power control parameter set indication field is 1bit and “0” is indicated, or
      * open-loop power control parameter set indication field is 2bits and “00” is indicated
  + Open-loop power control parameter set indication field can be separately configurable for DCI format 0\_1 and DCI format 0\_2
    - If open-loop power control parameter set indication field is not present for a DCI format, use P0 from *P0-PUSCH-AlphaSet*
  + A single configuration of P0-PUSCH-Set applies to both DCI format 0\_1 and DCI format 0\_2

## **RAN1#100-e**

Agreements:

* Confirm that 14OS can be configured for timedurationforCI (when 1-slot is the configured UL CI monitoring periodicity with more than one monitoring occasions within 1 slot)
* The possible values for *CI-PayloadSize*, are {1,2,4,5,7,8,10,14,16,20, 28,32,35,42,56,112}

The following TP is endorsed

------------------------------------ Start of TP for 38.213 --------------------------------------------

**11.2A Cancellation indication**

< Unchanged parts are omitted >

For a group of symbols, ** bits from each set of bits have a one-to-one mapping with  groups of PRBs where each of the first ** groups includes ** PRBs and each of the remaining ** groups includes ** PRBs. A UE determines a first PRB index as  and a number of contiguous RBs as  from frequencyRegionforCI that indicates an offset  and a length  as RIV according to [6, TS 38.214], and from offsetToCarrier in FrequencyInfoUL-SIB that indicates  for a SCS configuration of an active DL BWP where the UE monitors PDCCH for DCI format 2\_4 detection.

< Unchanged parts are omitted >

------------------------------------ End of TP for 38.213 --------------------------------------------

Agreements:

* The maximum UL CI monitoring periodicity is 10 slots.
* Up to X BDs can be configured per UL CI monitoring occasion, X to be decided between X=1 or X=2 in RAN1#100bis.

No RAN1 spec impact - RRC parameter update only.

Agreements:

* UE derives the RUR start based on “logical time” (i.e. assuming DL timing difference is 0 and TA=0) and the actual cancellation symbol based on “actual time” (i.e. assuming actual DL timing difference, actual TA)
* A new RRC parameter delta\_offset d having possible values {0, 1, 2} OFDM symbols is introduced, update the spec as the following

|  |
| --- |
| For the serving cell, the UE determines the first symbol of the symbols to be the first symbol that is after + d from the end of a PDCCH reception where the UE detects the DCI format 2\_4.corresponds to the PUSCH processing capability 2 [6, TS 38.214] assuming  with being the smallest SCS configuration between the SCS configurations of the PDCCH and of a PUSCH transmission or of an SRS transmission on the serving cell. |

* Clarify the following by a RAN1 spec update (see below)
  + UE is not expected to cancel the transmission of SRS or PUSCH before the first symbol that is T\_proc,2 after the end of the reception of the last symbol of the PDCCH carrying the ULCI including the effect of the timing advance.

38.213 Text proposal (maybe further refined by spec editor)

|  |
| --- |
| An indication by a DCI format 2\_4 for a serving cell is applicable to PUSCH or SRS transmissions on the serving cell. For the serving cell, the UE determines the first symbol of the symbols to be the first symbol that is after from the end of a PDCCH reception where the UE detects the DCI format 2\_4, where *d* is provided by higher layer parameter [xxxx]. corresponds to the PUSCH processing capability 2 [6, TS 38.214] assuming with being the smallest SCS configuration between the SCS configurations of the PDCCH and of a PUSCH transmission or of an SRS transmission on the serving cell. UE is not expected to cancel the transmission of SRS or PUSCH before the first symbol that is after the end of the reception of the last symbol of the PDCCH carrying the ULCI including the effect of the timing advance. |

Agreements:

* UE performs the UL cancellation based on any detected UL CI, no additional specification for the case of overlapping reference time region for multiple UL CI occasions.
* A cancelled PUSCH transmission by a UE is counted towards the number of PUSCH that a UE can support per slot

Conclusion:

* It is possible for a UE to indicate both  *pa-PhaseDiscontinuityImpacts*  (i.e. 6-23) and the support of UL CI for intra-band UL CA
* For a UE indicates a capability to cancel overlapping PUSCHs on different intra-band serving cells (if any), and the capability of *pa-PhaseDiscontinuityImpacts*, and if the PUSCH on at least one serving cell is cancelled, the UE cancels the (repetition of the) PUSCHs transmission on all other intra-band serving cell(s). The cancellation of the (repetition of the) PUSCH transmission on a the set of intra-band serving cell(s) includes all symbols from the earliest symbol that is overlapping with the first cancelled symbol of the PUSCH on the serving cell for which the DCI format 2\_4 is applicable to.

## **TR 38.824**

|  |
| --- |
| 7.2 Potential enhancements In the following sub-sections, potential enhancements for UL inter UE Tx prioritization/multiplexing are presented. It is recommended to specify both UL cancelation scheme and enhanced UL power control scheme in the work item phase. 7.2.1 UE UL cancelation mechanisms UE UL cancelation mechanisms are considered as one potential enhancement for UL inter-UE Tx prioritization/multiplexing and are studied from several aspects, including the potential mechanisms (e.g. UE UL cancelation/pausing indication, UL continuation indication, UL re-scheduling indication), physical channel/signal used for the UL cancelation indication, UE processing timeline for the UL cancelation indication, UE monitoring behaviours for the UL cancelation indication, UE PDCCH monitoring capability if the UL cancelation indication is by PDCCH, methods to ensure the reliability of the indication for UE UL cancelation.  Either PDCCH or sequence can be considered as potential options for the UL cancelation indication. If PDCCH is used, either group common DCI or UE-specific DCI can be considered as potential options. If sequence is used, either group common sequence or UE-specific sequence can be considered.  The monitoring periodicity for the UL cancelation indication should be configurable by the gNB and UE supporting UL cancelation indication should be able to support more than one monitoring occasions for the UL cancelation indication in a slot. If PDCCH is used, whether the UE PDCCH monitoring capability (number of CCEs/BDs per slot) should be increased is to be further investigated.  The UE processing time for UL cancelation indication should be equal or shorter than N2 defined in Rel-15 UE capability#2.  Upon detecting an UL cancelation indication, UE cancels the corresponding UL transmission. The corresponding UL transmission may include an on-going UL transmission, or an UL transmission that has not been started. After cancelation, the UE may resume the transmission afterwards as one option, or may not resume the transmission afterwards as another option. 7.2.2 Enhanced UL power control Enhanced UL power control is considered as one potential enhancement for UL inter-UE Tx prioritization/multiplexing and the study mainly focuses on enhanced dynamic power boost for URLLC UE, including dynamic change of power control parameters (e.g. P0 and alpha without SRI configured) and enhanced TPC (e.g. increased TPC range and finer granularity). The need of URLLC UE power change during one transmission instance is not envisioned. It is assumed that there is no change of eMBB UE power control scheme in this study item.  Enhanced dynamic power boost for URLLC UE are studied from several aspects, including feasibility of boosting UE power in power limited or interference limited scenarios, physical channel/signal used for the signalling, UE processing timeline for the signalling, UE monitoring behaviours for the signalling, UE PDCCH monitoring capability if the signalling is by PDCCH and methods to ensure the reliability of the signalling.  It is concluded that the potential enhanced UL power control may include UE determining the power control parameter set (e.g. P0, alpha) based on scheduling DCI indication without using SRI, or based on group-common DCI indication. Increased TPC range compared to Rel-15 may also be considered. Power boosting is not applicable to power limited UEs. |

# List of contributions and proposals

|  |  |  |  |
| --- | --- | --- | --- |
| 1 | [**R1-2001547**](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_100b_e/Docs/R1-2001547.zip) | Corrections on UL inter-UE multiplexing | Huawei, HiSilicon |
| 2 | [**R1-2001615**](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_100b_e/Docs/R1-2001615.zip) | Remaining issues on UL inter-UE multiplexing between eMBB and URLLC | ZTE |
| 3 | [**R1-2001673**](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_100b_e/Docs/R1-2001673.zip) | UL inter UE Tx prioritization for URLLC | vivo |
| 4 | [**R1-2001697**](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_100b_e/Docs/R1-2001697.zip) | Maintenance of Rel-16 URLLC Enhanced inter UE Tx prioritization/multiplexing | Nokia, Nokia Shanghai Bell |
| 5 | [**R1-2001777**](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_100b_e/Docs/R1-2001777.zip) | Inter UE Tx prioritization and multiplexing | OPPO |
| 6 | [**R1-2001788**](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_100b_e/Docs/R1-2001788.zip) | Remaining Issue of Inter-UE Prioritization and Multiplexing of  UL Transmissions | Ericsson |
| 7 | [**R1-2001817**](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_100b_e/Docs/R1-2001817.zip) | Remaining issues on inter-UE multiplexing | Sony |
| 8 | [**R1-2001841**](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_100b_e/Docs/R1-2001841.zip) | Remaining issues on enhanced inter UE Tx prioritization/multiplexing | MediaTek Inc. |
| 9 | [**R1-2001873**](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_100b_e/Docs/R1-2001873.zip) | Remaining issue on inter-UE prioritization | Panasonic Corporation |
| 10 | [**R1-2001923**](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_100b_e/Docs/R1-2001923.zip) | Remaining issues of UL inter UE Tx prioritization | LG Electronics |
| 11 | [**R1-2002002**](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_100b_e/Docs/R1-2002002.zip) | Remaining issues on enhanced inter-UE multiplexing | Intel Corporation |
| 12 | [**R1-2002086**](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_100b_e/Docs/R1-2002086.zip) | Remaining issues on inter-UE UL multiplexing | CATT |
| 13 | [**R1-2002134**](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_100b_e/Docs/R1-2002134.zip) | Remaining issues for inter-UE multiplexing | Samsung |
| 14 | [**R1-2002211**](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_100b_e/Docs/R1-2002211.zip) | Remaining issues on inter UE Tx prioritization/multiplexing | CMCC |
| 15 | [**R1-2002252**](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_100b_e/Docs/R1-2002252.zip) | Enhanced inter UE Tx prioritization/multiplexing | ETRI |
| 16 | [**R1-2002257**](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_100b_e/Docs/R1-2002257.zip) | Remaining issues of enhanced inter UE Tx prioritization/multiplexing | Spreadtrum Communications |
| 17 | [**R1-2002307**](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_100b_e/Docs/R1-2002307.zip) | Inter-UE prioritization/multiplexing | InterDigital, Inc. |
| 18 | [**R1-2002333**](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_100b_e/Docs/R1-2002333.zip) | Remaining Issues on Inter-UE Cancellation for eURLLC | Apple |
| 19 | [**R1-2002548**](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_100b_e/Docs/R1-2002548.zip) | Remaining issues on uplink Inter-UE Tx Multiplexing and Prioritization | Qualcomm Incorporated |
| 20 | [**R1-2002637**](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_100b_e/Docs/R1-2002637.zip) | Remaining issues on inter-UE multiplexing for NR URLLC | WILUS Inc. |