**3GPP TSG-RAN WG1 Meeting #112bis-eR1-23XXXXX**

e-meeting, April 17th – April 26th, 2023

**Agenda item: 7.2**

**Source: Moderator (CATT)**

**Title: Moderator summary #X on Maintenance of Rel-17 URLLC & IIoT maintenance (intra-UE multiplexing)**

**Document for: Discussion and Decision**

# Introduction

As per chairman’s guidance, the email discussion is planned according to the following schedule:

[112bis-e-R17-URLLC-02] Email discussion on Rel-17 URLLC & IIoT maintenance (intra-UE multiplexing) by April 21 – Yanping (CATT)

**The following TDocs have been allocated to this email thread by Mr. Chairman:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **TDoc** **Number** | **Tdoc title** | **company** | **Specs & clause** | **Issue number** |
| [**R1-2302443**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_112b-e/Docs/R1-2302443.zip) | Correction on multiplexing of different PHY priorities in 38.213 | Nokia, Nokia Shanghai Bell | 38.213Clause 9 | Issue #1 |
| [**R1-2302464**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_112b-e/Docs/R1-2302464.zip) | Draft CR on HARQ-ACK multiplexing on PUSCH with different priority | vivo | 38.213Clause 9 | Issue #2 |
| [**R1-2302654**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_112b-e/Docs/R1-2302654.zip) | Correction on HARQ-ACK multiplexing on PUSCH with different priority | CATT | 38.213Clause 9 |
| [**R1-2302657**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_112b-e/Docs/R1-2302657.zip) | Correction on UCI multiplexing with different priorities | CATT | 38.213Clause 9.2.5 | Issue #3 |
| [**R1-2303108**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_112b-e/Docs/R1-2303108.zip) | Discussion on PUCCH power control for mutlplexing HARQ-ACK of different priorities | Samsung | 38.213Clause 9.2.5.3 | Issue #4 |
| [**R1-2303109**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_112b-e/Docs/R1-2303109.zip) | Correction on Intra-UE mutlplexing of HARQ-ACK of different priorities | Samsung |

# Issue#1: Deletion of editorial notes

* 1. Background & companies’ inputs

Nokia/NSB in [**R1-2302443**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_112b-e/Docs/R1-2302443.zip) based on the following reasoning:

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| --- | --- |
| ***Reason for change:*** | In the procedures of multiplexing of different PHY priorities, some editorial notes by the editor are still present  |
|  |  |
| ***Summary of change:*** | Remove the editorial notes for multiplexing of different PHY priorities in clause 9.  |
|  |  |
| ***Consequences if not approved:*** | Unclear conditions for multiplexing of different PHY priorities |

provided the following draft CR to 38.213, Sec. 9

|  |
| --- |
| 9 UE procedure for reporting control information< Unchanged parts are omitted >- if - a PUCCH transmission with HARQ-ACK information, without repetitions, with smaller priority index overlaps with a PUCCH transmission only with HARQ-ACK information, without repetitions, with larger priority index, or - a PUCCH transmission without repetitions that includes HARQ-ACK information of smaller priority index overlaps with a PUCCH transmission without repetitions using a PUCCH resource with PUCCH format 2/3/4 with HARQ-ACK information and SR of larger priority index, or- a PUCCH transmission with HARQ-ACK information, without repetitions, with smaller or larger priority index overlaps, respectively, with a PUSCH transmission with larger or smaller priority index< Unchanged parts are omitted > |

* 1. Initial moderator assessment & suggested handling

It is not clear to moderator whether the intention from editor is to keep the note in the spec. Companies are invited to share your views on whether the proposed change is needed. If agreed, moderator thinks that is can be referred to the 38.213 editor CR.

* 1. Issue to be handled during RAN1#112bis-e?

**Question: Do you support discussing the Issue (overall) during RAN1#112bis-e?**

|  |  |
| --- | --- |
| Yes - support:  |  |
| No - not support:  |  |

**Question: If to be handled during RAN1#112bis-e, do you think this could be referred to the editor CR or is a separate CR needed?**

|  |  |
| --- | --- |
| Refer to Editor CR  | Vivo,New H3C Huawei/HiSi |
| Separate CR |  |

**Comments on the moderator comments / suggested handling or any other comments on the draft CR:**

|  |  |
| --- | --- |
| *Company* | *Comments*  |
| vivo | We think the CR is not essential, keeping the sentence is good for undetrstanding. We are also Ok to delete it. It should be Editor CR. |
| Huawei/HiSi | Same view as vivo, that we can leave it to Editor |
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# Issue#2: HARQ-ACK multiplexing on PUSCH with different priority

* 1. Companies’ inputs

Vivo in [**R1-2302464**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_112b-e/Docs/R1-2302464.zip) and CATT in [**R1-2302654**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_112b-e/Docs/R1-2302654.zip) discussed HARQ-ACK multiplexing on PUSCH with different priority.

The reasoning provided by vivo is as follows.

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| --- | --- |
| ***Reason for change:*** | To capature the following agreement, in the currenet specificaiton, it specifies that when a UE resolves the overlapping for PUCCH and PUSCH transmissions of different priority indexes, the UE multiplexes HARQ-ACK information in a PUSCH transmission, as is subsequently described in this clause for multiplexing HARQ-ACK information from a PUCCH transmission in a PUSCH transmission of a same priority index, if a PUCCH transmission with HARQ-ACK information of a first priority index overlaps with one or more PUSCH transmissions of a second priority index that is different than the first priority index, where ‘as is subsequently described in this clause for multiplexing HARQ-ACK information from a PUCCH transmission in a PUSCH transmission of a same priority index’ covers more cases than selectig PUSCH for HARQ-ACK mulitplexing, such as codebook generation on PUSCH, etc., which is not aligned with RAN1 agreements.**Agreement**For resolving collision of PUCCHs and PUSCHs of different priorities in step 2.2, Rel-15/16 rule is reused for PUSCH selection for HARQ ACK multiplexing-            FFS: Whether/how dropping is performed before UCI multiplexing-            Note: The priorities of PUCCH and PUSCH candidates for multiplexing in step 2.2 are different |
|  |  |
| ***Summary of change:*** | The UE multiplexes HARQ-ACK information in a PUSCH transmission, as is subsequently described in this clause for determining the PUSCH for multiplexing HARQ-ACK information from a PUCCH transmission in a PUSCH transmission of a same priority index, if a PUCCH transmission with HARQ-ACK information of a first priority index overlaps with one or more PUSCH transmissions of a second priority index that is different than the first priority index |
|  |  |
| ***Consequences if not approved:*** | UE behaviour is not clear in the concered case. |

The reasoning provided by CATT is as follows.

|  |  |
| --- | --- |
| ***Reason for change:*** | For HARQ-ACK multiplexing on a PUSCH with different priority, the DAI field should not be applied. |
|  |  |
| ***Summary of change:*** | Clarify that for HARQ-ACK multiplexing on a PUSCH with different priority, UE would not apply the DAI indicated in the DCI corresponding to the PUSCH. |
|  |  |
| ***Consequences if not approved:*** | For HARQ-ACK multiplexing on PUSCH with different priority, UE would apply the DAI indicated in the DCI, which is incorrect. |

The text proposals provided by vivo and CATT are as follows to clause 9 of 38.213:

|  |
| --- |
| 9 UE procedure for reporting control information< Unchanged parts are omitted >- third, the UE resolves the overlapping for PUCCH and PUSCH transmissions of different priority indexes- the UE drops PUSCH transmissions of smaller priority index that overlap with a PUCCH transmission with positive SR of larger priority index prior to multiplexing UCI in a PUSCH transmission of smaller priority index, if any- the UE drops PUSCH transmissions of smaller priority index that overlap with a PUCCH transmission with repetitions of larger priority index prior to multiplexing UCI in a PUSCH transmission of smaller priority index, if any- the UE multiplexes HARQ-ACK information in a PUSCH transmission, as is subsequently described in this clause for determining the PUSCH for multiplexing HARQ-ACK information from a PUCCH transmission in a PUSCH transmission of a same priority index, if a PUCCH transmission with HARQ-ACK information of a first priority index overlaps with one or more PUSCH transmissions of a second priority index that is different than the first priority index< Unchanged parts are omitted > |
| 9 UE procedure for reporting control information< Unchanged parts are omitted >- third, the UE resolves the overlapping for PUCCH and PUSCH transmissions of different priority indexes- the UE drops PUSCH transmissions of smaller priority index that overlap with a PUCCH transmission with positive SR of larger priority index prior to multiplexing UCI in a PUSCH transmission of smaller priority index, if any- the UE drops PUSCH transmissions of smaller priority index that overlap with a PUCCH transmission with repetitions of larger priority index prior to multiplexing UCI in a PUSCH transmission of smaller priority index, if any- the UE multiplexes HARQ-ACK information in a PUSCH transmission, as is subsequently described in this clause for multiplexing HARQ-ACK information from a PUCCH transmission in a PUSCH transmission of a same priority index except that a DAI field included in a DCI format scheduling the PUSCH transmission is not applied for the HARQ-ACK information, if a PUCCH transmission with HARQ-ACK information of a first priority index overlaps with one or more PUSCH transmissions of a second priority index that is different than the first priority index< Unchanged parts are omitted > |

* 1. Initial moderator assessment & suggested handling

The issue seems valid and should be discussed according to moderator’s understanding. A separate CR is preferred if agreed.

* 1. Issue to be handled during RAN1#112bis-e?

**Question: Do you support discussing the Issue (overall) during RAN1#112bis-e?**

|  |  |
| --- | --- |
| Yes - support:  | Vivo,New H3C |
| No - not support:  |  |

**Question: If to be handled during RAN1#112bis-e, do you think this could be referred to the editor CR or is a separate CR needed?**

|  |  |
| --- | --- |
| Refer to Editor CR  |  |
| Separate CR | vivo,New H3C Huawei/HiSi |

**Comments on the moderator comments / suggested handling or any other comments on the draft CR:**

|  |  |
| --- | --- |
| *Company* | *Comments*  |
| Huawei/HiSi | We are not against to discuss it, but our view is that the original version is clear already.For the procedure of multiplexing HARQ on PUCCH/PUSCH, we think there are two steps:* Step 1: HARQ-ACK CB generation (Clause 9.1). This has nothing to do with intra-UE MUX behaviors, so the UL DAI is only interpreted as the intra-priority.
* Step 2: UCI multiplexing for multiple UCI types/priorities (Clause 9.2.5). The UE behavior of this section happens after the HARQ CB is generated, and is impacted by inter-priority MUX procedure.

Our understanding is that **the highlighted part is not applicable to HARQ-ACK CB generation clauses (9.1.2.2 and 9.1.3.2) but applicable to the highlighted part in Clause 9.5.**

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| -    third, the UE resolves the overlapping for PUCCH and PUSCH transmissions of different priority indexes-    the UE drops PUSCH transmissions of smaller priority index that overlap with a PUCCH transmission with positive SR of larger priority index prior to multiplexing UCI in a PUSCH transmission of smaller priority index, if any-    the UE drops PUSCH transmissions of smaller priority index that overlap with a PUCCH transmission with repetitions of larger priority index prior to multiplexing UCI in a PUSCH transmission of smaller priority index, if any-    the UE multiplexes HARQ-ACK information in a PUSCH transmission, as is subsequently described in this clause for multiplexing HARQ-ACK information from a PUCCH transmission in a PUSCH transmission of a same priority index, if a PUCCH transmission with HARQ-ACK information of a first priority index overlaps with one or more PUSCH transmissions of a second priority index that is different than the first priority index |
| **9.2.5  UE procedure for reporting multiple UCI types**……For each PUCCH resource in the set that satisfies the aforementioned timing conditions, when applicable,-     the UE transmits a PUCCH using the PUCCH resource if the PUCCH resource does not overlap in time with a PUSCH transmission after multiplexing UCI following the procedures described in clauses 9.2.5.1 and 9.2.5.2-     the UE multiplexes HARQ-ACK information and/or CSI reports in a PUSCH if the PUCCH resource overlaps in time with a PUSCH transmission, as described in clause 9.3, and does not transmit SR. In case the PUCCH resource overlaps in time with multiple PUSCH transmissions, the PUSCH for multiplexing HARQ-ACK information and/or CSI is selected as described in clause 9. If the PUSCH transmission by the UE is not in response to a DCI format detection and the UE multiplexes only CSI reports, the timing conditions are not applicable-     the UE does not expect the resource to overlap with a second resource of a PUCCH transmission over multiple slots if the resource is obtained from a group of resources that do not overlap with the second resource.  |

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# Issue#3: UCI multiplexing with different priorities

* 1. Companies’ inputs

CATT in [**R1-2302657**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_112b-e/Docs/R1-2302657.zip) provided a draft CR to clause 9.2.5 of 38.213 based on the following reasoning:

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| ***Reason for change:*** | In last RAN1 meeting, the following modifications in red were approved for UCI multiplexing. UE multiplexes UCI of different priority indexes is missing as in yellow highlighted part.

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| --- |
| 9.2.5 UE procedure for reporting multiple UCI types*<Unchanged parts are omitted>*If a UE would transmit multiple overlapping PUCCHs in a slot or overlapping PUCCH(s) and PUSCH(s) in a slot and, when applicable as described in clauses 9.2.5.1, ~~and~~ 9.2.5.2 and 9.2.5.3, the UE is configured to multiplex different UCI types or UCI of different PHY priorities in one PUCCH, and at least one of the multiple overlapping PUCCHs or PUSCHs is in response to a DCI format detection by the UE, the UE multiplexes all corresponding UCI types if the following conditions are met. If one of the PUCCH transmissions or PUSCH transmissions is in response to a DCI format detection by the UE, the UE expects that the first symbol of the earliest PUCCH or PUSCH, among a group overlapping PUCCHs and PUSCHs in the slot, satisfies the following timeline conditions |

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| ***Summary of change:*** | Add the description that UE multiplexes UCI of different priority indexes if the conditions are met. |
|  |  |
| ***Consequences if not approved:*** | The UE behavior of UCI multiplexing is incomplete. |

with the following draft CR to clause 9.2.5 of 38.213:

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| --- |
| 9.2.5 UE procedure for reporting multiple UCI types**<Unchanged parts are omitted>**If a UE would transmit multiple overlapping PUCCHs in a slot or overlapping PUCCH(s) and PUSCH(s) in a slot and, when applicable as described in clauses 9.2.5.1, 9.2.5.2 and 9.2.5.3, the UE is configured to multiplex different UCI types or UCI of different priority indexes in one PUCCH, and at least one of the multiple overlapping PUCCHs or PUSCHs is in response to a DCI format detection by the UE, the UE multiplexes all corresponding UCI types or UCI of different priority indexes if the following conditions are met. If one of the PUCCH transmissions or PUSCH transmissions is in response to a DCI format detection by the UE, the UE expects that the first symbol of the earliest PUCCH or PUSCH, among a group overlapping PUCCHs and PUSCHs in the slot, satisfies the following timeline conditions**<Unchanged parts are omitted>** |

* 1. Initial moderator assessment & suggested handling

The issue seems valid and should be discussed according to moderator’s understanding. If agreed, moderator thinks that is can be referred to the 38.213 editor CR.

* 1. Issue to be handled during RAN1#112bis-e?

**Question: Do you support discussing the Issue (overall) during RAN1#112bis-e?**

|  |  |
| --- | --- |
| Yes - support:  | vivo,New H3C Huawei/HiSi |
| No - not support:  |  |

**Question: If to be handled during RAN1#112bis-e, do you think this could be referred to the editor CR or is a separate CR needed?**

|  |  |
| --- | --- |
| Refer to Editor CR  | vivo Huawei/HiSi |
| Separate CR | vivo,New H3C |

**Comments on the moderator comments / suggested handling or any other comments on the draft:**

|  |  |
| --- | --- |
| *Company* | *Comments*  |
| vivo | Either Editor CR or Separate CR is fine to us. |
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# Issue#4: PUCCH power control for mutlplexing HARQ-ACK of different priorities

* 1. Companies’ inputs

Samsung discussed in [**R1-2303108**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_112b-e/Docs/R1-2303108.zip) the issue that the transmitting power of the resulting PUCCH becomes minus infinity in case there is a LP PUCCH with HARQ-ACK of 2 or more bits overlapping with a HP PUCCH with HARQ-ACK only for SPS PDSCH receptions if all the HP SPS PDSCHs are canceled by dynamic signalling.

Three options below are provided and a draft CR based on Option 3 is provided.

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| Option 1: UE does not transmit the LP HARQ-ACK.Option 2: UE transmits the original LP PUCCH with LP HARQ-ACK and considers the HP PUCCH with SPS HARQ-ACK does not exist.Option 3: Define a minimum value for to avoid such issue. |

A draft CR in [**R1-2303109**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_112b-e/Docs/R1-2303109.zip) based on the following reasoning:

|  |  |
| --- | --- |
| ***Reason for change:*** | When multiplexing HARQ-ACK of different prorities in a PUCCH format 2/3/4, if the payload of HARQ-ACK of higher priority is no larger than 11, is used to determine . If the HARQ-ACK of higher priority only includes HARQ-ACK of SPS PDSCHs and all the SPS PDSCH are canceled by dyanmic signalling, and . The UE behaviour is not clear in this case. |
|  |  |
| ***Summary of change:*** | Define a minimum value 1 of when multiplexing HARQ-ACK of different prorities in a PUCCH format 2/3/4, |
|  |  |
| ***Consequences if not approved:*** | Unclear UE behaviour |

provided the following draft CR to 38.213, Sec. 9.2.5.3

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| --- |
| 9.2.5.3 UE procedure for reporting UCI of different priorities\*\*\* Unchanged text is omitted \*\*\*If a UE transmits a PUCCH that includes HARQ-ACK information bits of priority 0 and 1 using a PUCCH resource that includes PUCCH format 2, 3 or 4, the UE determines a power for the PUCCH transmission as described in clause 7.2.1 assuming that the PUCCH includes only UCI bits of priority 1, where . If bits, max replaces in the calculation in clause 7.2.1; otherwise, replaces in the calculation in clause 7.2.1.\*\*\* Unchanged text is omitted \*\*\* |

* 1. Initial moderator assessment & suggested handling

This issue seems to be valid to moderator. But it is moderator’s understanding that the same issue may happen for a PUCCH with HARQ-ACK for multiple SPS configurations and all the SPS configurations are cancelled. For both cases, UE cannot calculate a proper transmission power for PUCCH so that the UE behaviour is undefined. Without specification changes, gNB should avoid such cases. Companies are invited to share your views.

* 1. Issue to be handled during RAN1#112bis-e?

**Question: Do you support discussing the Issue (overall) during RAN1#112bis-e?**

|  |  |
| --- | --- |
| Yes - support:  |  |
| No - not support:  | vivo Huawei/HiSi |

**Question: If to be handled during RAN1#112bis-e, do you think this could be referred to the editor CR or is a separate CR needed?**

|  |  |
| --- | --- |
| Refer to Editor CR  |  |
| Separate CR |  |

**Comments on the moderator comments / suggested handling or any other comments on the draft TP / CR:**

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| --- | --- |
| *Company* | *Comments*  |
| vivo | It can be a corner case or avoided by gNB. For Rel-16, if more than 2 HARQ-ACK bits for SPS PDSCHs, and all the SPS PDSCHs are canceled by dynamic signalling, the issue is similar. |
| Huawei/HiSi | In this case, the UE will not generate the HP HARQ bits, then there is no overlapping with HP (i.e., the LP PUCCH is transmitted standalone)?

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| --- |
| 9.1 HARQ-ACK codebook determinationIf a UE is provided *pdsch-HARQ-ACK-CodebookList*, the UE can be indicated by *pdsch-HARQ-ACK-CodebookList* to generate one or two HARQ-ACK codebooks. If the UE is indicated to generate one HARQ-ACK codebook, the HARQ-ACK codebook is associated with a PUCCH of priority index 0. If a UE is provided *pdsch-HARQ-ACK-CodebookList*, the UE multiplexes in a same HARQ-ACK codebook only HARQ-ACK information associated with a same priority index. If the UE is indicated to generate two HARQ-ACK codebooks- a first HARQ-ACK codebook is associated with a PUCCH of priority index 0 and a second HARQ-ACK codebook is associated with a PUCCH of priority index 1- the UE is provided first and second for each of {*PUCCH-Config*, *UCI-OnPUSCH*, *PDSCH*-*codeBlockGroupTransmission*} by {*PUCCH-ConfigurationList*, *UCI-OnPUSCH-ListDCI-0-1*, *PDSCH-CodeBlockGroupTransmissionList*} or {*PUCCH-ConfigurationList*, *UCI-OnPUSCH-ListDCI-0-2*, *PDSCH-CodeBlockGroupTransmissionList*}, respectively, for use with the first and second HARQ-ACK codebooks, respectivelyIf a UE receives a PDSCH without receiving a corresponding PDCCH, or if the UE receives a PDCCH indicating a SPS PDSCH release, the UE generates one corresponding HARQ-ACK information bit. If the UE generates two HARQ-ACK codebooks, the UE is indicated by *harq-CodebookID*, per SPS PDSCH configuration, a HARQ-ACK codebook index for multiplexing the corresponding HARQ-ACK information bit.  |
| 11.1.1 UE procedure for determining slot format…For a set of symbols of a slot that are indicated as flexible by *tdd-UL-DL-ConfigurationCommon*, and *tdd-UL-DL-ConfigurationDedicated* if provided, or when *tdd-UL-DL-ConfigurationCommon*, and *tdd-UL-DL-ConfigurationDedicated* are not provided to the UE, and if the UE does not detect a DCI format 2\_0 providing a slot format for the slot- the UE receives PDSCH or CSI-RS in the set of symbols of the slot if the UE receives a corresponding indication by a DCI format- the UE transmits PUSCH, PUCCH, PRACH, or SRS in the set of symbols of the slot if the UE receives a corresponding indication by a DCI format, a RAR UL grant, fallbackRAR UL grant, or successRAR- the UE receives PDCCH as described in clause 10.1- if the UE is configured by higher layers to receive PDSCH in the set of symbols of the slot, the UE does not receive the PDSCH in the set of symbols of the slot |

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# Outcome

TBA