**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** |
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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** |
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## 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. |
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## 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. |
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## 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.  |
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# 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