**3GPP TSG-RAN WG2 Meeting #113-eR2-21xxxxx**

**Electronic meeting, Jan 25th – Feb 5th, 2021**

**Agenda item:** 8.11.2.1

**Source:** CATT

**Title:** Report of [AT113-e][608][POS] Continue discussion of latency enhancements

**Document for:** Discussion and Agreement

# 1 Introduction

This is to continue discussion on P4 in R2-2102304. The goal of this discussion [AT113-e][608] is:

* discuss whether to send an LS to SA2 in relation to P4 of R2-2102304
* determine if one of the TPs in P4 is agreeable
* [AT113-e][608][POS] Continue discussion of latency enhancements (CATT)

Scope: Discuss the proposals in R2-2100407 and R2-2101950 and converge to an agreeable TP. Additional latency enhancements from the previous email discussion can be captured if they have a clear consensus. Recommendations from RAN2 perspective should be clarified.

Intended outcome: Endorsable TP (+summary in R2-2102304)

Deadline: Tuesday 2021-02-02 1200 UTC – extended to Thursday 2021-02-04 0200 UTC to discuss whether to send an LS to SA2 in relation to P4 of R2-2102304, and determine if one of the TPs in P4 is agreeable.

Companies are invited to provide inputs and comments by **Wednesday 2021-02-03 15:00 UTC**.

The remainder of this document is organized as the following. Section 2 contains the questionnaire on proposal 4 in in R2-2102304. The purpose is to collect the views and identify the commonalties and differences to decide whether to send an LS to SA2 and determine one of TPs into TR.

To make it easier to find the correct contact delegate in each company for potential follow-up questions, the rapporteur encourages the delegates who provide their contact information in this table:

|  |  |
| --- | --- |
| Company | Delegate contact |

|  |  |
| --- | --- |
|  |  |
|  |  |
| Nokia | mani.thyagarajan@nokia.com |
| ZTE | liu.yansheng@zte.com.cn |
| vivo | yuanyuanwang@vivo.com |
| CATT | lijianxiang@datangmobile.cn |
| Intel | Yi.guo@intel.com |

# 2 Discussion

## 2.1 Summary of previous discussion

As documented in latency analysis in the endorsed Text proposal for TR38.857 on latency reduction results in R2-2102095.

|  |  |  |
| --- | --- | --- |
| Step 1 LPP Request capabilities | 18-34.5 | Processing delays: 14 ms  -                         UE: TUEProc-RRCDLInfo  -                         gNB: TgNBProc-NAS/LPP  -                         AMF: TAMFProc  -                         LMF: TLMFProc  Signalling delay:4-20.5ms  -                         UE-gNB: TUE-gNB  -                         gNB-AMF: TgNB-AMF  -                         AMF-LMF: TAMF-LMF  Note 1: the LPP capability processing delay is counted together in response message. |
| Step 2 LPP Provide Capabilities | 25-54.5 | Processing delays: 21-34 ms  -                         UE:  -                         TUEProc-RRCULInfo  -                         TUEProc-LPPCapab  -                         gNB: TgNBProc-NAS/LPP  -                         AMF: TAMFProc  -                         LMF: TLMFProc  Signalling delay:4-20.5 ms  -                         UE-gNB: TUE-gNB  -                         gNB-AMF: TgNB-AMF  -                         AMF-LMF: TAMF-LMF |

The maximum LPP delay in fetching capability is 89ms (34.5ms + 54.5ms). As provided analysis previously in [R2-2008810], [R2-2010072], [R2-2009023], [R2-2101392],

* Skip the capability procedure (can reduce the latency caused by exchange of capability as above)
* Support the process that UE location capabilities report to AMF in idle/inactive directly without entering into RRC\_CONNECTED mode in LPP session, in order to reduce the latency and support the positioning in Idle/Inactive mode.
* If this capability is stored in Core Network Node such as AMF similar to radio capabilities; the 90ms can be minimized. Since, AMF may provide the capability as part of Location Request.

Additionally, storing of positioning capability is to reduce TTFF, mentioned in [R2-2010072] and [R2-2009023].

Time to First Fix (TTFF) defined in 22.261: time elapsed between the event triggering for the first time the determination of the position-related data and the availability of the position-related data at the positioning system interface.

**Observation: Majority of companies (13/15) agreed to capture capability procedure for latency reduction into TR in the previous discussion reported in R2-2102304 (Summary of [608]). Majority agrees to recommend the agreed text proposal.**

## 2.2 LS to SA2

Majority of companies (13/15) agreed SA2 will be involved. Some companies believe capability solution is related to latency reduction; RAN2 can make a conclusion and send LS to SA2. There is no RAN2 work. Some companies think companies can bring it to SA2 by themselves.

**Q1: Do you agree to send a LS to SA2？**

|  |  |  |
| --- | --- | --- |
| **Company name** | **Agree/Disagree** | **Comments** |
| Nokia | Disagree | The contributions on UE capability enhancements seen so far, are all just discussing the general idea of storing the capabilities in AMF and allowing LMF to retrieve it from AMF. There are some papers pointing to what signalling message could be used to signal the capabilities from UE to AMF. Some papers just mention that if we avoid the capability exchange over LPP it reduces latency. None of them had shown what is the latency gain. Just because the LPP procedure is avoided the latency associated with that procedure can be gained is not right. It only moves the latency from LPP to somewhere in the overall signalling flow involving UE positioning. Since RAN2 had not done an E2E latency evaluation (due to time crunch), RAN2 cannot say for sure what the merits are of such an enhancement and hence cannot endorse or recommend a solution to SA2 for further study. Companies are free to propose such CN solutions for UE capability exchange enhancements directly to SA2. Note that we are not saying this solution is not acceptable. Only that such solutions should be directly discussed in SA2 and RAN2 cannot recommend it at this time given the lack of thorough study in RAN2. |
| Ericsson | Agree | We think the logic is simple here. We avoid LPP capability fetch procedure as AMF provides this to LMF. AMF anyway has to send the Location request Message to LMF, so it is simply appending the capability there. So, it is not right to say we are moving the latency to CN signalling. Since capabilities are already stored, thus there is gain in latency. |
| Qualcomm | Disagree | The assumption seems to be that the LPP capability procedure can be skipped completely if the AMF/LMF has a stored version of the UE capabilities available. We don't think this assumption is correct.  Storing UE positioning capabilities in the NW can only work for capabilities which are static and/or long-term valid. Obviously, storing capabilities which depend on the current radio configuration (e.g., some UL-PRS capabilities) is not meaningful/possible. Other capabilities, such as DL-PRS processing capabilities etc. may be time varying too (e.g., may depend on the current UE situation (e.g., for power saving, a UE may advertise lower DL-PRS processing capabilities in certain scenarios)). Or in general, if a user turns-off location services, a UE may not advertise positioning capabilities at all, etc.  Therefore, the benefit of storing positioning capabilities in the NW seems limited. If it were to be supported, an LMF might still need to receive an indication from the UE that the stored capabilities are still valid and/or an indication of any changed capabilities. Therefore, there would be no latency gain. |
| ZTE | Agree | We share the similar view with Ericsson. If LPP capability exchange procedure between UE and LMF can be skipped, it is clear that the latency caused by step1&2(capability request&response) can be omitted. Meanwhile, no more procedure will be added into the common positioning procedures we discussed in recent meetings. From our point of view, this is the latency gain. And it is valid at least in some use cases.  An LS should be sent to SA2 before we analyze how much latency gain can be achieved for storing positioning capability in AMF and in what conditions UE can store what kinds of positioning capability in AMF(This part can be discussed in WI phase). From our mind, before we further discussing all detail cases, RAN2 should be confirmed that SA2 does not reject storing the UE capability in AMF side .  In Rel-17 positioning SI, it is clear that RAN1 and RAN2 are responsible for leading the discussion of positioning latency reduction. That’s another reason why we prefer to send an LS to SA2 and trigger the related discussion at SA2 side. |
| Ericsson |  | Just to respond to QC that UL SRS capabilities are already stored in AMF. We do not see any reason as why DL PRS cannot be also stored. |
| vivo | Disagree | Currently no evidence provides how AMF stores capability can help on latency. In this phase we are trying to find a way for latency enhancement, which means AMF store “might” help, need study but haven’t reach a conclusion AMF stores capability really has latency gain. |
| Lenovo, Motorola Mobility | Disagree | The issue is also related to the completion of the Positioning Enhancement SI and the corresponding impact on RAN2’s latency reduction work. Given the concerns by some companies and lack of time, it is not clear that we can recommend capability storage as a latency reduction mechanism in the TR without verification from SA2. |
| CATT | Agree | Skipping LPP positioning capability fetch leads to the maximum 89ms latency reduction, which brings obvious latency gain. The reason sending LS to SA2 is that it mainly affects the specification of SA2, so it is necessary for SA to evaluate what kind of impact needs to be considered. Furthermore, as leading group of positioning technology, RAN2 can firstly trigger other group to study the technology via LS, and it is also the most reasonable way.  In addition, we don't quite agree with QC's opinion on the dynamic change of capabilities. The existing radio capabilities can also be changed, but it is still necessary to save the radio capabilities on AMF. Is there any essential difference between the two capabilities in this respect? |
| Intel | Agree | 1 capability stored in AMF can avoid the steps between UE and LMF, and therefore can reduce latency significant;  2 Regarding dynamic capability mentioned by QC, we assume that is some capabilities may be changed based on CA configuration; But that could be changed even during the positioning session, and so far we do not have any solution on that. Therefore do not see the serious problem on this part;  3 The solution mainly impacts SA2, and therefore LS is needed to SA2. |
| oppo | Disagree | Further study is needed |

The draft LS can be found as below:

“RAN2 has done latency analysis and the below are the latency values for fetching capabilities as shown in Table 1. RAN2 would like to understand from SA2 if it is feasible to store the Positioning capabilities in a core network node in order to reduce the latency and Time To First Fix.

RAN2 would kindly request SA2 for their input on this”

Table 1: Latency performance analysis for UE assisted DL-TDOA and DL-AoD

| Step | Delay Value [ms] | Description of Latency Component |
| --- | --- | --- |
| Step 1 LPP Request capabilities | 18-34.5 | Processing delays: 14 ms  -                         UE: TUEProc-RRCDLInfo  -                         gNB: TgNBProc-NAS/LPP  -                         AMF: TAMFProc  -                         LMF: TLMFProc  Signalling delay:4-20.5ms  -                         UE-gNB: TUE-gNB  -                         gNB-AMF: TgNB-AMF  -                         AMF-LMF: TAMF-LMF  Note 1: the LPP capability processing delay is counted together in response message. |
| Step 2 LPP Provide Capabilities | 25-54.5 | Processing delays: 21-34 ms  -                         UE:  -                         TUEProc-RRCULInfo  -                         TUEProc-LPPCapab  -                         gNB: TgNBProc-NAS/LPP  -                         AMF: TAMFProc  -                         LMF: TLMFProc  Signalling delay:4-20.5 ms  -                         UE-gNB: TUE-gNB  -                         gNB-AMF: TgNB-AMF  -                         AMF-LMF: TAMF-LMF |
| Step 3 LPP Provide Assistance Data | 28-44.5 | Processing delays: 21-34 ms  -                         UE:  -                         TUEProc-RRCDLInfo  -                         TUEProc-LPPAssi  -                         gNB: TgNBProc-NAS/LPP  -                         AMF: TAMFProc  -                         LMF: TLMFProc  Signalling delay:4-20.5 ms  -                         UE-gNB: TUE-gNB  -                         gNB-AMF: TgNB-AMF  -                         AMF-LMF: TAMF-LMF |
| Step 4 LPP Request Location Information | 23-39.5 | Processing delays: 19 ms  -                         UE:  -                         TUEProc-RRCDLInfo  -                         TUEProc-LPPLocationRe  -                         gNB: TgNBProc-NAS/LPP  -                         AMF: TAMFProc  -                         LMF: TLMFProc  Signalling delay:4-20.5ms  -                         UE-gNB: TUE-gNB  -                         gNB-AMF: TgNB-AMF  -                         AMF-LMF: TAMF-LMF |
| Step 5 RRC Location Measurement Indication | 5-8.5 | Processing delays: 5-8 ms  -                         UE: TUEProc-RRCLocationMeas  -                         gNB: TgNBProc-RRC  Signalling delay:0-0.5ms  -                         UE-gNB: TUE-gNB |
| Step 6 RRC Measurement Gap configuration | 13-13.5 | Processing delays: 13 ms  -                         UE: TUEProc-RRCReconf  -                         gNB: TgNBProc-RRC  Signalling delay:0-0.5ms  -                         UE-gNB: TUE-gNB |
| Step 7 DL PRS measurement | 88.5 | TDL-Meas |
| Step 8 LPP Provide Location Information | 20-39.5 | Processing delays: 16-19 ms  -                         UE:  -                         TUEProc-RRCULInfo  -                         TUEProc-LPPLocationRe  -                         gNB: TgNBProc-NAS/LPP  -                         AMF: TAMFProc  -                         LMF: TLMFProc  Signalling delay:4-20.5 ms  -                         UE-gNB: TUE-gNB  -                         gNB-AMF: TgNB-AMF  -                         AMF-LMF: TAMF-LMF |
| Step 9 LMF calculation | 2-30 | TLMF-Calc |
| Total values | 222.5-353 |  |

**Q2: If answer of Q1 is “Yes”, do you agree the above LS content sent to SA2?**

|  |  |  |
| --- | --- | --- |
| **Company name** | **Agree/Disagree** | **Comments** |
| Ericsson | Agree | We are fine with either sending an LS or capturing in TR or both.  The LS looks good so we also inform SA2 about the detail numbers and SA2 can then analyse further and keep RAN2 in loop with their findings. |
| ZTE | Agree |  |
| CATT | Agree |  |
| Intel | Agree |  |
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## 2.3 Text proposal

6/15 companies proposed the common understanding on “SA/CT will be involved during WI”. 9/15 companies agree without modification. It seems that there is no majority on the proposed TP in previous discussion.

So we continue to discuss the options of text proposal as below.

Option1: The following enhancements of signaling & procedures for reducing NR positioning latency are considered as beneficial:

**--------------------------------Text Proposal #3-----------------------------------------------------------------------------------**

The following enhancements of signaling & procedures for reducing NR positioning latency are recommended for normative work, including DL and DL+UL positioning methods

* + The following enhancements of signaling & procedures for reducing NR positioning latency are considered as beneficial:
    - Latency reduction related to storing UE capability in AMF procedure. It is proposed that SA2 should study whether this should be recommended for normative work in SA/CT.

**----------------------------End of Text Proposal #3-------------------------------------------------------------------------------**

Option2: The details of the solutions are left for further discussion in normative work, which may include the following aspects:

**--------------------------------Text Proposal #4-----------------------------------------------------------------------------------**

The following enhancements of signaling & procedures for reducing NR positioning latency are recommended for normative work, including DL and DL+UL positioning methods

* + The details of the solutions are left for further discussion in normative work, which may include the following aspects:
    - Latency reduction related to storing UE capability in AMF procedure.
    - SA/CT will be involved during WI.

**----------------------------End of Text Proposal #4-------------------------------------------------------------------------------**

**Q3: Which option do you prefer to capture into TR?**

|  |  |  |
| --- | --- | --- |
| **Company name** | **Agree/Disagree** | **Comments** |
| Nokia | Disagree | Don’t agree with either option 1 or option 2. Option 1 and TP#3 says “are considered as beneficial”. TP#3 also says “recommended for normative work”. As already stated, this is not OK since RAN2 has not studied the proposed enhancement very well or evaluated the benefits of it.  Option 2 says “left for further discussion in normative work”. TP#4 says “recommended for normative work” and “left for further discussion in normative work”. Option 2 is clearly not saying it is left for further study. Again, this is not OK since RAN2 has not studied the proposed enhancement very well or evaluated the benefits of it |
| Ericsson | Agree | We are fine with either Option |
| Qualcomm | Disagree | Don’t agree with either option 1 or option 2. We would be O.K. with phrasing the conclusion in the same way as for location request and assistance data. E.g.,  The following enhancements of signaling & procedures for reducing NR positioning latency can be studied and specified, if needed   * Latency reduction related to the request and response of positioning assistance data (e.g., via RRC signaling, MAC-CE and/or physical layer procedure) * Latency reduction related to the reception of DL PRS (e.g., priority rules for the reception of DL PRS) * Latency reduction related to the reporting of the measurements (e.g., CG-based transmission) * Latency reduction related to the request and response of UE positioning capabilities (e.g., via storing UE capabilities in the network). |
| ZTE | Agree | We are fine for either option. |
| Vivo | Disagree | Same view with Qualcomm. |
| Lenovo, Motorola Mobility | Disagree | Share Nokia’s and QC’s view. |
| CATT | Agree | We are fine for either option. |
| Intel | Agree | We are fine with each option. |
| oppo | Disagree | Similar view as Qualcomm |

# 3 Conclusion

**TBD**

# 4 References

1. R2-2100407 [Post112-e][617][POS] Evaluation of latency enhancement solutions (CATT)‎, CATT
2. R2-2010868 [AT112-e][607][POS]Gathering of latency enhancement solutions (CATT), CATT
3. RP-202900 New WID on NR Positioning Enhancements, CATT, Intel Corporation, Ericsson
4. 3GPP TR 38.857 V1.0.0 (2020-12)
5. R2-2010669 Summary of 8.11.2 Enhancements for commercial use cases
6. R2-2008810 Further discussion on enhancements for commercial use cases, CATT
7. R2-2008886 Discussion on End-to-End Latency Reduction for DL/UL Positioning, InterDigital, Inc.
8. R2-2009001 Report of [Post111-e][625][POS] End-to-end latency analysis (Intel), Intel Corporation
9. R2-2009023 Solution directions to reduce end-to-end latency, Intel Corporation
10. R2-2010096 NR Positioning Latency Analysis and Enhancements, Qualcomm Incorporated
11. R2-2010276 Discussion on IDLE INACTIVE pos, on-demand PRS and latency analysis, Huawei, HiSilicon
12. R2-2010277 Discussion on R17 positioning enhancement, Huawei, HiSilicon
13. R2-2010072 Enhancements for commercial use cases, Ericsson
14. R2-2009039 Discussion on positioning enhancement, vivo
15. R2-2009137 Discussion on positioning enhancements for commercial use cases, Spreadtrum Communications
16. R2-2009577 Positioning enhancements on RRC idle/inactive UE and latency reduction, Beijing Xiaomi Electronics
17. R2-2009897 Considerations on potential positioning enhancements, Sony
18. R2-2010627 Discussion on enhancement for commercial use cases, Samsung R&D Institute UK
19. R2-2008261 [AT111-e][612][POS] Assumptions for analysis of commercial use cases, Ericsson
20. R2-2101950 Summary of AI 8.11.2.1 Latency analysis and latency enhancements CATT
21. R2-2100933 On Positioning Latency Reduction Solutions Lenovo, Motorola Mobility
22. R2-2101392 Discussion on Latency Aspects Ericsson