**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:

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| 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]
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# 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?**

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| **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
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| 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.
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| 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.
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| 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
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| 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.**
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| 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. |
| Vodafone | We expect that some downscoping will help with keeping Rel 17 on schedule. |
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## 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.**

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| **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.*
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| 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
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| 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.  |

## 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.

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| **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.**

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| **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
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| 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.  |

## 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]:

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| **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.**
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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?**

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| **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. |

## 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.

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| **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.**
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**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.**

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| **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. |

# Intermediate phase

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# Fine tuning phase

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# Conclusion

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# 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