3GPP TSG-RAN WG3 #121 R3-234552

Toulouse, France, 21-25 August 2023

Agenda Item: 26.2

Source: Nokia (moderator)

Title: Summary of Offline Discussion for CB # R18URLLC\_Solution

Document for: Approval

# Introduction

**CB: # R18URLLC\_Solution**

**- Discuss the open issue above on RAN TSS report over NG and F1**

**- Discuss open issue left for other topics**

**- Capture agreements to TP**

**- Capture agreements and open issue**

**- LS to RAN2/SA2?**

(moderator - Nok)

Summary of offline disc [R3-234552](Inbox\R3-234552.zip)

# For the Chairman’s Notes

[TBD]

# Discussion

## 5GS network timing synchronization status and reporting

### NGAP

AMF-initiated procedure

**Option A**: new class 1 Timing Synchronisation Status procedure [2][4][10]

* TIMING SYNCHRONISATION STATUS REQUEST message includes the RAN TSS Request Type IE (start, stop) [2]
* If TSS reporting is not supported in all the gNB-DUs connected to the gNB-CU, then gNB-CU shall respond to the AMF with failure. [4]

**Option B**: new class 2 TSS Information Control procedure [5]

* Contains simple indicator (e.g., start/stop)

**Option C**: reuse AMF Configuration Update procedure [12]

* Enhance the existing AMF CONFIGURATION UPDATE message for the RAN TSS report initiation procedure.

gNB-initiated procedure

Agreed online:

|  |
| --- |
| **In NGAP, introduce a new Timing Synchronisation Report procedure (class 2) to enable the gNB to report RAN TSS to the AMF.**  **The (NGAP) TIMING SYNCHRONISATION STATUS REPORT message includes the RAN Timing Synchronisation Status IE and the RAN TSS Scope IE (indicating whether the scope of the RAN TSS is “all cells within a single gNB” or “list of Cell IDs within a single gNB”). The detail IE design needs to be further discussed.** |

For detail design of the *RAN TSS Scope* IE:

**Option A**: [2]

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| IE/Group Name | Presence | Range | IE type and reference | Semantics description |
| CHOICE *RAN TSS scope* | M |  |  |  |
| >*all cells* |  |  |  |  |
| >>Global gNB ID | M |  | 9.3.1.6 |  |
| >*list of cells* |  |  |  |  |
| **>>RAN TSS Cell List** |  | *1* |  |  |
| **>>>RAN TSS Cell Item** |  | *1..<maxnoofCellsTSS* |  |  |
| >>>>NR CGI | M |  | 9.3.1.7 |  |

**Option B**: [5]

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| IE/Group Name | Presence | Range | IE type and reference | Semantics description |
| CHOICE *TSS Information* | M |  |  |  |
| *>RAN node level* |  |  |  |  |
| >>RAN Timing Synchronisation Status Information | M |  | 9.3.1.x3 |  |
| *>RAN area level* |  |  |  |  |
| >>Timing Synchronization Status Area List | M |  | 9.3.1.y2 |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| IE/Group Name | Presence | Range | IE type and reference | Semantics description |
| Timing Synchronization Status Area Item |  | *1..<maxnoofTSSItems>* |  |  |
| **>Cell List Areas** |  | *1..<maxnoofCelllistareas>* |  |  |
| >>NG-RAN CGI | M |  | 9.3.1.73 |  |
| > RAN Timing Synchronisation Status Information | M |  | 9.3.1.X3 |  |

Clock Accuracy IE encoding:

CHOICE structure:

Choice A: INTEGER with precise granularity, as low as e.g. 10ns or 25ns, e.g.:

* INTEGER (1..100000000, …) in units of 10ns
* INTEGER (1..4000000, …) in units of 25ns
* INTEGER (0 to 32767, …) in units of 25ns

Choice B: refer to Table 5 of IEEE Std 1588, e.g.:

* ENUMERATED (25ns, 100ns, 250ns, 1us, 2dot5 us, 10us, 25us, 100us, 250us, 1ms, 2dot5ms, 10ms, 25ms, 100ms, 250ms, 1sec, …)
* INTEGER (0..255)
* INTEGER (32..47, …)

Choice C: ENUMERATED with ranges (value + granularity?, low end + high end?)

**Or:**

No CHOICE structure: The choice structure of Clock Accuracy is not necessary, to remove the related EN and define the Clock Accuracy IE as INTEGER (0..100000, …), the unit is ns. [12]

Range: up to 1 second?

Thresholds

**From [4]:**

The threshold to trigger event for reporting of clock quality information to AMF shall be configured by OAM in gNB-CU or gNB-DU or both.

**From [2]: Ask SA2?**

Should RAN3 assume that the gNB-DU is pre-configured with

1. multiple thresholds per timing synchronization status attribute, one for each value of per-UE clock quality acceptance criteria that the gNB-CU might receive from the AMF; or
2. a single threshold per timing synchronization status attribute, e.g., the strictest value that the gNB is expected to report?

Note that in case (b), there may be additional RAN3 protocol impacts to ensure that the gNB-CU is able to accurately evaluate the clock quality acceptance criteria for UEs that are more tolerant of clock quality degradation than the pre-configured threshold per timing synchronization status attribute.

Clock Quality Acceptance Criteria IE encoding:

**From [2][12]:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| IE/Group Name | Presence | Range | IE type and reference | Semantics description |
| Synchronisation State | O |  | BIT STRING {  locked (0),  holdover (1),  freeRun (2) }  (SIZE (8, …)) | Each position in the bitmap represents a synchronisation state.  If a bit is set to “1”, the respective synchronisation state is acceptable. If a bit is set to “0”, the respective synchronisation state is not acceptable.  Bits 3-7 reserved for future use. |
| Traceable to UTC | O |  | ENUMERATED (true, …) |  |
| Traceable to GNSS | O |  | ENUMERATED (true, …) |  |
| Clock Frequency Stability | O |  | BIT STRING (SIZE (16)) | Indicates the offsetScaledLogVariance as specified in TS 23.501 [9]. |
| Clock Accuracy | O |  | INTEGER (0..100000000, …) | Clock accuracy expressed in units of 10 ns. |
| Parent Time Source | O |  | BIT STRING {  syncE (0),  pTP (1),  gNSS (2),  atomicClock (3),  terrestrialRadio (4),  serialTimeCode (5),  nTP (6),  handset (7),  other (8) }  (SIZE (16, …)) | Each position in the bitmap represents a parent time source.  If a bit is set to “1”, the respective parent time source is acceptable. If a bit is set to “0”, the respective parent time source is not acceptable.  Bits 9-15 reserved for future use. |

Other:

* RAN3 to confirm the WA as agreement - When Clock Quality Detail Level IE has value “clock quality metrics”, all clock quality metrics supported by the gNB implementation are delivered to the UE [4][5][12]
* The gNB is responsible for determining whether to provide clock quality information to the UE. In cases of CU/DU split, this decision is made by the gNB-CU. [12]
* Remove the ENs of RAN Timing Synchronisation Status Information IE.

### Miscellaneous

**From [8]:**

* Proposal 3: discuss and agree the continuous reporting of the 5G Clock quality information to the UE during mobility. The clock quality related information is sent to the target RAN during handover procedure, and the target RAN feedbacks its clock quality information.

### F1AP specific

F1AP procedures

Mirror relevant NGAP agreements, except no need for *RAN TSS Scope* IE in REPORT/TRANSFER message.

### Stage 2 (TS 38.401)

Signalling flow in [1] (update based on NGAP/F1AP decisions)

Proposal 3: Agree to the Stage 2 text proposal for TS 38.401 in Annex A.

### LS to other groups

Send an LS to RAN2/SA2 about the following:

RAN3 agreement on encoding of the Timing Synchronisation Status Attributes IE and any other relevant RAN3 agreements. [2][5]

Question to SA2 [2] whether RAN3 should assume

1. multiple pre-configured thresholds per RAN TSS attribute (one for each value of per-UE acceptance criteria that the gNB-CU might receive from the AMF), or
2. a single pre-configured threshold per RAN TSS attribute (e.g., the strictest value that the gNB is expected to report).

## TSN integration

Proposals in [3], [7], [8], [13]

Specification status in SA2 does not seem mature? E.g. LS from CT4 in R3-234532 with many basic questions.

RAN3-related open issues (high level):

* Whether AN-TL support at the NG-RAN node is known by the SMF/CUC via control plane signalling or via OAM pre-configuration
* Whether TL-containers are transparent to AMF (e.g. is get/set visible to NGAP protocol)
* Whether “get” information exchange is UE-associated signalling (e.g. during PDU session resource establishment) or non-UE associated
* Others?

## RAN feedback for low latency communication

### General

Is proactive RAN feedback applicable/relevant after the initial establishment of the TSC QoS flow, e.g. can “proactive RAN feedback” be provided to the CN by a target gNB (YES or NO)?

Moderator: Is there a common understanding of how proactive feedback works? The moderator’s understanding (from TS 23.501 section 5.27.2.5.2) is as follows:

* *The BAT offset shall always be provided by NG-RAN and it shall be within the BAT Window.*
* *The feedback from RAN implies that the RAN accepts the BAT offset.*
* 🡺 Therefore, the “BAT” is no longer the BAT received by the NG-RAN, but rather the BAT received by the NG-RAN adjusted by the BAT offset. It is this “BAT” that is signalled in any subsequent TSC Assistance Information (i.e. there is no need/relevance to further signal the BAT offset in handover signalling with expectation that the target will re-derive the BAT).

NO [3]:

* In NGAP, clarify (e.g. in semantics description) that target gNB shall ignore BAT Window and Periodicity Range IEs if received in a HANDOVER REQUEST message.
* In XnAP, the BAT Window and Periodicity Range IEs are not needed in the TSC Assistance Information IE.

??? [6]:

* For NGAP, include the TSC Traffic Characteristics Feedback (including the Burst Arrival Time Offset and the adjusted Periodicity) during handover procedure in the HANDOVER REQUEST ACKNOWLEDGE and PATH SWITCH REQUEST messages. RAN3 can send a LS to SA2 if not agreed (LS draft can be found in the Annex).

??? [11]

* The proactive RAN feedback applicable/relevant after the initial establishment of the TSC QoS flow, include handover

Burst Arrival Time Window IE

**Option A**: [3]

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **IE/Group Name** | **Presence** | **Range** | **IE type and reference** | **Semantics description** |
| Burst Arrival Time Window Start | M |  | INTEGER (0..320000, …) | Start of the burst arrival time window calculated with reference to the *Burst Arrival Time* IE, expressed in units of 1 us. Integer values are negative. |
| Burst Arrival Time Window End | M |  | INTEGER (0..320000, …) | End of the burst arrival time window calculated with reference to the *Burst Arrival Time* IE, expressed in units of 1 us. Integer values are positive. |

**Option B**: [6][11]

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| IE/Group Name | Presence | Range | IE type and reference | Semantics description |
| Earliest Burst Arrival Time | M |  | Burst Arrival Time  9.3.1.133 | Indicates the acceptable earliest arrival time of the first packet of the data burst at either the ingress of the RAN (downlink flow direction) or the egress of the UE (uplink flow direction). |
| Latest Burst Arrival Time | M |  | Burst Arrival Time  9.3.1.133 | Indicates the acceptable latest arrival time of the first packet of the data burst at either the ingress of the RAN (downlink flow direction) or the egress of the UE (uplink flow direction). |

Burst Arrival Time Offset IE

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **IE/Group Name** | **Presence** | **Range** | **IE type and reference** | **Semantics description** |
| Burst Arrival Time Offset | M |  | INTEGER (-320000..320000, …) | Burst arrival time offset expressed in units of 1 us. |

Adjusted Periodicity IE:

reuse the same encoding as the existing Periodicity IE.

Capability for BAT Adaptation IE:

encoded as ENUMERATED (true, …) or ENUMERATED (supported, …)

### F1AP impacts

Is DU involved in RAN feedback?

**Option 1**: DU is involved for reactive feedback only [3]:

* the TSC Assistance Information IE and the NOTIFY message should be enhanced to mirror relevant IEs from NGAP.

**Option 2**: DU is involved for both proactive and reactive feedback [11]:

* include the Burst Arrival Time Window, Capability for BAT adaptation and Periodicity Range in the TSC Assistance Information IE.
* include the TSC Traffic Characteristics Feedback (including the Burst Arrival Time Offset and the optional Adjusted Periodicity) in the UE CONTEXT SETUP RESPONSE, UE CONTEXT MODIFICATION RESPONSE, and NOTIFY messages.

**Option 3**: DU is not involved in RAN feedback [4].

### Other

NR-DC case

Proposal 4 in [6]: For the NR-DC case, for XnAP, include the TSC Traffic Characteristics Feedback (including the Burst Arrival Time Offset and the optional Adjusted Periodicity) in the following messages:

* S-NODE ADDITION REQUEST ACKNOWLEDGE message
* S-NODE MODIFICATION REQUEST ACKNOWLEDGE message
* S-Node initiated NOTIFICATION CONTROL INDICATION message

# Discussion (round 2)

[TBD]

# Conclusion, Recommendations [if needed]

[TBD]

# References

1. R3-233815 (TP for TS 38.401 BL CR) Stage 2 for timing resiliency and URLLC (Nokia, Nokia Shanghai Bell, Samsung, Qualcomm, CATT)
2. R3-233816 (TP for TS 38.413 BL CR) Further stage 3 details for timing resiliency (Nokia, Nokia Shanghai Bell)
3. R3-233904 Interworking with TSN network and RAN feedback (Nokia, Nokia Shanghai Bell)
4. R3-233986 Discussion on Open Issues in Timing Resiliency and uRLLC (Qualcomm Incorporated)
5. R3-234023 (TP to TRS\_URLLC BLCR for TS 38.413, TS 38.423 and TS 38.473) Support of 5G Timing Resiliency enhancements (Huawei, China Unicom)
6. R3-234024 (TP to TRS\_URLLC BLCR for TS 38.413, TS 38.423 and TS 38.473) Support of RAN feedback enhancements (Huawei, China Unicom)
7. R3-234025 (TP to TRS\_URLLC BLCR for TS 38.413) Support of TSN enabled transport network (Huawei, China Unicom, China Telecommunication)
8. R3-234321 Discussion on NR Timing Resiliency and URLLC enhancements (Ericsson)
9. R3-234322 Text Proposals on Support NR Timing Resiliency and URLLC enhancements (Ericsson)
10. R3-234396 Discussion on Network timing synchronization status and reporting (CATT)
11. R3-234397 TP for BLCR to TS38.413 Adapting downstream and upstream scheduling (CATT)
12. R3-234428 Discussion and TPs for timing synchronization status and reporting (ZTE)
13. R3-234429 Discussion on TSN integration and RAN feedback (ZTE)