3GPP TSG-RAN WG3 Meeting #111-e R3-211021

Online, 25 January – 4 February 2021

**Agenda item: 21.1**

**Source: Nokia (moderator)**

**Title: Summary of Offline Discussion - propagation delay compensation**

**Document for: Approval**

# 1 Introduction

**CB: # NRIIOT2-PDC**

**- UE-based PDC is out of scope for RAN3?**

**- RAN3 can start to study the PDC in network part or postpone the discussion on propagation delay compensation until RAN1/RAN2 decides the final the propagation delay compensation enhancements solution?**

**-** **Define the typical hops for scenarios? Define the mapping list of Synchronization source and Scenarios?**

**- F1AP impacts of network-based PDC? E.g., PD estimation is performed at the gNB-DU? If gNB compensation is agreed in RAN2, gNB-CU controls gNB-DU to report the Propagation delay compensation (e.g. NTA/2, the updated TA, the clock offset of propagation delay ) information by on-demand or periodically?**

**- The CN informs the NG-RAN that UE Uu synchronicity budget has strict requirement? Send a LS to SA2 to request that SMF can provide an assistance information for gNB to determine the appropriate 5G time synchronization scheme for a UE?**

**- Whether enhancement is needed to fulfil the time synchronisation enhancements during the handover procedure? E.g., during handover the source NR-RAN node informs the target NG-RAN node the TSN reference information used for the UE? UE behaviour?**

**- RAN3 should study solutions for reducing TSN data transmission interruption during handover? E.g., DAPS HO can be used for TSN traffic data transmission?**

**- Identify the issues to be discussed in RAN3**

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

(Nokia - moderator)

Summary of offline disc

# 2 For the Chairman’s Notes

The following is proposed for agreement in Phase 1 of email discussion:

Proposal 1: RAN3 to send an LS to RAN1/RAN2 indicating that gNB-based PDC has RAN3 impacts, and that RAN3 awaits confirmation from RAN1 and RAN2 that gNB-based PDC is to be supported.

Proposal 2: RAN3 to wait for reply LS from RAN1 and RAN2, before further discussing gNB-based PDC.

Proposal 3: RAN3 to discuss what information (if any) may be needed by the gNB from the CN, to assist the gNB in making PDC decisions. Discussion to continue at next meeting, focusing first on the use case / motivation / requirements.

Proposal 4: RAN3 to postpone further discussion on UE mobility, pending RAN2 agreement on the information (if any) needed to be exchanged between source and target gNBs.

Other conclusions:

- Whether or not data interruption during handover is an issue for TSN traffic needs RAN2 confirmation (contribution driven in RAN2).

# 3 Discussion

It is proposed to divide the discussion into two phases:

**- Phase 1: Identify the issues to be discussed in RAN3**

Deadline: Please provide your views by 11:00am UTC Wednesday January 27th (i.e. before the scheduled online session for IIoT)

**- Phase 2: Further discussion to capture agreements and open issues**

Deadline: TBD pending outcome of Phase 1

## 3.1 Phase 1: Identify issues to be discussed in RAN3

A total of 16 papers were submitted to Agenda Item 21.1, addressing various issues which are discussed individually in the sub-sections below.

### 3.1.1 Propagation delay compensation

Propagation delay compensation (PDC) can potentially be performed by either the UE or gNB:

a) **UE-based PDC**: propagation delay is compensated by the UE, using PD estimation performed by either the UE or gNB (which reports it to the UE);

b) **gNB-based PDC**: propagation delay is pre-compensated by the gNB.

NOTE: The method(s) for PD estimation are currently under discussion in RAN1.

Nokia [1] believes that UE-based PDC is out of scope for RAN3, while gNB-based PDC has F1AP impacts that can be further discussed with the assumption that PD estimation is possible at the gNB-DU (by means that will be decided by RAN1).

ZTE [2] proposes that if gNB-based PDC is agreed in RAN2, the gNB-CU controls the gNB-DU to report the PDC. An F1AP CR with stage 3 details is provided in [4].

CATT [9] proposes that RAN3 focus on the network part of PDC and lists several issues that could be further investigated by RAN3.

Huawei [5] and Samsung [12] propose to postpone RAN3 discussion on PDC pending further progress in RAN1 and/or RAN2.

Observations: There does not appear to be a common understanding regarding which WG is responsible for deciding if gNB-based PDC is supported. In our understanding, neither RAN1 nor RAN2 has directly addressed this question, and it is unclear whether this is because e.g. companies in RAN1/RAN2 assume “some other WG” will make the decision, or already assume that it is supported, or delay the decision until after RAN1 completes its study on PD estimation options, etc. Therefore, to proactively ensure that all WGs are on the same page, the moderator would like to propose that RAN3 send an LS to RAN1/RAN2 indicating that gNB-based PDC has RAN3 impacts, and that RAN3 awaits confirmation from RAN1 and RAN2 that gNB-based PDC is to be supported in Rel-17 (or that they leave the final decision to RAN3).

**Proposal 1: RAN3 to send an LS to RAN1/RAN2 indicating that gNB-based PDC has RAN3 impacts, and that RAN3 awaits confirmation from RAN1 and RAN2 that gNB-based PDC is to be supported (or that the final decision is left to RAN3).**

**Proposal 2: RAN3 to wait for reply LS from RAN1 and RAN2, before further discussing gNB-based PDC.**

**Question: Please provide your company view on the above proposals.**

**Please respond YES or NO (with optional comments). If proposal 1 is agreed, a draft LS will be discussed in the Phase 2 email discussion.**

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| --- | --- |
| *Company* | *Comments* |
| Huawei | Generally YES.  We may suggest to remove the brackets “(or that the final decision is left to RAN3)” since anyhow this will be discussed and decided by RAN2. |
| ZTE | Yes. We think it necessary to wait for the RAN1/RAN2 conclusion. |
| Nokia | Yes. Details of the LS can be checked during Phase 2 of the email discussion. |
| CATT | Yes. Wait for RAN1/2 decsion |
| Samsung | Yes. We think the impact on RAN3 would be clarified after some further progress in RAN1/2. |
| Ericsson | Yes to Proposal 2.  We wait for more progress from the other groups |
| Qualcomm | Yes, this is a good way forward |
| Apple | Yes for proposal 1. |
| China Telecom | Yes for proposal 1 |

Conclusion: Agree to Proposals 1 and 2.

### 3.1.2 Uu time synchronization budget

In a LS exchange between RAN1 and RAN2, two representative use cases were described having different synchronicity budget requirements:

a) Control-to-Control, which involves two Uu interfaces with synchronicity budget per Uu interface of ±145ns to ±275ns; and

b) Smart Grid, which involves one Uu interface with synchronicity budget of ±795ns to ±845ns.

ZTE [2] proposes that CN indicates to gNB the reference time synchronization requirement for one-way transmission. An NGAP CR with stage 3 details is provided in [3].

Huawei [5] proposes that CN informs gNB that the Uu synchronicity budget has strict requirement, to assist the gNB decision to apply PDC. An NGAP CR with stage 3 details is provided in [6].

Observations: This topic seems independent of whether PDC is UE-based or gNB-based. Although the details of the ZTE and Huawei proposals differ, the basic common denominator is that CN provides information to the gNB so that it has knowledge of the UE’s synchronization accuracy requirement.

**Proposal 3: RAN3 to discuss what information (if any) may be needed by the gNB from the CN, to assist the gNB in making PDC decisions.**

**Question: Please provide your company view on the above proposal.**

**Please respond YES or NO (with optional comments). If proposal 3 is agreed, discussion can continue in the Phase 2 email discussion (based on [2][3][5][6]) or at the next meeting.**

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| *Company* | *Comments* |
| Huawei | YES  We agree with the moderator’s analysis on the independence of whether PDC is UE-based or gNB-based. And this need can be decided by RAN3 itself. |
| ZTE | Yes.  Taking into account the clock synchronization of the 5G system defined in TS 22.104, the synchronization budget 1us is between the sync master and any device of the clock domain. The end to end synchronization requirements for Control-to-Control and Smart Grid scenarios are 500ns and 1000ns, respectively. Considering that the different reference time synchronization requirement may have different network equipment consumption, so different reference time synchronization requirement should be distinguished. In addition, the CN may not know the Uu synchronicity budget for different scenarios, CN can only distinguish the end to end synchronization requirements(e.g. for Control-to-Control or for Smart Grid scenarios).  Considering that clock synchronization is used for TSC services, CN can include end to end reference time accuracy indication in TSCAI. |
| Nokia | Yes. It seems that signalling from the CN needs to be supported (e.g. to enable gNB to determine whether to invoke Rel-17 PDC), and of course NGAP signalling is RAN3 scope. |
| CATT | Not sure. Does the CN have the information? From subscribe? Or deployment? |
| Samsung | Maybe. RAN3 should clarify the use case first.  We don’t see a clear requirement and a usage scenario in the overall system that different time synchronization requirement for different PDU sessions or different UEs should be used. |
| Ericsson | Motivation needs to be clarified. Is it to differentiate per UE, per PDU session?  We need to understand what tools already have today first.  In our view, the RAN3 discussion cannot be independent of RAN1/RAN2 decision on PDC. |
| Qualcomm | Maybe but not really for this meeting. Similar to comments from CATT, Samsung and Ericsson. Also this seems like an end-to-end topic so the first question is whether there is such a requirement from any other groups on this (including SA2). |
| Apple | As suggested by the other companies, the scenario needing this information needs to be clarified first. Also as Qualcomm mentions, there needs to be some discussion on if there is any requirement for these scenarios in other groups beyond RAN3. |
| China Telecom | The scenario and use case shall be clarified first. The discussion on this issue can be postponed to next meeting. |

Conclusion: Agree to proposal 3. Discussion to continue at next meeting, focusing first on the use case / motivation / requirements.

### 3.1.3 UE mobility

RAN2 has been discussing two potential enhancements related to mobility:

a) UE receives the reference time information of the target cell during handover.

b) Source cell sends information to the target cell regarding the UE’s need for reference time information.

ZTE [2] observes that if information needs to be exchanged between source and target cells during handover, this can be achieved using RRC containers defined by RAN2. Huawei [8] indicates the target gNB can be aware of UE’s preferenceby the *referenceTimeInfoPreference-r16* IE from source cell to target cell using the RRC: *HandoverPreparationInformation* contained in the XnAP: HANDOVER REQUEST message, and it can send the time synchronization message to the UE when the UE successfully accesses the target gNB. Samsung [13] indicate that the information can be provided from target cell to source cell using the RRC: *HandoverCommand* contained in the XnAP: HANDOVER REQUEST ACKNOWLEDGE message. Therefore, all three companies conclude that UE mobility has no impact to RAN3 specifications.

CATT [10] observes that UE may need to refresh the clock during handover. The target node may provide reference time to the UE during handover, and the UE can immediately request reference time via UE Assistance Information after access to the target node. This all appears to be in RAN2 scope, so [10] does not appear to raise any RAN3 issues.

Ericsson [14] proposes that the source gNB provide time reference information to the target node at the NGAP/XnAP protocol level. An NGAP CR is provided in [15] for NG-based handover, proposing that the information include Uncertainty, Time Information Type, TSN distribution, and Periodicity. A companion XnAP CR is provided in [16] for Xn-based handover.

Observations: UE mobility is currently under discussion in RAN2, and three companies currently believe it has no impact on RAN3 specifications. Therefore, it seems beneficial to wait for further RAN2 progress, to check whether RAN2 agrees on the need for information exchange between source and target gNBs, and if so whether RAN2 agrees that the needed information can be exchanged using RRC containers.

**Proposal 4: RAN3 to postpone further discussion on UE mobility, pending RAN2 agreement on the information (if any) needed to be exchanged between source and target gNBs.**

**Question: Please provide your company view on the above proposal.**

**Please respond YES or NO (with optional comments).**

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| --- | --- |
| *Company* | *Comments* |
| Huawei | YES |
| ZTE | Yes. |
| Nokia | Yes. RAN3 discussion, if needed, can be triggered by LS from RAN2. |
| CATT | Yes, |
| Samsung | Yes. |
| Ericsson | Yes. We would be fine to not discuss this in detail at this meeting. But we also need to be clear that some aspects are purely RAN3 related and not dependent on the RAN2 progress. |
| Qualcomm | Ok with P4 |
| Apple | YES, Agree with the proposal. |
| China Telecom | Yes |

Conclusion: Agree to Proposal 4.

### 3.1.4 Other

CATT [11] observes that the performance requirements of TSN traffic cannot be fulfilled during handover, and therefore RAN3 should study solutions for reducing TSN data transmission interruption during handover. Dual Active Protocol Stack (DAPS) handover was introduced in Rel-16 to reduce data interruption during handover, but further study is needed how to handle TSCAI parameters during DAPS HO and whether DAPS HO can be used for TSN traffic data transmission.

Observations: RAN3 should first confirm whether the issues raised in [11] are in the WID scope (i.e. directly related to propagation delay compensation enhancements), and if so whether the issues are in RAN3 scope.

**Question: Are the issues raised in [11] within the scope of the WID, and if so, also within RAN3 scope?**

**Please respond YES or NO (with optional comments). If there is consensus that the issues raised in [11] are within WID and RAN3 scope, discussion can continue in the Phase 2 email discussion (based on [11]) or at the next meeting.**

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| *Company* | *Comments* |
| Huawei | It is not clear to us what exact the issue is. Maybe the proponent company can provide more details before answering the question. |
| ZTE | Argee with HW. |
| Nokia | Whether or not performance requirements of TSN can be fulfilled during HO does not seem like RAN3 scope. The issue should first be confirmed by SA2 and/or RAN2. |
| CATT | The gPTP message for the TSN clock sync is TSN traffic and it is transferring or dataforwarding during handover. We need study the DATA interruption for this TSN traffic. It may or not impact the PDC enhancement.  For other TSN traffic adapt the DAPS, I don’t know whether this WID need to cover. But we really need to study it. |
| Samsung | Agree with Huawei. The issue is still unclear. |
| Ericsson | Agree that user plane interruption at HO needs to be reduced/avoided but this is not strictly related to PDC enhancements.  Whether or not DAPS is a suitable solution for supporting TSN traffic at HO seems should be first discussed in RAN2. |
| Qualcomm | This does look primarily like a RAN2 lead topic. But open for more analysis. |
| Apple | Agree with others. The issues still need to be clarified and further it might be a RAN2 topic first. |
| China Telecom | We need to study the performance of TSN traffic during the mobility procedure. We are also open for more anyalsis. |

Conclusion: Whether or not data interruption during handover is an issue for TSN traffic needs RAN2 confirmation (contribution driven in RAN2).

## 3.2 Phase 2: TBD

[TBD]

# 4 Conclusions, Recommendations

[TBD]

# References

1. R3-210093, RAN3 impacts of propagation delay compensation enhancements (Nokia, Nokia Shanghai Bell)
2. R3-210200, Analysis of Propagation Delay Compensation enhancements (ZTE)
3. R3-210201, CR for TS38.413 on propagation delay compensation enhancements (ZTE)
4. R3-210202, CR for TS38.473 on propagation delay compensation enhancements (ZTE)
5. R3-210479, RAN3 impacts of the time synchronization enhancement (Huawei)
6. R3-210480, Network-aware of the synchronization requirement (Huawei)
7. R3-210481, [Draft] LS on network-aware of the synchronization requirement (Huawei)
8. R3-210482, Time synchronization during handover (Huawei)
9. R3-210776, Discussion on Propagation Delay Compensation (CATT)
10. R3-210777, Discussion on time synchronization for mobility (CATT)
11. R3-210778, Discussion on Data interruption during mobility (CATT)
12. R3-210783, Discussion on supporting the propagation delay compensation (Samsung)
13. R3-210784, Discussion on the time synchronization enhancement during the mobility (Samsung)
14. R3-210873, Discussion on Further enhanced NR-IIoT: Enhancements for support of time synchronization (Ericsson)
15. R3-210874, Enhancements for support of time synchronization (Ericsson)
16. R3-210875, Enhancements for support of time synchronization (Ericsson)