**3GPP TSG RAN WG1 Meeting #110bis-e R1-22xxxxx**

**e-meeting, Oct 10th – 19th, 2022**

**Source: Intel Corporation, CATT, Ericsson**

**Title: Post-meeting Comments to Draft TR 38.859 v020: Study on expanded and improved NR positioning**

**Agenda item: 9.5**

**Document for: Discussion**

# Introduction

A draft for TR 38.859: Study on expanded and improved NR positioning incorporating decisions until week #1 of RAN1 #110bis meeting are presented.

This document aims to collect any feedback to the draft TR shared in [DRAFT 3GPP\_TR\_38.859\_v0.2.0\_r6](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_110b-e/Inbox/drafts/9.5%28FS_NR_pos_enh2%29/post-110bis-e-02_TRreview/DRAFT%203GPP_TR_38.859_v0.2.0_r6.docx).

Please follow the naming convention in this example:

* *Post-meetingComments to draftTR38859v020-v000.docx*
* *Post-meetingComments to draftTR38859v020-v001-CompanyA.docx*
* *Post-meetingComments to draftTR38859v020-v002-CompanyA-CompanyB.docx*
* *Post-meetingComments to draftTR38859v020-v003-CompanyB-CompanyC.docx*

If needed, you may “lock” a spreadsheet file for 30 minutes by creating a checkout file, as in this example:

* Assume CompanyC wants to update *SLPosScenReq\_FLS-v002-CompanyA-CompanyB.docx*.
* CompanyC uploads an empty file named *SLPosScenReq\_FLS-v003-CompanyB-CompanyC.checkout*
* CompanyC checks that no one else has created a checkout file simultaneously, and if there is a collision, CompanyC tries to coordinate with the company who made the other checkout (see, e.g., contact list below).
* CompanyC then has 30 minutes to upload *SLPosScenReq\_FLS-v003-CompanyB-CompanyC.docx*
* If no update is uploaded in 30 minutes, other companies can ignore the checkout file.
* Note that the file timestamps on the server are in UTC time.

Please note that there is NO need to send an info email to the reflector just to inform that you have uploaded a new version of this document. Companies are invited to enter the contact info in the table below.

# Company views

Please provide any feedback to the latest version of the draft TR below.

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| Company | Comments |
| CATT | Very minor editorial comments related to CPP: 6.3 NR Carrier Phase Positioning …  For the purposes of discussion, for NR downlink and/or uplink carrier phase positioning, the carrier phase (CP) at a RF frequency at a receiver is a phase that is a function of the signal propagation time from a Tx antenna reference point of a transmitter (e.g., a TRP or a UE) to an Rx antenna reference point of the receiver (e.g., a UE or a TRP). The propagation time can be expressed in a fractional part of a cycle of the RF frequency and a number of integer cycles, but the CP may be independent of the number of integer cycles.  … 6.3.1 Potential Solutions for NR Carrier Phase Positioning …  The use of positioning reference unit (PRU) to facilitate NR carrier phase positioning is studied.   * For DL NR carrier phase positioning, a PRU works as a UE to receive the DL PRS reference signals and provide the DL carrier phase measurements to the LMF, where the double differential measurements can be obtained by the difference of the DL carrier phase measurements from the target UE and those from the PRU for eliminating the measurement errors. * For UL NR carrier phase positioning, a PRU works as a UE to transmit the UL SRS signals for positioning purpose. The TRPs provide the UL carrier phase measurements obtained from the UL SRS signals of the target UE and of the PRU to the LMF, where the double differential measurements can be obtained by the difference of these UL carrier phase measurements for eliminating the measurement errors.   … 6.3.2 Summary of Evaluations for NR Carrier Phase Positioning …  The effectiveness of using double differential technique with PRU to eliminate the impact of the initial phases of the transmitter and the receiver on NR carrier phase positioning are evaluated in the study item. The evaluation results from the sources ([73], [75], [76], [77]) show that the initial phases of the transmitter and the receiver can be removed effectively by the double differential technique with the use of PRU:   * Source [73] shows the positioning accuracy of <1cm (80%) for Inf-SH and < 1cm (50%) for Inf-DH can be reached when the PRU is located within a distance of 5m from the target UE. * Source [75] shows the positioning accuracy of <1cm (80%) for Inf-SH and <1cm (50%) for Inf-DH can be reached under the condition that the PRU is located in a fixed location in LOS of the TRP. * Source [77] shows that the accuracy of <1cm (50%) when the PRU is located within 1m of the target UE. However, the effectiveness reduces when the PRU is located away from the target UE because the channel conditions of the PRU is different from the target UE. * Note: in the above results, all other error sources (except initial phase error) were not modelled.   The impact of the residual CFO at the transmitter and the receiver for NR carrier phase positioning are evaluated during the study item.   * The evaluation results from the sources ([73], [76]) show that the impact of residual CFO on carrier phase positioning is negligible. * The evaluation results from the source ([75]) show that the impact of the residual CFO on the performance of carrier phase positioning can be mitigated with the use of the double differential technique with a PRU that is located at a fixed location in LOS of the TRP. |
| Huawei, HiSilicon | Also a couple of editorial suggestions.  **1. section 5.2.1.1:** we suggest the following change to the description of measurements  With regards to the Positioning methods supported using SL-PRS measurements at least the following measurements are considered:   * SL Rx-Tx time difference measurement * SL RSTD measurement * SL RSRP measurement * SL RSRPP measurement * SL RTOA measurement * SL Azimuth angle of Arrival (AoA) and SL Zenith angle of Arrival (ZoA) measurement.   **2. section 5.2.1.1:** We see different terminologies used as Tx-Rx turnaround, RxTx Turnaround, Rx-Tx turnaround. Is it possible to have a unified one?  **3. section 6.1.1.1:** We suggest to make the following change  The distributions of RSTD, RTOA, and UE/gNB Rx-Tx time difference measurement errors are studied considering the following aspects:   * Whether TEG-related timing error is an independent error source from timing related measurement error (e.g., RTOA, RSTD, UE/gNB Rx-Tx time difference) * Whether the measurement error is considered for each ToA or for the reported RSTD value * Other Details (e.g., mean and standard deviation).   **4. section A.1:** Maybe the following sentence could be changed as below.  The evaluation assumptions are listed in Tables A.1-2 through A.1-6 for the relevant evaluation assumptions of all use-cases and those for each of the identified use-cases of V2X, public safety, commercial, and IIoT respectively.  **5:** The colour of some titles/captions could be changed to black, e.g. Table 6.1.1-2, title 6.4.2. |
| vivo | **Comment 1 in section 6.3: The related agreement and description about the red highlighted part are not found in the SID and previous agreement, so, maybe we can remove it in this stage**  **Comment 2 in section 6.3: Based on the SID, the yellow highlighted part seems as the sub-bullet of the SID**  In the SID [7], the following objectives for the study on solutions for accuracy improvement based on NR carrier phase measurements have been identified:   * Study on reference signals, physical layer measurements, and physical layer procedures to enable positioning based on NR carrier phase measurements for both UE-based and UE-assisted positioning.   In this study, the reuse of existing PRS and SRS is prioritized, with consideration of new reference signals only if found necessary.  In the following three subclauses, the feasibility, achievable performance, and expected specification impact for support of positioning methods utilizing NR carrier phase measurements are presented. |
| CATT2 | **Some further comments:**   1. Comment 1:   For vivo’s comment 1 to remove the highlighted sentence, we assume the sentence is added by the moderator with the intention to help a reader to read or understand the TR. This is similar to the sentence added in Section 5.2, “*In the following subclauses the studies on potential solutions for sidelink positioning are summarized, focusing on physical layer aspects, architecture, and signalling procedures.”* So, we are fine for having the sentence. If there is concern is about the wording of the sentence, we are also fine to have a further discussion in the next meeting.   1. Comment 2:   As described in the SID, the study includes mainly three parts: “reference signals, physical layer measurements, and physical layer procedures”. The description of the Section 6.3.1 seems already arranged to cover the three parts in sequence. But, I am wondering if we could make it clearer by adding three separate sub-clauses in Section 6.3.1 as follows: 6.3.1 Potential Solutions for NR Carrier Phase Positioning6.3.1.1 Reference signals for NR carrier phase positioning Existing DL PRS and UL SRS for positioning can be re-used as the reference signals to enable positioning based on NR carrier phase measurements for both UE-based and UE-assisted positioning. Whether to consider enhancements of the existing DL PRS and UL SRS for better positioning performance is to be studied further. Note that the use of MIMO SRS for positioning purpose is transparent to UE. 6.3.1.2 Physical layer measurements for NR carrier phase positioning The study of the accuracy improvement based on NR carrier phase measurements includes:   * UE-based and UE-assisted carrier phase positioning * UL carrier phase positioning and DL carrier phase positioning * NR carrier phase positioning with the carrier phase measurements of one carrier frequency or multiple frequencies * Combination of NR carrier phase positioning with another standardized Rel. 17 positioning method, e.g., DL-TDOA, UL-TDOA, Multi-RTT, etc.   For DL UE-assisted NR carrier phase positioning, at least the following options are considered:   * the difference between the carrier phase measured from the DL PRS signal(s) of the target TRP and the carrier phase measured from the DL PRS signal(s) of the reference TRP; * the carrier phase measured from the DL PRS signal(s) of a TRP.   For UL UE-assisted NR carrier phase positioning, at least the carrier phase measured from the UL SRS for positioning purpose is considered. 6.3.1.3 Physical layer procedures for NR carrier phase positioning The impact of integer ambiguity on NR carrier phase positioning and potential solutions to resolve the integer ambiguity when using carrier phase measurements to estimate the propagation delay/distance between transmitting and receiving nodes are studied.  …… |
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