**3GPP TSG RAN WG1 #104b-e R1-210xxxx**

**e-Meeting, April 12th – 20th, 2021**

**Agenda item:** 8.8

**Source:** Moderator (Qualcomm)

**Title:** FL summary for Reply LS to [R1-2102298](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_104b\Docs\R1-2102298.zip)

**Document for:** Discussion/Decision

# Introduction

This document summarizes companies’ view for reply LS to [R1-2102298](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_104b\Docs\R1-2102298.zip).

# Response to RAN4 Question

**Question from RAN4 to RAN1: For analysis for the amount of tolerable phase change between repetitions, RAN4 respectably asks RAN1 if RAN1 has specific scenario what RAN4 should focus in their study? (e.g contiguous/non-contiguous transmission, within one time slot or multiple time slots, TDD band or FDD band etc)**

**The following table summarizes companies’ answers to this question in submitted contributions.**

|  |  |
| --- | --- |
| **Company name** | **Answer to RAN4 question in contributions** |
| **ZTE** | * Use case 1: back-to-back PUSCH transmissions within one slot. * Use case 2: non-back-to-back PUSCH transmissions within one slot. * Use case 3: back-to-back PUSCH transmissions across consecutive slots. * Use case 4: non-back-to-back PUSCH transmissions across consecutive slots. * Use case 5: PUSCH transmissions across non-consecutive slots.   Note: RAN1 assumes “back-to-back PUSCH transmission” has zero gap in-between adjacent PUSCH transmissions. |
| **OPPO** | * Use case 1: back-to-back PUSCH transmissions within one slot. * Use case 2: non-back-to-back PUSCH transmissions within one slot. * Use case 3: back-to-back PUSCH transmissions across consecutive slots. * Use case 4: non-back-to-back PUSCH transmissions across consecutive slots. * Use case 5: PUSCH transmissions across non-consecutive slots.   Note: RAN1 assumes “back-to-back PUSCH transmission” has zero gap in-between adjacent PUSCH transmissions. |
| **VIVO** | * Use case 1: back-to-back PUSCH transmissions within one slot. * Use case 2: non-back-to-back PUSCH transmissions within one slot. * Use case 3: back-to-back PUSCH transmissions across consecutive slots. * Use case 4: non-back-to-back PUSCH transmissions across consecutive slots. * Use case 5: PUSCH transmissions across non-consecutive slots.   Note: RAN1 assumes “back-to-back PUSCH transmission” has zero gap in-between adjacent PUSCH transmissions. |
| **LG** | * Use case 1: back-to-back PUSCH transmissions within one slot. * Use case 2: non-back-to-back PUSCH transmissions within one slot. * Use case 3: back-to-back PUSCH transmissions across consecutive slots. * Use case 4: non-back-to-back PUSCH transmissions across consecutive slots. * Use case 5: PUSCH transmissions across non-consecutive slots.   Note: RAN1 assumes “back-to-back PUSCH transmission” has zero gap in-between adjacent PUSCH transmissions. |
| **Ericsson** | * Both contiguous and non-contiguous repetition of PUSCH in a set of symbols across slots * Both contiguous and non-contiguous repetition of PUCCH in a set of symbols across slots or within a slot |
| **Huawei** | SuggestRAN4 to focus on the scenario of non-back-to-back PUSCH transmissions in phase change tolerance study   * + E.g. there are un-scheduled symbols or slots between PUSCH transmissions   + E.g. there are other signals transmitted between PUSCH transmissions |
| **China Telecom** | Besides the agreed 5 use cases, since RAN4 is discussing non-back-to-back transmission with non-zero gap in-between adjacent transmissions, to facilitate the discussion as requested by RAN4, RAN1 should provide the more information.  We suggest the following additional information for non-back-to-back transmission with non-zero gap in-between adjacent transmissions:   * **For non-back-to-back PUSCH transmissions within one slot, RAN1 is considering the following case:**   + **Non-zero gap in-between adjacent PUSCH transmissions due to invalid symbol(s) for PUSCH repetition type B**   + **Non-zero gap in-between adjacent PUSCH transmissions for different TBs scheduled by network.** * **For non-back-to-back PUSCH transmissions across slots, RAN1 is considering the following case:**   + **Non-zero gap in-between adjacent PUSCH transmissions due to SRS or PUCCH transmission from other UE(s) in-between adjacent PUSCH transmissions**   + **Non-zero gap in-between adjacent PUSCH transmissions due to invalid symbol(s)/orphan symbol for PUSCH repetition type B**   + **Non-zero gap in-between adjacent PUSCH transmissions for different TBs scheduled by network.** |
| **Sierra Wireless** | We need to provide RAN4 with some **focused** use cases so re-iterating all 5 use cases is not that useful. Focus should be on non-back-to-back in these scenarios:   * Use case 4: non-back-to-back PUSCH transmissions across consecutive slots. * Use case 5: PUSCH transmissions across non-consecutive slots.   Additional information similar to what China Telecom provide but even more focused:   * Focus on non-back-to-back scenarios cause by SRS, PUCCH from other UEs, invalid slots and TDD DL slots |

Based on the above table, for PUSCH transmission, the situation seems quite stable. Therefore, FL has the following proposal.

**FL Proposal 1: For PUSCH transmission, Inform RAN4 the following 5 use cases which are considered in RAN1.**

* Use case 1: back-to-back PUSCH transmissions within one slot.
* Use case 2: non-back-to-back PUSCH transmissions within one slot.
* Use case 3: back-to-back PUSCH transmissions across consecutive slots.
* Use case 4: non-back-to-back PUSCH transmissions across consecutive slots.
* Use case 5: PUSCH transmissions across non-consecutive slots.

Note: RAN1 assumes “back-to-back PUSCH transmission” has zero gap in-between adjacent PUSCH transmissions.

For PUCCH transmission, more discussion is needed. Therefore, companies are encouraged to provide input on how to answer RAN4’s question for PUCCH in the following table.

|  |  |
| --- | --- |
| **Company name** | **Answer to RAN4 question for PUCCH transmission** |
| **Ericsson** | We think use cases 1-5 for PUSCH can also apply to PUCCH, but use cases 1 & 2 could be treated at a lower priority.  For PUCCH, at least inter-slot DMRS bundling should be beneficial from a coverage enhancement perspective. Use case 3 is the most straightforward given prior RAN4 feedback for PUSCH. Use cases 4 and 5 should be beneficial especially for TDD, if they are indeed feasible. Therefore, we think we should list them and ask RAN4 on whether they are feasible, as we do for PUSCH.  Sub-slot repetition for PUCCH is supported in Rel-17 for URLLC, and so use cases 1 & 2 can be of interest. However, we understand that common use cases for sub-slot repetition are for diversity and/or beam blocked scenarios. So one way forward would be to list use cases 1 & 2 as a lesser priority for PUCCH, which would allow further discussion of the need for DMRS bundling with sub-slot repetition based on RAN4’s answer of its feasibility. |
| **Samsung** | Ok to consider all use cases. |
| **Intel** | As PUCCH repetitions are only defined across different slots, we think use cases 3-5 for PUSCH can apply for joint channel estimation for PUCCH.  For sub-slot repetition for PUCCH, it is currently under the discussion in Rel-17, which is not finalized yet. We do not think RAN1 is ready to send an LS for use case 1 and 2 for joint channel estimation for PUCCH. |
| vivo | For multiple PUCCH transmissions within a slot in Rel-16, only a short PUCCH format together with a long PUCCH format is supported, which make it difficult to support DMRS bundling for different PUCCH format.  While in Rel-17, sub-slot PUCCH repetition within a slot may be supported in URLLC AI, it should be discussed that whether subslot repetition need to be considered.  5 use cases for PUSCH are also applicable for PUCCH in the reply LS, and it is up to RAN4 to provide the feasibility of the use cases, and RAN1 can further make decision on whether these use cases need to be supported for DMRS bundling. |
| ZTE | Regarding the reply for PUSCH, RAN4 is also asking whether RAN1 would consider TDD band or FDD band. In our view, both TDD band and FDD band are considered in RAN1, which should be informed to RAN4.  As for the reply for PUCCH, we are fine to consider the 5 use cases of PUSCH for PUCCH. |
| Qualcomm | For Proposal 1, can we add that we are considering two scenarios for non-back-to-back transmissions --- one scenario considers unscheduled symbols in the middle of two PUSCH transmissions and the second scenario considers other uplink transmissions in the middle of two PUSCH transmissions. We think tolerance limits on phase continuity could be different in these two cases. Consider the following amendment:   * Use case 2: non-back-to-back PUSCH transmissions within one slot. * Scenario 2a: unscheduled symbols in the middle of two PUSCH transmissions * Scenario 2b: other uplink transmissions in the middle of two PUSCH transmissions * Use case 4: non-back-to-back PUSCH transmissions across consecutive slots. * Scenario 3a: unscheduled symbols in the middle of two PUSCH transmissions * Scenario 3b: other uplink transmissions in the middle of two PUSCH transmissions   For PUCCH, we think only repetitions across slots are of interest, and so we make the following proposal  **Proposal 2: For PUCCH repetitions, Inform RAN4 the following use cases are considered in RAN1.**   * Use case 1: back-to-back PUCCH repetitions across consecutive slots. * Use case 2: non-back-to-back PUCCH repetitions across consecutive slots. * Scenario 2a: unscheduled symbols in the middle of two PUCCH repetitions * Scenario 2b: other uplink transmissions in the middle of two PUCCH repetitions * Use case 3: PUCCH repetitions across non-consecutive slots.   Note: RAN1 assumes “back-to-back PUCCH repetition” has zero gap in-between adjacent PUCCH repetitions. |
| CATT | Fine with the proposal. |
| Panasonic | We are fine to consider that 5 use cases for joint channel estimation for PUSCH are also applicable for PUCCH in the reply LS. |
| LG | We have similar view with Ericsson. For same reason, it is desirable for use case 3, 4 and 5 to be higher priority and for use case 1 and 2 to be lower priority. |
| CMCC | For the PUCCH, we are open for use case 1-5. Whether some of the cases should be deprioritized could be discussed, since too many use cases will increase the workload of RAN4 and may delay the responses.  We also support the views that more specific information should be provided to RAN4 for both PUSCH and PUCCH, such as TDD and FDD band, more specific cases in-between the adjacent uplink transmissions, e.g. un-scheduled symbols, SRS and etc. |
| Nokia/NSB | Same view as Ericsson, including prioritization. |
| InterDigital | We are ok with the proposals and consider the 5 use cases for PUCCH as well. |
| Lenovo, Motorola Mobility | We are fine with the proposals and suggest to include same use cases can be considered for PUCCH as well |
| Apple | For PUSCH, we share similar view as QC to be more specific on non-back-to-back PUSCHs (where RAN4 already mentioned DL reception will lose phase continuity), whether or not there is another UL transmission in between PUSCHs. In addition, we would like to consider UCI multiplexing in some of the repetitions for all 5 cases.  For PUCCH, case 1 and case 2 are not supported for PUCCH with repetitions. |
| Sierra Wireless | Same view as Ericsson |

**Based on the feedback received in the above table. FL make the following proposals.**

**Updated FL Proposal 1: For PUSCH transmission, Inform RAN4 the following ~~5~~ use cases (in both TDD and FDD bands) which are considered in RAN1.**

* **Use case 1: back-to-back PUSCH transmissions within one slot.**
* **Use case 2: non-back-to-back PUSCH transmissions within one slot.**
  + **Use case 2a: unscheduled symbols in the middle of two PUSCH transmissions**
  + **Use case 2b: other uplink transmissions in the middle of two PUSCH transmissions**
* **Use case 3: back-to-back PUSCH transmissions across consecutive slots.**
* **Use case 4: non-back-to-back PUSCH transmissions across consecutive slots.**
  + **Use case 4a: unscheduled symbols in the middle of two PUSCH transmissions**
  + **Use case 4b: other uplink transmissions in the middle of two PUSCH transmissions**
* **Use case 5: PUSCH transmissions across non-consecutive slots.**

Note: RAN1 assumes “back-to-back PUSCH transmission” has zero gap in-between adjacent PUSCH transmissions.

**FL Proposal 2: For PUCCH transmission, Inform RAN4 the following use cases (in both TDD and FDD bands) which are considered in RAN1, and suggest RAN4 to prioritize the study on use case 3, 4a, 4b, and 5 for PUCCH transmission.**

* **Use case 1: back-to-back PUCCH transmissions within one slot.**
* **Use case 2: non-back-to-back PUCCH transmissions within one slot.**
  + **Use case 2a: unscheduled symbols in the middle of two PUCCH transmissions**
  + **Use case 2b: other uplink transmissions in the middle of two PUCCH transmissions**
* **Use case 3: back-to-back PUCCH transmissions across consecutive slots.**
* **Use case 4: non-back-to-back PUCCH transmissions across consecutive slots.**
  + **Use 4a: unscheduled symbols in the middle of two PUCCH transmissions**
  + **Use 4b: other uplink transmissions in the middle of two PUCCH transmissions**
* **Use case 5: PUCCH transmissions across non-consecutive slots.**

Note: RAN1 assumes “back-to-back PUCCH transmission” has zero gap in-between adjacent PUCCH transmissions.

Comments to FL proposal 1 and 2 can be provided in the following table.

|  |  |
| --- | --- |
| **Company name** | **Comments** |
| **Huawei, HiSilicon** | We believe the enhancement here is generic to all bands with uplink symbols, so please replace “in both TDD and FDD bands” with “in TDD, FDD and SUL bands” for both proposals.  In the RAN4 reply LS, the discussions focused on PUSCH/PUCCH repetition because only repetition was requested in previous RAN1 LS. However, the current RAN1 discussions also cover the case without repetition, it is better to inform RAN4 this. So we suggest to add a note to clarify it.  ***Note: All above use cases cover the transmissions with and without repetition.*** |
| **Ericsson** | Support both proposals 1 and 2.  Since there is some discussion of whether carrier aggregation is deprioritized, if we want to be careful to avoid excluding SUL at this stage, we prefer to say “in both paired and unpaired bands”, rather than Huawei’s “in TDD, FDD and SUL bands” which is hopefully sufficiently neutral.  Joint channel estimation for use cases without repetition (other than TBoMS) are still being discussed, and so we think it is not appropriate to amend the LS as Huawei suggests at this time. If/when we agree to such use cases, we can inform RAN4, whether in this LS or a later one. |
| **Samsung** | We are fine with the FL’s proposals 1 and 2. |
| **WILUS** | We are fine with the FL’s proposal 1.  For proposal 2, since the WID clearly states that “Specify mechanism to support DMRS bundling across PUCCH repetitions”, we suggest to change “**PUCCH transmissions**” to “**PUCCH repetitions**”. |
| **Panasonic** | We are fine with the proposals 1 and 2. |
| **Qualcomm** | For Proposal 1, can we add the following two sub-cases to use case 5:   * + **Use case 5a: unscheduled symbols/slots in the middle of two PUSCH transmissions**   + **Use case 5b: other uplink transmissions in the middle of two PUSCH transmissions**   For Proposal 2:  Could we change “PUCCH transmission” to “PUCCH repetition”? The WID specifically considers bundling only across repetitions for PUCCH.  Suggest adding the following two sub-cases under use case 5:   * + **Use case 5a: unscheduled symbols/slots in the middle of two PUCCH repetitions**   + **Use case 5b: other uplink transmissions in the middle of two PUCCH repetitions**   Use case 1 and 2 to be dropped. They are not valid use cases as per the current spec. |
| **CATT** | We are OK with Qualcomm’s suggestion for proposal 1 and extending to SUL.  For proposal 1, as pointed out by WULIS and Qualcomm, it should be PUCCH repetition instead of PUCCH transmission. If so, we don’t think the first two cases are typical case for coverage enhancement(Rel-15/16 does not support intra-slot PUCCH repetition and even in Rel-17 it is not the typical case for coverage enhancement). Correspondingly, we don’t think it is necessary to ask RAN4 to study on use case 1 and use case 2 even with low priority.  Furthermore, the use case 5 is not needed as the only case for PUCCH repetition on the non-consecutive slots would be there are unavailable symbols, e.g. semi-static DL symbols or SSB transmission, for the PUCCH transmission. In this case, it is already clear that phase continuity cannot be maintained. |
| **vivo** | We are fine with proposal 1 & 2. |
| **ZTE** | We are fine with the proposals, and also the suggestion from several companies to change PUCCH transmissions to PUCCH repetitions. |
| **Intel** | We are fine with the proposal 1. For Proposal 2, we also suggest to change to PUCCH repetition.  In addition, we share similar view as QC for Case 1 and 2 for joint channel estimation for PUCCH. As the sub-slot PUCCH repetition is under the discussion, we suggest we discuss this later once the design is stable. For the reply LS to RAN4, we do not need to mention this. |
| **Nokia/NSB** | Agree with changing “PUCCH transmission” to “PUCCH repetition”.  Agree with Ericsson’s comment on “paired and unpaired spectrum”.  Also Agree that Use case 1 and 2 of Proposal 2 may not be relevant, after all. However, we are fine with keeping them in with low-priority, given that we see merit in sending a more complete LS to RAN4 also for future reference. |
| **Sierra Wireless** | Support with Qualcomm’s suggested additions and deletions. |
| **Huawei, HiSilicon** | Not OK with “paired and unpaired spectrum” because it precludes SUL and this WI is generic to all bands. Paired bands is not a RAN4 term nor a RAN1 term.  Since a cycle of LS request and reply takes multiple meetings, better to ask RAN4 for all potential RAN4 impact for joint channel estimation at one time, including the case without repetition. To be specific, whether or not there is additional RAN4 impact to support “without repetition” compared to “only repetition”. Since TBoMS is not a PUSCH repetition as commented by Ericsson, the RAN4 answer for “without repetition” is needed anyway. Additionally, the main bullet is “considered” instead of “agreed”, the note seems not to imply any new agreement. But to address Ericsson’s concern, the note could be  ***Note: In addition to repetition and PUSCH TBoMS, all above use cases may also cover the PUSCH transmissions ~~with and~~ without repetition.*** |

# Other related issues

This section summarizes a few other related issues which are mentioned in companies’ contributions.

VIVO has following proposals.

**Proposal 1: To confirm with RAN4 the understanding that, it is not feasible to perform DMRS bundling at gNB if the TPMI precoder changes between PUSCH transmissions.**

Comments to VIVO proposal 1 can be added in the following table.

|  |  |
| --- | --- |
| **Company name** | **Comments to VIVO proposal 1** |
| **Ericsson** | We think that this is worth asking RAN4, since the answer could vary with the UE’s coherence capability. |
| **Samsung** | In general, we are fine with the proposal. |
| **Intel** | We are fine with the proposal. |
| **Vivo** | Support this proposal. |
| ZTE | Fine with the proposal. Then, we may also need to confirm with RAN4 about whether TA can be adjusted between PUSCH transmissions. |
| Qualcomm | This is our understanding, but it will be good to get it clarified as it is not explicitly listed in RAN4’s response to Q1. |
| CATT | Support the proposal. |
| Panasonic | We are fine with the proposal in general. |
| LG | Agree with ZTE. It should be confirmed by RAN4 that not only TPMI precoder change but also TA adjustment in-between PUSCH transmission is feasible or not to perform DMRS bundling. |
| CMCC | Fine with the proposal.  Also as mentioned in our contribution, we want to check the performance impact due to the phase drifting or phase change. As in the FDD band, the uplink slots are always consecutive, in which the phase of UE could change very much. We want to know how long or how many slots could be used for joint channel estimation or DMRS bundling considering that the phase of is always changing or drifting. |
| Nokia/NSB | Fine with the proposal. |
| Lenovo, Motorola Mobility | We are fine with the proposal |
| Huawei, HiSilicon | OK with the proposal.  DMRS bundling seems more like a term at transmitter side, but joint channel estimation seems more like a term at receiver side. Therefore, seems better to replace “DMRS bundling” with “joint channel estimation” |

**Proposal 2: To confirm with RAN4 that, whether other UL transmissions, e.g. SRS or UL transmissions with different waveform, in between the PUCCH/PUSCH repetitions have impact on DMRS bundling, and whether any additional conditions are required.**

Comments to VIVO proposal 2 can be added in the following table.

|  |  |
| --- | --- |
| **Company name** | **Comments to VIVO proposal 2** |
| **Ericsson** | This seems to be related to the non-back-to-back investigations RAN4 is already doing, so may not really be needed. However, there is no harm in asking this in our view. |
| **Samsung** | Same view as Ericsson |
| **Intel** | We share similar view as Ericsson. It is still under the discussion in RAN4, so we may not need to ask RAN4 for this proposal. |
| Vivo | Support this proposal.  Since RAN4 did not provide any feedback on whether other transmission can be allowed in between the PUSCH repetition, RAN1 can further ask RAN4 on this question.  We have concerns on the feasibility of DMRS bundling, for the following reasons. First, different channels/signals have different power control mechanism. Secondly, even if the nominal transmission power of the signals/channels can be restricted to be same, the actual transmission power of different signals/channels can be different due to some RAN4 requirements, e.g. MPR requirements. For example, based on MPR requirements in TS38.101, the MPR for PUSCH with CP-OFDM waveform is 1.5dB for inner RB allocation, and that for PUCCH (format 0/1/3/4) and SRS is 0dB. Hence, the actual transmission power may be difficult to maintain consistent across these transmissions. |
| ZTE | Based on RAN4’s reply, our understanding is RAN4 is still discussing if UE can maintain phase continuity for scenario of other physical signals/channels in-between PUCCH or PUSCH repetitions. |
| Qualcomm | With the subcases under use case 2 and 4 as in our modified proposal, this may not be necessary. |
| CATT | Same view as Ericsson. |
| Panasonic | We think it is not necessary to have this proposal because RAN4 is still discussing this use case. |
| LG | Basically agree to proposal, but some modification is needed. It is better not to limit the question to different waveforms, but to ask about the impact of the existence of in-between uplink transmission, which is understood in the same context as the proposal below. It would be better to be merged with the proposal below. |
| CMCC | We support to provide more specific information to facilitate RAN4’s discussion. The proposal 2 from vivo could reformed and added under the FL’s proposal 1 and potential PUCCH proposals. |
| Nokia/NSB | Same view as Ericsson. |
| InterDigital | We are ok with the proposal.  We have additional comment. For additional conditions, we would like to ask RAN4 a specific question. It is regarding the PT-RS which is being discussed in 104b-e-NR-R17-CovEnh-02. In the discussion, the use of PT-RS to aid joint channel estimation is considered. We would like to propose to ask RAN4 if evaluation for phase continuity can include PTRS. For PTRS configuration in RAN4 evaluation, we can propose something like the following where the number of PRSs is taken from the evaluation assumption during the SI.  FR2, QPSK, 30 PRB, DFTsOFDM, Number of PT-RS groups = 2, Number of samples per PT-RS group = 4. |
| Lenovo, Motorola Mobility | Agree with Ericsson’s view |
| Apple | Same view as Ericsson |
| FL | With the subcases added in the updated UL proposal 1 and 2, I believe this proposal is not needed.  Regarding the issue related to PT-RS mentioned by Interdigital, I would recommend companies to share your views on this, using this table. I will summarize the situation in next round of FL summary. |

Based on the input received in above tables, FL make the following proposal.

**FL Proposal 3: In the reply LS to RAN4, ask RAN4 to confirm that “Applying the same TPMI precoder across PUSCH transmissions” is a necessary condition to keep phase continuity across PUSCH transmissions.**

**FL proposal 4: In the reply LS to RAN4, ask RAN4 the answer to the following questions:**

* **Whether “no TA adjustment in between PUCCH transmissions or PUSCH transmissions” is a necessary condition to keep phase continuity across PUCCH or PUSCH transmissions?**

Comments to FL proposal 3 and 4 can be provided in the following table.

|  |  |
| --- | --- |
| **Company name** | **Comments** |
| **Huawei, HiSilicon** | Ok with proposal 3.  Regarding proposal 4, we don’t feel TA adjustment has impact. But OK to ask RAN4. |
| **Ericsson** | Support proposals 3 & 4. |
| **Samsung** | We are fine with the FL proposal 3. For our clarification, what is the issue from TA adjustment? |
| **Panasonic** | We support FL proposal 3. We would like to know a motivation of FL proposal 4. |
| **Qualcomm** | Support |
| **CATT** | We are not sure on the TA adjustment issue either.  OK with proposal 3. |
| **ZTE** | Support both proposal 3 and 4.  Regarding TA adjustment, if TA could be changed within the bundle, then there would be some gap between the actual transmission time of each PUSCH/PUSCH within the bundle. Depending on the gap size, it may have impacts on the phase continuity. |
| **Intel** | We are fine with Proposal 3.  For proposal 4, it is also not clear to us the impact from TA adjustment for joint channel estimation. But we are okay to ask RAN4. |
| **Nokia/NSB** | Support both proposals. |
| **Sierra Wireless** | Support both proposals. |

LG has the following proposal.

“In addition to that, it needs to be clarified that whether requirements for the cases between “uplink transmission in-between the PUSCH or PUCCH repetition in the same band for TDD case” and “no downlink reception and no uplink transmission in-between the PUSCH or PUCCH repetition in the same band for TDD case” needs to be classified or not. If needed, different requirements according to cases should be specified.”

Comments to LG proposal can be added in the following table.

|  |  |
| --- | --- |
| **Company name** | **Comments to LG proposal** |
| **Ericsson** | This seems to be related to the non-back-to-back investigations RAN4 is already doing, so may not really be needed. However, there is no harm in asking this in our view. |
| **Samsung** | We are fine to send LS to clarify the uplink transmission in-between the PUSCH or PUCCH repetition. But, scenario of no downlink reception in-between the PUSCH or PUCCH repetition in the same band for TDD case is clear based on previous RAN4’s reply. |
| **Intel** | We share similar view as Ericsson. It is still under the discussion in RAN4, so we may not need to ask RAN4 for this proposal. |
| ZTE | Our understanding is, the following condition has to be met according to RAN4 LS.  *‘No downlink reception in-between the PUSCH or PUCCH repetition in the same band for TDD case’*  And, for the following scenario, RAN4 is still discussing whether UE can maintain phase continuity  *‘scenario of other physical signals/channels in-between PUCCH or PUSCH repetitions from the UE perspective, e.g., SRS or PUCCH transmission in-between the PUSCH repetition for the UE’* |
| Qualcomm | Yes, we think it will be good to know whether phase continuity tolerance and/or requirements could be different if (a) there are other intervening uplink transmissions and (b) there is intervening downlink reception in the same band.  In addition, we would also like to know whether phase continuity can be maintained if there is downlink reception in a different band from uplink. |
| CATT | We share the similar views there is no need to send such an LS. Besides, no DL reception in-between two uplink transmissions is clear. |
| Panasonic | We share same understanding with Ericsson and ZTE. It may not need to ask RAN4 for this proposal. |
| LG | It is correct that the condition according to the LS of RAN4 is no downlink reception in between PUSCH transmission, what we would like to ask RAN4 is different with that. It is questionable for us whether the requirement of DMRS bundling will change or not when there is other uplink transmission in between PUSCH transmission and when there is no uplink transmission in between. As commented above, it is better to be merged. |
| Nokia/NSB | Same view as Ericsson. |
| Lenovo, Motorola Mobility | Similar view as Ericsson |
| Apple | Same view as Ericsson |
| Sierra Wireless | Same view as Qualcomm. Good to know whether phase continuity tolerance and/or requirements **could be different** if (a) there are other intervening uplink transmissions and (b) there is intervening downlink reception in the same band. |
| FL | The UL related part in LG proposal is already added into FL proposal 1 and 2. The DL related part in LG proposal is already clear in RAN4 LS. |
| Qualcomm | Could we please seek a clarification on whether phase continuity can be maintained across two uplink transmissions if there is an intervening downlink reception in a different band from uplink --- this is not currently mentioned in the response from RAN4. |

Ericsson has following proposal.

“RAN1 would like to further inform RAN4 that the TB processing over multi-slot PUSCH (‘TBoMS’) feature will also support joint channel estimation. While RAN1 is still discussing whether the numbers of PUSCH symbols can be different between slots of a TBoMS transmission, the scenarios for PUSCH repetition above can be a starting point for RAN4 TBoMS studies. RAN1 will provide further guidance if additional scenarios should be focussed upon.”

Comments to Ericsson proposal can be added in the following table.

|  |  |
| --- | --- |
| **Company name** | **Comments to Ericsson proposal** |
| **Ericsson** | Use cases 1 & 2 do not seem applicable to TBoMS, so we can rephrase this as “RAN1 would like to further inform RAN4 that the TB processing over multi-slot PUSCH (‘TBoMS’) feature will also support joint channel estimation. Use cases 3 – 5 are being considered to support TBoMS in RAN1.” |
| **Samsung** | It seems no need to send an LS to RAN4 for TBoMS with joint CE. We think that the conditions according to potential use cases for joint CE can be applied to TBoMS in principle. |
| **Intel** | We do not have strong view. It seems no need to ask RAN4 for TBoMS. |
| **vivo** | TBoMS can be regarded as PUSCH repetition for determine the feasibility for joint channel estimation. It seems a RAN1 topic on feasibility of JCE for TBoMS, if RAN4 have provided the conditions for UE to maintain phase continuity and power consistency. However, there is no harm in informing RAN4. |
| ZTE | No strong preference. Basically, the 5 use cases can apply to TBoMS and also multiple-TB case. If we need to add TBoMS, we may also need to add multiple-TB case. |
| Qualcomm | At this point, given that we have nothing specific about TBoMS agreed, we suggest not mentioning TBoMS. Prefer to first get clarification on the 5 use cases previously identififed. |
| CATT | From JCE point of view, we think the scenarios captured in proposal 1 can be directly applied to TBoMS. It seems there is no need to ask RAN4 for TBoMS individually. |
| Panasonic | We think this proposal is not necessary because potential use cases for joint CE can be used for TBoMS in general. |
| LG | Since TBoMS is currently under discussion, it is premature to mention it and it will be included in 5 use cases because it is fundamentally PUSCH. Therefore, it seems no need to ask RAN4 for TBoMS in our understanding. |
| CMCC | For TBoMS, at least a same MCS or modulation should be used over the multiple slots. And other issues or details could follow the replies from RAN4.  Currently we do not see any other issues or details of TBoMS related to joint channel estimation needs to check with RAN4. |
| Nokia/NSB | The 5 use-cases RAN1 identified do not include description of bit to RE mapping and are TB-agnostic. Thus we think there is no need for this question and whatever RAN4 will answer to RAN1 eventually will be valid for TBoMS as well. |
| Lenovo, Motorola Mobility | We don’t see the need to have a separate question for TBoMS. |
| Apple | Not needed. |
| FL | Majority think there is no need to ask RAN4 this question in the reply LS, until RAN1 has further progress on TBoMS. |