**3GPP TSG-RAN WG1 Meeting #115 R1-23xxxxx**

**Chicago, USA, November 13 – 17, 2023**

**Agenda Item: 7.1**

**Source: Moderator (Huawei)**

**Title: Summary 2 of discussion on the HARQ-ACK Multiplexing in Multi-PUSCH scheduling**

**Document for: Discussion and Decision**

# Introduction

In RAN1#114bis meeting, HARQ-ACK multiplexing in multiple-PUSCH scheduling was discussed. For the usage of UL DAI for multi-PUSCH scheduling, the following agreement was captured in the Chair’s Note.

|  |
| --- |
| If the PUSCH transmission over the multiple slots is scheduled by a DCI format that includes a DAI field, or if the multiple PUSCHs over **the** multiple slots are scheduled by a DCI format that includes a DAI field, the value of the DAI field is applicable for multiplexing HARQ-ACK information in the PUSCH transmission in any slot from the multiple slots where the UE multiplexes HARQ-ACK information. |

For different HARQ-ACK CB size for PUSCH repetitions and multi-PUSCH scheduling, the following proposal were discussed but not agreed in RAN1#114bis.

|  |
| --- |
| **Proposal for conclusion**For a PUSCH over N slots or N PUSCHs over multiple slots that are scheduled by a DCI format 0\_1, when HARQ-ACK is multiplexed on more than one PUSCH transmission from the PUSCH over N slots or the N PUSCHs, the size of HARQ-ACK CB is determined per PUSCH transmission.* No spec change is necessary.
 |

# Discussion

During the online discussion, there is one concern on the case of PUSCH repetition type B and the proposed conclusion in was not endorsed.

In R1-2311668, Apple proposed to capture following conclusion

***Proposal 1: It must be concluded in RAN1 that***

* ***For a PUSCH repetition Type-A or Type-B over N slots or N PUSCHs over multiple slots that are scheduled by a DCI format 0\_1, when HARQ-ACK is multiplexed on more than one PUSCH transmission from the PUSCH over N slots or the N PUSCHs, the size of HARQ-ACK CB is determined per PUSCH transmission.***
* ***No spec change is necessary.***

In R1-2312222, Huawei, HiSilicon proposed to capture following conclusion

***Proposal 1: Capture the following conclusion in Chair’s Note***

***For a PUSCH over N slots or N PUSCHs over multiple slots that are scheduled by a DCI format 0\_1, when HARQ-ACK is multiplexed on more than one PUSCH transmission from the PUSCH over N slots or the N PUSCHs, the size of HARQ-ACK CB is determined per PUSCH transmission.***

* ***A PUSCH transmission is an (actual) repetition of a PUSCH over N slots or a PUSCH of N PUSCHs over multiple slots***
* ***No specification change is needed***

According to current specification in clause 9 of TS38.213, the text of “If a UE transmits a PUSCH over multiple slots or multiple PUSCHs over multiple slots that are scheduled by a DCI format 0\_1” include both PUSCH repetition type A and type B. Thus, the size of HARQ CB in different slots of a PUSCH are calculated individually, irrespective of the repetition type. Furthermore, if a PUCCH in a slot overlaps with multiple actual repetition of a PUSCH in a slot for repetition type B, the earliest actual repetition of PUSCH in a slot overlapped with PUCCH would be used to multiplex the UCI. Thus, the following conclusion are proposed to be captured in Chair’s Note.

**FL Proposal: Capture the following conclusion in Chair’s Note**

**For a PUSCH repetition Type-A or Type-B over N slots or N PUSCHs over multiple slots that are scheduled by a DCI format 0\_1, when HARQ-ACK is multiplexed on more than one PUSCH transmission from the PUSCH over N slots or the N PUSCHs, the size of HARQ-ACK CB is determined per PUSCH transmission.**

* **A PUSCH transmission is an (actual) repetition of a PUSCH over N slots or a PUSCH of N PUSCHs over multiple slots**
* **No specification change is needed**

Companies please provide your views on the FL proposal in the following table.

|  |  |  |
| --- | --- | --- |
| Company | Y/N | Comment |
| DCM | Y |  |
| Samsung |  | We think that the current version does not cover N PUSCHs over a slot. Therefore, we propose the following modifications.For a PUSCH repetition Type-A or Type-B over one or more slots or N PUSCHs over one or more slots that are scheduled by a DCI format , when HARQ-ACK is multiplexed on more than one PUSCH transmission from the PUSCH over N slots or the N PUSCHs, the size of HARQ-ACK CB is determined per PUSCH transmission.* A PUSCH transmission is an (actual) repetition of a PUSCH over one or more slots or a PUSCH of N PUSCHs over one or more slots
* No specification change is needed
 |
| Apple | Y | Support FL’s proposed conclusion but also Ok with both Samsung’s version |
| CATT | Y | We are ok with the FL’s proposal. But in our understanding, one intention of the proposal is to discuss the PUSCH repletion over multiple slots. We are wondering why N=1 slot is considered for this proposal? We are not sure the case of one slot should be included in the proposal.  |
| Qualcomm |  | We are supportive of the proposal, but we prefer the text following the spec (similar to Samsung’s view).For a PUSCH ~~repetition Type-A or Type-B~~ over multiple slots or multiple PUSCHs over multiple slots ~~one or more slots or N PUSCHs over one or more slots~~ that are scheduled by a DCI format , when HARQ-ACK is multiplexed on more than one PUSCH transmission from the PUSCH over multiple slots or multiple PUSCHs over multiple slots ~~N slots or the N PUSCHs~~, the size of HARQ-ACK CB is determined per PUSCH transmission.* A PUSCH transmission is an (actual) repetition of a PUSCH over multiple slots or a PUSCH of multiple PUSCHs over multiple slots ~~one or more slots or a PUSCH of N PUSCHs over one or more slots~~
* No specification change is needed
 |
| Ericsson | N | We think that the editorial spec update agreed in RAN1#114bis is sufficient, and that the highlighted text automatically implies that the CB size is determined per PUSCH transmission.If the PUSCH transmission over the multiple slots is scheduled by a DCI format that includes a DAI field, or if the multiple PUSCHs over **the** multiple slots are scheduled by a DCI format that includes a DAI field, the value of the DAI field is applicable for multiplexing HARQ-ACK information in the PUSCH transmission in any slot from the multiple slots where the UE multiplexes HARQ-ACK information.The DAI field in an UL DCI is T-DAI only (no C-DAI field), and due to the mod behavior, a given indicated value of T-DAI implies multiples possible DL assignments, e.g., 2, 6, 10, …. The UE determines the actual number of assignments, and thus the codebook size, based on C-DAI in previous received DCIs in combination with the T-DAI indicated in the UL DCI. So, of course the codebook sizes can be different, and of course are determined per PUSCH transmission. We don’t think a conclusion is needed.Regarding Type A and Type B repetition, the current spec already captures behavior for both. The only difference for Type B is that the HARQ-ACK is multiplexed in the earlier actual repetition in the slot, and this behavior is already contained in current spec. |
| Moderator |  | To Ericsson: I agree with your interpretation and I think it is also the common understanding after the discussion in previous two meetings. There is no spec change. However, I think it would still be helpful to capture such conclusion in Chair’s Note, especially for colleagues not attending the meeting. There is confusion even for us at the beginning. Then considering the comments from companies thinking the conclusion is necessary, may I suggest we go with the text from Qualcomm. By comparing the text from Qualcomm and Samsung, the only difference is whether to include the case of PUSCH repetition type B within a slot. However, on the HARQ-ACK multiplexing, it is talking about the CB size in different slots of a PUSCH with repetition or multiple PUSCHs. So, it may be not necessary to mention “a PUSCH with repetition type B over one slot”. “a PUSCH over multiple slots” can be either repetition type A or type B as long as it spans more than one slot.Let’s see whether the following can be acceptable to all**Proposed conclusion:****For a PUSCH over multiple slots or multiple PUSCHs over multiple slots that are scheduled by a DCI format, when HARQ-ACK is multiplexed on more than one PUSCH transmission from the PUSCH over multiple slots or multiple PUSCHs over multiple slots, the size of HARQ-ACK CB is determined per PUSCH transmission.*** **A PUSCH transmission is an (actual) repetition of a PUSCH over multiple slots or a PUSCH of multiple PUSCHs over multiple slots.**
* **No specification change is needed.**
 |
| Samsung |  | Not agree with the update.Our intention is to apply the same behaviour for the following two cases which are not included in the conclusion. @Moderator, @CATT is the intention to exclude the two cases? If so, what is the intended UE behaviour? If not, please capture the two cases.Case 1: Type-B repetition Case 2: Multiple PUSCHs in a slot scheduled by a DCI format |
| Apple2 |  | We all know what we are talking about here, this conclusion is really needed for people outside this discussion, that we know based on some offline discussions there was some misalignmenet on UE behavior and NW expectation. Having said that, we have a slight preference on Samsung’s version. |
| CATT |  | Until now, we undertand Samsung’s intention, and also support to include the above two cases (N=1 slot) into the conclusion. We are ok with Samsung’s version.  |
| Ericsson |  | Now we understand the scenario that Samsung mentions after seeing the above drawingsRegarding Samsung’s Case 2, the current spec does not capture it, so if that case needs to be supported, a conclusion is not good enough; a spec change is needed:If a UE transmits a PUSCH over multiple slots or multiple PUSCHs over ~~multiple~~ one or more slots that are scheduled by a DCI format 0\_1, and the UE would transmit a PUCCH with HARQ-ACK and/or CSI information over a single slot that overlaps with the PUSCH transmission in one or more slots of the multiple slots, and the PUSCH transmission in the one or more slots fulfills the conditions in clause 9.2.5 for multiplexing the HARQ-ACK and/or CSI information, the UE multiplexes the HARQ-ACK and/or CSI information in the PUSCH transmission in the one or more slots. The UE does not multiplex HARQ-ACK and/or CSI information in the PUSCH transmission in a slot from the multiple slots if the UE would not transmit a single-slot PUCCH with HARQ-ACK and/or CSI information in the slot in case the PUSCH transmission was absent.Regarding Samsung’s Case 1, the current spec captures it:If a UE transmits a PUSCH with repetition Type B and the UE would transmit a PUCCH with HARQ-ACK and/or CSI information over a single slot that overlaps with the PUSCH transmission in one or more slots, the UE expects all actual repetitions of the PUSCH transmission [6, TS 38.214] that would overlap with the PUCCH transmission to fulfill the conditions in clause 9.2.5 for multiplexing the HARQ-ACK and/or CSI information, and the UE multiplexes the HARQ-ACK and/or CSI information in the earliest actual PUSCH repetition of the PUSCH transmission that would overlap with the PUCCH transmission and includes more than one symbol. The UE does not expect that all actual repetitions that would overlap with the PUCCH transmission do not include more than one symbol.The following agreed TP from RAN1#114bis does not capture either Case 1 or Case 2, so if both of these need to be supported, then a conclusion is not good enough; a spec change is needed on top of the TP from RAN1#114bis:If the PUSCH transmission over the multiple slots is scheduled by a DCI format that includes a DAI field, or if the multiple PUSCHs over **the** ~~multiple~~ one or more slots are scheduled by a DCI format that includes a DAI field, or if the PUSCH transmission with repetition Type B over one or more slots is scheduled by a DCI format that includes a DAI field, the value of the DAI field is applicable for multiplexing HARQ-ACK information in the PUSCH transmission in any slot from the multiple slots where the UE multiplexes HARQ-ACK information.With these spec updates, there should be no need for an additional conclusion. |
| Samsung |  | We are find with the spec change. We would like to propose this version. If the PUSCH transmissions or  repetitions over the ~~multiple~~ one or more slots ~~is~~ are scheduled by a DCI format that includes a DAI field, ~~or if the multiple PUSCHs over~~**~~the~~**~~multiple one or more slots are scheduled by a DCI format that includes a DAI field,~~ ~~or if the PUSCH transmission with repetition Type B over one or more slots is scheduled by a DCI format that includes a DAI field,~~the value of the DAI field is applicable for multiplexing HARQ-ACK information in ~~the~~ any PUSCH transmission or repetition in any slot from the multiple slots where the UE multiplexes HARQ-ACK information. |
| Moderator |  | Thanks for the further feedback. Consideirng there are missing cases in current spec, a TP is needed anyway. I am trying to merge the changes from Samsung and Ericsson as following. In such case, the conclusion may not be need. If it is acceptable to all, I will prepare a draft CR for tomorrow online session. **Proposed TP:** **(the green texts are changes on top of the endorsed CR (red) in last meeting)**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*If a UE transmits a PUSCH over multiple slots or multiple PUSCHs over ~~multiple~~ one or more slots that are scheduled by a DCI format 0\_1, and the UE would transmit a PUCCH with HARQ-ACK and/or CSI information over a single slot that overlaps with the PUSCH transmission in one or more slots of the multiple slots, and the PUSCH transmission in the one or more slots fulfills the conditions in clause 9.2.5 for multiplexing the HARQ-ACK and/or CSI information, the UE multiplexes the HARQ-ACK and/or CSI information in the PUSCH transmission in the one or more slots. The UE does not multiplex HARQ-ACK and/or CSI information in the PUSCH transmission in a slot from the multiple slots if the UE would not transmit a single-slot PUCCH with HARQ-ACK and/or CSI information in the slot in case the PUSCH transmission was absent.If a UE transmits a PUSCH with repetition Type B and the UE would transmit a PUCCH with HARQ-ACK and/or CSI information over a single slot that overlaps with the PUSCH transmission in one or more slots, the UE expects all actual repetitions of the PUSCH transmission [6, TS 38.214] that would overlap with the PUCCH transmission to fulfill the conditions in clause 9.2.5 for multiplexing the HARQ-ACK and/or CSI information, and the UE multiplexes the HARQ-ACK and/or CSI information in the earliest actual PUSCH repetition of the PUSCH transmission that would overlap with the PUCCH transmission and includes more than one symbol. The UE does not expect that all actual repetitions that would overlap with the PUCCH transmission do not include more than one symbol.If the PUSCH transmission over the multiple slots is scheduled by a DCI format that includes a DAI field, or if the PUSCH transmission with repetition Type B over one or more slots is scheduled by a DCI format that includes a DAI field, or if the multiple PUSCHs over **the** one or more than one ~~multiple~~ slots are scheduled by a DCI format that includes a DAI field, the value of the DAI field is applicable for multiplexing HARQ-ACK information in the PUSCH repetition or transmission in any slot from the one or more than one ~~multiple~~ slots where the UE multiplexes HARQ-ACK information.\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* |
| Ericsson |  | Support the above TP from the Moderator. If this TP is agreed, then we don’t need an additional conclusion. |
| Samsung |  | For the first paragraph, it is a different issue, suggest to ONLY focus on the DAI issue. For the 3rd paragraph, we have a strong prefernce on our original version. We can have a conclusion for clarification and adopt an alignment CR. |
| DCM |  | Support the Moderator’s TP. Not support the Samsung’s version.Why the text agreed at the last meeting is removed to cover what Samsung want to do is unclear and the Samsung’s version leads to ambiguity, i.e., whether multi-PUSCH scheduling is included or not, which was solved in the last meeting. The moderator’s version is more concrete, and thus we strongly suggests the version.  |
| Apple |  | We don’t support additional spec chasnge. The endorsed CR already covers both cases by Samsung. Only aspect that is questionable is about the size of CB, for which we are all aligned and a conclusion is sufficient.  |
| Samsung |  | As required by FL, we suggest the follow TP for the first paragraphIf a UE transmits ~~a~~ PUSCH over ~~multiple~~ one or more slots or ~~multiple~~ one or more PUSCHs over ~~multiple~~ one or more slots that are scheduled by a DCI format ~~0\_1~~, and the UE would transmit a PUCCH with HARQ-ACK and/or CSI information over a single slot that overlaps with the PUSCH transmission in one or more slots of the ~~multiple~~ one or more slots, and the PUSCH transmission in the one or more slots fulfills the conditions in clause 9.2.5 for multiplexing the HARQ-ACK and/or CSI information, the UE multiplexes the HARQ-ACK and/or CSI information in the PUSCH transmission in the one or more slots. The UE does not multiplex HARQ-ACK and/or CSI information in the PUSCH transmission in a slot from the ~~multiple~~ one or more slots if the UE would not transmit a single-slot PUCCH with HARQ-ACK and/or CSI information in the slot in case the PUSCH transmission was absent.…If the PUSCH transmissions or  repetitions over the ~~multiple~~ one or more slots ~~is~~ are scheduled by a DCI format that includes a DAI field, ~~or if the multiple PUSCHs over~~**~~the~~**~~multiple one or more slots are scheduled by a DCI format that includes a DAI field,~~ ~~or if the PUSCH transmission with repetition Type B over one or more slots is scheduled by a DCI format that includes a DAI field,~~the value of the DAI field is applicable for multiplexing HARQ-ACK information in ~~the~~ any PUSCH transmission or repetition in any slot from the ~~multiple~~ one or more  slots where the UE multiplexes HARQ-ACK information. |

# Summary of discussion

Based on the discussion and feedback so far, the group shared the following common understanding that

**When HARQ-ACK is multiplexed on more than one PUSCH transmissions from multiple PUSCH transmissions over one or more slots or more than one PUSCH (actual) repetitions from the PUSCH over one or more than one slots with repetition type A or type B, the size of HARQ-ACK CB is determined:**

* **per PUSCH transmission for**
	+ **multiple PUSCHs over one slot (A1)**
	+ **multiple PUSCHs over more than one slots (A2)**
* **per PUSCH (actual) repetition for**
	+ **A PUSCH transmission with repetition type A over more than one slot. (B1)**
	+ **A PUSCH transmission with repetition type B over one slot (B2)**
	+ **A PUSCH transmission with repetition type B over more than one slot (B3)**

However, on whether the following specification (according to alignment CR R1-2310725 after RAN1#114bis), companies may have different understanding, especially on the wording of “multiple slots” highlighted in green.

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**9 UE procedure for reporting control information**

\*\*\* Unchanged text is omitted \*\*\*

If a UE transmits a PUSCH over multiple slots or multiple PUSCHs over multiple slots that are scheduled by a DCI format 0\_1, and the UE would transmit a PUCCH with HARQ-ACK and/or CSI information over a single slot that overlaps with the PUSCH transmission in one or more slots of the multiple slots, and the PUSCH transmission in the one or more slots fulfills the conditions in clause 9.2.5 for multiplexing the HARQ-ACK and/or CSI information, the UE multiplexes the HARQ-ACK and/or CSI information in the PUSCH transmission in the one or more slots. The UE does not multiplex HARQ-ACK and/or CSI information in the PUSCH transmission in a slot from the multiple slots if the UE would not transmit a single-slot PUCCH with HARQ-ACK and/or CSI information in the slot in case the PUSCH transmission was absent.

If a UE transmits a PUSCH with repetition Type B and the UE would transmit a PUCCH with HARQ-ACK and/or CSI information over a single slot that overlaps with the PUSCH transmission in one or more slots, the UE expects all actual repetitions of the PUSCH transmission [6, TS 38.214] that would overlap with the PUCCH transmission to fulfill the conditions in clause 9.2.5 for multiplexing the HARQ-ACK and/or CSI information, and the UE multiplexes the HARQ-ACK and/or CSI information in the earliest actual PUSCH repetition of the PUSCH transmission that would overlap with the PUCCH transmission and includes more than one symbol. The UE does not expect that all actual repetitions that would overlap with the PUCCH transmission do not include more than one symbol.

If the PUSCH transmission over the multiple slots is scheduled by a DCI format that includes a DAI field, or if the multiple PUSCH transmissions over the multiple slots are scheduled by a DCI format that includes a DAI field, the value of the DAI field is applicable for multiplexing HARQ-ACK information in the PUSCH transmission in any slot from the multiple slots where the UE multiplexes HARQ-ACK information.

When a UE would multiplex HARQ-ACK information in a PUSCH transmission that is configured by a *ConfiguredGrantConfig*, and includes CG-UCI [5, TS 38.212], the UE multiplexes the HARQ-ACK information in the PUSCH transmission if the UE is provided *cg-UCI-Multiplexing*; otherwise, if the HARQ-ACK information and the PUSCH have same priority index, the UE does not transmit the PUSCH and multiplexes the HARQ-ACK information in a PUCCH transmission or in another PUSCH transmission; if the HARQ-ACK information and the PUSCH have different priority indexes, the UE does not transmit the channel with the smaller priority index.

\*\*\* Unchanged text is omitted \*\*\*

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One interpretation#1 is from Samsung that “multiple slots” implies for “one or more than one slots”. Samsung’s TP only replaced one of the “multiple slots” in the 3rd paragraph (reproduced based on the alignment CR as below). However, from moderator’s point of view, the rest of highlighted places should be updated accordingly in order to keep consistence across paragraphs.

------------------------------- start of TP#1 -----------------------------------------------------------------------------------

**9 UE procedure for reporting control information**

\*\*\* Unchanged text is omitted \*\*\*

If a UE transmits a PUSCH over multiple slots or multiple PUSCHs over multiple slots that are scheduled by a DCI format 0\_1, and the UE would transmit a PUCCH with HARQ-ACK and/or CSI information over a single slot that overlaps with the PUSCH transmission in one or more slots of the multiple slots, and the PUSCH transmission in the one or more slots fulfills the conditions in clause 9.2.5 for multiplexing the HARQ-ACK and/or CSI information, the UE multiplexes the HARQ-ACK and/or CSI information in the PUSCH transmission in the one or more slots. The UE does not multiplex HARQ-ACK and/or CSI information in the PUSCH transmission in a slot from the multiple slots if the UE would not transmit a single-slot PUCCH with HARQ-ACK and/or CSI information in the slot in case the PUSCH transmission was absent.

If a UE transmits a PUSCH with repetition Type B and the UE would transmit a PUCCH with HARQ-ACK and/or CSI information over a single slot that overlaps with the PUSCH transmission in one or more slots, the UE expects all actual repetitions of the PUSCH transmission [6, TS 38.214] that would overlap with the PUCCH transmission to fulfill the conditions in clause 9.2.5 for multiplexing the HARQ-ACK and/or CSI information, and the UE multiplexes the HARQ-ACK and/or CSI information in the earliest actual PUSCH repetition of the PUSCH transmission that would overlap with the PUCCH transmission and includes more than one symbol. The UE does not expect that all actual repetitions that would overlap with the PUCCH transmission do not include more than one symbol.

If the PUSCH transmissions or repetitions over the one or more than one slotsare scheduled by a DCI format that includes a DAI field, the value of the DAI field is applicable for multiplexing HARQ-ACK information in any PUSCH transmission or repetition in any slot from the multiple slots where the UE multiplexes HARQ-ACK information.

\*\*\* Unchanged text is omitted \*\*\*

-------------------------------------------end of TP1--------------------------------------------------------------------------

The other interpretation#2 is from Ericsson and also moderator that “multiple slots” implies only for “more than one slots”. In such case, the A2 and B2 (corresponding case 2 and case 1 in Samsung’s response) is missing. The corresponding TP#2 are as following

------------------------------------------------------ start of TP#2 -----------------------------------------------------------

If a UE transmits a PUSCH over multiple slots or multiple PUSCHs over one or multiple slots that are scheduled by a DCI format 0\_1, and the UE would transmit a PUCCH with HARQ-ACK and/or CSI information over a single slot that overlaps with the PUSCH transmission in the one or more slots, and the PUSCH transmission in the one or more slots fulfills the conditions in clause 9.2.5 for multiplexing the HARQ-ACK and/or CSI information, the UE multiplexes the HARQ-ACK and/or CSI information in the PUSCH transmission in the one or more slots. The UE does not multiplex HARQ-ACK and/or CSI information in the PUSCH transmission in a slot from the one or multiple slots if the UE would not transmit a single-slot PUCCH with HARQ-ACK and/or CSI information in the slot in case the PUSCH transmission was absent.

If a UE transmits a PUSCH with repetition Type B and the UE would transmit a PUCCH with HARQ-ACK and/or CSI information over a single slot that overlaps with the PUSCH transmission in one or more slots, the UE expects all actual repetitions of the PUSCH transmission [6, TS 38.214] that would overlap with the PUCCH transmission to fulfill the conditions in clause 9.2.5 for multiplexing the HARQ-ACK and/or CSI information, and the UE multiplexes the HARQ-ACK and/or CSI information in the earliest actual PUSCH repetition of the PUSCH transmission that would overlap with the PUCCH transmission and includes more than one symbol. The UE does not expect that all actual repetitions that would overlap with the PUCCH transmission do not include more than one symbol.

If the PUSCH transmission over the multiple slots is scheduled by a DCI format that includes a DAI field, or if the PUSCH transmission with repetition Type B over the one or multiple slots is scheduled by a DCI format that includes a DAI field, or if the multiple PUSCH transmissions over the one or multiple slots are scheduled by a DCI format that includes a DAI field, the value of the DAI field is applicable for multiplexing HARQ-ACK information in the PUSCH repetition or transmission in any slot from the one or multiple slots where the UE multiplexes HARQ-ACK information.

--------------------------------------------------------end of TP2 -------------------------------------------------------------

# Conclusion

Based on the discussion, moderator proposal following options for online check:

Alt 1: down select between TP1 or TP2

------------------------------- start of TP#1a ----------------------------------------------------------------------------------

**9 UE procedure for reporting control information**

\*\*\* Unchanged text is omitted \*\*\*

If a UE transmits PUSCH over one or more slots or multiple PUSCHs over one or more slots that are scheduled by a DCI format, and the UE would transmit a PUCCH with HARQ-ACK and/or CSI information over a single slot that overlaps with the PUSCH transmission in one or more slots of the one or more slots, and the PUSCH transmission in the one or more slots fulfills the conditions in clause 9.2.5 for multiplexing the HARQ-ACK and/or CSI information, the UE multiplexes the HARQ-ACK and/or CSI information in the PUSCH transmission in the one or more slots. The UE does not multiplex HARQ-ACK and/or CSI information in the PUSCH transmission in a slot from the one or more slots if the UE would not transmit a single-slot PUCCH with HARQ-ACK and/or CSI information in the slot in case the PUSCH transmission was absent.

If a UE transmits a PUSCH with repetition Type B and the UE would transmit a PUCCH with HARQ-ACK and/or CSI information over a single slot that overlaps with the PUSCH transmission in one or more slots, the UE expects all actual repetitions of the PUSCH transmission [6, TS 38.214] that would overlap with the PUCCH transmission to fulfill the conditions in clause 9.2.5 for multiplexing the HARQ-ACK and/or CSI information, and the UE multiplexes the HARQ-ACK and/or CSI information in the earliest actual PUSCH repetition of the PUSCH transmission that would overlap with the PUCCH transmission and includes more than one symbol. The UE does not expect that all actual repetitions that would overlap with the PUCCH transmission do not include more than one symbol.

If the PUSCH transmissions or repetitions over the one or more than one slotsare scheduled by a DCI format that includes a DAI field, the value of the DAI field is applicable for multiplexing HARQ-ACK information in any PUSCH transmission or repetition in any slot from the one or more slots where the UE multiplexes HARQ-ACK information.

\*\*\* Unchanged text is omitted \*\*\*

-------------------------------------------end of TP1a--------------------------------------------------------------------------

------------------------------------------------------ start of TP#2a -----------------------------------------------------------

If a UE transmits a PUSCH over multiple slots or multiple PUSCHs over one or multiple slots that are scheduled by a DCI format 0\_1, and the UE would transmit a PUCCH with HARQ-ACK and/or CSI information over a single slot that overlaps with the PUSCH transmission in the one or more slots, and the PUSCH transmission in the one or more slots fulfills the conditions in clause 9.2.5 for multiplexing the HARQ-ACK and/or CSI information, the UE multiplexes the HARQ-ACK and/or CSI information in the PUSCH transmission in the one or more slots. The UE does not multiplex HARQ-ACK and/or CSI information in the PUSCH transmission in a slot from the one or multiple slots if the UE would not transmit a single-slot PUCCH with HARQ-ACK and/or CSI information in the slot in case the PUSCH transmission was absent.

If a UE transmits a PUSCH with repetition Type B and the UE would transmit a PUCCH with HARQ-ACK and/or CSI information over a single slot that overlaps with the PUSCH transmission in one or more slots, the UE expects all actual repetitions of the PUSCH transmission [6, TS 38.214] that would overlap with the PUCCH transmission to fulfill the conditions in clause 9.2.5 for multiplexing the HARQ-ACK and/or CSI information, and the UE multiplexes the HARQ-ACK and/or CSI information in the earliest actual PUSCH repetition of the PUSCH transmission that would overlap with the PUCCH transmission and includes more than one symbol. The UE does not expect that all actual repetitions that would overlap with the PUCCH transmission do not include more than one symbol.

If the PUSCH transmission over the multiple slots is scheduled by a DCI format that includes a DAI field, or if the PUSCH transmission with repetition Type B over the one or multiple slots is scheduled by a DCI format that includes a DAI field, or if the multiple PUSCH transmissions over the one or multiple slots are scheduled by a DCI format that includes a DAI field, the value of the DAI field is applicable for multiplexing HARQ-ACK information in the PUSCH repetition or transmission in any slot from the one or multiple slots where the UE multiplexes HARQ-ACK information.

--------------------------------------------------------end of TP2a -------------------------------------------------------------

Alt 2: capture the following conclusion in Chairman’s note.

* In the following paragraphs, the multiple slots highlighted can include the case of one slot. Note: the final paragraph includes change of alignment CR in RAN1#114bis.

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**9 UE procedure for reporting control information**

\*\*\* Unchanged text is omitted \*\*\*

If a UE transmits a PUSCH over multiple slots or multiple PUSCHs over multiple slots that are scheduled by a DCI format 0\_1, and the UE would transmit a PUCCH with HARQ-ACK and/or CSI information over a single slot that overlaps with the PUSCH transmission in one or more slots of the multiple slots, and the PUSCH transmission in the one or more slots fulfills the conditions in clause 9.2.5 for multiplexing the HARQ-ACK and/or CSI information, the UE multiplexes the HARQ-ACK and/or CSI information in the PUSCH transmission in the one or more slots. The UE does not multiplex HARQ-ACK and/or CSI information in the PUSCH transmission in a slot from the multiple slots if the UE would not transmit a single-slot PUCCH with HARQ-ACK and/or CSI information in the slot in case the PUSCH transmission was absent.

If a UE transmits a PUSCH with repetition Type B and the UE would transmit a PUCCH with HARQ-ACK and/or CSI information over a single slot that overlaps with the PUSCH transmission in one or more slots, the UE expects all actual repetitions of the PUSCH transmission [6, TS 38.214] that would overlap with the PUCCH transmission to fulfill the conditions in clause 9.2.5 for multiplexing the HARQ-ACK and/or CSI information, and the UE multiplexes the HARQ-ACK and/or CSI information in the earliest actual PUSCH repetition of the PUSCH transmission that would overlap with the PUCCH transmission and includes more than one symbol. The UE does not expect that all actual repetitions that would overlap with the PUCCH transmission do not include more than one symbol.

If the PUSCH transmission over the multiple slots is scheduled by a DCI format that includes a DAI field, or if the multiple PUSCH transmissions over the multiple slots are scheduled by a DCI format that includes a DAI field, the value of the DAI field is applicable for multiplexing HARQ-ACK information in the PUSCH transmission in any slot from the multiple slots where the UE multiplexes HARQ-ACK information.

\*\*\* Unchanged text is omitted \*\*\*

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* The HARQ-ACK codebook size can be same or different for different PUSCH transmissions or repetitions scheduled by a DCI format.

Alt 3: go with TP#3

-----------------------------------------------start of TP#3---------------------------------------------------------------------

**9 UE procedure for reporting control information**

\*\*\* Unchanged text is omitted \*\*\*

If a UE transmits a PUSCH over one or more slots or multiple PUSCHs over one or more slots that are scheduled by a DCI format, and the UE would transmit a PUCCH with HARQ-ACK and/or CSI information over a single slot that overlaps with the PUSCH transmission in the one or more slots, and the PUSCH transmission in the one or more slots fulfills the conditions in clause 9.2.5 for multiplexing the HARQ-ACK and/or CSI information, the UE multiplexes the HARQ-ACK and/or CSI information in the PUSCH transmission in the one or more slots. The UE does not multiplex HARQ-ACK and/or CSI information in the PUSCH transmission in a slot from the one or more slots if the UE would not transmit a single-slot PUCCH with HARQ-ACK and/or CSI information in the slot in case the PUSCH transmission was absent.

If a UE transmits a PUSCH with repetition Type B and the UE would transmit a PUCCH with HARQ-ACK and/or CSI information over a single slot that overlaps with the PUSCH transmission in one or more slots, the UE expects all actual repetitions of the PUSCH transmission [6, TS 38.214] that would overlap with the PUCCH transmission to fulfill the conditions in clause 9.2.5 for multiplexing the HARQ-ACK and/or CSI information, and the UE multiplexes the HARQ-ACK and/or CSI information in the earliest actual PUSCH repetition of the PUSCH transmission that would overlap with the PUCCH transmission and includes more than one symbol. The UE does not expect that all actual repetitions that would overlap with the PUCCH transmission do not include more than one symbol.

If the PUSCH transmission over the one or moreslots is scheduled by a DCI format that includes a DAI field, or if the multiple PUSCH transmissions over the one or more slots are scheduled by a DCI format that includes a DAI field, the value of the DAI field is applicable for multiplexing HARQ-ACK information in any PUSCH repetition or transmission in any slot from the one or more slots where the UE multiplexes HARQ-ACK information.

\*\*\* Unchanged text is omitted \*\*\*

-------------------------------------------------------end of TP#3-------------------------------------------------------------