**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**](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:** (*Based on GTW agreement*) 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 *(Editors note:*** *agreement from GTW):* 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. Having long maximum duration may result in too large timing error without TA adjustment depending on UE velocity.
* ***For further discussion if this can be agreed as a response to ran1***
  + **RAN4 answer:** Factors determining could include UE ability to defer frequency error corrections, timing corrections, etc. If a certain level of performance relative to ideal DMRS bundling is to be ensured, then maximum duration also depends on the phase jitter observed across slots.
* **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 is 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.

*Agreements from GTW not related to max duration:*

RAN4 has further agreed that 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 that for the case of other signals/channels in the gap between repetitions, it is not feasible for UE to transmit other channels 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.
  + PRB locations and PRB size
  + 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