**3GPP TSG RAN WG1 #106bis-e R1-211xxxx**

**e-Meeting, October 11th – 19th, 2021**

**Agenda item:** 8.8

**Source:** Moderator (Qualcomm)

**Title:** FL summary of discussion on incoming LS [R1-2108703](file:///C%3A%5CUsers%5Cyouns%5COneDrive%5CDocuments%5C3GPP%5CRAN1%20tdocs%5CTSGR1_106b-e%5CDocs%5CR1-2108703.zip) on PUCCH and PUSCH repetitions

**Document for:** Discussion/Decision

# Discussion

In R1-2108703(R4-2114991) “Reply LS on PUCCH and PUSCH transmissions”, RAN 4 asked the following question to RAN1:

* **What are the consequences if phase continuity cannot be maintained in the case of** **UL transmissions from other signals/channels in the repetition gap?**

Companies are welcome to provide answers in the table below.

|  |  |
| --- | --- |
| **Company name** | **Answer to RAN4 question** |
| Ericsson | To motivate our answer we’d first offer some observations:* PUCCH is likely to be transmitted at different power and in fewer PRBs than PUSCH, and is more likely to be frequency hopped that PUSCH
* SRS is used for CSI, and so tends to be transmitted in wider bandwidths and/or frequency hopped
* Many SRS configurations involve switching among antenna ports or beams different from PUSCH

Then we propose to answer RAN4’s question with:**Proposal:*** The consequences of not maintaining phase continuity for the case where UE transmits other signals/channels are not likely to be serious, since the constraints to meet phase continuity preclude the common use of this case for JCE.
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| CATT | In this case:* The UE is not required to maintain power consistency and phase continuity between the interrupted PUSCH/PUCCH.
* RAN1 may treat such interruption as an event, where an actual time domain window (TDW) in which the UE performs DMRS bundling shall be terminated. A new actual TDW may resume in the remaining PUSCH/PUCCH, depending on the UE capability. RAN1 is still discussing the details.
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| Intel | In our view, if phase continuity cannot be maintained in the case of UL transmission from other signals/channels during the repetition gap, joint channel estimation based on the PUSCH or PUCCH repetitions before and after the repetition gap may not be performed. This can be treated as starting point of a new actual time domain window. Especially when phase offset after repetition gap cancels that before repetition gap, this may cause detrimental effect on the channel estimation performance, and hence lead to potential decoding failure.So our understanding is that joint channel estimation may not be performed at the receiver if phase continuity cannot be maintained in the case of UL transmissions from other signals/channels in the repetition gap. |
| MediaTek | The prerequisite for JCE operation in RAN1 discussion is based on keeping the phase continuity and power consistency. If the phase continuity can’t be kept, the JCE can’t be performed in this case as the consequence. Such information may be enough for RAN4 LS reply.Whether/how to define actual TDW is the RAN1 issue so that there is no need to inform RAN4. |
| Samsung | In our perspective, if phase continuity cannot be maintained in the case of UL transmission from other signals/channels in the repetition gap, the joint channel estimation would not be applied. Therefore, if there is an UL transmission from other signals/channels in a window where DM-RS bundling is used, UE stops applying DM-RS bundling. The UE can apply DM-RS bundling in the slots after the UL transmission from other signals/channel (a new DM-RS bundle).  |
| LG | It is our understanding that the decision of start and end of actual time domain window is based on the events that break or cannot guarantee the power consistency or phase continuity of the transmission. And it is common understanding that other uplink transmission is an event if the phase continuity is broken due to the other uplink transmission. Therefore the ongoing actual time domain window should be terminated before the event and a new actual time domain window starts after the event. |
| ZTE | If phase continuity cannot be maintained in the case of UL transmissions from other signals/channels in the repetition gap, the consequence is such case would be regarded as an event that violates the power consistency and phase continuity, and JCE across the gap would not be supported.  |
| Nokia/NSB | Agree with Ericsson and MediaTek. We suggest keeping it short and simple, without going too deep in RAN details (symbols, slots, actual TDW etc.) which RAN4 does not care about for its work. We suggest the following wording:If phase continuity cannot be maintained in the case of UL transmissions of other signals/channels in the repetition gap, then DM-RS symbols transmitted before and after the transmission of such other signals/channels cannot be part of the same bundle. |
| QC (adding our response back as it got dropped after v005) | Here is our response:RAN1 is already working on a procedure to handle such scenarios. The UE is allowed to terminate bundling if such a transmission occurs and UE is expected to resume (subject to UE capability) bundling after the intervening transmission ends, assuming there are more PUSCH/PUCCH repetitions to transmit.On the whole we do not think this is likely to have a big impact on the overall performance. |
| Huawei, HiSilicon | Nokia’s proposed wording is better. No need to spend time on debating any wording to describe actual TDW or configured TDW. |
| Apple | In our view this event terminates DMRS bundling. Now whether or not UE can resume bundling for the remaining repetition occasions, if any, is subject to UE capability and further discussion in RAN1. |
| vivo | From UE perspective phase continuity cannot be maintained, RAN1is discussing actual TDW and restart of TDW. Whether joint channel estimation is done or not is up to gNB. Main thing is that the UE behavior and understanding at gNB should be aligned.  |

# Conclusion

Based on the comments received in previous section, it is obvious that the if other UL transmissions from other signals/channels in the repetition gap break the phase continuity, the DMRS bundling has to stop at the repetition gap. Regarding whether/how UE can resume DMRS bundling after the gap is within in RAN1 scope, as several companies suggested. Therefore, FL propose to take Nokia’s suggested wording to provide the answer to RAN4, and keep the discussion on whether/how to resume bundling with a new actual TWD within in RAN1.

**FL Proposal:** Regarding the following RAN 4 question to RAN 1,

* What are the consequences if phase continuity cannot be maintained in the case of UL transmissions from other signals/channels in the repetition gap?

The following answer is provided in the reply LS from RAN 1 to RAN 4,

* **If phase continuity cannot be maintained in the case of UL transmissions of other signals/channels in the repetition gap, then DM-RS symbols transmitted before and after the transmission of such other signals/channels cannot be part of the same bundle.**

FL hope the above is acceptable to all companies. Please provided in the following table any company has concern about the above proposal.

|  |  |
| --- | --- |
| **Company name** | **Concerns about above FL proposal** |
| vivo | How about adding “from UE perspective” as below?* **If phase continuity cannot be maintained in the case of UL transmissions of other signals/channels in the repetition gap, then DM-RS symbols transmitted before and after the transmission of such other signals/channels cannot be part of the same bundle from UE perspective.**
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| NTT DOCOMO | As it is obvious that DMRS bundling is not possible if the phase continuity is not maintained, we are not sure if this answer is what RAN4 expected. We prefer specifying the UE behavior that UE stops or restarts DMRS bunding subject to DMRS bundling in the LS reply.  |
| Sierra Wireless | Perhaps we could we add this sentence to the end to give a bit more information on how this works and introduce the idea of a phase discontinuity event:* **If phase continuity cannot be maintained in the case of UL transmissions of other signals/channels in the repetition gap, then DM-RS symbols transmitted before and after the phase discontinuity event ~~transmission of such other signals/channels~~ cannot be part of the same bundle. After the phase discontinuity event, it will be up to UE capabilities if the UE will restart DMRS bundling.**
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