**3GPP TSG-RAN WG2 Meeting #113-eR2-2102120**

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

**Agenda item:** 8.11.2.1

**Source:** CATT

**Title:** Text Proposals of latency enhancements

**Document for:** Discussion and Agreement

# 1 Introduction

This is to continue discussion of the proposals in R2-2100407 and R2-2101950. The goal of this discussion [AT113-e][608] is:

* converge to an agreeable TP for latency enhancements
* recommendations from RAN2 perspective
* [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

Deadline: Tuesday 2021-02-02 1200 UTC

In this contribution, we propose a text proposal for the TR for latency enhancements in R17.

# 2 Conclusion

There are agreements during online discussion as below.

Agreements:

The following TPs are endorsed, with an indication of which items originate from RAN2:

--------------------------------Text Proposal #1-----------------------------------------------------------------------------------

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 the measurement gap

 Latency reduction related to the reporting and request of the measurement (e.g., via RRC signaling, MAC-CE and/or physical layer procedure, and/or priority rules)

 Latency reduction related to measurements

 Latency reduction related to the reporting and request of positioning assistance data (e.g., via location scheduling in advance of the time of when the location is needed)

----------------------------End of Text Proposal #1--------------------------------------------------------------------------

--------------------------------Text Proposal #2-----------------------------------------------------------------------------------

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)

----------------------------End of Text Proposal #2--------------------------------------------------------------------------

**High level summary of offline discussion on P4:**

**6/10 companies disagreed LS to SA2 and 4/10 companies agreed LS to SA2.**

**Proposal 1: No LS to SA2 on capabilities (6/10).**

**Proposal 2: RAN2 to discuss and agree the text proposal as below (6/10).**

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

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).

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

# 3 Text Proposal

*Start of Text Proposal*

# 7 Studied NR positioning enhancements

The following enhancements have been considered during this study:

* Partial staggering and non-staggering RE mapping of SRS for positioning with different combinations of comb-factors and symbol lengths, including the methods/signalling for addressing potential time-domain aliasing due to the partial/non-staggering RE mapping.
* Semi-persistent and a-periodic transmission and reception of DL PRS
  + Semi-persistent means MAC-CE triggered
  + Aperiodic would correspond to DCI-triggered
* On-demand transmission and reception of DL PRS
  + On-demand corresponds to the UE-initiated or network-initiated request of PRS and/or SRS, i.e. UE or LMF request/suggesting/recommending specific PRS pattern, ON/OFF, periodicity, BW, etc.
* Multipath mitigation techniques including but not limited to the following:
  + The applicable scenarios and performance benefits of multipath mitigation techniques
  + The methods/measurement/signaling for the LOS/NLOS detection and identification
  + The measurements for supporting the multipath mitigation/utilization
  + The procedure and signaling for supporting the multipath mitigation/utilization
  + Implementation-based solutions (e.g., outlier rejection) without the need of any additional specified method/measurements/procedures/signaling.
  + Note: The above study applies to DL only, UL only, DL+UL positioning solutions for UE-based and UE-assisted positioning.
* NR positioning for UEs in RRC\_IDLE state and UEs in RRC\_INACTIVE state, including the benefits on latency, network/UE efficiency and UE power consumption
* For reducing NR positioning latency, more efficient signaling & procedures enabling a device to request and report positioning information, which may include, but not limited to, the following aspects:
  + DL PRS/SRS configuration, activation or triggering.
  + The request for positioning information (the assistance data, etc.).
  + The report of positioning information (the measurement report, etc.).
  + Storing UE capabilities procedure
  + Note: It is not within RAN1 scope to analyze positioning architecture enhancements to enable such more efficient signaling & procedures.
  + Note: RAN1 does not make any assumptions on whether the LCS architecture specified in TS 23.273 is enhanced or not.
* Simultaneous transmission by the UE and reception by the gNB of the SRS for positioning across multiple CCs and multiple slots, including
  + The scenarios and performance benefits of the enhancement
  + The impact of channel spacing, TA and timing offset, phase offset, frequency error, and power imbalance across slots or CCs to the positioning performance for intra-band contiguous/ non-contiguous and inter-band scenarios
* Scenario, benefits, and methods for improving the accuracy of the UL AoA and DL-AoD methods for both UE-based and network-based (including UE-assisted) positioning
* Scenario, benefits, methods and signaling for improving positioning accuracy in the presence of the UE Rx/Tx transmission delays, and/or gNB Rx/Tx transmission delays for UE-based and network-based (including UE-assisted) positioning.
* Aggregating multiple DL positioning frequency layers of the same or different bands for improving positioning performance for both intra-band and inter-band scenarios
* The scenarios and performance benefits of aggregating multiple DL positioning frequency layers
* The impact of channel spacing, timing offset, phase offset, frequency error, and power imbalance among CCs to the positioning performance for intra-band contiguous/ non-contiguous and inter-band scenarios
* UE complexity considerations

*Next Text proposal*

## 10.8 Enhancements of signaling & procedures for reducing NR positioning latency

Aperiodic reception of DL PRS from the TRPs of the serving gNB and aperiodic reception of DL PRS from the TRPs of the neighbouring gNBs can be studied further and if needed, specified during normative work.

* Note: Aperiodic reception corresponds to DCI-triggered reception

Semi-persistent reception of DL PRS from the TRPs of the serving gNB and Semi-persistent reception of DL PRS from the TRPs of the neighbouring gNBs can be studied further and if needed, specified during normative work.

* Note: Semi-persistent reception in the above corresponds to MAC-CE activated reception

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 the measurement gap
    - Latency reduction related to the reporting and request of the measurement (e.g., via RRC signaling, MAC-CE and/or physical layer procedure, and/or priority rules)
    - Latency reduction related to measurements
    - Latency reduction related to the reporting and request of positioning assistance data (e.g., via location scheduling in advance of the time of when the location is needed) [RAN2]

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) [RAN2]
  + Latency reduction related to the request and response of UE positioning capabilities (e.g., via storing UE capabilities in the network) [RAN2].

No assumptions are made on whether the LCS architecture specified in TS 23.273 is enhanced or not.

*End of Text proposal*

# 5 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