**3GPP TSG RAN WG1 Meeting #111 R1-22xxxxx**

**Toulouse, France, November 14th – 18th, 2022**

**Source: Intel Corporation (Moderator)**

**Title: Post-meeting Comments to Draft TR 38.859 v030: Study on expanded and improved NR positioning**

**Agenda item: 9.5**

**Document for: Discussion**

# Introduction

This document summarizes the following RAN1 email discussion:

[Post-111-Positioning\_TR] Email discussion for endorsement of TR38.859 update according to the agreements at RAN1#111 – Debdeep (Intel)

* From Nov 28 until Nov 29

A draft for TR 38.859: Study on expanded and improved NR positioning, incorporating decisions until end of RAN1 #111 meeting, is presented.

This document is used to collect any feedback to the draft TR shared in the folder [\TR38.859\DRAFT\_TR](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_111/Inbox/drafts/9.5%28FS_NR_pos_enh2%29/TR38.859/DRAFT_TR) and its subsequent revisions.

Please follow the naming convention in this example:

* *CommentsToDraftTR38859v030-v000.docx*
* *CommentsToDraftTR38859v030-v001-CompanyA.docx*
* *CommentsToDraftTR38859v030-v002-CompanyA-CompanyB.docx*
* *CommentsToDraftTR38859v030-v003-CompanyB-CompanyC.docx*

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* Assume CompanyC wants to update *CommentsToDraftTR38859v030-v002-CompanyA-CompanyB.docx*.
* CompanyC uploads an empty file named *CommentsToDraftTR38859v030-v003-CompanyB-CompanyC.checkout*
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# Company views

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

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| Company | Comments |
| Huawei, HiSilicon | **Section 2:**Reference [54] can be avoided, which is updated in [111]. Please also replace the observations derived from [54] to [111].**Section 2:**References [54] to [72] have wrong format. The comma should be removed, and the SPACE between t-doc number and t-doc title should be replaced with TAB.

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| R1-2208652, Discussion on positioning for RedCap UEs, vivo ==>R1-2208652 Discussion on positioning for RedCap UEs, vivo |

**Section 6.4.3:**Under the case of source [92], “Cell access procedures per 10.24s;” should be removed from row 4.**Section 6.4.4:**This section seems a little incomplete. It merged inputs from RAN1/RAN2 on SRS validity area, but other recommendations from RAN2 are missing.**Moderator: The inputs from RAN2 are based on the TP received from them. However, to address the above comment, a general statement “**In addition to the above, specification impact can be expected from the perspective of higher layers to support the potential enhancements for LPHAP as detailed in Subclause 6.4.2.2.**” that refers to the detailed section for higher layer aspects is now added.****Sections 6.4.2.2 and 7.6:**Multiple instances of R1/R2 should be better revised to RAN1/RAN2.**Section 7:**We prefer to change recommendation to conclusion, because this section not only summarizes the recommendation, also requirements and use cases (e.g. LPHAP).

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| Based on the studies conducted in RAN working groups, the following recommendations are made. |

**Section 7:**We think that a subsection summarizing the use cases and requirements of SL positioning/ranging should be captured in the conclusion, e.g. the table as shown in Table 5.1-1.**Section A.3:**In the row of UE/TRP antenna phase center offset (PCO), we think that the explanation to Example 1 and Example 2 in the NOTE should be swapped. Maybe Ren can also check it.**Section X (Change history):**RAN3#118 should be added as well to the meetings list. |
| CMCC | 1. Regarding bullets b, d under Section 6.4.2.2 Higher layer aspects, as they were agreements made by RAN2 and were explicitly mentioned “is/are recommended for normative work”, I was wondering whether they should be moved to Section 6.4.4 Potential specification impact?**Moderator: The inputs from RAN2 are based on the TP received from them, and they were aware of the existence of Subclause 6.4.4. Thus, at this stage it would not be appropriate to substantially alter a RAN2-agreed text proposal.** **However, as responded to Huawei, a new sentence “**In addition to the above, specification impact can be expected from the perspective of higher layers to support the potential enhancements for LPHAP as detailed in Subclause 6.4.2.2.**” is now added to 6.4.4 to refer to potential spec impact for the higher layer aspects.** 2. The following agreement made in RAN1 seems to be forgotten:**Agreement**For the conclusion section of the TR:* Enhancements on simplified DL PRS configuration with 1-symbol PRS can be studied further and if needed, specified during normative phase.

**Moderator: It is already captured in the Conclusions section of the TR (Subclause 7.7 LPHAP).**3. Regarding the following agreement, as the note clearly says no RAN1 specification impact has been identified, I’m not sure whether it should be captured in Section 6.4.4 Specification impact?**Agreement**Extending DRX cycle beyond 10.24s was studied and found beneficial towards meeting the battery life requirement for LPHAP, and is recommended for normative work on Rel-18 positioning enhancements from RAN1’s perspective. * Note: no RAN1 specification impact has been identified

**Moderator: It would be better to capture here since it carries information related to potential spec impact – that there is none expected for RAN1 specs, although RAN1 has recommended its introduction during normative work.** |
| ZTE | Thanks for Debdeep’s great effort, please find our comments and revisions (marked in red) as follows.**For DRAFT 3GPP\_TR\_38.859\_v0.3.0\_main****Section 5.1**The reference index number of TS 22.104 is not correct.  TS 22.104 ~~[5]~~ [6]**Section 5.2.1**Typos, we noticed that SL-PRS was replaced by SL PRSSL PRS in multiple places.**Section 5.3.1**We found several typos.(1)For V2X use case in highway scenario, 14 sources ([19], [20], [21], [22], [23], [24], [26], [27], [29], [30], [31], [32], [33], [78]) provided simulation results for FR1, and 2 sources ([27], [32]) provided simulation results for FR2. * For absolute horizontal accuracy, the results were provided by 14 sources. 12 out of 14 sources show that, the target requirement Set A can be achieved, and 9 out of ~~13~~14 sources show that the target requirement Set B cannot be achievable even with 100MHz.

(2)* For distance accuracy of ranging, the results were provided by 12 out of 14 sources. 7 out of 12 sources show that the target requirement Set A can be achievable by 20MHz, and 7 out of 12 sources show that the target requirement Set B cannot be achieved with 100MHz bandwidth.

(3)* For angle accuracy of ranging, the results were provided by 6 out of 11 sources. 5 out of 6 sources show that the target requirement Set A can be achieved with 20MHz or 40MHz, and 4 out of 6 sources show that the target requirement Set B cannot be achieved with 100MHz.

(4)* For distance accuracy of ranging, the results were provided by 5 out of 9 sources. 4 out of 5 sources show that the target requirement Set A can be achievable by 100MHz, and 3 out of 5 sources show that the target requirement Set B cannot be achieved with 100MHz bandwidth.

(5)For IIOT use case in InF-DH scenario, 7 sources ([18], [19], [20], [24], [28], [30], [32]) provided simulation results for FR1, and 1 source ([32]) provide~~s~~d simulation results for FR2.**Section 5.3.2*** For Public safety, 1 source ([24]) shows performance improvement of Joint Uu-SL absolute positioning compared to SL-only or Uu-only positioning.
* For commercial use case, 1 source ([24]) shows performance improvement of Joint Uu-SL absolute positioning compared to SL-only positioning.

**Section 6.3.2**The value range of N is ±1 and align with others in the TR.* Source [85]) shows
* When multiple subcarriers with in one PFL are used:
* For InF-SH scenario with other errors (initial phase on both TRP and UE sides)
	+ DL-CPP accuracy (Case 1-2-9, N is limited to ~~+~~±1): 0.12 m@50% and 0.25m @80%.

**Section 6.4**The following agreement was achieved in the RAN1#111. However, it is weird that this agreement is not mentioned anywhere in section 6.4.x of TR 38.859, even not mentioned “6.4.2 Potential Enhancements for Low Power High Accuracy Positioning”, but come out in the conclusion for LPHAP in Section 7.6.We prefer to include the following agreement in Section 6.4.**Agreement**For the conclusion section of the TR:* Enhancements on simplified DL PRS configuration with 1-symbol PRS can be studied further and if needed, specified during normative phase.

**Moderator: Now added to 6.4.2.1.****For DRAFT 3GPP\_TR\_38.859\_v0.3.0\_AnnexB6\_X**There is a blank column in Table B.6.7.2-1, which is recommended to be deleted. |
| vivo | 1. for RTT-type, we prefer to remove ‘either’, and change “or ” to “and“ if both are removed.
* RTT-type solutions using SL
* This includes ~~either~~ single-sided (also known as one-way) RTT ~~or~~ and double-sided (also known as two-way) RTT
1. A typo(duplicate “SL-PRS”) appears multiple times in section 5.2.1, 5.2.2 and 7.2, for example

With regards to the Positioning methods supported using SL PRSSL PRS measurements at least the following measurements are agreed to be introduced:  |
| CATT | **Comment 1**: Section 3.3 Abbreviations* Suggest either adding the following or refer to other spec, e.g., TS 38.305 for the definitions.

ARP Antenna Reference PointDL-AoD Downlink Angle-of-DepartureDL-TDOA Downlink Time Difference Of ArrivalDNU Do Not UseLMF Location Management FunctionMulti-RTT Multi-Round Trip TimePRU Positioning Reference UnitRSRP Reference Signal Received PowerRSRPP Reference Signal Received Path PowerTRP Transmission-Reception PointRTOA Relative Time of ArrivalUL-TDOA Uplink Time Difference of Arrival* Suggest adding the following:

CFO Carrier Frequency OffsetCP Carrier PhaseCPP Carrier Phase PositioningDD Double Differenttial LOS Line of SightNLOS Non Line of SightPCO Phase Center OffsetPFL Positioning Frequency LayerSD Single Differential**Moderator: A reference to TS 38.305 is now added.****Comment 2:** Annex A.3: Evaluation Methodology for NR Carrier Phase PositioningThe following agreement incudes the evaluation assumptions for using the carrier phase measurements of multiple DL positioning frequency layers for NR carrier phase positioning. Suggste capturing these assumptions in the TR Annex A.3, e.g.,The evaluation of the benefits of using the carrier phase measurements of multiple DL positioning frequency layers for NR carrier phase positioning may include the impact of the time gap between the carrier phase measurements of multiple DL PFLs.* Note 1: The initial phase error and the frequency error for each PFLs can be modelled independently
* Note 2: For the evaluation, the PRS signals of all PFLs of a TRP can be assumed to be transmitted from the same ARP or from different ARPs of the TRP.
* Note 3: The location error for ARPs can be modelled independently.
* Note 4: The timing errors of the PFLs may not be the same for PFLs in different bands or frequency ranges.
* Note 5: In Rel-17, simultaneous reception of DL PRS from multiple frequency layers is not supported

AgreementFurther study the benefits of using the carrier phase measurements of multiple DL positioning frequency layers for NR carrier phase positioning, which may include the impact of the time gap between the carrier phase measurements of multiple DL PFLs.* Note 1: The initial phase error and the frequency error for each PFLs can be modelled independently
* Note 2: For the evaluation, the PRS signals of all PFLs of a TRP can be assumed to be transmitted from the same ARP or from different ARPs of the TRP.
* Note 3: The location error for ARPs can be modelled independently.
* Note 4: The timing errors of the PFLs may not be the same for PFLs in different bands or frequency ranges.
* Note 5: In Rel-17, simultaneous reception of DL PRS from multiple frequency layers is not supported

**Moderator: This is already captured in 6.3.1.3.** |
| Qualcomm | First comment:* We need to decide what we ll do with the columns on “meet requirement” in the evaluation results of CPP. E.g., B4.1.2, B4.3.2, B.4.5.2, B.4.6.2, B.4.8.2.

 Could we jut remove the expression “target requirement” eg, **Met ~~target requirements?~~ 1cm @ 50 or 80%(Yes/No)**In B.4.3.2 it doesn’t even say what is the “target requirement” they have assumed Second comment:From the RAN4 LS R4-2220439, the following statement is not captured in the conclusion section even though RAN4 added it in the LS. * *RAN4 did not perform feasibility studies for RRM aspects of carrier phase measurements and needs to wait for conclusive RAN1 study outcomes.*
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| CATT2 | **Comment 1:** For Qualcomm’s firat comment, we are fine either making the change as Qualcomm suggested, or make it clear that the target requirement is proposed by the source, e.g., “**Met proposed target requirements? 1cm @ 50 or 80%(Yes/No)****Moderator: The suggestion from Qualcomm may be better as using “proposed target requirements” reads a bit weird in the present context.****Comment 2:**For Table B.4.7.2-1 Case 12, there is a typo in “CPO a=2, X=5”. It should be “CPO a=3, X=5”.**Comment 3:**We like to withdraw the comment 2 of our previous comments, considering that the agreement was already captured in Section 6.3.1.3. |
| Qualcomm2 | Third comment: * We think it is useful in the PRS/SRS Aggregation Conclusion Section to remind that this topic was also studied in the previous TR (38.857) where one can find additional results, and recommendations, otherwise, it may appear to an outside reader that the topic was only investiaged in RAN4. There are now 4 sentences, all of which are from RAN4 perspective. For the sake of clarity of the study to an outside reader, a statement on the studied completed in RAN1 would be useful. For example:

"Conclusions on the PRS/SRS Bandwidth Aggregation from the study performed in RAN1 can be found in [2]”**Moderator: A reference to R17 studies is now added to the Conclusions section.**Forth Comment: * In the PRS/SRS Aggregation, we think it is better for a reader to start a new sentence that incorporates the LS from RRM perspective:

“The assumption for a single-chain Tx architecture is that PRS/SRS resources to be aggregated are transmitted from a single Tx antenna. [Start new paragraph]From RRM perspective, the following are assumed for PRS bandwidth aggregation:”Fifth comment:* In Section 5.2.1.2 there is a remaining “SL PRS” from a sentence that was removed.

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| AT&T | **Comment 1:** Section 3.1 and 3.3. * Similar to CATT comment, suggest to add TS 38.305 as a reference and refer to this for many of the missing, but already well defined definitions and abbreviations.
* For example:
	+ For the purposes of the present document, the abbreviations given in TR 21.905 [6], TS 38.305 [x], and the following apply.

**Comment 2:** Section 5.4* Options for Signaling between LMF and UE will be down-selected during normative work.

**Comment 3:** Section 6.5.3* From RAN1’s perspective, the following has been identified for potential specification impacts of NR positioning for RedCap UEs:
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| AT&T2 | **Comment 2: Section 2.**[7] RP-222616: "Revised SID on Study on expanded and improved NR positioning". |
| CATT3 | **Comment 1:** For Huawei’s comment on Section A.3, yes, we share the similar view that the explanation to Example 1 and Example 2 in the NOTE should be swapped**.**  |
| Futurewei | **In Section 5.4** Add the potential mechanism for resource coordination work: A new sidelink reference signal (SL PRS), including details of sequence design, physical structure, resource mapping, and potential mechanisms for SL PRS resource coordination (.g., Inter-UE Coordination (IUC)-like solutions)Based on the RAN 1 agreement**Agreement**…* “Potential mechanisms, if needed, for SL PRS resource coordination across a number of transmitting UEs (e.g., Inter-UE Coordination (IUC)-like solutions) can be considered further during normative work. “

**Moderator: This is second level details as part of resource allocation, hence it was not listed. However, now a simpler version of the proposed text is now added to the bullet on resource allocation instead of the bullet on SL PRS design.*** SL PRS resource allocation Scheme 1 and Scheme 2, where Scheme 1 corresponds to a network-centric resource allocation, and Scheme 2 corresponds to UE autonomous SL PRS resource allocation, and potential mechanisms for SL PRS resource coordination.

 The following agreement is captured in Section 6.4.4, but the agreement does not explicitly say there is a potential specification impact. As such, Section 6.4.2.1 is more appropriate to capture this agreement.**Agreement**From RAN1’s perspective, DL PRS measurement for UEs in RRC\_IDLE state is recommended for the normative workSimilarly, the following agreement is captured in Section 6.4.4. The note explicitly mentions no RAN1 specification impact. Thus, it should be moved to Section 6.4.2.1**Agreement**Extending DRX cycle beyond 10.24s was studied and found beneficial towards meeting the battery life requirement for LPHAP, and is recommended for normative work on Rel-18 positioning enhancements from RAN1’s perspective. Note: no RAN1 specification impact has been identified**Moderator: As responded to CMCC, the “no spec impact” is only for RAN1, and this is relevant information in the context of potential spec impact for a feature that is being recommended. Thus, it would be helpful to have it here.**  |
| Nokia/NSB | Thanks for all the effort on the TR. We have some comments: 1. RSRPP is referred to in Section 5.2.2.3, it would be good to define this term or list it in Abbreviations**Moderator: With the addition of reference to TS 38.305 in the Abbreviations section, it should now be addressed.** 2. We would suggest in Section A.3 to remove the part about multi-path mitigation techniques. We think the vast majority of the results do not investigate this topic and the text in other sections of the TR is sufficient. **Moderator: Given that A.3 is about EVM, it may not be appropriate to remove an agreed consideration because of insufficient numbers of evaluations reported for it.** 1. In Section B.4.7 we think the columns “Gain [m] vs Rel.17 solution” should be removed. These are not part of the agreed template and we did not agree to capture results relative to Rel-17. Similary we think that target requirements were not agreed in this SI for CPP so the columns with “meet requirements” should be removed from other sources in B.4.X. It may give the reader the impression that requirements were set but they were not.

**Moderator: My original proposal was to remove all the columns that refer to meeting target requirements or gains, etc. However, we decided to be more inclusive and represent the data from individual sources since anyway they are captured separately. Thus, the latest approach has been to keep all the columns with the removal of the phrase “target requirements”. If this is not acceptable, I think we would have to go back to my original plan of removing all of these columns.**1. In Section 6.4.3, regarding the following paragraph “Evaluation results on battery life assuming no SRS (re)configuration together with ultra-deep sleep state are provided by 11 sources ([92], [93], [96], [97], [98], [99], [101], [103], [108], [109], [110]) out of 19 sources, and the target requirement of 6~12 months is achieved by all 11 sources.”, [97,Nokia/NSB] did now show the target requirement is achievable since we only considered the baseline assumption of ultra-deep sleep state, so we ask for changing “all 11 sources” to “10 of 11 sources”.

5. We don’t feel that adding something to the conclusion section on PRS/SRS bandwidth aggregation as suggested by QC is necessary. Such a sentence can maybe be added to Section 6.X but we don’t feel adding it to the conclusion is justified. This is a Rel-18 TR not a Rel-17 TR.**Moderator: Adding a reference to an earlier study should not be controversial. It is indeed the case that just mentioning the RAN4 study renders this part of the summary a bit w/o context for anyone who is not familiar with the Rel-17 studies. In this context, adding it to Conclusions section seems more appropriate than in 6.2.x which pertains primarily to the current studies.** |
| **Moderator** | **All comments received thus far have been addressed in “\_r01” of the following documents in the drafts folder (**[**/TR38.859/Comments**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_111/Inbox/drafts/9.5%28FS_NR_pos_enh2%29/TR38.859/Comments)**):** * **Main document**
* **Annex B4**
* **Annex B6\_X**

**Responses to some of the comments are provided in-lines above. For the rest of the suggestions, they have all been incorporated.****In particular, for the evaluation results tables for NR CPP, the suggestion to remove the phrase “target requirements” is implemented now.** **In this regard,** * **@Ericsson: I would like to check if we can also remove the column for “Met target requirements” for the tables with Ericsson results.**
* **@Huawei: It would be great if Huawei could confirm the “target requirements” assumed in reference [79] for the evaluation results tables.**
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| Huawei, HiSilicon2 | To moderator: our assumption on the target requirement for CPP was 1cm@50%. Sorry for not having corrected this earlier.The column can be revised as “Met 1cm@50%”.Regarding the comments from Futurewei, we also think that the following three bullets on Scheme 2 resource allocation should somehow be reflected in the section of identified spec impact because indeed they have spec impact.

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| Regarding Scheme 2 SL PRS resource allocation, at least the following aspects are studied:* Resource selection mechanism for SL PRS
* Inter-UE coordination
* Aspects for congestion control mechanisms for SL PRS.
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| Nokia/NSB\_2 | A few replies to moderator comments:1. Unfortunately we still suggest to remove all the columns in the CPP result capture which were not agreed in the template. We appreciate the effort to find a way forward with the columns but we don’t want to give the impression that some companies skipped the Rel-17 evaluation which is both not true and was never agreed to be captured in the TR in our view. 2. On the Rel-17 TR reference we can drop our suggestion to keep it out but I hope it is obvious to all companies that the conditions/assumptions under which the prior conclusions were drawn are totally different than the conditions/assumptions in Rel-18. Different error sources were evaluated and considered in each study and it is not a simple apples to apples comparison. 3. Sorry there was a typo in our prior 1st comment. It should have read RSPP not RSRPP. I think RSPP is still not defined in TS 38.305? Not a critical issue.  |
| Samsung | Thanks for all the effort on the TR. We have some comments as: 1. Update reference [87] from R1-2212550 to R1-22128592. Remove reference [140] since reference [141] (R1-2212051) provides the same results.3. “The impact of the ARP errors on NR carrier phase positioning is evaluated. 9 out of 9 sources ([79], [80], [81], [85], [ 86], [87], [88], [90])”. There are only 8 sources listed, maybe is missing. |