3GPP TSG-RAN WG3 Meeting #112-e R3-212651

Online, 17 – 27 May 2021

**Agenda item: 21.2**

**Source: Nokia (moderator)**

**Title: Summary of offline: NRIIOT1-PDC**

**Document for: Discussion and Decision**

# 1 Introduction

This paper summarizes the following email discussion:

**CB: # NRIIOT1-PDC**

**- Network based propagation delay compensation mechanism has impact on RAN3, wait for reply LS from RAN1 and RAN2?**

**- The core network indicates to gNB the reference time synchronization requirement for one way transmission? Include the Time synchronization error budget for Uu?**

**- The UE mobility does not impact the RAN3 specification or during handover the source NR-RAN node informs the target NG-RAN node the TSN reference information used for the UE?**

**- Capture WF and open issues in the summary**

(Nok - moderator)

Summary of offline disc [R3-212651](C:\\Users\\x00300387\\AppData\\Roaming\\eSpace_Desktop\\UserData\\x00300387\\ReceiveFile\\Inbox\\R3-212651.zip)

# 2 For the Chairman’s Notes

[TBD]

# 3 Discussion (Phase 1)

Please provide your Phase 1 views by 18:00 UTC Friday May 21st

## 3.1 Assistance information from CN to gNB

At RAN3#111e, the following open issue was captured in the Chair’s Minutes:

What information (if any) may be needed by the gNB from the CN, to assist the gNB in making PDC decisions needs further discussion. Discussion to continue at next meeting, focusing first on the use case / motivation / requirements (e.g., inputs from other groups).

There is also a related LS from SA2 in [8].

Overview of papers:

The time synchronization error budget available for the NG-RAN is defined in TS 22.104 and depends on the scenario. For **Control-to-Control** there are two Uu interfaces involved and a total error budget of 900ns (450ns per Uu interface), while for **Smart Grid** there is a single Uu interface involved and a total error budget of 1us.

There is ongoing discussion in RAN2/SA2 whether NG-RAN can benefit from receiving the time synchronization error budget available for the NG-RAN. In RAN3, company views are as follows:

- ZTE [1]: CN indicates to the gNB the reference time synchronization requirement for one-way transmission. Values are 500ns or 1us.

- CATT [2]: Include the time synchronization error budget for Uu in the QoS flow parameter, if RAN2 agrees to use it for assisting the PDC selection.

- Nokia [3]: CN provides Uu synchronicity budget to the gNB as a UE-level parameter. Values are 10ns resolution up to 500ns, and coarser resolution (e.g. 50/100ns) up to 1us.

- Huawei [4]: CN provides a simple indication for the strict synchronization budget requirement, or even time synchronization error budget over the Uu interface for the UE.

- Samsung [5], Ericsson [6]: Wait for RAN2 progress.

Moderator’s Summary and Proposal:

There appears to be general consensus that it would be beneficial for NG-RAN to receive assistance information related to the time synchronization error budget available to the NG-RAN. Some open issues that can be derived from the RAN3 papers include:

1) How to express the assistance information? For example, a simple indication (e.g. “strict synchronization required”), or a time synchronization error budget available for the NG-RAN (e.g. a value in ns), the granularity of the time synchronization error budget, etc.

2) Is the assistance information at QoS flow level or UE level?

3) Is the assistance information (and accurate time synchronization in general) specific to TSC, or independent of TSC?

However, there is parallel discussion ongoing in RAN2/SA2 as evidenced by the LS in [8] (no action to RAN3), and the above open issues appear to be in RAN2/SA2 scope.

Proposed way forward:

- Wait for RAN2/SA2 decision on Time Synchronization assistance parameters before further discussing in RAN3.

**Question 1: Please provide your views on the moderator’s summary and proposed way forward.**

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| **Company** | **Comments** |
| ZTE | We agree with the moderator. RAN2 and SA2 are discussing the above issues, RAN3 can be further discussed based on the corresponding conclusions.  However, as far as we know, when the gNB supports mixed scenarios(Control-to-Control and/or for Smart Grid) at the same time, CN cannot accurately calculate the time synchronization error budget of Uu, and the service type cannot be identified without CN indication in the gNB, so we prefer a simple indication for scenarios(Control-to-Control and/or for Smart Grid). |
| Huawei | We are fine with the way forward.  Given the majority companies views in favour of this assistance information, we suggest to add in the way forward:  - RAN3 sees benefits to introduce the time synchronization assistance parameter. RAN3 will wait…… |
| Nokia | We agree with the proposed way forward. Regarding the 3 open issues:   1. The gNB cannot know the Uu sync budget by itself, so CN should provide it (preferably as a value). 2. UE level parameter. The Uu synchronicity budget is a 5G clock attribute that it is UE specific, not PDU Session specific. 3. Independent of TSC. Time synchronization as a service in Rel-17 is an independent TSC service by itself, it may be part of TSC traffic or not (e.g. TSCAI is not required for time synchronization configuration). |
| Samsung | Agree on the moderator’s summary. We think the budget information would be beneficial, but RAN3 needs to wait for RAN2/SA2 decision. |
| CATT | Agree with moderator. How to handle the information can be discussed after RAN2/SA2 get conclusion |
| Ericsson | We should wait for RAN2/SA2 progress on this matter. |

Proposed conclusion: Capture the following in the Chair’s Notes:

Wait for RAN2/SA2 decision on Time Synchronization assistance parameters before further discussing in RAN3.

## 3.2 UE mobility

At RAN3#111e, the following open issue was captured in the Chair’s Minutes:

Further discussion on the UE mobility issues which are not related with RAN2.

Overview of papers:

ZTE [1] believes that there is no RAN3 impact due to UE mobility, under the assumption that any information needing to be exchanged between source and target can be carried within RRC containers (i.e. RAN2 scope).

CATT [2] and Samsung [5] believe that UE mobility is not an issue based on the following RAN2 assumptions:

**Assumptions:**

- There is no UE clock drift issue to be addressed

- The source and target gNB are tightly synchronized to the same master clock within the budget and there is no need to optimize anything for HO.

**Agreements**

- gPTP message interruption during mobility is not considered in the Rel-17 IIoT WI (i.e. no further specification impact are considered)

Two companies believe that UE mobility creates an issue that has RAN3 (XnAP) impacts:

- Ericsson [7]: After a successful handover, there is delay for the target NG-RAN node to deliver Reference Time Information (RTI) to the UE, not only because the propagation delay from the target to the UE is different than from the source to the UE, but also because of the time it takes for the target to prepare the information comprising the reference time. In the disaggregated deployment, the CU needs to extract the time reference information from the DU.

- Nokia [3]: After the UE establishes the connection to the target gNB, the target gNB needs to determine a Reference Time Information (RTI) configuration that will satisfy the timing accuracy required by the UE. The RTI configuration at the target may need to be different than the source depending on e.g. difference in propagation delays, difference in synchronization topology, the level of synchronization accuracy at the source just prior to handover, etc.

Moderator’s Summary and Proposal:

Companies do not yet have a common understanding on whether there is an issue with UE mobility, so the first step is to clarify and confirm the issue.

The moderator’s understanding of the issue raised in [7] and [3] is as follows:

- **Issue (to be confirmed)**: How does the target gNB determine the actions it must take to maintain the timing accuracy required by the UE? For example, when the next RTI is needed (e.g. how much delay can be tolerated to deliver the first RTI), the periodicity of the RTI, the need for propagation delay compensation, etc.

- ZTE [1] describes a RAN2-based solution, where the source gNB provides the *referenceTimeInfoPreference* to the target gNB (in RRC container for handover preparation), and the target gNB provides RTI to the UE via the source gNB (in RRC container for handover command).

It is proposed to first focus on whether the issue can be acknowledged (without going into solutions at this stage).

**Question 2: Do you acknowledge the issue? If not, how is the issue solved without RAN3 impacts?**

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| **Company** | **Comments** |
| ZTE | We think there is not issue for RTI configuration during HO. Because the RTI configuration is to synchronize the clock between DT-TT and NW-TT(e.g. between UE and CN), and both the source gNB and target gNB are synchronized to the master clock(e.g. the CN clock). Thus, during the HO procedure, it is feasible that the source gNB provides the RTI to UE or the target gNB provides the RTI to UE, and both options does not impact RAN3 specification. E.g. if the source gNB provides the RTI to UE during HO procedure, RTI is included in RRCReconfiguration, which only impacts RAN2; if the target gNB provides the RTI to UE during HO procedure, as described in [1], the current RRC container is enough. |
| Huawei | We generally think this was mainly discussed in RAN2, but with conclusions that RAN2 will not do any optimization.  We acknowledge this issue. In our understanding, the synchronisation time period，broadcast/unicast mode and Clock Type used in the source RAN could be used as an assistant information by the target RAN node. These information is useful for the synchronisation time configuration reference by target RAN. |
| Nokia | We acknowledge the issue. The referenced RAN2 assumptions imply that:   1. all UEs will have the same TS accuracy budget, which is not aligned with the most recent discussions triggered by the SA2 LS (benefit for CN to provide time synchronization error budget); and 2. accuracy budget is same for source and target gNB, which is not necessarily true.   Currently the target gNB will have no means of properly determining an RTI configuration suitable for the provided NG-RAN budget. We think the source gNB can provide useful assistance information to the target gNB which will help it make the proper decisions when determining an RTI configuration.  We don’t believe it makes sense to “copy” the same RTI configuration from source to target, as the NG-RAN budget can be different for the UE at the target gNB. The source gNB should signal the target gNB with the UEs current accuracy which the target gNB can compare with the NG-RAN budget and decide the proper RTI configuration. We see no need to explicitly transfer the clock type, as we do not see a relevant scenario where the target gNB delivers RTI based on different clock source than the source gNB (e.g. only local clock to local clock, or GPS to GPS). The information needed to facilitate RTI configuration determination at the target gNB is not automatically captured in the handover messages, and hence RAN3 needs to be involved |
| Samsung | We’re not sure whether the issue is acknowledged by RAN2. Anyway if the issue is confirmed, we have the similar view as ZTE.  Currently the reference time info is delivered from the NG-RAN to the UE by using RRC message. And the ReferenceTimeInfoPreference can be already included in the UEAssistanceInformation in the HandoverPreparationInformation, the CG-Config and the CG-ConfigInfo messages. So if the reference time information of the target cell needs to be delivered to the UE via the source cell, the reference time information of the target cell could be included in the RRC HandoverCommand message. |
| CATT | RAN2 has discussed and get the assumption “tightly synchronized”. We are ok to open the discussion on this issue in RAN3. But we need identify the scenario and inquired RAN2. If we agree to exchange information between two node, the in container and outer container solution are both workable. |
| Ericsson | We acknowledge the issue and believe that it is beneficial to indicate to the target gNB from the source gNB that a UE needs reference time delivery so that the target gNB prepare the transmission of the 5G reference time as soon as possible.  The ReferenceTimeInfoPreference in the RRC container is not always present. It depends on the network/UE configuration, etc, facts. This is only feasible if UE supports and sends 5G reference time request on RRC by UE assistance information (which is not true for all UEs in all deployments), e.g., if the source gNB already broadcast the time, then the UE won’t send this UE assistance information. |

A majority of companies acknowledge the issue: *How does the target gNB determine the actions it must take to maintain the timing accuracy required by the UE*?

However, there is some disagreement whether solutions are entirely within RAN2 scope (e.g. involves only RTI configuration information that is transferred via RRC containers) or may be at least partially within RAN3 scope (e.g. involves assistance information that is exchanged at XnAP level). Since this depends on the solution, it is proposed that RAN3 can further discuss about assistance information that may be useful for the target gNB to maintain the timing accuracy required by the UE.

Proposed conclusion: Capture the following in the Chair’s Notes:

Further discuss assistance information that may be useful for the target gNB to maintain timing accuracy required by the UE following handover, focusing on RAN3 aspects.

# 4 Conclusions, Recommendations

Capture the following in the Chair’s Notes:

Wait for RAN2/SA2 decision on Time Synchronization assistance parameters before further discussing in RAN3.

Further discuss assistance information that may be useful for the target gNB to maintain timing accuracy required by the UE following handover, focusing on RAN3 aspects.

# References

1. R3-211596, *Analysis of Propagation Delay Compensation enhancements*, ZTE
2. R3-211844, *Discussion on Propagation Delay Compensation Enhancements*, CATT
3. R3-212379, *Time synchronization enhancements*, Nokia, Nokia Shanghai Bell
4. R3-212146, *Time synchronization assistance parameters*, Huawei
5. R3-212397, *Discussion on the propagation delay compensation enhancements*, Samsung
6. R3-212337, *Discussion on Time Synchronization assistance parameters*, Ericsson
7. R3-212050, *Discussion on Further enhanced NR-IIoT: Enhancements for support of time synchronization*, Ericsson
8. R3-211455, *LS on Time Synchronization assistance parameters*, SA2