3GPP TSG-RAN WG2 Meeting #124 R2-23xxxxx

Chicago, USA, 13 – 17 November 2023 *R2-2313866/R2-2313998*

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| *CR-Form-v12.2* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
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|  | **38.300** | **CR** | **0730** | **rev** | **2** | **Current version:** | **17.6.0** |  |
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| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* | | | | | | | | |
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| ***Proposed change affects:*** | UICC apps |  | ME | **X** | Radio Access Network | **X** | Core Network | **X** |

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| ***Title:*** | Introduction of Timing Resiliency and URLLC enhancements | | | | | | | | | |
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| ***Source to WG:*** | Nokia (Rapporteur), Nokia Shanghai Bell | | | | | | | | | |
| ***Source to TSG:*** | R2 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | TRS\_URLLC-NR-Core | | | | |  | ***Date:*** | | | 2023-11 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **B** |  | | | | | ***Release:*** | | | Rel-18 |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) … Rel-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18) Rel-19 (Release 19)* | |
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| ***Reason for change:*** | | The WID on NR Timing Resiliency and URLLC enhancements was approved in RP-230754. This CR is to specify the necessary functions and procedures to support the objectives. | | | | | | | | |
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| ***Summary of change:*** | | Stage 2 support for R18 NR Timing Resiliency and URLLC enhancements:  - Support the 5GS network timing synchronization status and reporting.  - Support adapting downstream and upstream scheduling based on RAN feedback for low latency communication.  - Support Interworking with TSN network deployed in the transport network | | | | | | | | |
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| ***Consequences if not approved:*** | | A stage 2 overview of the agreed mechanisms for Timing resiliency and URLLC is missing. | | | | | | | | |
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| ***Clauses affected:*** | | 16.8.x1, 16.8.x2, 16.y, 18.1 | | | | | | | | |
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|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | | **X** |  | Other core specifications | | | | TS38.331 CR4258  TS38.401 CR0309  TS38.410 CR0046  TS38.413 CR0972  TS38.423 CR1049  TS38.473 CR1168  TS38.470 CR0119 | | |
| ***affected:*** | |  | **X** | Test specifications | | | | TS/TR ... CR ... | | |
| ***(show related CRs)*** | |  | **X** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
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| ***This CR's revision history:*** | | Rev 1: RAN2 CR agreed in in R2-2313866 capturing RAN2 agreements.  Rev 2: Merge of the RAN2 agreed text in R2-2313866 with the RAN3 endorsed text (R2-2313998/R3-238133) | | | | | | | | |

*First Modified Subclause*

16.8.x1 Network timing synchronization monitoring

16.8.x1.1 General

While time synchronization service is offered by the 5GS, the network timing synchronization status of the gNB may change. The gNB detects timing synchronization degradation or improvement locally and informs the consumer of the information as follows:

- TSCTSF may receive information about timing synchronization status from the gNB via the AMF based on node-level reporting configuration.

- UE may receive clock quality information from the gNB based on UE-level clock quality control information.

16.8.x1.2 Network timing synchronization monitoring towards CN

For NG-RAN timing synchronization monitoring support, the 5GC initiates RAN Timing Synchronisation Status (TSS) Reporting procedure to obtain the change of network timing synchronization status of gNBs.

The gNB may receive RAN timing synchronization status information request from the AMF, see TS 23.501 [3]. The RAN timing synchronization status information includes the gNB node-level information about timing synchronization operation status. The gNB timing synchronization status may comprise one or more of the following information elements: synchronization state, traceability to UTC, traceability to GNSS, clock frequency stability, clock accuracy, parent time source, as defined in Table 5.27.1.12-1 in TS 23.501 [3].

Based on NG-RAN’s capabilities of reporting timing synchronisaation status, NG-RAN accepts or rejects the request from AMF. NG-RAN can be pre-configured with thresholds for attributes on timing synchronisaation status reporting via OAM. When the thresholds are met or exceeded, events will be triggered and NG-RAN reports Timing Synchronization Status to AMF. For detailed procedure on the Timing Synchronization Status reporting, refer to TS 38.401 Clause 8.x.1 [4].

16.8.x1.3 Network timing synchronization monitoring towards UE

The gNB may receive clock quality reporting control information for a UE from the AMF, see TS 23.501 [3]. The clock quality reporting control information contains the clock quality detail level (i.e., “metrics” or “acceptable/not acceptable indication”) and clock quality acceptance criteria for the UE (if the clock quality detail level equals "acceptable/not acceptable indication”). Based on the clock quality reporting control information, the gNB determines how to provision clock quality information to the UE:

- If the clock quality detail level equals "clock quality metrics", the gNB provides clock quality metrics supported by the gNB to the UE, i.e., one or more of the following information elements: synchronization state, traceability to UTC, traceability to GNSS, clock frequency stability, clock accuracy, parent time source, as defined in Table 5.27.1.12-1 in TS 23.501 [3].

- If the clock quality detail level equals "acceptable/not acceptable indication", the gNB indicates “acceptable” to the UE if the gNB's timing synchronization status matches the acceptance criteria received from the AMF; otherwise, the gNB indicates "not acceptable" to the UE. Clock quality acceptance criteria can be defined based on one or more information elements listed in Table 5.27.1.12-1 in TS 23.501 [3].

To provision clock quality information to the UEs:

- For UEs in the RRC CONNECTED state, the gNB uses unicast RRC signaling. The RRC signaling includes Event ID and clock quality information.

- For UEs that are not in the RRC\_CONNECTED state, the UE first needs to establish or resume the RRC connection to receive the gNB timing synchronization status information from the gNB via unicast RRC signaling. The gNB broadcasts Event ID in SIB9 to notify its timing synchronization status. Event ID or gNB ID change serves as a notification for the UEs reading the SIB information that there is new RAN timing synchronization status information available.

The following figure describes the signalling procedure of gNB reporting clock quality information to a UE:

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**Figure 16.8-3: Signalling procedure of gNB reporting clock quality information to a UE**

0. The gNB node is pre-configured for the thresholds for each timing synchronization status attribute as described in clause 5.27.1.12 in TS 23.501 [2]. If there is a change on its primary source so that the thresholds are exceeded or met again, the NG-RAN node detects a change on its timing synchronization status (e.g., degradation, failure, recovery).

1. The gNB notifies a change on its timing synchronization operation using Event ID in SIB9. The Event ID scope is local to gNB.

2. The UE in RRC\_INACTIVE or RRC\_IDLE determines if there is clock quality information update available at the gNB based on SIB9 information. For a UE in RRC\_CONNECTED status, steps 2-3 can be skipped.

3. If there is a RAN timing synchronization status update available, the UE’s RRC layer indicates this to the NAS layer which may request the RRC layer to initiate RRC Setup or RRC Resume procedure.

4. The gNB determines clock quality information reporting to the UE (e.g., metrics or “acceptable/not acceptable”).

5. The gNB sends the clock quality information to the UE via unicast RRC signaling.

16.8.x2 RAN feedback for adaptation of Burst Arrival Time and Periodicity

The NG-RAN may support the proative feedback and reactive feedback mechanisms as specified in TS 23. 501 [3]. The NG-RAN can provide the feedback in order to align the arrival of the traffic bursts with the next expected transmission opportunity over the air interface in each direction (i.e. DL or UL) for a QoS flow.

*Next Modified Subclause*

16.y Support for TSN enabled Transport Network

The NG-RAN may support the TSN enabled Transport Network during PDU Session Resource establishment or modification procedure as specified in TS 23. 501 [3].

*Next Modified Subclause*

18.1 Support of SDT procedure over RACH

For SDT procedure over RACH, if the UE accesses a gNB other than the last serving gNB, the UL SDT data/signalling is buffered at the receiving gNB, and then the receiving gNB triggers the XnAP Retrieve UE Context procedure. The receiving gNB indicates SDT to the last serving gNB and the last serving gNB decides whether to relocate the UE context or not. Other SDT assistance information (e.g., single packet, multiple packets) may also be provided by the receiving gNB to help the decision of UE context relocation. If the UE is configured with the clock quality control information, the last serving gNB may perform full UE context relocation.

If the last serving gNB decides not to relocate the full UE context, it transfers a partial UE context containing SDT RLC context information necessary for the receiving gNB to handle SDT via the Partial UE Context Transfer procedure.

Then, in case SDT is used for user data over DRBs, UL/DL tunnels are established for DRBs configured for SDT between the receiving gNB and the last serving gNB. The PDCP PDU of UL/DL data is transferred over the tunnels, until the last serving gNB terminates the SDT session and directs the UE to continue in RRC\_INACTIVE by sending the *RRCRelease* message.

Or in case SDT is used for signalling, SRB PDCP PDUs are transferred between the receiving gNB and the last serving gNB via the XnAP RRC Transfer procedure, until the last serving gNB terminates the SDT session and directs the UE to continue in RRC\_INACTIVE by sending the *RRCRelease* message.

During the SDT session, in case the receiving gNB detects that no more packets are to be transmitted, or radio link problem is detected, the receiving gNB may also request to terminate the SDT session to the last serving gNB via the UE Context Retrieve Confirmation procedure.

*End of Changes*