**3GPP TSG RAN Meeting #93-e RP-21XXXX**

e-Meeting, September 13th – 17th, 2021

Agenda Item: 9.3.2.1

Title: Summary of email discussion [93e-17-IIoT-URLLC-Scope]

Source: Samsung (RAN1 Chair)

Document for: Discussion and Decision

# Introduction

As part of Rel-17 NR, there is an ongoing work item on *Enhanced Industrial Internet of Things (IoT) and ultra-reliable and low latency communication (URLLC) support for NR*. The work item is due for stage-3 completion by Q4 of 2021 in RAN1 and Q1 of 2022 in other working groups. For RAN1, there are only two WG meetings until the deadline of the stage-3 completion.

A number of companies have submitted contributions on how to move forward on multiple IIoT/eURLLC topics. A summary of the topics discussed in relevant contributions [1] ~ [6] is as follows:

* Intra-UE multiplexing and prioritization enhancements [1], [2], [3], [5]
* UE feedback enhancements for HARQ-ACK [2], [3]
* CSI feedback enhancements to allow for more accurate MCS selection [2], [3], [4]
* Enhancements for support of time synchronization [1], [2], [5], [6]
* Enhancements based on new QoS related parameters [1]

The purpose of the email thread [93e-17-IIoT-URLLC-Scope] is to collect company views and if possible, converge on a way forward on how to more efficiently progress the Rel-17 work on *Enhanced Industrial Internet of Things (IoT) and ultra-reliable and low latency communication (URLLC) support for NR*. For your reference, the detailed objectives in the WID [7] are provided below:

|  |
| --- |
| 1. Study, identify and specify if needed, required Physical Layer feedback enhancements for meeting URLLC requirements covering
	* + UE feedback enhancements for HARQ-ACK [RAN1]
		+ CSI feedback enhancements to allow for more accurate MCS selection [RAN1]

Note: DMRS-based CSI feedback is not in scope of this WI 1. Uplink enhancements for URLLC in unlicensed controlled environments [RAN1, RAN2]:
	1. Specify support for UE-initiated COT for FBE with minimum specification effort
	2. Harmonizing UL configured-grant enhancements in NR-U and URLLC introduced in Rel-16 to be applicable for unlicensed spectrum
2. Intra-UE multiplexing and prioritization of traffic with different priority based on work done in Rel.16 [RAN1]:
3. Specify multiplexing behavior among HARQ-ACK/SR/CSI and PUSCH for traffic with different priorities, including the cases with UCI on PUCCH and UCI on PUSCH.
4. Specify PHY prioritization of overlapping dynamic grant PUSCH and configured grant PUSCH of different PHY priorities on a BWP of a serving cell including the related cancelation behavior for the PUSCH of lower PHY priority, taking the solution developed during Rel-16 as the baseline
5. Enhancements for support of time synchronization:
6. RAN impacts of SA2 work on uplink time synchronization for TSN, if any. [RAN2]
7. Propagation delay compensation enhancements (including mobility issues, if any). [RAN2, RAN1, RAN3, RAN4]
8. RAN enhancements based on new QoS related parameters if any, e.g. survival time, burst spread, decided in SA2. [RAN2, RAN3]
 |

# Initial phase

To kick off the initial discussions, the following sub-sections provide general questions for collecting views on the Rel-17 work item on Enhanced IIoT and URLLC. The views collected will be used to come up with moderator proposals to focus the follow up discussions in the next phase to more specific issues.

## Intra-UE multiplexing and prioritization enhancements

With only two RAN1 meetings left, intra-UE multiplexing and prioritization enhancements still has significant amount of work to be done. All four contributions to RAN#93-e discussing this topic propose a downscoping of the relevant work.

**Question/Request#1: Moderator would like to check company views on possible downscoping of intra-UE multiplexing and prioritization enhancements. Whether or not downscoping is necessary? And if so, which part of the objective should be downscoped?**

|  |  |
| --- | --- |
| **Company** | **Views** |
| OPPO | We think down-scoping could help RAN1 to complete the WI in time. Further, the following functionalities could be deprioritized first if any down-scoping should be considered on intra-UE multiplexing/prioritization: - *Simultaneous Tx of PUCCH/PUSCH*: RAN1 agreed to support this for inter-band CA only. So its value in real deployment is lower than other features.  - *Overlapping between CG and DG PUSCH*: The RAN1 discussion on this part has been heavily dependent on corresponding Rel-16 maintenance discussion, so we expect it would be either controversial or with very limited time when the essential part of Rel-17 discussion starts.   |
| Lenovo/Motorola Mobility | Considering the level of discussions, agreements, and amount of time RAN1 spent on multiplexing UCI of different priorities on PUCCH or PUSCH, we don’t think down-scoping is needed at this point. As having done for the HARQ-ACK feedback enhancement topic, RAN1 can make a bulk of agreements to complete the feature in next 2 meetings.  |
| Qualcomm | We don’t think down-scoping is necessary but if some scope reduction needs to be agreed, we would prefer down-scoping only CG and DG PUSCH overlap handling.  |
| Samsung | We think that after the August meeting, the status of URLLC is such that it does not need any down-scoping.If any down-scoping is still desired, we would prefer to down-scope simultaneous PUCCH and PUSCH because, under the current framework, its usefulness will be limited.  |
| Spreadtrum | We support down scoping. Considering there are only two meeting left, and there are little agreements on overlapping between CG and DG PUSCH, we prefer to down scope this functionality from Rel-17 IIoT-URLLC. |
| Xiaomi | Downscoping is necessary. Since too many efforts has been put in UCI multiplexing, and it has already been extensively discussed in R16 URLLC, we support keep going on this topic and let go of others. And if still too much workload, UCI multiplexing on PUCCH can be prioritized and deprioritize UCI multiplexing on PUSCH |
| Apple | Down-scoping can help RAN1 to finish Rel-17 URLLC design on time:The obvious candidate for downscoping is *“*PHY prioritization of overlapping dynamic grant PUSCH and configured grant PUSCH of different PHY priorities”*.* Compared with Rel-16 URLLC design, the treatment on overlapping between CG and DG PUSCH may require the cancellation of an ongoing transmission. As revealed in the Rel-16 maintenance on UL skipping and L1/L2 priority, companies hold fundamentally different understandings on many issues. With the URLLC setup (e.g. L1/L2 priority, UL skipping, etc), it is unclear under what conditions PUSCHs will be generated, then it is questionable to define further behaviour concerning cancellation of one by another.Simultaneous PUCCH/PUSCH Tx is another topic for downscoping. |
| InterDigital | We also don’t think downscoping is needed. But, if necessary, we are ok to down scope simultaneous Tx of PUCCH and PUSCH as its use case in real deployment is limited as also mentioned by several companies.  |
| Quectel | We are fine to do down-scoping although we don’t think down-scoping is so necessary considering the progress (especially on the framework) at RAN1#106e. If down-scoping is to be agreed , we think CG and DG PUSCH overlap handling and simultaneous PUCCH/PUSCH transmission could be candidates. |
| CATT | We support down-scoping. We propose to down-scope PHY prioritization of overlapping CG and DG PUSCHs as in RP-212235. The reason is that PHY prioritization of overlapping CG and DG PUSCHs depends on clarification of Rel-16 UE behavior, which is not clear yet in RAN1#106-e. Given that RAN1#106b-e meeting will only treat Rel-17 items, the Rel-16 UE behavior can be concluded in RAN1#107-e meeting at the earliest. It is impossible to finalize Rel-17 intra-UE prioritization in the same meeting.We are also open to down-scope simultaneous Tx of PUCCH/PUSCH if necessary. |
| DOCOMO | We don’t think down-scoping is necessary but if down-scoping is needed, we are OK to down-scope CG and DG PUSCH overlap handling. |
| Intel | * The following down-scoping components were observed from the referred tdocs
	+ Objective level
		- (opt1) Remove the whole objective 3a of UCI multiplexing on PUCCH and PUSCH
		- (opt2) Remove the whole objective 3b of DG/CG uplink grant prioritization
		- (opt3) Remove simultaneous PUSCH and PUCCH transmission on different carriers (*note, there is no separate objective for this feature, but it may be classified as a separate objective*)
	+ Sub-objective level
		- (opt4) For 3a, specify only UCI on PUCCH multiplexing, no UCI on PUSCH
		- (opt5) For 3a, limit the number of overlapping channels of different priority in a cell up to two
* From Intel perspective, we are open to any down-scoping. We understand that objective level discussion is more appropriate for RAN plenary, without going to detailed components of each objective. However, 3a itself is still huge and even if 3b is removed, the progress on 3a may not be improved much. In summary our priority as follows:
	+ Opt1 is not preferred since effectively drops the most important and being worked out part
	+ Opt2 and Opt3 are fine, since the progress there is minimal
	+ Opt4 or Opt5 can be additionally considered to reveal still a huge scope of UCI on PUCCH/PUSCH multiplexing
 |
| China Telecom | Agree down scoping to help RAN1 to finish the design in the next 2 meetings.“PHY prioritization of overlapping dynamic grant PUSCH and configured grant PUSCH of different PHY priorities on a BWP of a serving cell” is preferred to be down scoped as limited time would be left after the related Rel-16 maintenance discussion is clear. We are open to other down scoping aspects. |
| Huawei, HiSilicon | We are fine to do some down-scoping for intra-UE multiplexing and prioritization enhancements. Our views on the three related items are as below:1. **Simultaneous PUCCH/PUSCH of different PHY priorities (at least for inter-band CA):** RAN1 can stop the related work on this aspect. The applicable scenarios for this feature is limited, e.g. only for inter-band CA. That is, it cannot address issue for non-CA case and intra-band CA case, which are probably more typical scenarios. It is preferred to keep the feature that can be applied to more broad scenarios.
2. **Overlapping DG PUSCH and CG PUSCH of different PHY priorities:** We can accept to remove this objective from the WID for the sake of completing Rel-17 on time, though we feel that once the issues for Rel-16 maintenance are addressed, then seems not much additional work needed for this objective.
3. **Multiplexing behavior among HARQ-ACK/SR/CSI and PUSCH for traffic with different priorities:** This objective should be kept. We already have spent much effort/time on this objective, and have achieved agreements on some basic framework and basic function like coding, it is not good to drop the whole objective at this stage. RAN1 can prioritize discussion of some cases with high priority first in the coming two RAN1 meetings if needed, e.g. HP HARQ-ACK & LP HARQ-ACK on PUCCH/PUSCH.
 |
| ZTE | **We are fine to down-scope this topic to ensure completion of RAN1 work in time. We suggest dropping "simultaneous PUCCH/PUSCH of different PHY priorities " and "overlapping CG and DG PUSCH enhancements". Because these two features only targets limited scenarios and not fully discussed yet.** **For the multiplexing behavior** among HARQ-ACK/SR/CSI and PUSCH for traffic with different priorities, we have already defined the overall framework and agreed the basic multiplexing behavior for overlapping cases with two channels. In general, we think the progress is reasonable so far.  |
| Nokia, NSB | We think down-scoping is needed. We still think that down-scoping of the ‘Intra-UE multiplexing of UCI of different priorities on PUCCH and PUSCH’ to be the most natural choice for down-scoping based on the following facts: * Removal of PHY prioritization of CG and DG PUSCH of different PHY priorities will not reduce the workload sufficiently to enable completion in time as this item / feature is very small compared to the other two. Moreover, if this item is removed the baseline question to us is why the network would operate with different PHY priorities in first place if there is no possibility to have the full PHY prioritization operation for PUSCH and then anyhow multiplex the UCI of the different priorities on PUCCH and PUSCH. Thus, we see having the CG/DG PUSCH overlap of different priorities possible is really a pre-requisite to have additional enhancements in that area in Rel-17. We still think that this feature with some effort spent in RAN1 can be completed, especially if it is not treated as 2nd priority item in RAN1 any longer.
* Simultaneous PUSCH / PUCCH should be possible to be completed in time, if we would also spend some time on it in the RAN1 discussions. It seems, that we spend 80 to 90% of the time on Intra-UE mux of different PHY priorities there so there has not been too much time spent on the feature after having the agreement to support this in Rel-17 in first place. We still think that this feature with some effort spent in RAN1 can be completed, especially if it is not treated as 2nd priority item in RAN1 any longer.
* It is true what companies said that we clearly spend some 80 to 90% of the time on the intra-UE multiplexing of UCI of different priorities on PUCCH/PUSCH over the past 7 RAN1 meetings / 5 quarters. But at the same time, we only achieved to our understanding less than 50% of what needs to be done to have the feature completed. It is really not on how much time and effort had been spent so far in RAN1, but how much effort and time would still be needed! Therefore, we don’t think that even if we only continue the work on this feature RAN1 can complete it in time, as also in the past year almost all RAN1 GTW time and the RAN1 discussion effort has been spent on this feature without sufficient progress so far. So this is the clear pick for down-scoping here.
 |
| vivo | In order to finalize the feature in time, we think it is necessary to down-scope some topics of intra-UE multiplexing and prioritization enhancements. Given the progress and efforts we made for each topic, we prefer to focus on the objective of multiplexing of UCI of different priorities on PUCCH & PUSCH. Down-scope following items* PHY prioritization of overlapping dynamic grant PUSCH and configured grant PUSCH of different PHY priorities on a BWP of a serving cell
* Support of simultaneous PUCCH and PUSCH transmission within a PUCCH cell group
 |
| Telecom Italia | We believe downscoping is necessary. Moreover, since it is the WI rapporteur to suggest downscoping, we propose to follow the rapporteur’s guidance as a minimum |
| MediaTek | We are fine to have **down-scoping with the following views:**1. **Simultaneous PUCCH/PUSCH of different PHY priorities:** this feature must be kept. It in incorrect to say this is limited case while RAN1 develops other features that target CA operation (e.g. PUCCH carrier switching) for URLLC. Also, compared to LP/HP multiplexing, the spec impact is small and can be finalized within the remaining time for the WI.
2. **Multiplexing among HARQ-ACK/SR/CSI and PUSCH for traffic with different priorities:** we are supportive of down-scoping this feature;
	1. Regardless of how much this feature was discussed in RAN1, the progress still limited.
	2. There are already much less complex features agreed by RAN1 that the network can use to recover a dropped LP channel (e.g. HARQ-ACK re-transmission).
	3. Multiplexing LP and HP channels comes with an impact to the HP channel reliability.
3. **Overlapping DG-PUSCH/CG-PUSCH of different PHY priorities:** We can accept **down-scoping this feature if the majority of the companies support this.**
 |
| LG | We basically think the down-scoping is necessary for this intra-UE multiplexing/ prioritization topic. Observing the relevant progress so far and considering the potential standard workload, simultaneous PUCCH+PUSCH TX and CG/DG PUSCH prioritization should be down-scoped.Especially, in case of simultaneous PUCCH+PUSCH TX, we don’t see the essentiality to introduce it in Rel-17 since it is just an indirect solution from the perspective of intra-UE multiplexing, and (as commented by some companies) its applicable scenarios/use cases would be quite limited to e.g., intra-band CA, same SCS, etc. |
| Ericsson | We are fine with down-scoping but in our view there should be a realistic view on the remaining work and also keep features that can provide additional value that are not accomplished by other features.* **Overlapping CG/DC: We Support down-scoping.**
	1. This topic has not picked up for discussions despites the inputs. However, due to dependency to Rel-16 discussions and its complications, it can be down-scoped.
* **Simultaneous PUCCH/PUSCH: We do not support down scoping.**
	1. This topic has not picked up for discussions despites the inputs and technically motivated benefits. The logistics of enabling this feature is not comparable at all to enabling UCI mux with different priority. What it is needed for this feature to be supported is to have a clarity on framework and then decide where in the chain the related functionalities are applicable. That also includes limitation of applicable UL cells. So basically, **some decisions on logistics are needed**, not complicated technical design like PUCCH format, coding, etc. It was unfortunate that framework discussions were postponed to late stage instead of initial steps.
	2. On the limited scenarios for this feature, we totally disagree with using such arguments for decision of support or not. The same argue can be made for intra-UE mux with different prio where the main use case of this feature can be achieved with already supported feature i.e. retransmission dropped HARQ-ACK. If the motivation is HP SR, the extent of efforts for retrieve HP SR when we have HP CG as well, is not really justified. So, why should we make the intra-UE even more complex where we have other methods to receive the dropped low priority HARQ-ACK?
	3. This feature enables functionality that was not supported before and it paves the path for considering such functionality for intra-band as well in certain conditions are fulfilled. UL CA is important, and its improvements should not be dismissed. This feature provides flexibility to retrieve LP UCI without the burden on intra-UE multiplexing.
* **UCI mux with different prio: We are fine with down-scoping if needed.**
	+ Last meeting, thankfully some clarity on the framework which was crucial for the progress, was achieved. However, we share the same concern as Rapporteur that we are not hopeful the remaining work should be completed by end of Rel-17. On the other hand, tremendous amount of work was spent, **only on this topic and on design details.** If the group insists to continue this topic, it should not be achieved by compromising simultaneous PUCCH/PUSCH where its **lack of progress was due to lack of discussion**.
 |
| Vodafone | We expect that some downscoping will help with keeping Rel 17 on schedule. |
| Panasonic | We don't agree to down-scoping of intra-UE multiplexing. This has been continued from Rel.16. We think "PHY prioritization of overlapping DG PUSCH and CG PUSCH of different PHY priorities" and "simultaneous PUCCH and PUSCH" should be rather down-scoped |
| Sony | We do ***not*** think down scoping is necessary. However, if we really must then consider down scoping simultaneous transmissions of PUCCH & PUSCH.It isn’t clear what the concerns or mega issues are for UCI multiplexing of different priorities. We already agreed the major aspects of this feature i.e.:* **When to multiplexed.** Here we agreed is enabling/disabling of multiplexing is indicated by gNB. Here if we agree to use a dynamic indicator, we would avoid having to define all sorts of complicated rules on when to multiplex and this aspect is pretty much done
* **What PUCCH resource to use.** We already agreed to use the PUCCH Resource from the set of HP PUCCH resources for the multiplexed UCI (the “issue” about missing DCI for a Low Priority Type 2 CB is insignificant to non-existent since Type 2 CB is guarded by DAI).
* **How to code the UCI bits in PUCCH.** We agreed on separate coding and these coding schemes are already defined in Rel-15/Rel-16. We even define a new separate MaxCodeRate.
* **How much PUSCH resource to use.** We already agreed on two new sets of beta values. Remaining piece is to decide whether to have 1 or 2 alpha values.
* **What about multiplexing more than two PUCCH/PUSCH.** We mad an agreement on sorting out PUCCH/PUSCH of each priority then sort out PUCCH/PUSCH of different priorities.

The remaining issues are not big showstoppers. So we do not see why we need to totally remove this entire feature. |

## UE feedback enhancements for HARQ-ACK

RAN1 made good progress on UE feedback enhancements for HARQ-ACK. However, there was one contentious issue with reference to PUCCH carrier switching: whether or not PUCCH carrier switching should include SUL and if so, which cases are supported.

**Question/Request#2: Moderator would like to check company views on SUL and PUCCH carrier switching with reference to HARQ-ACK feedback enhancements.**

|  |  |
| --- | --- |
| **Company** | **Views** |
| CMCC | RAN1#106-e was trying to clarify/discuss the scenarios for PUCCH carrier switching, specifically the following 4 cases were under discussion:**Case 1: PUCCH carrier switching among different cells not being configured with SUL****Case 2-1: PUCCH carrier switching among different cells where at least one cell is configured with SUL. For the cells having SUL configured, PUCCH is only configured either for NUL or SUL.****Case 2-2: PUCCH carrier switching among different cells where at least one cell is configured with SUL. For cells having SUL configured, PUCCH may be configured for NUL carrier, SUL carrier or both****Case 3: PUCCH carrier switching for a single cell configured with SUL and having PUCCH configured for NUL and SUL**Based on the discussion in RAN1, it seems some companies have concern on the cases involving SUL. ***From our perspective, both CA case and SUL related cases should be supported for PUCCH carrier switching***. From CMCC perspective, both CA and SUL are important features and deployment scenarios, therefore we should do the enhancements for both, especially when there might be only very minor additional specification effort to support all the cases. Therefore, we proposal the following:**For PUCCH carrier switching, the following switching scenarios are supported in Rel-17:****Case 1: PUCCH carrier switching among different cells not being configured with SUL****Case 2-1: PUCCH carrier switching among different cells where at least one cell is configured with SUL. For the cells having SUL configured, PUCCH is only configured either for NUL or SUL.****Case 2-2: PUCCH carrier switching among different cells where at least one cell is configured with SUL. For cells having SUL configured, PUCCH may be configured for NUL carrier, SUL carrier or both****Case 3: PUCCH carrier switching for a single cell configured with SUL and having PUCCH configured for NUL and SUL** |
| Lenovo/Motorola Mobility | This can be discussed in RAN WG1 level. We don’t think it is necessary to discuss this topic in RAN-P. |
| Qualcomm | Consistent with our previous comments, Case 1 and Case 2.1 are in scope. Cases 2-2 and 3 are not in scope. This is the direct consequence of the RAN1 agreements we had up to now.  |
| Samsung | We are OK to include SUL for PUCCH carrier switching. However, in general, that should be under the requirement of minimum specification impact as agreed and as justified by the limited applicability of the feature.  |
| Xiaomi | We support to include the SUL in PUCCH carrier switching. On the one hand, SUL is already supported in preceding specification. On the other hand, switching among different carriers within one cell is an important case too, which should not be precluded. |
| Apple | We are open to the study on supporting SUL under PUCCH carrier switching, but prefer to make the decision at the working group level. |
| CATT | We support to include SUL for PUCCH carrier switching considering that the same design can be applied with minimal additional specification efforts if any and the interest and requirement from operator. |
| DOCOMO | We are fine to include SUL for PUCCH carrier switching. |
| Intel | We are open to consideration of Case 2-1 from RAN1#106-e. |
| China Telecom | From China Telecom’s point of view, enabling PUCCH carrier switching for the 4 cases as listed above involving SUL makes the benefits of the feature be applicable to more commercial scenarios with limited specification effort, so we support it. |
| China Unicom | SUL is an optional feature in 5G network. We should not rule it out.  |
| Huawei, HiSilicon | **We think all cases should be supported for PUCCH carrier switching, including CA case (i.e. case 1) and cases involving SUL (i.e. case 2-1, case 2-2 & case 3)**. Firstly, both CA and SUL have been deployed in practical network, it is beneficial to do the enhancements for both framework. From benefits perspective, the support of switching between NUL and SUL is exactly the same as the support of switching between FDD and TDD, and FDD and FDD under case 1. Secondly, it is expected that the additional standard effort to support all cases is very marginal and uniform design can be applied to all scenarios in almost all cases. Therefore, really there is no any reason to preclude scenarios involving SUL. **Therefore, we agree with the proposal from CMCC to take all the 4 cases for PUCCH carrier switching in Rel-17.** If people are really worried about the potential specification impact, we are fine to add some restriction, e.g. add “with minimum specification impact” to the end of the main bullet in the proposal from CMCC.  In addition, as described above, from motivation perspective, the support of switching between NUL and SUL is exactly the same as the support of switching between FDD and TDD, and FDD and FDD under case 1. If some company really insists not supporting switching between NUL and SUL, to be fair let’s only take case 1 and restrict that PUCCH carrier switching is only done among different TDD cells, though it will be a very unfortunate outcome.  |
| ZTE | For PUCCH carrier switching, RAN1 has only agreed Case 1. For other cases, we are open to consider and suggest further discussing in RAN1. In general, we think the following proposal from feature lead in RAN1#106-e has summarized the status very well: * *Continue to use the current notation on the feature ‘PUCCH carrier switching’ but to use the ‘PUCCH cell / target PUCCH cell / PUCCH reference cell’ for other proposal discussions as the lack of progress of whole feature.*
* *‘PUCCH carrier switching’ including SUL is not precluded in Rel-17 and can be further studied until the open issues about SUL are all addressed.*
 |
| Nokia, NSB | In contrast to other issues (different sub-sections) which had been extensively discussed in RAN1, the support of SUL for PUCCH carrier/cell switching is new as the issue had not been on the table even for the time-span of a full RAN1 meeting (the issue had just been raised in the middle of RAN1#106-e). There had not been any RAN1 input documents / TDocs or sufficient discussions in RAN1 due to this fact. Therefore, we think that we need to give companies some time to analyse and have the related discussions and agreement in RAN1. We agree with ZTE above, that if RAN action is needed the cited proposal from RAN1 feature lead from RAN1 could be the only agreeable thing here. We are specifically surprised, that some companies state that RAN should directly make a decision here (without prior RAN1 analysis) and then in other down-scoping discussions many of the same companies claim that more RAN1 discussions would be needed or the decision should be done in RAN1 (even though they had been discussed in RAN1 for more than a year).  |
| vivo | According to RAN1 HARQ-ACK enh. FL summary in R1-2108547, we are supportive for at least Case 2-1 and open to support Case 2-2 and Case 3 (Case description is listed as below). Compared to other HARQ-ACK enh. features, the PUCCH carrier switching is far behind the schedule, we think it is desirable that RAN can give some guidance so that RAN1 can focus on some details to finalize this feature. If it is difficult to have consensus on including SUL into PUCCH carrier switching, we think the proposed WA to support PUCCH carrier switching only involving TDD carriers should be taken to move forward. In addition, aiming for minimum specification impact as agreed for PUCCH carrier switching, we would like to propose the maximum number of carriers supported for PUCCH carrier switching is two. * Case 2-1: PUCCH carrier switching among different cells where at least one cell is configured with SUL. For the cells having SUL configured, PUCCH is only configured either for NUL or SUL.
* Case 2-2: PUCCH carrier switching among different cells where at least one cell is configured with SUL. For cells having SUL configured, PUCCH may be configured for NUL carrier, SUL carrier or both
* Case 3: PUCCH carrier switching for a single cell configured with SUL and having PUCCH configured for NUL and SUL
 |
| MediaTek | We are supportive of including SUL as part of the PUCCH carrier switching. In our view, there is no need to exclude any of the cases unless it has been shown that it will impact the design of the feature. So far, there is no issue that has been identified by including the SUL cases. |
| LG | We think Cell-level PUCCH carrier switching is sufficient (negative to switching between NUL and SUL in a cell considering time left).In the existing specification, switching between NUL and SUL has been different level from cells. We think switching between SUL and NUL is an operation within a cell, so we prefer to distinguish cell switching and carrier switching. PUCCH carrier/cell switching will need to define UE behaviour on a lot of aspects. We think it is desirable to minimize complexity of the feature, to proceed efficient discussion. Considering current situation, we suggest to subject the discussion to cell-level PUCCH carrier switching, and discuss whether to additionally require carrier-level switching on the top of cell-level switching afterward.  |
| Ericsson | From our point of view, Case 1 and Case 1-2 are covered by the current agreements. The reason is that the agreements describe the functionality of PUCCH carrier switching is applicable to cells configured with PUCCH. Extension to Case 2-2 and Case 3 is NOT direct extension of the agreement. It needs its own discussion and investigation to whether ADDIOTNALLY be supported on not.**Therefore, WG should proceed on completing the design of PUCCH carrier switching for Case 1 and Case 2-2 without relying on the outcome of discussion whether Case 2-2 and Case 3 are supported.** Proponents of Case 2-2 and Case 3 can present the arguments. The inclusion or not, should be decided in WG considering the overall situation of completion of Rel-17.Therefore, a useful guidance from plenary would be as the following for improved WoW:**Proposed conclusion:*** WG should proceed on completing the design of PUCCH carrier switching for Case 1 and Case 2-2 without relying on the outcome of discussion whether and how Case 2-2 and Case 3 are supported.
 |
| Panasonic | We don't see big difference on the amount of the standardization. This can be discussed in RAN1 level. |
| Sony | We are fine to consider SUL in PUCCH carrier switching which increase the benefit of this feature.  |

## CSI feedback enhancements to allow for more accurate MCS selection

RAN1 made the following conclusion on delta-MCS in RAN1#106-e after discussing the topic in GTW sessions and over emails.

|  |
| --- |
| **Conclusion**There is no consensus in RAN1 on the support of delta-MCS in Rel-17. |

Given the conclusion, no further discussions on delta-MCS will take place in RAN1 unless RAN decides otherwise.

During the RAN1 discussions in RAN1#106-e (August), the general thinking among all interested companies was that if delta-MCS needs to be supported in Rel-17, the decision would have to be made in RAN1#106-e in order to secure enough time for follow up specification details on delta-MCS (only two more RAN1 meetings left).

In RAN#93-e, Qualcomm, DOCOMO, Sony, CATT, ZTE, and Ericsson submitted RP-212107 [4] which proposes to re-open the discussions on delta-MCS in RAN1.

**Question/Request#3: Moderator would like to check company views on re-opening the discussions on delta-MCS in RAN1.**

|  |  |
| --- | --- |
| **Company** | **Views** |
| CMCC | We do not think it is a good idea to re-open the discussion on delta-MCS in RAN plenary meeting, especially considering that some companies observed the benefit brought by the it is not significant, and cannot justify the related enhancement. |
| OPPO | We are supportive to the principle as proposed in RP-212107 to re-open RAN1 discussion on delta-MCS. Meanwhile, we do not think plenary discussion should go to a detailed level as in RAN1 discussion; for example, the number of bits in delta-MCS report should be discussed and determined in RAN1. The guidance from RANP should be just on high-level.  |
| Futurewei | We also don’t agree to re-open the discussion on delta-MCS in RAN plenary meeting. The benefit of the scheme is not justified and there will be a lot of open questions and work. As stated in the SR of this WI, the progress is behind schedule. If any RAN plenary intervention is needed, it should be to down-scoping instead of re-opening issues. |
| Lenovo/Motorola Mobility | We prefer not to re-open the discussion, as argument to support or to oppose the scheme will most likely be repeated including the discussions on the performance, and applicability to new transmissions in different frequency resources. |
| Qualcomm | We are supportive of this proposal. As mentioned before, if some agreement can be reached on how to select among the alternatives, e.g. as in the following ▪ Alt. 1: Delta-MCS is reported in same resource as HARQ-ACK without additional time on top of the Rel-15 PDSCH-to-HARQ delay~~▪ Alt. 2: Delta-MCS is reported in resource separate from HARQ-ACK~~~~▪ Alt. 3: RRC configures between Alt. 1 and Alt. 2~~then the remaining time is sufficient in RAN1 to work out the rest of the details. We are open to other selection among the alternatives as well, but preferably it should conclude the selection in RAN#93e.  |
| Samsung | We have technical concerns on the proposal from RP-212107 and in particular, on:(a) not allowing additional UE processing time subject to UE capability (we do not even know yet the best metrics or a processing time required to obtain them), and(b) having 1 bit for delta-MCS (1 bit does not provide any information for the general case that BLER can vary among transmissions).We also believe that re-opening the discussion again is not likely to lead to a consensus on a design and will be counter-productive to the completion of Rel-17 IIoT. |
| Spreadtrum | We prefer not to reopen CSI enhancement, especially, there is still no analysis of impaction to PDSCH processing time. It is too urgent to conclude that when Delta-MCS is in the same PUCCH resource with HARQ-ACK, there is no additional time on Rel-15 timeline. We are open for further study if timeline issue can be included in the scope, and majority views support it. |
| Apple | RAN1 has already drawn a conclusion, which should be respected. In addition, Delta-MCS is quite different from conventional HARQ/CSI feedback (so its specification is no small thing), which should be carefully studied and then specified if necessary. We are not sure now there is enough time to do that, given there are only two meetings left. We prefer to focusing on work on the rest of URLLC topics. |
| InterDigital | We are ok to reopen the discussion related to delta-MCS if supported by majority companies although revisiting RAN1 agreement in RAN is not our preference. As pointed out by few companies, one of main concerns on the delta-MCS was additional UE processing time which can be addressed by the text proposed by Qualcomm. On the performance issues, there are still different views which can be discussed further in the working group if agreed to reopen.  |
| Quectel | Although we think delta-MCS is a useful feature for URLLC, we tend to agree with some other companies that it may not be a good idea to re-open the discussion. Given the impressions from RAN1 discussion, it is quite likely to end up with the same situation even if the discussion is re-open. |
| CATT | We support the proposal in RP-212107, which aims to find a way forward to support delta-MCS in Rel-17. |
| DOCOMO | We are supportive for the proposal. Regarding the potential workload issue, if we could achieve decisions on the necessity of additional timeline and resource for delta-MCS reporting as in RP-212107, the remaining time would be sufficient for the work item completion. |
| Intel | * RAN1 made a technical conclusion that “there is no consensus in R17 to support delta MCS”
* It was based on both performance evaluation and concerns about implementation, testability, overhead, increased processing delay for HARQ-ACK, etc
* Based on the above,
	+ it is not recommended that RAN plenary overrides RAN1 decision with the understanding that RAN plenary is not in full context of the technical part. The technical concerns still hold.
	+ the proposal still contains “further study” main bullet, that means we again postpone decision on support of this feature to the next meeting with only 2 meetings left
	+ with the whole R17 URLLC/IIOT item being in danger in terms of scope and expected completion time, it is wiser to re-allocate the TUs which were spent for CSI to other agendas
 |
| Huawei, HiSilicon | We prefer not to re-open the discussion unless there is hope to have a different outcome from more RAN1 discussion. However, based on the discussion in the past RAN1 meetings, the concerns from companies are not only on whether to introduce additional processing capability, thus it is expected that most likely we will get the same conclusion even more discussion are given. In addition, the workload of URLLC/IIoT is already high and we are discussing down-scoping of other objectives, therefore re-opening the discussion seems not good.  |
| ZTE | We support to re-open the discussion on delta-MCS in RAN1. Regarding the benefits, we agree the GTW comments that the reason we kept delta-MCS during the down-scoping in last RAN plenary is there was already a consensus among all companies about the benefits of delta-MCS over other reporting mechanism. From NW vendor perspective, it becomes more efficient to report delta-MCS and HARQ-ACK together in one PUCCH resource, thanks to addressing timeline issue as proposed in RP-212107.  |
| Nokia, NSB | We agree with some of the earlier comments, that delta-MCS could be a useful feature for URLLC but at the same time RAN1 made the conclusion to not pursue this further in Rel-17. Overturning a RAN1 conclusion in RAN less than three weeks later clearly seems to be not a good way to operate in 3GPP. But of course, if a strong majority of companies sees a need to overturn RAN1, we would not be objecting to re-open the related discussions.  |
| Telecom Italia | We do not support to re-open the discussion in RAN1 at this stage of the planned completion of Rel 17 |
| MediaTek | We are concerned with the fact that now the proposal in RP-212107 only considers zero delay for delta-MCS report transmission compared to the Rel-15 PDSCH-HARQ timeline. If this discussion to be re-opened in RAN1, the following modification to the proposal in RP-212107 must be considered:▪ ~~Support one~~ Identify feasibility of the following options:▪ Alt. 1: Delta-MCS is reported in same resource as HARQ-ACK without additional time on top of the Rel-15 PDSCH-to-HARQ delay▪ Alt. 2: Delta-MCS is reported in a separate resource from HARQ-ACK. A separate processing timeline is introduced for the delta-MCS reporting that is larger than the PDSCH-to-HARQ processing timeline. |
| LG | This issue should not be re-opened by respecting RAN1 decision (no consensus on it).As mentioned in RP-212107, there were some reasons that we couldn’t reach a consensus. Also, the situation could change in every time, so some concerns could be alleviated. However, we don’t think it couldn’t be a reason to re-open the discussion which has been concluded. The reason why we made the conclusion is that we respect chairman’s concern that it is difficult to complete the feature during two meetings without an agreement supporting the feature. We also think that it is doubtable there can be sufficient discussion time when we re-open the discussion from now on. Moreover, we would be careful to make the case to re-open the discussion which has been concluded. Obviously, we don’t think we can re-open all discussion even if some issues are resolved.  |
| Ericsson | As we commented in GTW, we are fine RAN plenary to decide the support of Delta-MCS where the alternatives are reduced as proposed in RP-212107 and the timeline issue is addressed. Upon the decision in RAN plenary, the work in RAN1 would be limited and can be continued.With respect to concern raised, in our understanding the feature would be subject to UE capability and provides considerable benefits to obtain enhanced CSI report without suffering the large overhead caused by 4-bits CQI report. Otherwise, the option would be not benefiting any CSI enhancements in Rel-17 when overhead is detrimental. |
| Panasonic | We also don’t agree to re-open the discussion on delta-MCS in RAN plenary meeting. |
| Sony | Our understanding of “no consensus” means that it is neither supported nor not supported in RAN1, due to objections. We noted that “objections” should be reserved for highly severe & destructive issues but they are used too casually in RAN1. We think that it is fine to re-consider delta-MCS because:* The main arguments against delta-MCS was that there were not sufficient details on the feature which we believe was highly unusual & unconventional for *any* feature in the history of 3GPP, where we force companies to agreed and lay out all the details of a feature before agreeing to support it. Although we did not meet this extraordinarily high standard of providing all details of the feature, we have a good framework agreed by the supporting companies as in RP-212107, which we can use to define this feature
* An ***objection*** rather than an argument was made that delta-MCS should not consume more processing time than HARQ-ACK and would not accept the possibility of configurations or UE capability indication. The supporting companies, notably a UE vendor, can now confirm that the processing time will not be affected. However, some other objecting companies seemed to have changed the goal post and wants more processing time to process delta-MCS instead. It seemed like delta-MCS needs to be some sort of Schrödinger's cat where it can be both, does not consume more processing time and also consume more processing time at the same instant.
* There are companies that showed gain and companies that did not show gain. This is not a surprise since the gain of this feature depends on the gNB scheduler which is network specific and we observed that at least 3 network vendors found gains and benefits in using this feature. It is therefore not accurate to say that there is no benefit whatsoever for delta-MCS.

Hence we think it is fair to re-consider delta-MCS. |

## Enhancements for support of time synchronization

Enhancements for support of time synchronization was discussed in RAN#92-e for possible RAN guidance but without any outcome. While some progress has been made in the working groups in Q3, there is still no formal decision on which scheme(s) is to be supported in Rel-17. Given the limited time left until the completion of Rel-17, the rapporteur for Rel-17 IIoT and URLLC has proposed the following compromise in [1]:

|  |
| --- |
| **Proposal 2: For propagation delay compensation enhancements, RAN to agree the following compromise proposal:** * **Support for baseline TA-based propagation delay compensation based on the Rel-15 / 16 timing advance procedure (i.e. Alt. 1) in Rel-17 without changes on existing TA requirements.**
* **Support for Rx-Tx measurement based propagation delay compensation as the (main) Rel-17 PDC enhancement.**
 |

The above proposal is also made in [2]. From moderator’s point of view, the above proposal seems to be a reasonable way forward to ensure that Rel-17 has proper support of time synchronization for the envisioned use cases.

**Question/Request#4: Are there any strong concerns on the above proposal from the work item rapporteur on enhancements for support of time synchronization?**

|  |  |
| --- | --- |
| **Company** | **Views** |
| CMCC | **For propagation delay compensation enhancements**Since current LMF-based RTT method involves CN, RAN and UE which costs long delay, it is not suitable for IIOT, which requires ultra-low delay. Hence, the design of enhanced RTT-based method only involved gNB and UE is needed. This means that the current NAS signaling for positioning needs to be adapted into AS signaling for the TSC PDC, which will require significant discussion for details. From our perspective, RTT-based PDC method is not so simple that can reduce the work load of the WID. Additionally, RAN1 has sent LS to RAN4 and RAN4 is involved in the discussion. Therefore, we prefer not to so rush to preclude the TA-based PDC solution in RAN plenary and continue the evaluation and discussion in RAN1/4/2. Maybe, a joint session of RAN1, RAN2 and RAN4 for this topic can be added into the slot. |
| OPPO | Yes, we do have the concern. As mentioned in GTW, RAN1 has not yet completed the analysis for RTT-based PDC to confirm its capability to meet RAN2 Uu interface error budget. On the other hand, thanks to focused efforts in RAN1 #106e, now RTT-based PDC becomes the PDC candidate having the largest spec impacts (examples including configuring/defining PRS outside of positioning protocol from RAN2, defining new CSI-RS-based timing sync performance requirements in RAN4, copying gNB Rx-Tx time difference report from wired link between gNb and positioning server to wireless link between gNB and UE, and etc). Therefore, if RTT-based PDC is selected now, the risk is either RAN1 finds out later it cannot meet RAN2 error budget even with feasible RAN4 performance requirement improvement, or RAN1 confirms RTT-based PDC can meet RAN2 error budget but RAN1/RAN2/RAN4 have hard time to complete all spec work in Rel-17 time frame.[1] mentions a “deadlock” between companies supporting RTT-based PDC and companies supporting TA-based PDC. We have different view on this statement. In our view, the real “deadlock” comes from the fact that RAN1 has three error models for TA-based PDC and another three error models for RTT-based PDC, so RAN1 cannot even agree upon a numerical comparison between the two error performances for RTT-based PDC and TA-based PDC respectively. Such “deadlock” is technical and should be solved in RAN1, for example, to narrow down to one single error analysis formula for each PDC candidate. Our preference is to continue the discussion in RAN1, e.g. to determine the error performance formula for all PDC solutions currently on the table (RAN1 may need to do this anyway in the end for the chosen PDC solution). If RANP intervention is indeed desired, we think RANP could give the following guidance * to make RTT-based PDC thinner, e.g., by picking just one DL-RS between PRS and CSI-RS, in order to make RAN2/RAN4 load lighter if RTT-based PDC is finally chosen by RAN1.
* whether to allow the capability of meeting RAN2 error budget being SINR dependent (So far there is argument that the one-way propagation delay estimation performance can be made better in RTT-based PDC by utilizing specific DL-RS but such improved performance in error budget calculation has to be SINR dependent [per RAN4 outcome]; in contrast, other PDC solutions such as TA-based PDC still stay with SINR-independent error budget calculation -- so the comparison among PDC solutions in this way does not seem to be applet-to-apple, due to different SINR conditions for timing error upper-bounds).

Finally, we would like to remind the group: OPPO provided a solution called implicit PDC in the past RAN1/RAN2 meetings since April, also mentioned in the last RANP. We showed this solution can have no impacts to RAN1/RAN4; RAN2 signaling modification could be sufficiently make it to meet RAN2 error budget. If the major interest here in RANP is to find a solution that can simply ensure timely completion of WI objective on PDC, we do not see a reason why this solution has been put out of consideration.  |
| Lenovo/Motorola Mobility | In our view, this should be concluded or agreed in RAN WG1 level. |
| Qualcomm | We agree with the moderator’s input proposal. The main PDC method should be RTT-based. In addition, TA-based method can be further supported as long as it is done without any TA procedure change/enhancement.  |
| Samsung | The progress in previous RAN 1 was good. We think technical discussions and decision can be made in working group. On the other hand, we can understand rapporteur’s concern. If this proposal is acceptable for most of companies, we can live with the proposal.  |
| Xiaomi | We prefer a single solution for PDC, considering the limited time remaining in Rel-17 and the standard work required in both RAN1 and RAN2. As both TA-based PDC and RTT-based PDC are targeting at resolving the same issue, the extra complexity of specifying two solutions is not necessary. |
| CATT | In general, we do not think RAN intervention is needed for PDC.For TA-based PDC enhancements, an LS has been sent to RAN4 and it is premature to preclude TA-based enhancements at this point before the reply LS from RAN4.For RTT-based PDC, RAN WG can continue the discussion regardless. |
| Intel | We are supportive.Note, that although we sent LS to RAN4 asking for feasibility of enhanced TA-based PDC, the timeline for the expected reply does not really allow to consider it in RAN1 work. Thus, the above WF looks quite reasonable. |
| Huawei, HiSilicon | We can accept proposal 2 from the rapporteur. Indeed it is challenging to complete PDC for all working groups since inter-communications needed across working groups. However, if it is not agreeable for companies because we didn't get feedback from RAN4 yet, it would be good if RAN can give some guidance as below:**Provide the following RAN guidance on propagation delay compensation enhancements:*** **RAN1 prioritize the discussion of RTT-based PDC in RAN1#106-e, and send LS to RAN2/4 if any issue relevant to other working group is identified.**
* **RAN4 should provide LS reply on RAN1 LS(s), e.g. R1-2108635 on TA-based PDC, before RAN1#107-e meeting.**

If RAN4 can provide feedback to RAN1 before RAN1#107-e, RAN1 might still be able to make decision on whether TA-based PDC and/or RTT-based PDC would be taken. From RAN1 perspective, once the decision is made, it seems not much additional work needed. Of course, then RAN2 and RAN4 need to complete the feature in one meeting in Q1 in 2020 also.  |
| ZTE | **We are not fine with the proposal.** **For TA-based solution, RAN1 has already sent an LS to RAN4 about feasibility. It’s better to** leave RAN1 for decision based on the technical assessment from RAN4.  **If the feasibility is confirmed by RAN4, it is easily to finish the specification work in time. Because TA-based PDC is already supported in legacy and few additional spec effort for enhancements is needed. For example, we can simply** reuse the mechanism specified in IAB, i.e., introducing a new MAC CE with higher granularity to indicate a more accurate TA on top of the legacy TA command. That is all what we need to specify.**For the RTT-based PDC,** companies still have different understanding about its framework in RAN1. I**t is too controversial, even without any consensus on sending the LS to RAN4. In addition, we agree above comments about the uncertainty of satisfying the requirement and larger spec impacts compared to TA-based solution. Thus, it is too premature and not reasonable to decide RTT based PDC as the only solution for Rel-17.**  |
| Nokia, NSB | Support. Given the current situation and the fact, that RAN1 was not able to e.g. agree on sending on LS on RTT based operation to RAN2 and/or RAN4 (e.g. just informing their conditional agreements) clearly shows that things are not on track there. These two competing methods have now been discussed in RAN1 for about a year (so nothing new there) without RAN1 being able to really be able to proceed by having some agreements on what actually in the end is to be supported. Note, that it is not just about when RAN1 is ready with its decision but there is also impact to other working groups such as RAN2, RAN3 and RAN4 which should not be forgotten.  |
| vivo | Yes, we have concern on above proposal. For both TA-based solution and RTT-based solution, it is not clear yet which one can meet RAN2 Uu interface error budget for all use cases. From the specification impacts and achieved progress, it is not reasonable to preclude to enhance TA-based solution:* For TA-based PDC, RAN1 already sent LS to RAN4 to ask the feasibility on enhanced Te and TA command indication granularity. Actually, it is possible to satisfy the requirement for all use cases based on TA-based PDC if the reply from RAN4 is positive. TA-based method has been studied and applied widely in NR and previous system. Less spec impact is required.

For Rx-Tx measurement based PDC, many parameters are not determined in RAN4 for evaluation, e.g.,* + $error\_{UE,RxTx diff}$ for 30kHz and δ value for 15kHz
	+ $error\_{BS,RxTx diff}$for fading channel

So, it is early to say Rx-Tx measurement based PDC can meet the requirement without RAN4 input/work. In addition, RTT-based PDC requires a new measurement procedure and reference signals other than PRS for Rx-Tx measurement if PRS is not configured. The spec impact is larger than TA-based method.  |
| MediaTek | **We have concern on the proposal, we do not think RAN intervention is needed for PDC. This should be left to RAN1 to decide which method to be supported based on technical merit.** |
| LG | We had discussed about which scheme would be able to cover specified scenarios. However nothing is clear yet, RTT-based PDC may cover all scenarios and TA-based PDC may be suitable for specific scenario, based on discussions so far. Considering limited time, we prefer to support either TA-based PDC only or RTT-based PDC only (if TA-based PDC cannot cover the considered scenario) rather than support both. |
| Ericsson | **We fully support the proposal.****We had similar discussion previous RAN plenary. Supporting the proposal helps the progress of WG. We should make the priority clear by RAN plenary that any work on enhancements should be spend on RTT-based while for TA-based, enhancement is not needed. In that way, we can complete the work with a useful outcome addressing different use cases.*** TA-based without enhancement for smart-grid use case (loose requirement)
* RTT-based (with enhancement) for control-to-control use case (tight requirement)
 |

## Enhancements based on new QoS related parameters

The work item rapporteur made the following proposal in [1] to ensure timely completion of the enhancements based on new QoS related parameters.

|  |
| --- |
| **Proposal 3: For the objective on New QoS parameter, RAN should provide the following guidance to RAN2:*** **Sharpen the focus and concentrate on the specification work for survival time solution based on “HARQ NACK” that RAN2 has agreed to work/study.**
* **Other options should be dropped for the time being.**
* **If no consensus can be reached by the end of Rel-17, RAN2 should postpone the discussion to future releases.**
 |

**Question/Request#5: Companies are requested to provide their views on the above proposal for RAN guidance to RAN2 on enhancements based on new QoS related parameters.**

|  |  |
| --- | --- |
| **Company** | **Views** |
| CMCC | We support this proposal and prefer that RAN2 only focus on the fast feedback mechanism, i.e. HARQ NACK or UL retransmission triggering the adjustment of resource usage, e.g. PDCP duplication triggering.  |
| OPPO | We are generally fine with the first two bullets. But wonder why the last bullet is needed. To our best knowledge, there is a chance that Rel-18 does not have URLLC item. So the last bullet provides almost nothing but some confusion because it is a rare practice to promise a “postponed feature” to show up by a delay of more than one release. If the intention is just to say “**If no consensus can be reached by the end of Rel-17, the objective on new QoS parameter should be removed from WID**”, this can be discussed in December RANP. Anyhow “No consensus, no support in the release” is a common practice in 3GPP.  |
| Lenovo/Motorola Mobility | We are supportive of the proposed RAN guidance to RAN2.  |
| Qualcomm | Our view is similar to Oppo’s. We agree with the first two bullets. The last bullet seems unnecessary as it is not really actionable. What will be discussed in future releases is up to future SI/WI scope(s). We cannot make decisions about that now. The only thing we can decide now is what is in and what is out of Rel-17. I’m sure the rapporteur intended to say the same, but the proposed bullet could be interpreted differently.  |
| Samsung | RAN2 discussion on QoS related scheduling has been well-organized so far and on-time completion is still possible. We think whether to drop other solutions can be decided in WG2, after technical discussions in the next quarter. |
| Xiaomi | We support the proposal, as this can reduce the work load in RAN2 and facilitate the QoS discussion in Rel-17. |
| Apple | While we are fine to concentrate on the HARQ NACK as initial/first approach, the exact solution is rather not yet settled. There is also an option to combine the HARQ NACK with a TX-side timer and as Nokia pointed out in the discussion paper, many details are yet to be established. We think the solution options should be a RAN2 WG decision. Plus, it seems a bit premature to drop other options currently. In particular, the second bullet should be removed from proposal 3. Bullet 1 reflects the direction that RAN2 has agreed, maybe there is no need “to sharpen the focus”. Further, other methods to enhance reliability during survival time have not quite been discussed. Rather than removing enhancement options we think the discussion can be continued in Rel-18 to allow for proper evaluation of those items. |
| CATT | We do support the proposal except the last bullet. RAN2 WG has progressed the difficult issue of Survival Time step by step through several constructive discussions, and it should not be envisioned, at this stage, that we fail on the design details stage. Indeed, assuming the first 2 bullets of the above proposal, we believe that it would be unlikely that no consensus can be reached on the exact design of the solution based on “HARQ-NACK”. And even in that case, it can be discussed in next plenary. |
| DOCOMO | We are fine with the proposal to facilitate the discussion. |
| Intel | We recommend leaving the discussion to RAN2, and we don’t see strong need to RAN intervention to this topic. |
| Huawei, HiSilicon | We support the first two bullets in the above proposal from the rapporteur. In order to ensure at least some enhancement defined for New QoS parameters in Rel-17, it is the time for us to focus and concentrate on the specification work for survival time solution based on “HARQ NACK” that RAN2 has agreed to work/study. At this stage, it is not clear whether we will have Rel-18 IIoT/URLLC item, thus the third bullet might not be feasible.  |
| ZTE | RAN2 has agreed stage-2 direction to go for "HARQ NACK” solution but meanwhile companies have identified some remaining issues for this solution. We believe RAN2 can handle these issues when they specify the "HARQ NACK” solution. So we don't see any necessity of RAN guidance on this issue. |
| Nokia, NSB | Support first two bullets i.e. all except the last bullet, as commented by other companies the third bullet should be removed (as this a clear consequence, if RAN2 will not be ready in time).  |
| vivo | We do not think RAN intervention is necessary for this topic. RAN2 has agreed to work on at least HARQ NACK solution, with details FFS. As the impact of HARQ NACK solution to RAN1 and RAN2 is not completely clear to us, we think it is safe to only agree HARQ NACK solution can be prioritized. Other solution, i.e., TX\_timer based solution does not need to be excluded by RAN and we should leave the discussion and decision to corresponding WG.  |
| Telecom Italia | We support the rapporteur’s proposal. At this stage of the planned completion of Rel 17 |
| LG | We agree on first two proposals. Considering the remaining discussion time, it is necessary to focus on completion of HARQ NACK based solution than to continue discussion on multiple options for ST. We also agree on the intention of the last proposal but have sympathy to other companies saying that it should be removed from the R17 WID than proposing to postpone to the next release because it may depend on whether we will have relevant WI or not. |
| Ericsson | We support the proposal (first two bullets). If agreed, it is important to clarify that the exact definition of "HARQ NACK" is still open for discussion, for example, can be re-tx grant, configured grant type 2 activation command, etc. On 3rd bullet, similarly to others, we think last bullet needs reformulation although the intention seems to be as explained by OPPO, QC. We share the intention. That would be the consequence if the feature cannot be completed. |
| Panasonic | We support the proposal. |

# Intermediate phase

Based on the company inputs in the initial round, the moderator has summarized the status with proposals for moving forward in the following subsections.

## Intra-UE multiplexing and prioritization enhancements

The following alternatives for downscoping were identified during the initial round discussions. Each of the alternatives had good level of support in the initial phase.

1. Downscope the support for simultaneous TX of PUCCH/PUSCH
2. Downscope the support for PHY prioritization of overlapping DG-PUSCH/CG-PUSCH
3. Downscope the support for both simultaneous TX of PUCCH/PUSCH and PHY prioritization of overlapping DG-PUSCH/CG-PUSCH

In addition to the companies which proposed downscoping of some sort, there were multiple companies who indicated that RAN intervention (downscoping) was not needed and preferred further WG level discussions. Considering different aspects and company views, Alt-B seems to be acceptable to majority of companies. Furthermore multiple companies have indicated that they can accept Alt-C as well. Moderator would like to check if companies can accept the following Proposal#3.1. If the Proposal#3.1 cannot be accepted due to strong concerns, moderator recommendation would be to take Alt-B.

**Proposal#3.1: (Alt-C) Downscope the support for both simultaneous TX of PUCCH/PUSCH and PHY prioritization of overlapping DG-PUSCH/CG-PUSCH.**

|  |  |
| --- | --- |
| **Company** | **Views** |
| Qualcomm | We find only Alt-B acceptable. |
| OPPO | We support Proposal 3.1 (Alt-C).  |
| DOCOMO | We are fine with Alt-B but not with Alt-C. As remaining issues for simultaneous PUSCH/PUCCH Tx should be less, we think it is OK to keep it. |
| Samsung | Support the proposal. Also OK with Alt-B |
| Apple | We support Alt.-C, can also live with Alt-B. |
| Spreadtrum | We support proposal. also fine with Alt-B |
| InterDigital | We prefer Alt-A. The required workload to complete PHY prioritization of overlapping DG-PUSCH/CG-PUSCH is relatively small but it addresses important scenario. If we need to choose between Alt-B and Alt-C, our preference is on Alt-C. |
| Intel | Agree with Proposal 3.1. |
| CATT | We are fine with the proposal, i.e. Alt-C. We are also fine with Alt-B. |
| vivo | We support above Proposal#3.1. |
| Lenovo/Motorola Mobility | We are fine with the proposal (Alt-C). |
| Nokia, NSB | We could accept the proposal, i.e. Alt. C, although not our preference at all but considering the majority view from companies in the initial round, and we could also be fine with Alt. A, but* We still think Alt.-D, downscoping of “Multiplexing UCI of different priorities on PUCCH or PUSCH” would be the best choice overall considering the current progress and the still needed work in Rel-17. But it seems this was not brought even up as an alternative for discussion by the moderator for the intermediate round.
* We cannot agree to Alt-B, as this is the smallest / least effort of the three features and does not solve the problem we are having. Moreover, the reason to introduce PHY prioritization in the first place had been to schedule a more urgent PUSCH and pre-empt the queue there. The CG/DG overlapping PUSCH there would only complete the needed PHY prioritization in this respect. Therefore, keeping the other two features but not this one would just be illogical from PHY priority based UL operation / usefulness as well as also considering the reduction of effort here.
 |
| LG | We support the moderator’s proposal (Alt-C). |
| ZTE | Support the proposal, and also fine with Alt B.  |
| China Telecom | We are fine with Proposal#3.1: (Alt-C), and also OK with Alt-B. |
| Huawei, HiSilicon  | We support above Proposal#3.1. For Alt-B, as we expressed before, once the issues for Rel-16 maintenance are addressed, then seems not much additional work needed for it in Rel-17, thus it doesn't help much from reducing workload perspective.  |
|  |  |

## UE feedback enhancements for HARQ-ACK

There was no consensus in the initial round on whether PUCCH carrier switching should include SUL or not. At least three companies indicated that the decision should be made in RAN1 and not in RAN. While there is no consensus, majority of companies have indicated that they can be at least open towards including SUL for PUCCH carrier switching. As discussed in RAN1 and also provided by multiple companies, there are four possible cases under consideration with Case 2-1, Case 2-2, and Case 3 involving SUL:

* Case 1: PUCCH carrier switching among different cells not being configured with SUL
* Case 2-1: PUCCH carrier switching among different cells where at least one cell is configured with SUL. For the cells having SUL configured, PUCCH is only configured either for NUL or SUL.
* Case 2-2: PUCCH carrier switching among different cells where at least one cell is configured with SUL. For cells having SUL configured, PUCCH may be configured for NUL carrier, SUL carrier or both
* Case 3: PUCCH carrier switching for a single cell configured with SUL and having PUCCH configured for NUL and SUL

Moderator would like to check company views on the possible support of Case 2-1, Case 2-2, and Case 3 in Rel-17 for the intermediate round.

|  |  |
| --- | --- |
| **Company** | **Views** |
| Qualcomm | Consistent with our previous comments, only Case 2.1 is in scope. Cases 2-2 and 3 are not in scope. This is the direct consequence of the RAN1 agreements we had up to now.  |
| DOCOMO | We are open to support SUL Cases 2-2 and 3 in addition to Case 2.1. However, it is more important to finalize the fundamental features for PUCCH carrier switching, i.e., to support at least Cases 1 and 2-1, in the remaining RAN1 meetings. In that sense, we are also OK with the conclusion proposed by Ericsson as below in this meeting, and to defer to RAN1 whether/how to support Cases 2-2 and 3.**Proposed conclusion:*** WG should proceed on completing the design of PUCCH carrier switching for Case 1 and Case 2-1 without relying on the outcome of discussion whether and how Case 2-2 and Case 3 are supported.
 |
| Samsung | Support Cases 2-1 and 3. Do not support Case 2-2 because it will increase spec impact for diminishing benefit of a feature that already has limited applicability/use cases |
| Intel | Case 1 and Case 2-1 are natural and seems covered by the agreements. The other two cases require more technical discussion in RAN1 to be supported. |
| CATT | We support all the cases. |
| vivo | We are fine to include all cases for PUCCH carrier switching.  |
| Lenovo/Motorola Mobility | Case 2-2 would require heavy spec work but with marginal benefits. In our view, RAN1 should focus on completion of case 1 and case 2-1 for the remaining RAN1 meetings for Rel-17.  |
| Nokia, NSB | We agree and would be supportive of the proposed conclusion in the DOCOMO reply (initially proposed by Ericsson in the initial round). As mentioned by some companies, we also think that cases 2-2 and 3 would require further discussions and Case 1 and Case 2-1 to be covered by the current agreements.  |
| LG | As we had mentioned in RAN1 discussion, we support case 1 and case 2-1. The case 1 and case 2-1 can be supported by cell-level indication only and would have least complexity. For case 2-2 and 3, we think it require considerable time to discuss. Considering PUCCH carrier switching is a part of HARQ-ACK agenda which is also a part of WI, we think case 1 and 2-1 would be sufficient for current situation. The case 2-2 and 3 can be discussed afterward for carrier-level indication on the top of cell-level indication. |
| ZTE | We are fine to support Case 2-1. If any guidance needed, we are fine with the proposed conclusion from Ericsson and DOCOMO. Without knowing how to address the open issues for Case 2-2 and Case 3 and how much work would be needed, it would be imprudent to agree on these two cases in this plenary meeting. In general, we are open to consider these cases but suggest to further discuss the details in RAN1 first.  |
| China Telecom | We support all the cases involving SUL for PUCCH carrier switching. |
| Huawei, HiSilicon | As replied in the initial round, we think all cases should be supported for PUCCH carrier switching, including CA case (i.e. case 1) and cases involving SUL (i.e. case 2-1, case 2-2 & case 3). Detailed reasons as given before. Looking at the comments from companies, for case 2-2, if people feel more comfortable to leave it as FFS at this moment, we can accept it since we still need to discuss the maximum number of supported PUCCH carriers for the feature of PUCCH carrier switching. However, really there is no any technical reason to preclude case 3. As we explained before, from benefits perspective, the support of case 3 is exactly the same as the support of switching between FDD and TDD, and FDD and FDD under case 1. In addition, from complexity perspective, actually it is the simplest scenario among the 4 cases.  |
| CMCC | Consistent with our previous comments. We support to include all cases. |
|  |  |
|  |  |

## CSI feedback enhancements to allow for more accurate MCS selection

In the initial round, at least 12 companies have explicitly indicated negative views on re-opening RAN1 discussions on delta-MCS. Even though there are 7 companies (including 6 companies who have co-sourced RP-212107) with positive views on re-opening the RAN1 discussions, it is clear that RAN will not be able to achieve consensus to do so. Based on the initial round comments, the following proposal is provided. Companies are invited to provide additional views on the following proposal if your company position has changed compared to the initial round. If the views are mostly unchanged, moderator recommendation is to close the discussion on delta-MCS for RAN#93-e.

**Proposal#3.3: No RAN intervention is needed on delta-MCS.**

|  |  |
| --- | --- |
| **Company** | **Views** |
| Qualcomm | Our views have not changed; therefore, we don’t agree with Proposal#3.3.  |
| DOCOMO | Our views have not changed; we still prefer to reopen and continue the discussion on delta-MCS. |
| Samsung | Agree with moderator’s proposal.  |
| Apple | Agree with moderator’s proposal. |
| Spreadtrum | Agree with moderator’s proposal. |
| InterDigital | We are ok with the moderator’s proposal given that reopening the discussion on delta-MCS is not the preferred option from majority number of companies. |
| Intel | Support Proposal 3.3 |
| CATT | Our views have not changed and we still prefer to continue discussing delta-MCS. |
| Lenovo/Motorola Mobility | We support Proposal#3.3. |
| Nokia, NSB | We could be fine with moderator’s proposal, as if we don’t achieve consensus in RAN to overturn the RAN1 conclusion (which from the feedback from companies in the initial seem rather improbable) or would not achieve any conclusion in RAN (either way), the RAN1 conclusion would still stand.  |
| LG | We support the moderator’s proposal.  |
| ZTE | We still prefer to reopen the discussion on delta-MCS.  |
| Huawei, HiSilicon | Agree with moderator’s proposal. |
| CMCC | Agree with moderator’s proposal |
|  |  |
|  |  |

## Enhancements for support of time synchronization

Of the 15 companies who provided their company views in the initial round, 8 companies preferred to continue discussions in working groups without RAN intervention at this point. While making a decision in RAN on which PDC method(s) to proceed with would be difficult, RAN guidance to ensure that relevant working groups can complete their work in time would be beneficial.

**Proposal#3.4: For the objective on enhancements for support of time synchronization, RAN should provide the following guidance:**

* **RAN4 to provide reply LS to RAN1 (e.g. in response to R1-2108635 on TA-based PDC) before the start of RAN1#107-e (Nov 11th) to facilitate completion of RAN1 work on enhancement for propagation delay compensation**

|  |  |
| --- | --- |
| **Company** | **Views** |
| Qualcomm | We would be ok with Proposal#3.4, conditioned on making the following changes, in line with the Huawei proposal:**Proposal#3.4: For the objective on enhancements for support of time synchronization, RAN should provide the following guidance:*** **RAN1 prioritize the discussion of RTT-based PDC in RAN1#106-e, and send an LS to RAN2/4 if any issue relevant to other working group is identified.**
* **RAN4 to provide reply LS to RAN1 (e.g. in response to R1-2108635 on TA-based PDC) before the start of RAN1#107-e (Nov 11th) ~~to facilitate completion of RAN1 work on enhancement for propagation delay compensation~~**
 |
| OPPO | We are ok to Proposal from moderator, but disagree with modification from Qualcomm to focus on RTT-based PDC only in RAN1 Oct meeting, because:* Similar to RTT-based PDC, TA-based PDC also has three error performance formula from which RAN1 needs to pick just one. So the focus cannot be RTT-based PDC only in next RAN1 meeting if RAN1 is supposed to keep TA-based PDC in the loop.
* We have strong concern in seeing implicit PDC solution is continuously ruled out from discussion of solution selection w/o giving any technical reason, especially under the circumstance that the key concern here is to timely complete PDC feature while implicit PDC can have spec impacts to RAN2 only.
 |
| Samsung | Agree with moderator’s proposal. We think that RAN1 can discuss specific solution and potential issue without having additional information on top of the proposal.  |
| Intel | The next RAN4 #101-e meeting will take place in Nov and partially overlaps with the RAN1 meeting. The RAN4 discussions can take place in RAN4 #101-e meeting, but we are not sure if RAN4 agreement can be reached within one meeting. So, there is a risk that feedback may not be received before the start of RAN1 #107e meeting or not all conclusions could be reached by that time.Taking the above into account, we still prefer the original WF which makes things clear so that RAN1 can spend the remaining two meetings specifying the necessary details. |
| CATT | We support moderator’s proposal. |
| vivo | We support moderator’s Proposal#3.4. |
| Lenovo/Motorola Mobility | We are fine with the proposal. |
| Nokia, NSB | We think the moderator proposal will not be sufficient, as also noted by Intel in the initial reply in terms of timeline.We think at least some additional guidance as proposed by HW & QC would be needed, but to address the concerns from companies to focus on RTT based we could clarify that of course we continue to complete the evaluation assumptions for both methods (modification in yellow on top of QC / HW):  **Proposal#3.4: For the objective on enhancements for support of time synchronization, RAN should provide the following guidance:*** **Besides completing the evaluation assumptions for TA and RTT-based PDC, RAN1 prioritize the discussion of RTT-based PDC in RAN1#106-e, and send an LS to RAN2/4 if any issue relevant to other working group is identified.**
* **RAN4 to provide reply LS to RAN1 (e.g. in response to R1-2108635 on TA-based PDC and a potential RAN1 LS on RTT-based PDC) before the start of RAN1#107-e (Nov 11th)**
 |
| LG | We are fine with the moderator’s proposal. |
| ZTE | We are fine with the proposal. We don’t think any RAN guidance is needed to prioritize any detailed discussion in RAN1.  |
| Huawei, HiSilicon | We are fine with moderator’s proposal. As to the bullet on prioritizing RTT-based PDC, seems controversial among companies, however I think it doesn't make much difference from RAN1 handling perspective, no matter whether we add it or not. When I made the suggestion in the initial round, I went through the potential remaining issues for both TA-based PDC and RTT-based PDC, and found that there are more issues to discuss for RTT-based PDC and we may need to send LS to RAN2/RAN4 also on RTT-based PDC, that’s why I think ok to say prioritize RTT-based PDC, but it doesn't mean that we won’t discuss TA-based PDC. From feature lead perspective, I think we will try to discuss the remaining issues for both TA-based PDC and RTT-based PDC as much as possible, just to prepare well for completing TA-based PDC and/or RTT-based PDC in Rel-17 in time.For the second bullet on RAN4, I think it is fine to update as what Nokia suggested. I used “e.g.” in the initial round because I was thinking we might send LS to RAN4 on RTT-based PDC also, ok to make it clearer.  |
| CMCC | We are supportive to continue the TA-based PDC scheme as we explained in initial phase. But just for reminder, it is not feasible for RAN4 to provide reply LS to RAN1 before the start of RAN1#107-e meeting since RAN4’s next meeting is held at Nov. |
|  |  |

## Enhancements based on new QoS related parameters

In general, companies were positive towards the initial round proposal (from the WI rapporteur) with a revision to remove the last bullet. The revised proposal is provided below. Companies are invited to provide additional views on the following proposal if there are strong concerns. If there are no strong concerns, moderator recommendation is to take Proposal#3.5 and close the discussion on enhancements based on new QoS related parameters for RAN#93-e.

**Proposal#3.5: For the objective on New QoS parameter, RAN should provide the following guidance to RAN2:**

* **Sharpen the focus and concentrate on the specification work for survival time solution based on “HARQ NACK” that RAN2 has agreed to work/study.**
* **Other options should be dropped for the time being.**

|  |  |
| --- | --- |
| **Company** | **Views** |
| Qualcomm | We agree with Proposal#3.5. |
| OPPO | We are ok with Proposal 3.5.  |
| DOCOMO | We agree with Proposal#3.5 |
| Samsung | We are ok with Proposal#3.5 |
| Apple | In our view the remaining set of options can be discussed at WG level since some of the technical details are still open. Thus, we suggest removing the second bullet. |
| InterDigital | RAN2 is on track to complete discussions on survival time on time. RAN2 has already agreed to focus on HARQ-NACK based solutions and is still discussing other solutions. Which solutions R2 select can therefore be decided in WG2. We don’t see the need for plenary intervention at this point. |
| Intel | We think the issue should be left up to RAN2. However, if majority considers that sharpening the scope is required, we can accept it. |
| CATT | We support Proposal#3.5. |
| vivo | We have some concerns on the 2nd sub-bullet of the proposal. As commented, many details of the HARQ NACK solution is not clear yet, there is also option to combine the HARQ NACK and Timer. We think RAN2 should decide whether to drop other options or not based on the progress. We would be fine with the proposal with following changes: **Proposal#3.5: For the objective on New QoS parameter, RAN should provide the following guidance to RAN2:*** **Sharpen the focus and concentrate on the specification work for survival time solution based on “HARQ NACK” that RAN2 has agreed to work/study.**
* **~~Other options should be dropped for the time being.~~**
 |
| Lenovo/Motorola Mobility | We are supportive of Proposal#3.5.  |
| Nokia, NSB | We support Proposal#3.5.  |
| LG | We agree with Proposal#3.5.  |
| ZTE | We are fine with first bullet but still think the second bullet is unnecessary.We share similar views as vivo that many details of the HARQ NACK solution are not clear and need to be further discussed anyway. It is possible that some technical points (maybe from other options) can be useful to complete the “HARQ NACK” solution or solve some remaining issues of it. We don’t see any reason to prevent such discussion in RAN2. So, we also suggest deleting the second bullet.  |
| Huawei, HiSilicon | We support Proposal#3.5.  |
| CMCC | We agree with Proposal#3.5. |
|  |  |
|  |  |

# Final phase

…

# Conclusion

…

# References

[1] RP-211939 Rapporteur views on status of Rel-17 URLLC/IIoT WI Nokia, Nokia Shanghai Bell

[2] RP-212002 Discussion on progress in Rel-17 URLLC/IIOT Intel Corporation

[3] RP-212024 Scope discussion on Rel-17 IIOT/URLLC vivo

[4] RP-212107 Views on RAN1 scope for URLLC/IIOT Qualcomm, DOCOMO, Sony, CATT, ZTE, Ericsson

[5] RP-212235 Progress and scope of Rel-17 enhanced IIoT and URLLC CATT

[6] RP-212349 Propagation Delay Compensation for URLLC/IIoT Ericsson

[7] RP-210854 Revised WID: Enhanced Industrial Internet of Things (IoT) and ultra-reliable and low latency communication (URLLC) support for NR Nokia, Nokia Shanghai Bell