**3GPP TSG-RAN WG2 Meeting #113-e *Draft* R2-21xxxxx**

**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

The conclusion of email discussion was captured here for reference.

**High level summary of discussion Q1:**

**More than half of companies (9/14) agree that the positioning configuration signaling in advance is not restricted to deferred MT-LR; it is equally applicable to MT-LR, NI-LR, and MO-LR. Majority of companies (11/13) agreed to recommend it.**

**Proposal 1: RAN2 to discuss and agree the text proposal #1 as below:**

**--------------------------------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-------------------------------------------------------------------------------**

Rapporteur’s Note: The text proposals from RAN2 in this email discussion will be captured into clause 10.8 Enhancements of signaling & procedures for reducing NR positioning latency in TR 38.857. So text proposals in this discussion follow the template of clause 10.8.

**High level summary of discussion Q2:**

**Majority of companies (11/15) agreed that at least existing CG-based solution should be captured into TR, and 4/15 companies share their concern on how CG could help on the latency reduction. There is no majority to support the recommendation of existing CG-based, FFS on the recommended text proposal.**

**Proposal 2: RAN2 to discuss and agree the text proposal #2 as below:**

**--------------------------------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 (existing CG-based transmission)

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

**Proposal 3: There is no majority to support the recommendation of existing CG-based, FFS on the recommended text proposal.**

**High level summary of discussion Q3:**

**Majority of companies (13/15) agreed to capture capability procedure for latency reduction into TR. There is no majority to support modification of TP, so Text Proposal is FFS. Majority agree to recommend the agreed text proposal.**

**Proposal 4: RAN2 to discuss the text proposal #3 & #4 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 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
  + 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 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 storing UE capability in AMF procedure.
    - SA/CT will be involved during WI.

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

**Proposal 5: There is no majority to support to capture the architecture enhancement aspect into TR. Disagree to capture the architecture enhancement aspect into TR.**

**Proposal 6: Disagree the broadcast delay optimization aspect as Rel-17 scope.**

**Proposal 7: Disagree the mechanisms for mitigating the effects of beam failure and NLOS effects as one of aspects of latency reduction.**

**Proposal 8: Disagree to capture the detail solutions from companies’ contributions for clause 8.2.**

# 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)
    - Latency reduction related to storing UE capability in AMF procedure.
    - SA/CT will be involved during WI.

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 (existing CG-based transmission)

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