**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:  | Nokia/NSB, Samsung |
| 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, ZTE, Nokia/NSB, LGE, Samsung, CATT |
| Separate CR | Nokia/NSB (combine with issue #2 in a CR to Sec. 9) |

**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 |
| Nokia/NSB | It can be either left to the editor CR, or if we anyhow have a change in the same part of Sec. 9 of 38.213, this could be combined with the Issue #2 into a single CR. Then no need for the editor to handle this.  |
| LGE | Similar view with vivo/Huawei. |
| Intel | In general, it would be good to be consistent throughput the specs and either not use such comment/note style, or use it in all similar places. For consistency, the note can be removed. But this is not essential and may eventually be kept as is. |
| Samsung | Fine with removing the note although it was added based on an explicit request by some company. |
| CATT | We are fine with either way, keep it or remove it. |

* 1. Round 1

It seems that companies are fine with the text proposal. Majority companies prefer to refer to editor CR and Nokia thinks that it could be combined with Issue #2 into a single CR if we anyhow have a change in the same part of Sec. 9 of 38.213. In addition, based on the feedback on Issue#3, it seems that companies are fine with the proposed change as well.

Given the current situation, moderator would like propose to have a single CR for Issue#1, Issue#3 and Issue#2 (if agreed). Please indicate if you do not agree with the proposed way forward. In addition, please comment if you do not agree with the text proposal of Issue#1.

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| --- | --- |
| *Company* | *Comments*  |
| QC | Sorry for late response – We did not notice the first round only has 24 hours discussion time.The note improves the clarity/readability of the spec. There is no need to remove it. Similar notes ("% start from the beginning after reordering unmerged resources at next step ", "% function that re-orders resources in current set Q", and "% the next two while loops are to re-order the unmerged resources ") were in Rel-15 spec Section 9.2.5 Pseudo codes. We don’t agree with the TP.  |
| New H3C | Slightly prefer keeping this description. |
| Xiaomi | Apologize for the late response. We are fine to leave it to Editor. |
| ZTE | To be decided by editor. |
| LGE | Same view with ZTE that it can be up to editor. |
| Apple | Fine to leave it undeleted for clarity. |
| DOCOMO | Same view with ZTE that it can be up to editor. |
| vivo | Same as other companies that it can be up to editor. |
| Huawei/HiSi | We can leave it to Editor |
| Nokia/NSB | We can leave this to the Editor (if this is controversial for QC) |

# 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.

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| --- | --- |
| ***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 $N\_{PUCCH}^{repeat}>1$ 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 $N\_{PUCCH}^{repeat}>1$ 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, ZTE, Nokia/NSB, LGE, CATT |
| No - not support:  | [Samsung] |

**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, Nokia/NSB, LGE, CATT |

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

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| --- | --- |
| *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 $N\_{PUCCH}^{repeat}>1$ 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 $Q$ 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.  |

 |
| Nokia/NSB | Would be good to at least discuss (to make sure there is no ambiguity) – if we need a CR or not in the end (looking at the comments by HW) could be an outcome of the discussions.  |
| Samsung | We think the spec is clear with the interpretation of ‘this clause’ as clause 9 excluding the sub-clause. If all the other companies see the need to discuss the issue, we are fine to discuss the issue.The intention of the ‘this clause’ refers to clause 9 only, CATT’s CR seems to contradict with the intention and thus is not prefered. |

* 1. Round 1

As proposed for Issue#1 in section 1.4, moderator would like propose to have a single CR for Issue#1, Issue#3 and Issue#2 (if agreed).

**Applicability of DAI for HARQ-ACK multiplexing in PUSCH with different priority**

For HARQ-ACK multiplexing in PUSCH with different priority, moderator would like to check whether the following is common understanding.

For HARQ-ACK multiplexing in PUSCH with different priority, DAI field included in a DCI format scheduling the PUSCH transmission is not applied for the HARQ-ACK information, i.e.

* If HP AN and LP AN are multiplexed on HP PUSCH or if LP AN is multiplexed on HP PUSCH, the payload (size) of the LP AN is determined by DAI in DL DCI and the payload (size) of the HP AN if any is detmerined by DAI in UL DCI.
* If HP AN and LP AN are multiplexed on LP PUSCH or if HP AN is multiplexed on LP PUSCH, the payload (size) of the HP AN is determined by DAI in DL DCI and the payload (size) of the LP AN if any is detmerined by DAI in UL DCI.

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| --- | --- |
| Agree | Samsung, vivo Huawei/HiSi, ZTE, Nokia/NSB, LGE |
| Not agree |  |

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| --- | --- |
| *Company* | *Comments*  |
| Samsung | ‘determined by DAI in DL DCI’ is not accurate, there can be HARQ-ACK for SPS PDSCHs. |
| vivo | As pointed by Samsung, for DG HARQ-ACK, we share the same understanding.  |
| ZTE | Share the same view with Samsung |
| Nokia/NSB | Agree with Samsung.  |
| LGE | It seems that DG HARQ-ACK is assumed in above FL’s sentences since it is intended for clarification on the DAI. |
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**HARQ-ACK spatial bundling for HARQ-ACK multiplexing in PUSCH with different priority**

For HARQ-ACK multiplexing in PUSCH with same priority, *harq-ACK-SpatialBundlingPUCCH* is replaced by *harq-ACK-SpatialBundlingPUSCH*. For HARQ-ACK multiplexing in PUSCH with different priority, it has not been discussed whether *harq-ACK-SpatialBundlingPUCCH* or *harq-ACK-SpatialBundlingPUSCH* should be applied if provided. Companies are invited to share your views.

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| --- | --- |
| *harq-ACK-SpatialBundlingPUCCH* | Samsung,vivo Huawei/HiSi, ZTE, Nokia/NSB, LGE |
| *harq-ACK-SpatialBundlingPUSCH* |  |

|  |  |
| --- | --- |
| *Company* | *Comments*  |
| Samsung | UE does not re-construct the HARQ-ACK codebook when multiplexing the HARQ-ACK in a PUSCH with a different priority. |
| vivo | We agree with Samsung. |
| LGE | Applying the PUCCH parameter is consistent with the above procedure/behaviour (i.e., applying DAI in DL DCI). |
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Based on the CRs and feedback in section 2.3, companies have different understandings on what the yellow highlighted texts refer to.

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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 $N\_{PUCCH}^{repeat}>1$ 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 formultiplexing 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 |

* Interpretation 1: It refers to Clause 9 and all the sub-clauses, which is the same as other cyan highlighted ‘clause’ in Clause 9.

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| In the remaining of this clause, the multiplexing or prioritization for overlapping channels are for overlapping channels with same priority index or for overlapping channels with a PUCCH carrying SL HARQ-ACK information unless stated otherwise.In the remaining of this clause, if a UE is provided *subslotLengthForPUCCH* for a cell for PUCCH transmission, a slot for an associated PUCCH resource of a PUCCH transmission with HARQ-ACK information on the cell includes a number of symbols indicated by *subslotLengthForPUCCH*, unless stated otherwise. |

* Interpretation 2: It 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 9.2.5.

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| **9.2.5  UE procedure for reporting multiple UCI types**……For each PUCCH resource in the set $Q$ 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. |

* Interpretation 3: It refers to Clause 9 only and all the sub-clauses are not included.

**Question: Which is your interpretation based on current spec?**

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| --- | --- |
|  | *Company* |
| Interpretation 1 |  |
| Interpretation 2 | Huawei/HiSi |
| Interpretation 3 | Samsung,vivo, Nokia/NSB |

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| *Company* | *Comments*  |
| Samsung | The text is to capture the following agreement. PUSCH selection rule is defined in clause 9.

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| **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 |

9.2.5 should not be included because clause 9.3 defines for UCI multiplexing in a PUSCH of different priorities, the highlight text is for a same priority.

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| **9.2.5  UE procedure for reporting multiple UCI types**……For each PUCCH resource in the set $Q$ 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. |

Not including 9.1.2.2 and 9.1.3.2 seems to be the intention of all the companies. |
| vivo | Agree that the text is to capture the agreement for PUSCH selection rule defined in clause 9. |
| Huawei/HiSi | As said in the last round, the cyan parts in Clause 9 and Clause 9.2.5 both mention “multiplexes HARQ-Ack information in a PUSCH”, so Clause 9 quotes Clause 9.2.5 to describe the UE behaviour of multiplexing harq on PUSCH.

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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 $N\_{PUCCH}^{repeat}>1$ 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 $Q$ 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  |

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**Question: Do you agree that interpretation 1 would lead to the understanding that for HARQ-ACK multiplexing on a PUSCH with different priority, the DAI** **indicated in the DCI would be applied, which is not the intended UE behavior?**

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| --- | --- |
| Yes  |  |
| No  |  |

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| --- | --- |
| *Company* | *Comments*  |
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**Question: Given that companies have different interpretations, do you agree with the text proposal from vivo/CATT or if you have any other text proposal?**

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| --- | --- | --- |
| Yes - support:  | Vivo CR in [**R1-2302464**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_112b-e/Docs/R1-2302464.zip)  | Samsung,vivo, Nokia/NSB |
| CATT CR in [**R1-2302654**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_112b-e/Docs/R1-2302654.zip) | QC, LGE |
| Other text proposal | Samsung |
| No - not support:  | [Huawei/HiSi] |

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| --- | --- |
| *Company* | *Comments*  |
| QC | We don’t support VIVO’s CR as we are not sure there is a critical issue with current spec. CATT’s CR clarifies UE behavior for a critical issue on HP+LP A/N mux on PUSCH. So we support it.  |
| Samsung | We don’t support CATT’s CR because CATT’s CR contradicts with Interpretation 3 which should be the correct understanding.We are fine with either vivo’s CR or clarifying the understanding of ‘this cause’ |
| QC2 | Can we not arguing “this clause” apply or not applying to which sections but first align the understanding of how to interpret the UL-DAI to see if all companies have the same the same understanding that is aligned with the intention of CATT CR? Then we can decide whether adopt the CR, or reject the CR but capture an conclusion in Chair’s notes to clarify spec, or do nothing.  |
| LGE | Agree with QC that it needs to be clarified whether the following is common understanding among the companies:- If HP AN and LP AN are multiplexed on HP PUSCH, then the payload (size) of the LP AN is determined by DAI in DL DCI while the payload (size) of the HP AN is detmerined by DAI in UL DCI.- If HP AN and LP AN are multiplexed on LP PUSCH, then the payload (size) of the HP AN is determined by DAI in DL DCI while the payload (size) of the LP AN is detmerined by DAI in UL DCI. |
| vivo | We don’t support CATT’s CR because CATT’s CR contradicts with Interpretation 3 which should be the correct understanding. |
| Huawei/HiSi | Our understanding is that the spec is self-explanatory already. But if other companies have different understandings/interpretations, we are OK to consider a CR or conclusion. |
|  |  |

# 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:

|  |  |  |
| --- | --- | --- |
| ***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.

|  |
| --- |
| 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 $S\_{0}$ of the earliest PUCCH or PUSCH, among a group overlapping PUCCHs and PUSCHs in the slot, satisfies the following timeline conditions |

 |
|  |  |
| ***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:

|  |
| --- |
| 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 $S\_{0}$ 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, ZTE, Nokia/NSB, LGE, Intel, Samsung, CATT |
| 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, ZTE, Nokia/NSB, LGE, Samsung, CATT, QC |
| Separate CR | vivo,New H3C, Nokia/NSB, LGE |

**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. |
| Nokia/NSB | Editor CR or to be combined with other issues in a 38.213 CR. Maybe no need to have separate CRs for each of these issues.  |
| LGE | Either way is OK. |
| Samsung | Agree with FL’s assessment. |
|  |  |

* 1. Round 1

As proposed for Issue#1 in section 1.4, moderator would like propose to have a single CR for Issue#1, Issue#3 and Issue#2 (if agreed). Please indicate if you do not agree with the proposed way forward. In addition, please comment if you do not agree with the text proposal of Issue#3.

|  |  |
| --- | --- |
| *Company* | *Comments*  |
| QC | As we commented in Section 1.4, we don’t agree with the TP for issue #1. It is fine to us to have a single CR for issue 2 and 3.  |
| New H3C | Support this proposal |
| xiaomi | Both CRs are fine to us. |
| ZTE | Support the proposal. |
| LGE | OK with the proposal. |
| Apple | Okay |
| DOCOMO | Support the proposal. |
| vivo | ok |
| Huawei/HiSi | In the last meeting, we agreed that the UCI of diff PHY priorities are added in the same paragraph. The CR for this meeting seems more like an editorial change in a later sentence which was missed in the last meeting. So an editor CR is preferred.

|  |
| --- |
| 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 |

 |
| Nokia/NSB | Support (but seems based on the current status of Issue #1, Issue #1 may be left to editor to decide if to capture or not) |

# 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.

|  |
| --- |
| 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 $n\_{HARQ-ACK}\left(i\right)$ 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, $n\_{HARQ-ACK,1}$ is used to determine $∆\_{TF,b,f,c}\left(i\right)$. If the HARQ-ACK of higher priority only includes HARQ-ACK of SPS PDSCHs and all the SPS PDSCH are canceled by dyanmic signalling, $n\_{HARQ-ACK,1}=0$ and $∆\_{TF,b,f,c}\left(i\right)=10log\_{10}\left(0\right)$. The UE behaviour is not clear in this case. |
|  |  |
| ***Summary of change:*** | Define a minimum value 1 of $n\_{HARQ-ACK,1}$ 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

|  |
| --- |
| 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 $N\_{RE}(i)=min\left(M\_{RB}^{PUCCH}⋅N\_{sc,ctrl}^{RB}⋅N\_{symb-UCI}^{PUCCH},\left⌈{\left(O\_{ACK,1}+O\_{CRC,1}\right)}/{\left(Q\_{m}⋅r\_{1}\right)}\right⌉\right)$. If $O\_{ACK,1}\leq 11 $bits, max$⁡n\_{HARQ-ACK,1}+O\_{SR,1}$ replaces $n\_{HARQ-ACK}\left(i\right)+O\_{SR}\left(i\right)+O\_{CSI}\left(i\right)$ in the $∆\_{TF,b,f,c}\left(i\right)$ calculation in clause 7.2.1; otherwise, $O\_{ACK,1}+O\_{CRC,1}$ replaces $O\_{ACK}\left(i\right)+O\_{SR}\left(i\right)+O\_{CSI}\left(i\right)+O\_{CRC}\left(i\right)$ in the$ BPRE(i)$ 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:  | Samsung |
| No - not support:  | vivo Huawei/HiSi, ZTE, Nokia/NSB, LGE, Intel, CATT, QC |

**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 | Samsung |

**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 |

 |
| ZTE | Share the view of Huawei. |
| Nokia/NSB | Agree with the HW assessment above.  |
| Samsung | Agree with FL that the issue exists for the case that all SPS PDSCHs are canceled. The issue is more severe in Rel-17 because the LP HARQ-ACK is uncessarily dropped in this case.The motivation of Rel-17 intra-UE multiplexing of different priorities is to avoid dropping LP HARQ-ACK and PUSCHs. This issue should be addressed to avoid uncessary LP HARQ-ACK dropping.@vivo, we do not agree that DCI cancels a SPS PDSCH is a corner case for URLLC. The feature of multiple SPS configurations is introduced in Rel-16 to reduce the latency for URLLC traffic not only for perodic traffic but also for aperidic traffic. For aperiodic traffic gNB can cancel the SPS if the traffic is not arrived by dynamis SFI/DCI. In Rel-17, PUCCH with LP HARQ-ACK can overlap with PUCCH with HP HARQ-ACK for SPS according to the agreement below. Please not the LP HARQ-ACK can be scheduled before gNB gets to know whether there is HP traffic arrives or not.

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| --- | --- |
| **Agreement**The following TP to remove the restriction of disallowing the collision between HP SPS HARQ-ACK with LP PUCCH/PUSCH is endorsed for the editor’s CR on TS38.213.

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| --- |
| **------------------ Text Proposal for 38.213 Section 9 ------------------**A UE does not expect to be scheduled to transmit a PUCCH or a PUSCH with smaller priority index that would overlap in time with a PUCCH of larger priority index with HARQ-ACK information only in response to a PDSCH reception without a corresponding PDCCH unless the UE is provided *UCI-MuxWithDifferentPriority*. A UE does not expect to be scheduled to transmit a PUCCH of smaller priority index that would overlap in time with a PUSCH of larger priority index with SP-CSI report(s) without a corresponding PDCCH. |

 |

@Huawei, we do not agree with your understanding. A UE generates the HARQ-ACK for SPS PDSCH if it is canceled by dynamic SFI/DCI based on the agreement below. The spec is also aligned with the agreement, the HARQ-ACK codebook for SPS PDSCHs is based on RRC signalling, the DCI does not impact the HARQ-ACK codebook generation.

|  |
| --- |
| Agreements: (updated)**HARQ-ACK feedback for a SPS PDSCH is included in the HARQ-ACK codebook when the SPS PDSCH is cancelled by DCI/dynamic SFI in which case NACK is generated for the SPS PDSCH.*** **For type-1 codebook, the main bullet is not applied if only a single HARQ-ACK bit, for an SPS PDSCH, is mapped on a PUCCH; otherwise, the main bullet is applied.**
* **For type-2 codebook, the main bullet is applied.**
 |

|  |
| --- |
| Set $N\_{cells}^{DL}$ to the number of serving cells configured to the UESet $N\_{c}^{SPS}$ to the number of SPS PDSCH configurations configured to the UE for serving cell $c$Set $N\_{c}^{DL}$ to the number of DL slots for SPS PDSCH receptions on serving cell $c$ with HARQ-ACK information multiplexed on the PUCCHSet $j=0$ – HARQ-ACK information bit indexSet $c=0$ – serving cell index: lower indexes correspond to lower RRC indexes of corresponding cellwhile $c<N\_{cells}^{DL}$ Set $s=0$ – SPS PDSCH configuration index: lower indexes correspond to lower RRC indexes of corresponding SPS configurations while $s<N\_{c}^{SPS}$Set $n\_{D}=0$ – slot index while $n\_{D}<N\_{c}^{DL}$if {a UE is configured to receive SPS PDSCHs from slot $n\_{D}-N\_{PDSCH}^{repeat}+1$ to slot $n\_{D}$ for SPS PDSCH configuration $s$ on serving cell $c$, excluding SPS PDSCHs that are not required to be received in any slot among overlapping SPS PDSCHs, if any according to [6, TS 38.214], or based on a UE capability for a number of PDSCH receptions in a slot according to [6, TS 38.214], or due to overlapping with a set of symbols indicated as uplink by *tdd-UL-DL-ConfigurationCommon* or by *tdd-UL-DL-ConfigurationDedicated* where $N\_{PDSCH}^{repeat}$ is provided by *pdsch-AggregationFactor-r16* in *sps-Config* or, if *pdsch-AggregationFactor-r16* is not included in *sps-Config*, by *pdsch-AggregationFactor* in *pdsch-**config*, andHARQ-ACK information for the SPS PDSCH is associated with the PUCCH}$\tilde{o}\_{j}^{ACK}$ = HARQ-ACK information bit for this SPS PDSCH reception $j=j+1$;end if$n\_{D}=n\_{D}+1$;end while$s=s+1$;end while$c=c+1$;end while |

 |
| LGE | Similar view with above HW’s comment.@Samsung, just question to the agreement below for clarification.What is the reason not to apply the main bullet if there is only a single HARQ-ACK bit for an SPS PDSCH in case of type-1 CB?

|  |
| --- |
| Agreements: (updated)**HARQ-ACK feedback for a SPS PDSCH is included in the HARQ-ACK codebook when the SPS PDSCH is cancelled by DCI/dynamic SFI in which case NACK is generated for the SPS PDSCH.*** **For type-1 codebook, the main bullet is not applied if only a single HARQ-ACK bit, for an SPS PDSCH, is mapped on a PUCCH; otherwise, the main bullet is applied.**
* **For type-2 codebook, the main bullet is applied.**
 |

 |
| Samsung2 | @LGThe first sub-bullet is to align the UE behaviour with legacy as in the conclusion below.

|  |
| --- |
| **Conclusion:*** **For type-1 codebook, Rel-15 behavior is not to include a HARQ-ACK bit for the SPS PDSCH if the SPS PDSCH is cancelled by dynamic SFI/DCI if only one HARQ-ACK bit for the SPS PDSCH is to be transmitted on a PUCCH.**
* **For type-2 codebook, Rel-15 behavior is to include a HARQ-ACK bit for SPS PDSCH if the SPS PDSCH is cancelled by dynamic SFI/DCI.**
 |

 |
| CATT | We think it is an optimization and can be avoided by gNB scheduling. |
| QC | Thanks for the discussion. A question to Samsung: if this is type 1 codebook and the 1 bit HP HARQ-ACK is not transmitted due to dynamic SFI cancel SPS PDSCH, then there is no HP+LP HARQ-ACK mux. There seems no problem. If this is type 2 codebook and the 1 bit HP HARQ-ACK is transmitted, then there is 1 bit HP HARQ-ACK and the current spec works, right? In either case, there seems no problem. Of course, please elaborate, if we missed something above.  |
| Samsung3 | @QC, for Type-2 HARQ-ACK codebook, the $n\_{HARQ-ACK,1}$= 0 and the transmitting power is minus infinity. Same issue exists for Type-1 HARQ-ACK codebook in case of multiple SPS PDSCHs. |
| QC2 | @Samsung, thank for the clarification. But how often this issue would happen where gNB configured a HP SPS PDSCH then use dynmic SFI to cancel some PDSCH? Can we leave it to gNB to handle by scheduling to avoid the issue, which seems Samsung’s position for many gNB misconfiguration issues? |
| Apple | Thanks for Samsung to raise the issue. If no solution is specified, a conclusion can be kept in Chairman’s notes. |
| Samsung4 | We are fine with a conclusion to clarify that gNB would avoid such case if it is the majority’s view. |

# Outcome

TBA