3GPP TSG-RAN WG3 #119bis-e R3-231899

Online, 17-26 April 2023

Agenda Item: 26.2

Source: Nokia (moderator)

Title: Summary of Offline Discussion for CB # URLLC\_RANenh

Document for: Approval

# Introduction

**CB: # URLLC\_RANenh**

**AMF provides Reporting control information to RAN for per UE:**

**- Introduce a new Clock Quality Reporting Control Information IE in the existing Time Synchronisation Assistance Information IE over NGAP? or AMF signals those control infor via new NGAP procedure?**

**- Introduce a new IE for Area scope of Time distribution?**

**- Encoding of Clock Quality Reporting Control Information?**

**RAN Reports TSS to AMF:**

**- Report TSS to AMF via NGAP based on gNB capability? or AMF acquires RAN TSS via OAM?**

**- How to report gNB capability of TSS reporting?**

**- Whether the TSS reporting configuration e.g, threshold is provided by AMF or pre-configured by OAM?**

**- Whether to use a new NGAP procedure or an existing procedure,e.g, NG SETUP REQUEST/RAN CONFIGURATION UPDATE to report timing synchronization status to AMF?**

**- Encoding of TSS Information?**

**Adapting traffic scheduling:**

**- Enhance existing NGAP TSC Assistance Information IE to include Burst Arrival Time Window, AMF Capability for adaptation, Periodicity Range, etc?**

**- Proactive RAN feedback to AMF via the response of PDU session resource setup/modify?**

**- Reactive RAN feedback to AMF via PDU session resource notify?**

**- What feedback information should be provided in the case of proactive or reactive feedback?**

**- Wait RAN2 progress of UL Scheduling adaptation**

**- Capture agreements and open issues**

(moderator - Nok)

Summary of offline disc [R3-231899](file:///C:\Users\q12059\AppData\Local\Temp\7zO023A30BE\Inbox\R3-231899.zip)

# For the Chairman’s Notes

[TBD]

# Discussion (round 1)

Please provide your Round 1 views (7 questions) by **9:00 UTC Thursday April 20th**, before the TRS\_URLLC online session.

## 5GS network timing synchronization status and reporting

### NGAP

There are many commonalities in the submitted papers. As a first step, it seems possible to merge many of the proposals into the following “baseline”:

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| For objective 1a (AMF providing clock quality reporting control information per-UE to the gNB):   1. Include a new *Clock Quality Reporting Control Information* IE in the existing *Time Synchronisation Assistance Information* IE. 2. The new *Clock Quality Reporting Control Information* IE includes Clock Quality Detail Level that can be set to “metrics” (clock quality metrics) or “indication” (acceptable/not acceptable indication).    1. If the Clock Quality Detail Level is set to “indication”, then *Clock Quality Acceptance Criteria* IE is included.   For objective 1d (gNB reporting node-level RAN timing synchronization status information towards the AMF, based on RAN timing synchronization status reporting configuration and gNB capability):   1. A new *RAN Timing Synchronisation Status Information* IE can be signalled towards the AMF    1. It contains Synchronisation State, Traceable to UTC, Traceable to GNSS, Clock Frequency Stability, Clock Accuracy, and Parent Time Source.    2. The encoding of Synchronisation State, Traceable to UTC, Traceable to GNSS, and Parent Time Source is ENUMERATED with codepoints aligned with TS 23.501.    3. The encoding of Clock Frequency Stability is FFS.    4. The encoding of Clock Accuracy is FFS, to be decided by RAN3 and should allow for different RAN implementations. 2. In which NGAP message(s) to include the *RAN Timing Synchronisation Status Information* IE requires further RAN3 discussion (**see Question #3**).   A draft TP capturing the above is in the CB folder, filename “**R3-23xxxx TP\_NGAP\_objective1**” |

Moderator’s comments:

* The above merges proposals from Nokia [3] (P1, P2, P3), Qualcomm [5] (P4, P5, P6), Ericsson [7] (P1, P2), CATT [8] (P1, P4, P5, P6), Huawei [11] (P4, P5), Samsung [13] (P1-1, P3), ZTE [15] (P1, P2, P6), and China Telecom [17] (P1).
* For item #2, there were several different proposals for how to encode the Clock Quality Detail Level. **The TP includes 2 options: Option A (CHOICE) and Option B (ENUMERATED).**
* For item #3, there is still some ongoing discussion in SA2 whether to e.g. add/remove certain enumerated values or to add/remove certain clock quality metrics. Therefore, a general Editor’s Note is included to indicate that the *RAN Timing Synchronisation Status Information* IE may be further refined based on SA2 and RAN3 progress.

**Question #1: Are the proposals listed in the box above agreeable? Please provide your comments below and/or directly in the draft TP. Please also indicate if you have a preference for the encoding of 9.3.1.x1 in the TP (Option A or Option B).**

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| *Company* | *Comment* |
| Huawei | Agree with the proposals.  We prefer option 1 (Choice structure) on the Clock Quality Reporting Control Information, since it clearly provides two possible ways from the AMF.  Also related to the question2 below (whether the clock metrics are UE level or not), option 1 can easily indicate the UE level metrics if this has consensus. |
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Clock Quality Detail Level is defined in TS 23.501 as follows: “*It indicates whether and which clock quality information to provide to the UE and can take one of the following values: clock quality metrics or acceptable/not acceptable indication.*”.

It seems that companies may be interpreting the “which” in this definition in two different ways:

* Interpretation 1: “Which” means which of the two possible values for Clock Quality Detail Level, i.e. clock quality metrics or acceptable/not acceptable indication.
* Interpretation 2: “Which” means which of the clock quality metrics to provide to the UE when the Clock Quality Detail Level is set to “clock quality metrics” (see Proposal 2 in [15]). This interpretation appears to assume that the UE is subscribed to a specific set of clock quality metrics, and only that set of metrics are delivered to the UE.

The implication to RAN3 signalling of these two interpretations can be seen as follows:

**For the case where Clock Quality Detail Level is set to “clock quality metrics”:**

**Option A: The Clock Quality Reporting Control Information additionally indicates which specific clock quality metrics are requested to be provided to the UE. When a RAN TSS report is triggered, it includes (based on gNB capability) only the requested clock quality metrics.**

**Option B: The Clock Quality Reporting Control Information does NOT indicate the clock quality metrics to provide to the UE, i.e., it is implicit that all clock quality metrics are requested to be provided to the UE. When a RAN TSS report is triggered, it includes (based on gNB capability) all clock quality metrics.**

Moderator’s comments:

* Option A appears to require support in the CN to convey the requested clock quality metrics over CN interfaces to the AMF. Therefore, it seems RAN3 should align with discussion/decisions in SA2.

**Question #2: Please state your view whether RAN3 signalling should support Option A or Option B.**

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| *Company* | *Comment* |
| Huawei | We think option A is the correct understanding, after internally checking with our SA2 colleague. Also, it is specified in TS 23. 501 that “following fields” (containing the clock metrics) are received form the UDM or TSCTSF which is per UE information.   * AMF also includes the clock quality reporting control information provided by the TSCTSF or received from UDM. Clock quality reporting control information may be present in the AF request or Access and Mobility Subscription data at the UDM, and contains the following fields: |
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Regarding the signalling of *RAN Timing Synchronisation Status Information* IE from the gNB to the AMF, this is needed to address objective 1d:

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| 1. 5GS network timing synchronization status and reporting [RAN3, RAN2]:  d. gNB reporting node-level RAN timing synchronization status information towards the AMF, based on RAN timing synchronization status reporting configuration and gNB capability. [RAN3] |

All companies agree that the *RAN Timing Synchronisation Status Information* IE is transferred using non-UE associated signalling, but three different solutions have been proposed:

**Solution 1**: AMF requests reporting of RAN TSS information using a new Class 1 procedure.

* New AMF-initiated Class 1 procedure to enable the AMF to request RAN TSS information from the gNB.
* New gNB-initiated Class 2 procedure to enable the gNB to report RAN TSS information to the AMF.

**Solution 2**: gNB is configured via OAM to provide RAN TSS, and existing procedures are reused.

* Enhance the NG SETUP REQUEST and RAN CONFIGURATION UPDATE messages to optionally include RAN TSS information.

**Solution 3**: AMF requests reporting of RAN TSS information using new Class 2 procedure.

* New AMF-initiated Class 2 Timing Synchronization Status Reporting Control procedure to request RAN TSS information from the gNB.
* New gNB-initiated Class 2 Timing Synchronization Status Report procedure to report RAN TSS information
* New gNB-initiated Class 2 Timing Synchronization Status Reporting Failure Indication procedure to enable gNB to indicate RAN TSS information reporting failure.

Moderator’s comments:

* The focus of this question is on reporting of RAN TSS information over NGAP. **Similar functionality is also needed over F1AP which is addressed in Question #4.**
* Company views seem to be influenced by their interpretations of the following text in SA2:
  + TS 23.501 states that “*RAN nodes may be pre-configured with the thresholds for each timing synchronization status attribute*”.
  + TS 23.502 running CR (currently under review in SA2) shows a step in clause 4.15.9.X.Z where the AMF sends an N2 message to the NG-RAN and states “*The TSCTSF sends the configuration of the NG-RAN timing synchronization status reporting to the NG-RAN via AMF using Namf\_NonUeN2MsgTransfer. The AMF interacts with NG-RAN to configure the reporting using N2 signaling.*”.
* Whether and how the gNB reports its time synchronisation status reporting capabilities should be considered.

**Question #3: For RAN TSS reporting over NG, which solution(s) is acceptable and why?**

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| *Company* | *Comment* |
| Huawei | Solution 2.  We understand OAM based approach is sufficient. And we think this is already captured in the RAN3 LS to SA2/RAN2 at the last meeting (in R3-230811).   * RAN3 assumes that a gNB may report all, some, or none of the attributes *based on the gNB implementation*, i.e. gNB makes the final decision on whether it performs time status reporting. Encoding details for these attributes require further RAN3 discussion and will be determined during the work item phase. RAN3 assumes that SA2 will align to RAN3 when it comes to the attributes and encoding.   Also, the TS 23.502 running CR is not officially merged into the spec, and can be corrected possibly at this April meeting. |
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### F1AP impacts

It is also necessary to signal the *RAN Timing Synchronisation Status Information* IE from the gNB-DU to the gNB-CU. This is motivated by two different objectives:

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| 1. 5GS network timing synchronization status and reporting [RAN3, RAN2]:  b. gNB delivering 5G Clock quality information to the UE in RRC\_CONNECTED state, based on the clock quality reporting control information and gNB capability. [RAN2, RAN3]  Note 1: Details of the 5G clock quality information will be decided by RAN3.  d. gNB reporting node-level RAN timing synchronization status information towards the AMF, based on RAN timing synchronization status reporting configuration and gNB capability. [RAN3] |

In other words, the F1AP signalling needs to support not only the reporting towards the AMF (objective 1d discussed in Question #3), but also the reporting towards the UE (objective 1b) that is based on the per-UE Clock Quality Reporting Control Information. In principle, the same three solutions can be considered:

**Solution 1**: gNB-CU triggers reporting of RAN TSS information using new Class 1 procedure

* New CU-initiated Class 1 procedure to enable the gNB-CU to request RAN TSS information from the gNB-DU.
* New DU-initiated Class 2 procedure to enable the gNB-DU to report RAN TSS information to the gNB-CU.

**Solution 2**: gNB-DU provides RAN TSS using existing procedures

* Enhance the F1 SETUP REQUEST and GNB-DU CONFIGURATION UPDATE messages to optionally include RAN TSS information.
* gNB-DU provides RAN TSS information based on OAM configuration.

**Solution 3**: gNB-CU triggers reporting of RAN TSS information using new Class 2 procedure

* New CU-initiated Class 2 Timing Synchronization Status Reporting Control procedure to request RAN TSS information from the gNB-DU.
* New DU-initiated Class 2 Timing Synchronization Status Report procedure to report RAN TSS information
* New DU-initiated Class 2 Timing Synchronization Status Reporting Failure Indication procedure to enable gNB-DU to indicate RAN TSS information reporting failure.

Moderator’s comments:

* Because the disaggregated RAN architecture is transparent to SA2, the reporting over F1AP has not been discussed in SA2 and the solution seems entirely RAN3 scope.

**Question #4: For RAN TSS reporting over F1, do you have the same preference as NG (i.e., align the solutions over NG and F1)? If not, which solution(s) is acceptable over F1 and why?**

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| *Company* | *Comment* |
| Huawei | Yes, to have same/unified signalling approach for F1AP and NGAP. |
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### UE in RRC\_IDLE and RRC\_INACTIVE

Although objective 1c is primarily RAN2 scope, there are several proposals related to this objective:

1. “*Cells within the single gNB sharing the common clock characteristics shall be grouped together by OAM to indicate common clock quality information to the UE via Event ID.*” (P7 in 1264)
2. “*Send a LS to RAN2 that from RAN3 perspective, RAN does not include another scope field of the report ID, but only broadcast the Event ID in SIB9.*” (P7 in 1412)
3. “*The value range for Event ID should be at least 65536.*” (P5 in 1195)

Regarding item #2, RAN3 already sent an LS to SA2/RAN2 at the last meeting (in R3-230811) which included the following information:

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| **For the question**: “*SA2 would like to kindly request RAN2 and RAN3 to provide feedback whether both scopes (group of cells per gNB, group of cells across gNBs) can be beneficial and supported.*”  **RAN3 answer**:  - Depending on gNB topology, clock quality information can be the same for some or all cells of a gNB. Also, topologies can exist where clock quality information is different between “groups of cells within a single gNB” (e.g. cells served by different gNB-DUs).  - RAN3 understands that it shall be possible for NG-RAN to ensure that UEs are kept in RRC\_IDLE or RRC\_INACTIVE state when moving between cells of a gNB with the same clock quality. From RAN3 point of view, this can be supported with just the “Event ID”.  - RAN3 does not see a need to support “group of cells across gNBs” in Release 18, considering its limited applicability and the likely specification effort (e.g. coordination of the reference report ID over the Xn interface). |

Therefore, an additional LS to RAN2 does not seem needed at this point. However, it would be useful to capture a formal RAN3 agreement that clock quality information can be cell-level information since this impacts RAN3 signalling. For example:

**RAN Timing Synchronisation Status Information can be the same or different between “groups of cells within a single gNB” (e.g., cells served by different gNB-DUs).**

**Question #5: Can the above be captured as a RAN3 agreement? Anything else related to objective 1c that would be useful to capture as a RAN3 agreement?**

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| *Company* | *Comment* |
| Huawei | Agree.  We want to point out that this agreement (even made at previous meeting) would have impact on objective 4 (RAN to report the TSS information to the AMF). Please see P3 below in our paper in R3-231412. Then we suggest this can be discussed in the Round 2.   * Introduce a choice structure for RAN timing synchronization status report (either node level or cell list level) from the gNB (gNB-CU) to the AMF over the NGAP interface, in the NG SETUP REQUEST message and RAN CONFIGURATION UPDATE message.   And we also suggest to send LS to RAN2 on the 5G clock quality information to the UE. But we are fine to send at next meeting till the clock quality information is clearer. |
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### Not treated at this meeting

Since this is the first meeting of the work item and there is limited time allocation, some proposals are left for potential discussion at a future RAN3 meeting (contribution driven):

* Potential E1AP impacts, as mentioned in [5] (P1, P3) and [17] (P2).
* Potential impacts of mobility, as mentioned in [7] (P3).
* Whether reporting thresholds are provided by AMF or configured via OAM, as mentioned in [15] (P7).
* Area Scope of Time Distribution, as mentioned in [15] (P3).

## RAN feedback for low latency communication

There are many commonalities in the submitted papers, and it seems possible to merge proposals into the following “baseline”:

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| For objective 3 (Adapting downstream and upstream scheduling based on RAN feedback for low latency communication):   1. In the existing *TSC Assistance Information* IE, include a CHOICE between RAN feedback type “proactive” and “reactive”.    1. If CHOICE is “proactive”, then *Burst Arrival Time* *Window* IE and optionally *Periodicity Range* IE are included.    2. If CHOICE is “reactive”, then *Capability for BAT Adaptation* IE is included. 2. For proactive feedback, TSC Feedback Information (Burst Arrival Time Offset and optionally Adjusted Periodicity) can be provided for downlink and/or uplink in:    1. *PDU Session Resource Setup Response Transfer* IE of the PDU SESSION RESOURCE SETUP RESPONSE message, and    2. *PDU Session Resource Modify Response Transfer* IE of the PDU SESSION RESOURCE MODIFICATION RESPONSE message.    3. Inclusion in other NGAP messages require further RAN3 discussion (**see Question #7**). 3. For reactive feedback, TSC Feedback Information (Burst Arrival Time Offset) can be provided for downlink and/or uplink (support for uplink is FFS pending RAN2) in:    1. *PDU Session Resource Notify Transfer* IE of the PDU SESSION RESOURCE NOTIFY message when sending a “not fulfilled” notification.   A draft TP capturing the above is in the CB folder, filename “**R3-23xxxx TP\_NGAP\_objective3**” |

Moderator’s comments:

* The above merges proposals from Nokia [4] (P1-P4), Qualcomm [6] (P1-P4), Ericsson [7] (P5-P6), CATT [9] (P1, P3), Huawei [11] (P8), Samsung [13] (P1-1, P3), ZTE [15] (P1, P2, P6), and China Telecom [17] (P4).
* For item #3, support for reactive feedback for uplink is pending RAN2. This is captured in the TP by an Editor’s Note in subclause 9.3.1.z4.

**Question #6: Are the proposals listed in the box above agreeable? Please provide your comments below and/or in the draft TP.**

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| *Company* | *Comment* |
| Huawei | Agree |
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For proactive feedback, it is proposed in [11] that the TSC Feedback Information (Burst Arrival Time Offset and optionally Adjusted Periodicity) can also be provided for downlink and/or uplink in:

1. *Associated QoS Flow List* IE in PDU SESSION RESOURCE SETUP RESPONSE message
2. *QoS Flow List with Data Forwarding* IE in HANDOVER REQUIRED Response message
3. *Path Switch Request Transfer* IE in PATH SWITCH REQUEST message

**Question #7: Are (a), (b), and (c) listed above agreeable?**

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| *Company* | *Comment* |
| Huawei | For b) and c), we think these changes are needed to support connected mobility, since during the handover procedure, the target gNB need to report its suggested TSC feedback information to the CN.  For a), we are fine not to have it, given that the IE can be directly included within the *PDU Session Resource Setup Response Transfer* IE of the PDU SESSION RESOURCE SETUP RESPONSE message |
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# Discussion (round 2)

[TBD]

# Conclusion, Recommendations [if needed]

[TBD]

# References

1. RP-230754 New WID on NR Timing Resiliency and URLLC enhancements (Nokia, Nokia Shanghai Bell)
2. S2-2305210 Procedures to support network timing synchronization status and reporting (Nokia, Nokia Shanghai Bell, NTT DOCOMO)
3. R3-231195 (TP for TS 38.413 BL CR) 5GS network timing synchronization status and reporting (Nokia, Nokia Shanghai Bell)
4. R3-231196 (TP for TS 38.413 BL CR) RAN feedback for low latency communication (Nokia, Nokia Shanghai Bell)
5. R3-231264 Discussion on Time Synchronisation Status and Reporting (Qualcomm Incorporated)
6. R3-231265 Discussion on Adaptive UL and DL Scheduling (Qualcomm Incorporated)
7. R3-231274 Discussion on NR Timing Resiliency and URLLC enhancements (Ericsson)
8. R3-231324 Discussion on Network timing synchronization status and reporting (CATT)
9. R3-231325 Discussion on Adapting downstream and upstream scheduling (CATT)
10. R3-231409 Support NR Timing Resiliency and URLLC enhancements (Ericsson)
11. R3-231412 (TP to TS 38.423 and 38.473) Support of Timing Resiliency and URLLC (Huawei, China Unicom)
12. R3-231413 Support of Timing Resiliency and URLLC (Huawei, China Unicom)
13. R3-231661 Discussion on network timing synchronization status and reporting (Samsung)
14. R3-231662 Discussion on adapting downstream and upstream scheduling based on RAN feedback (Samsung)
15. R3-231783 Discussion on timing synchronization status and reporting (ZTE)
16. R3-231784 Discussion on RAN feedback for downstream scheduling (ZTE)
17. R3-231811 Discussion on RAN3 Impact of Timing Resiliency and URLLC Enhancements (China Telecom)