**3GPP TSG-RAN WG4 Meeting #100-e R4-2114991**

**Electronic Meeting, Aug, 2021**

**Title:** Reply LS on PUCCH and PUSCH transmissions

**Response to:** LS on joint channel estimation for PUSCH and PUCCH (R1-2106212, R4-2111706)

**Release:** Release 17

**Work Item:** NR\_cov\_enh

**Source:** TSG RAN WG4

**To:** TSG RAN WG1

**Cc:**

**Contact Person:**

**Name:** Ville Vintola

**Tel. Number:**

**E-mail Address:** vvintola@qti.qualcomm.com

**Send any reply LS to: 3GPP Liaisons Coordinator,** **mailto:3GPPLiaison@etsi.org**

**Attachments:**

**1. Overall Description:**

**RAN1 question:** For joint channel estimation, is there a maximum duration during which UE is able to maintain power consistency and phase continuity under certain tolerance level? If any, how long is it?

**RAN4 answer:** Yes, there is a maximum duration but RAN4 has not agreed how many slots it is.

* **RAN1 question:** What factors determine the maximum duration?
	+ **RAN4 answer:** RAN4 has agreed that TA adjustment should be avoided across the PUSCH/PUCCH transmissions (i.e., from start of first transmission until the end of last transmission) for joint channel estimation. RAN4 is still investigating other factors impact in more detail.
* **RAN1 question:** Whether the maximum duration should be the same for different cases for both PUSCH and PUCCH?
	+ **RAN4 answer:** Yes
* **RAN1 question:** Whether the maximum duration is dependent on the modulation order of transmission, e.g., QPSK, 16QAM, 64QAM?
	+ **RAN4 answer:** Considering the scenario of coverage extension, RAN4 recommends to only focus on modulation orders not higher than QPSK, i.e., focus on QPSK (PUCCH and PUSCH), Pi/2 BPSK (PUCCH and PUSCH), BPSK (PUCCH).RAN4 is still discussing whether maximum duration depends on modulation order for the above modulation schemes.
* **RAN1 question:** Whether the maximum duration is dependent on UL waveform (DFT-s-OFDM vs. OFDM)?
	+ **RAN4 answer:** No
* **RAN1 question:** Whether the maximum duration is band specific?
	+ **RAN4 answer:** It may be FR dependent, and RAN4 is still discussing whether it is band dependent as well.
* **RAN1 question:** Besides the factors listed above, whether or not the maximum duration is further dependent on UE capabilities (e.g., multiple possible values for a given set of factor(s)), and if so, whether the UE should report such a duration
	+ **RAN4 answer:** Still under discussion in RAN4.

RAN4 has further agreed for the gap between PUSCH/PUCCH transmissions, that the 13-symbol is the maximum length for the gap for all SCS, and that the 14-symbol or 1ms will not be discussed in RAN4 anymore for un-scheduled gap in Rel-17.

RAN4 has agreed for the case of other signals/channels in the gap between repetitions, it is not considered for UE to transmit other channels in the gap with different settings.

For the case of other UL signals/channels in the gap between repetitions with same settings, as communicated in R4-2105417, RAN4 has further refined the conditions when phase continuity can be met as follows:

* Signals/channels with repetitions and other UL signals/channels in the gap have the same:
	+ PAPR and average power, e.g., PUSCH/PUCCH part of repetitions and SRS has same PAPR and average power.
	+ Allocated number and locations of PRBs transmitted
	+ Antenna port settings

RAN4 has not agreed detailed requirement for phase continuity and plans to revisit the above agreement in the scenario of other UL signals/channels in the gap once the requirement is defined. Therefore, RAN4 would like to ask RAN1 what are the consequences if phase continuity cannot be maintained in that scenario?

**2. Actions:**

**To RAN1 group.**

**ACTION:**  RAN4 would like to ask 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?

**3. Date of Next TSG-RAN WG4 Meetings:**

TSG-RAN4 Meeting#101-e Nov 2021 Electronic Meeting

TSG-RAN4 Meeting#101-Bis-e Jan 2022 Electronic Meeting