[94e-06-R18-PositionEvo] - Version 0.0.6

RAN

3GPP TSG-RAN Meeting #94e **RP-213528**

Electronic, 6 – 17 December 2021

Agenda Item: 8.6.1

Source: Email discussion moderator (Intel)

Title: Email discussion summary for [94e-06-R18-PositionEvo]

Document for: Discussion and decision

1 Introduction

This document reports on [94e-06-R18-PositionEvo] that discusses the potential Rel-18 item on positioning evolution.

The pre-RAN#94e email discussion summary can be found in RP-212666 and the draft WID created from that email discussion can be found in RP-212707. The RAN Chair and RAN WG Chairs have prepared a ”Summary for RAN Rel-18 Package” in RP-213469. The summary provides TU allocations for the WGs and provides the objectives to be used as a starting point for this discussion - they are based on the outcome of the last email discussion with a few modifications. Furthermore the summary proposes that the work should start with a 9 month study item, in contrast to the pre-meeting email discussion where it was assumed to be a work item with study phases for many of the objectives.

A draft SID has been created based on the draft WID from the last discussion with appropriate changes to make it a study item and with the other changes from the chair’s summary. All changes compare to the previous version are shown in revision marks. The WID is stored Inbox/Drafts/[94e-06-R18-PositionEvo]/draft-SID. Please refer to the draft SID in the inbox in order to provide your feedback - the justification and objective text is not copied into this NWM document as revision marks are not supported in NWM. At least in the early rounds of discussion, companies are asked to provide suggested modifications via NWM and not upload their own proposed revisions of the WID - this approach may be changed for later rounds.

2 Justification Text

2.1 Initial Round

Companies are asked to provide comments and suggestions to the justification text.

Feedback Form 1: Justification Text - Initial Round

1 – Nokia Denmark

On the justification section for LPHAP: The 2nd sentence reads a bit like the requirements are set for RAN already as battery life up to one year. It would be better to repeat that this is a SA1 requirement to make it clear where the requirement comes from. Also, Rel-17 only introduced support for RRC*inactive so RRC*idle should be removed.

2 – NTT DOCOMO INC.

RedCap positioning part (e.g. Release-17 has specified support for RedCap UEs...) may need to be updated if the corresponding item (i.e. third sub-bullet in the RedCap positioning objective) is removed from this SID.

3 – Samsung R&D Institute UK

Since Rel-17 NR positioning has introduced the support for positioning in RRC_INACTIVE states only, RRC_IDLE should be removed in the current justification text.

4 – Guangdong OPPO Mobile Telecom.

Regarding the higher accuracy part, the following sentences seem not needed. The main reason is that the current NR positioning method can also achieve shorter latency and lower power comsumption compared to GNSS. Thus, better performance than GNSS for indoor scenarios is not the motivation to introduce NR carrier phase positioning. The justification of NR carrier phase positioning should based on the performance gain compared to the existing NR positioning method.

”~~GNSS carrier phase positioning also has longer positioning latency and larger power consumption than GNSS code phase positioning due to the need to implement a carrier phase tracking loop to lock the very weak carrier signals. NR carrier phase positioning has potential for significant advantages over GNSS carrier phase such as shorter positioning latency and lower UE power consumption, and application to indoor deployments.~~”

5 – New H3C Technologies Co.

We have the similar view on positioning in inactive mode supported in Rel-17 with Samsung and idle mode shouldn’t be mentioned in justification text.

6 – Intel Corporation (UK) Ltd

No specific comments at this stage.

7 – Motorola Mobility Germany GmbH

We are generally fine with the justification text, however any potential down-scoping will necessitate corresponding changes to the justification text. Also agree that Rel-17 only provided targeted support for RRC_INACTIVE positioning and therefore RRC_IDLE positioning can be removed.

8 – VODAFONE Group Plc

LPHAP: One editorial: ”whether and whether” ->”whether and how” (or just ”whether”)

9 – Qualcomm Incorporated

- In the paragraph on PRS/SRS bandwidth aggregation, in the sentence: “increase the bandwidth for the transmission and reception of the positioning reference signals through the carrier aggregation”, We

suggest to write it as: "increase the bandwidth for the transmission and reception of the positioning reference signals ~~through the carrier aggregation~~ based on PRS/SRS bandwidth aggregation for intra-band carriers"

- In this sentence: "While Rel-17 NR positioning has introduced support for positioning in RRC_IDLE/INACTIVE states", NR Rel-17 introduced support for positioning in RRC Inactive state, and not in RRC Idle state. We suggest to keep only RRC Inactive state in the sentence.
- There is a repetition of the word "whether" here: there is a need to evaluate whether and whether the current system allows LPHAP requirements to be met

10 – AT&T GNS Belgium SPRL

We are generally fine with the baseline justification text, with only the following few exceptions:

- Propose that we update the following text given this is a SI and it could be envisioned that some integrity solutions could address any/all of the existing supported 3GPP positioning methods: "The focus in Rel-17 work was on GNSS integrity, and for Rel-18 it is natural to ~~be~~ extend this to address other ~~to RAT-dependent~~ positioning techniques as well..."
- Support removal of RRC_IDLE positioning in the LPHAP paragraph as others have noted.
- Rephrase the last sentence: "This ~~is~~ gap ~~to be closed by the present WI~~ is to be investigated in the present SI."

11 – SHARP Corporation

RRC_IDLE should be removed in the current justification text.

2.2 Summary from Initial Round

For the comment from DOCOMO, a moderator's note has been added to the text to remember to update the justification text when the eventual RedCap objectives are stable. The comment from OPPO has been partially taken into account, with part of the sentence referring to potential benefits of carrier phase being kept. All other comments have been fully taken into account in the updated objective text.

2.3 Intermediate Round

Companies are asked to provide comments and suggestions to the updated justification text.

Feedback Form 2: Justification text - Intermediate Round

1 – CATT

We prefer the following updates:

1) NR carrier phase positioning has potential for significant performance improvements ~~including~~ for indoor and outdoor deployments in comparison with the existing NR positioning methods.

2) "based on ~~based on~~ PRS/SRS bandwidth"

2 – Motorola Mobility Germany GmbH

Lenovo, Motorola Mobility :

We support the revised justification text.

3 – Apple Benelux B.V.

We are fine with the justification text. Some edits needed as shown below:

• " within allowed limit**s**"

• signals based on based on PRS/SRS bandwidth aggregation : **double "based on"**

• NR carrier phase positioning has **the** potential for

• for high accuracy, **and** extreme low power consumption

• with ~~the~~ **a** target accuracy of <1m, ~~the~~ **a** positioning interval of 15-30 seconds, and ~~the~~ **a** battery life of 6-12 months

• but there is a gap in ~~that~~ **the** core and performance requirements

2.4 Summary from Intermediate Round

All comments have been taken into account in the update to the SID.

2.5 Final Round

The justification text should now be very stable but companies may still provide further comments if required.

Feedback Form 3: Justification text - Final Round

1 – Nokia Denmark

Sorry this is a late comment, we missed that substantial text was deleted in the last round based on a comment from one company which seemed to be based on a misunderstanding. As well as providing improved accuracy indoors, NR carrier phase positioning can offer shorter latency and lower UE power consumption than RTK-GNSS outdoors, as well as providing resiliency against loss of GNSS due to jamming, satellite failure, etc.. Please therefore add back the following:

"NR carrier phase positioning has the potential for significant performance improvements for indoor and outdoor deployments in comparison with the existing NR positioning methods**, as well as shorter latency and lower UE power consumption in comparison with RTK-GNSS outdoors, and resiliency against loss of GNSS due to jamming, satellite failure, etc..**"

2 – Motorola Mobility Germany GmbH

Lenovo, Motorola Mobility :

Suggest a very minor editorial correction in the 5th Paragraph of the Justification text (removal of a redundant full stop):

"GNSS carrier phase positioning has been used very successfully for centimetre-level positioning but is limited to outdoor applications.~~.~~"

3 – CATT

We share the similar view as Nokia that NR carrier phase positioning can offer shorter latency and lower UE power consumption than GNSS carrier phase positioning, e.g., RTK.

One very minor editorial comment: ””NR Positioning Enhancements ” may be corrected as ”NR Positioning Enhancements”

2.6 Summary from Final Round

2 companies requested to retain the comment, removed after Initial Round, that carrier phase may be able to offer shorter latency and lower UE power consumption than RTK-GNSS carrier phase positioning. This has been added. The resiliency aspect as not been added back as to the moderator it seems a very obvious and unnecessary statement to say that something that doesn't rely on GNSS will be resilient against the loss of GNSS. Hopefully this is an acceptable approach to the 3 companies that have commented on this topic during the course of the discussion.

Other editorial comments also taken into account.

3 Sidelink positioning

3.1 Initial Round

Companies are asked to provide comments and suggestions to the objectives on sidelink positioning. The summary document from the RAN Chair added ”[unlicensed]” to the spectrum to be considered in the study. This is an aspect for which previous email discussions have not managed to reach consensus but, based on the inclusion in the summary document, we will have another attempt to find an acceptable way forward. A separate feedback form is provided for this discussion of unlicensed.

Feedback Form 4: Inclusion of unlicensed spectrum - Initial Round

1 – Futurewei Technologies

Not supportive of this inclusion and as in our past comments, inclusion of unlicensed spectrum positioning should be added after the availability of specs support of sidelink in unlicensed spectrum.

2 – China Mobile E-Commerce Co.

It should be noted that even for R18 sidelink evolution, operation on unlicensed spectrum is one of the objectives to be studied and specify if necessary, and we don't have any baseline design for SL over unlicensed band. Hence, we prefer first focused on the licensed and ITS spectrum in this release.

3 – Beijing Xiaomi Mobile Software

In order to achieve the sidelink positioning accuracy requirements, the large bandwidth for sidelike PRS is required. However, the ITS and licensed spectrum will not provide enough bandwidth for sidelink positioning. For ITS spectrum, the ITS bandwidth in all the regions are no more than 80MHz, and in some regions, it is only 20MHz. For licensed spectrum, operators may have no desire/capability to use a large licensed spectrum bandwidth for sidelink positioning, and the licensed spectrum can't be used for out of coverage

scenario. So we think the unlicensed spectrum should be included in the scope. At least, the spectrum and bandwidth requirements should be studied and evaluated to support sidelink positioning accuracy and use cases, instead of excluding the unlicensed spectrum directly.

For how to coordinate with the sidelink enhancements item, we think the sidelink enhancements item shoulde take into account the sidelink positioning signal when designs the LBT mechanism. Maybe we can add a note in the Rel-18 sidelink enhancement WID to clarify that sidelink positioning/ranging signal in unlicensed spectrum should be considered.

4 – Nokia Denmark

We see the value of including unlicensed spectrum for sidelink positioning, as otherwise the spectrum available for sidelink positioning may be limited in some regions. However, we are also conscious that (a) the sidelink enhancement item is likely to be considering basic sidelink operation in unlicensed spectrum in parallel, and (b) the overall effort required for sidelink positioning is already rather large. Therefore a possible way forward could be to try to phase sidelink unlicensed and sidelink unlicensed positioning sequentially, such as "unlicensed to be included if time permits, after basic sidelink operation in unlicensed spectrum has made sufficient progress".

5 – CATT

Our suggestion is not to consider unlicensed spectrum in Rel-18.

6 – NTT DOCOMO INC.

We do not think unlicensed spectrum should be included since the current scope is large and SL communication for unlicensed spectrum has not yet been discussed. Rel-18 SL positioning should focus on ITS and licensed spectrum.

7 – CITC

Focusing on ITS and licensed spectrum in R18 NR sidelink positioning can be firstly considered to meet the qualified positioning accuracy and latency requirements. Moreover, when the standardization work on SL communication in unlicensed spectrum is completed, then we can further disscuss the unlicensed spectrum.

8 – Samsung R&D Institute UK

We don't support including unlicensed spectrum in the scope since it is not yet supported in SL. It is better to wait first for the introduction of unlicensed spectrum to SL. In Rel-18 positioning, we need to study/specify sidelink positioning at first and determine whether licensed band can provide the required positioning accuracy and latency.

9 – Deutsche Telekom AG

We do not support this inclusion. SL is not supported in unlicesed and should be dropped from Rel-18 (see thread 05)

The SL positioning evolution should only consider ITS spectrum.

Licensed spectrum is also not supported in the SA1 requirements

10 – Huawei Tech.(UK) Co.. Ltd

Inclusion of unlicensed spectrum for SL positioning should rely on the progress of overall SL over unlicensed spectrum in Rel-18. Thus, it would be reasonable to take a step-by-step approach

and start only with licensed and ITS spectrum in this release.. Therefore our view hasn't changed, and considering that most of the discussion on this SI will be on how to better focus the work, we should not expand the scope to the study.

We prefer to keep the following bullets in the objective section, with the deletion of [unlicensed] and the deletion of the moderator's comment.

· Scenario/requirements ~~[Moderator comment: These could be moved to the justification section in the final WID]~~:

- Coverage scenarios to cover: in-coverage, partial-coverage and out-of-coverage
- Requirements: Based on requirements identified in TR38.845 and TS22.261 and TS22.104
- Use cases: V2X (TR38.845), public safety (TR38.845), commercial (TS22.261), IIOT (TS22.104)
- Spectrum: ITS, licensed, ~~[unlicensed]~~

11 – ZTE Corporation

We understand there may be some benefit to support unlicensed spectrum for SL positioning. However, considering the scope has been very large already and Rel-18 V2X will design the basic operation for regular SL in unlicensed spectrum, we suggest to specify SL positioning in unlicensed spectrum in Rel-19 or decide it in WI phase after regular SL in unlicensed spectrum is completed.

12 – MediaTek Inc.

We see significant benefits from SL positioning in unlicensed spectrum; as noted in RP-213354, the motivations for SL-U are also valid in relation to positioning. At the same time, we acknowledge that the positioning WI scope is large and there are cross-WI coordination challenges. Our suggestion is that, at a minimum, the SL positioning objectives should target forward compatibility with positioning in unlicensed spectrum, so that the functionality can be introduced later in Rel-18 or in a future release without requiring a redesign, with checkpoints between the positioning WI and the SL WI (e.g. at the transition from the positioning study phase) to confirm compatibility of the designs.

13 – TELECOM ITALIA S.p.A.

Fully agree with DT. No SL-U to be considered in this proposal

14 – ROBERT BOSCH GmbH

Considering the targeted use-cases and mainly V2X we highly encourage the inclusion of unlicensed spectrum. In our understanding, the available ITS band will not provide enough bandwidth to meet the requirements for V2X use cases in all regions. Inline with Nokia's comment we would propose to depend the detail of consideration of unlicensed spectrum for sidelink on the progress of sidelink operation in unlicensed spectrum.

15 – New H3C Technologies Co.

We think SL positioning in unlicensed spectrum shouldn't be considered in Rel-18 due to limited TUs and large work load.

16 – Intel Corporation (UK) Ltd

In our view, current SI has already quite large scope. Adding unlicensed spectrum for Rel.18 sidelink positioning further increases workload and opens new dimensions for discussions. We understand that availability of unlicensed bandwidth can provide accuracy benefits but considering large scope of the SI, our recommendation is to postpone this work to future releases or at least reduce current NR positioning objectives for improved accuracy, integrity, and power efficiency of NR positioning work for Rel.18

17 – LG Electronics Inc.

There were discussions at the GTW session yesterday on the scope of Rel.18 positioning enhancement WI was too broad. In addition, considering that it's not clear whether to support SL CA in Rel.18, the use of the unlicensed spectrum for ITS seems not urgent. We're in line with other companies that SL positioning based on the unlicensed band can be discussed in a later release, after the completion of SL communication based on the unlicensed band.

18 – Telia Company AB

SL-Unlicensed should not be considered as current SI is already too large vs. TU amount.

19 – InterDigital France R&D

The use of unlicensed spectrum should not be included in the scope for sidelink positioning. It should be considered once the use of unlicensed spectrum is stable for sidelink communication.

20 – Apple Benelux B.V.

Unlicensed support for sidelink positioning and ranging in Rel-18 should be de-prioiritized. We need a funcitional sidelink unlicensed design before we can integrate positioning into this. This is especially due to the fact that there is no guarantee that the channel access scheme chosen for sidelink unlicensed will be decided early in the discussion of the unlicensed SL WI if we are dealing with both the sub-6 Ghz and 60 GHz bands. Case in point, in the 60 GHz WI which is just concluding, channel access schemes were very controversial and wer still under discussion in RAN1 #107-e at the end of the WI.

21 – Motorola Mobility Germany GmbH

Lenovo, Motorola Mobility :

We do understand the benefits for improved SL positioning performance using the unlicensed bands, we think that careful coordination is required between the objectives in the SL evolution WI and the SL positioning objective. Certain milestones with respect to SL Unlicensed framework should be first achieved before SL positioning work can leverage such features, which can also avoid potential redundant work in the different projects.

22 – VODAFONE Group Plc

Agree with Telia Company.

23 – Qualcomm Incorporated

As we also pointed out in our submission (RP-212923) we support including Unlicensed spectrum in the scope of the study for several important reasons:

- To achieve the V2X positioning accuracy requirements, sidelink PRS will require a bandwidth of the order of 100MHz or better.
  - No region has allocated this much spectrum for ITS, and there is no clear indication of plans from operators to allow the use of sufficient licensed spectrum for V2X positioning operation.
- For the out-of-coverage use case, where only ITS and unlicensed spectrum are available, absent support of unlicensed band SL-PRS, the limited ITS spectrum precludes successful Sidelink Positioning operation.
  - Note that that for V2X, vehicles may sometimes be frequently entering and leaving network coverage areas which could damage in-coverage performance as well as out-of-coverage performance if PRS resources are being added and removed.
- We support the current proposal and suggest the SID be revised to reflect that as,
  - "Spectrum: ITS, licensed, unlicensed"

24 – AT&T GNS Belgium SPRL

We appreciate the benefits that could be achieved with inclusion of support of unlicensed spectrum for SL positioning. However, without existing SL support for unlicensed it may be difficult to achieve completion of this objective. We suggest SL positioning with unlicensed spectrum may be a 2nd priority following completion of the SL evolution WI.

25 – Sony Europe B.V.

The usage of unlicensed spectrum should not be considered in Rel-18 or it can be revisited later (if time permits).

In our view we should focus on the introduction of sidelink positioning operation. There are many aspects to be studied as shown in the objectives (use-cases, L1 aspects (reference signals, measurement, resource allocations, etc), protocol/signaling procedure, and architecture).

26 – SHARP Corporation

We should wait to consider the inclusion of unlicensed spectrum positioning until after the availability of specs supporting sidelink in unlicensed spectrum.

27 – Philips International B.V.

We support Xiaomi, Nokia and several other companies that unlicensed spectrum should be considered to be able to reach the accuracy requirements and to make it easier to deploy sidelink positioning in the market.

28 – Ericsson LM

Ericsson does not support inclusion of unlicensed spectrum in the study given that SL unlicensed has yet to be specified.

29 – Volkswagen AG

If sidelink is included in this WID then it should focus on the ITS band and / or FR1 unlicensed bands.

Feedback Form 5: Sidelink positioning - Initial Round

1 – vivo Mobile Communication Co.

The following can be merged:

Study and evaluate performance and feasibility of potential solutions for SL positioning, considering ***relative positioning, ranging and absolute positioning:*** [RAN1, RAN2]

2 – Futurewei Technologies

Support text as proposed.

3 – Nokia Denmark

On the first sub-bullet of the last main bullet for SL: What is the distinction between relative positioning and ranging? I would prefer this just said 'relative and absolute positioning'. Ranging could be considered one of the methods (e.g., RTT) which is already captured below.

4 – CATT

The work scope for SL positioning may be too large. For Rel-18, our suggestion is to focus on the basic functionalities of the sidelink positioning, and then in Rel-19 we may consider the further enhancements. Our suggestions are:

1) Deprioritized partial-coverage: For the coverage scenarios, we may first focus on in-coverage and out-of-coverage. The scenario for partial-coverage can be deprioritized in Rel-18.

2□Deprioritized IIOT use case: For the use cases, when if all use cases of V2X, public safety, commercial and IIOT are included, the workload for simulation evaluation is too much. Thus, our suggestion is to focus on V2X, public safety and commercial use cases in Rel-18. We may further consider IIOT use cases in Rel-19.

5 – Samsung R&D Institute UK

We suggest the following revision (marked in **bold**) to clean the wording (since we have signal design, we do not need repeat saying PHY layer control signaling) as

- Study of sidelink reference signals for positioning purposes **from PHY layer perspective,** including signal design**~~, phy layer control signalling~~**, resource allocation**~~, physical layer~~** measurements **and** associated **~~physical layer~~** procedures, etc [RAN1]

6 – Samsung R&D Institute UK

In addition, just one question for clarification, what is the difference between ranging and relative positing, do we need to include both? It is good to have this clarity to avoid endless discussions in the RAN working groups. If both are the same, then we should only list one

7 – Deutsche Telekom AG

As this work will ONLY be performed for the ITS spectrum (as no licensed SL pos is supported in SA1 and unlisensed SL is not defined) the scenario is only out-of-coverage !

8 – Beijing Xiaomi Mobile Software

We would like to point out the difference between Ranging and relative positioning, based on the definition in the TS 22.261, **Ranging:** refers to the determination of the distance between two UEs and/or the direction of one UE from the other one via direct device connection. **Relative positioning:** relative positioning is to estimate position relatively to other network elements or relatively to other UEs. So the relative positioning should calculate distance and angle simultaneously but ranging can acquire only distance or angle. We also see companies may have different understanding on the definition of ranging and relative positioning, we can further discuss and clarify it in the SI phase.

So we think the original wording should be kept as 'Relative positioning, ranging and absolute positioning'.

9 – Guangdong OPPO Mobile Telecom.

We are fine with the current version of this objective

10 – Huawei Tech.(UK) Co.. Ltd

It is not clear what "identified use cases and coverage scenarios" refer to since there is no objective to specifically identify. Perhaps the word "identified" could simply be deleted from the bullet point below:

- Define evaluation methodology with which to evaluate SL positioning for the ~~identified~~ uses cases and coverage scenarios, reusing existing methodologies from sidelink communication and from positioning as much as possible [RAN1].

We suggest removing "phy layer control signaling" from the third sub-subbullet of the fourth subbullet. With the current TU, we believe phy layer control signaling design should only focus on resource allocation and physical layer procedure, which results in duplicated description in the bullet.

- Study of sidelink reference signals for positioning purposes, including signal design, ~~phy layer control signalling,~~ resource allocation, physical layer measurements, associated physical layer procedures, etc [RAN1]

11 – MediaTek Inc.

We have the same understanding as Xiaomi about the distinction between ranging and relative positioning, and we tend to think it would be useful to keep this distinction in the objective.

In general we are OK with the current form of the SL positioning objectives.

12 – TELECOM ITALIA S.p.A.

Since vehicles already have radars and lidars, we do not see the need to work on sidelink positioning in 3GPP and propose to drop the objective.

If the objective is kept, the difference between relative position and ranging should be clarified

13 – ROBERT BOSCH GmbH

We support the current objectives for sidelink positioning.

14 – New H3C Technologies Co.

we have the similar view with CATT

15 – Intel Corporation (UK) Ltd

- Move the bullet with "Scenario/requirements" to justification section as mentioned by moderator
- Change the wording in the following bullet "Identify specific target performance requirements to be considered for the evaluation based on existing 3GPP work and inputs from industry forums [RAN1]"
  - Note: Our understanding is that there is no intention to ask RAN1 to come up with a new set of target requirements for positioning work in Rel.18. Oppositely, RAN1 is expected to rely on existing 3GPP work and inputs received from industry forums that have been provided to 3GPP.
- Modify the following sub-bullet (Relative positioning, ranging and absolute positioning) as follows
  - "Relative positioning~~,~~ (including ranging) and absolute positioning"
- Make change in the following sub-bullet with a reasoning that type(s) of control signaling needs to be also studied
  - "Study of sidelink reference signals for positioning purposes, including signal design, ~~phy layer~~ control signallin resource allocation, physical layer measurements, associated physical layer procedures, etc. [RAN1]"

16 – LG Electronics Inc.

We support the draft WID proposed by moderator.

17 – InterDigital France R&D

We support the WID.

18 – Apple Benelux B.V.

We are fine with the current objectives

19 – Motorola Mobility Germany GmbH

Lenovo, Motorola Mobility :

Support the SL Positioning objective text with high priority for Rel-18, although we also think that the SL positioning scope should also cover SL RAT-independent positioning methods as is the case with the Uu positioning framework. This would enable support of hybrid positioning between RAT-dependent and RAT-independent methods in partial coverage and out-of-coverage scenarios to improve absolute and relative positioning accuracy performance.

We therefore suggest a minor edit to the 2nd sub-bullet of the 4th bullet under SL positioning to accommodate this aspect:

”Study of positioning methods (e.g. TDOA, RTT, AOA/D, etc) including combination of SL positioning measurements with other RAT dependent positioning measurements (e.g. Uu based measurements) and **support of RAT-independent positioning methods over SL** [RAN1**, RAN2**]”.

The RAT-independent positioning work can be also be mainly handled by RAN2.

20 – VODAFONE Group Plc

If there are workload/TU issues, we see this as lower priority than NR Carrier Phase.

21 – Qualcomm Incorporated

Unlicensed spectrum is crucial for V2X Positioning and it should therefore be included in the scope. Assuming the above aspect is addressed, we are OK with the scope of this study item.

22 – SHARP Corporation

We support the comment made by Xiaomi to differentiate between Ranging and relative positioning. And we think the original wording should be kept as ‘Relative positioning, ranging and absolute positioning’

23 – Sony Europe B.V.

Generally support. In our view, we need to explicitly define the definition of (1) relative positioning and (2) ranging.

24 – AT&T GNS Belgium SPRL

We support the SL positioning objectives with the following small modifications:

- Agree with some comments on ambiguity of terms referring separately to relative positioning and ranging given they are related terms. We propose the following text: Relative positioning (e.g., ranging) and absolute positioning.
- Remove “RAT-dependent” from the 2nd sub-bullet in the last objective. RAT-independent measurements could also be envisioned, e.g., barometric pressure measurements, etc. We don’t feel there is a need to make this exclusion/distinction in the SI phase. The objective would simply change to: Study of positioning methods (e.g., TDOA, RTT, AOA/D, etc.) including combination of SL positioning measurements with other ~~RAT dependent~~ positioning measurements (e.g., Uu-based measurements).

25 – Philips International B.V.

In general we are OK with the current SL positioning objectives. We agree with Xiaomi about the distinction between ranging and relative positioning, and we think it is useful to keep this distinction in the objective.

26 – Ericsson LM

The current objectives assign the study of positioning architecture and signaling procedures to RAN2 “including coordination and alignment with SA2 as required”. We suggest to add RAN3: “…alignment with RAN3 and SA2 as required.”

The scenarios and requirements bullet can be moved to the justification.

The last bullet for the SL objective: “Recommend solutions, if any, to be specified in the normative phase [RAN1, RAN2] “ is the reason why any 3GPP study is conducted. We suggest to remove this bullet.

In order to limit the scope, we think the sidelink positioning measurements to study should be limited to sidelink timing and power measurements. We think SL AOA/AOD can be left to future releases. We note

that the corresponding Uu features, DL AOA and UL AOD, have not yet been specified. We also note that UEs typically don't have antennas suitable for SL AOA/SL AOD/DL AOA/UL AOD. SL AOA/SL AOD/DL AOA/UL AOD could still be of interest for certain use cases, such as for UEs with antennas mounted on the roof of a car. Still, considering the large scope of the work this can preferably be left to a later release. We thus propose the following modification of the second sub-bullet under the SL positioning performance and feasibility study objective:

- Study of positioning methods based on SL timing and power measurements (e.g. TDOA, RTT~~,~~ ~~AOA/D~~, etc) including combination of SL positioning measurements with other RAT dependent positioning measurements (e.g. Uu based measurements) [RAN1]

In the study components for sidelink communication and from positioning should be re-used as far as possible. We therefore propose the following modification to the third sub-bullet under the SL positioning performance and feasibility study objective:

- Study of sidelink reference signals for positioning purposes, including signal design, phy layer control signalling, resource allocation, physical layer measurements, associated physical layer procedures, etc , reusing existing reference signals, procedures etc, from sidelink communication and from positioning as much as possible [RAN1]

27 – InterDigital France R&D

We would like to make a small correction in our previous input. We support **the draft objective** for sidelink positioning.

3.2 Summary from Initial Round

Summary on unlicensed

Unsurprisingly, the situation is not much different from previous discussions of this topic. A significant majority of companies have the view that unlicensed should not be included in the scope of the study item with the main arguments being:

1. SL communication in unlicensed should be specified first
2. Complexity of managing SL communication in unlicensed and SL positioning in unlicensed in parallel
3. Workload considerations

A minority of companies maintain a strong opinions that unlicensed should be included for the following reasons:

1. ITS spectrum may not have sufficient bandwidth to meeting the accuracy requirements for V2X
2. Operators may be reluctant to allow the use of their licensed spectrum for sidelink and/or positioning.
3. When out of network coverage the only spectrum that can be used is ITS and as per above this may not be sufficient.

One company (DT) proposed that the SL positioning evolution should only consider ITS spectrum as licensed spectrum is not supported in the SA1 requirements. The moderator's assumption is that this comment may be directed at SL positioning for V2X use cases, but that other uses cases such as public safety would be targeted as licensed spectrum. Hence no change is proposed based on this comment.

Based on this feedback, the moderator's recommendation to not include unlicensed within the scope of the SI.

Proposal 1: Unlicensed spectrum is not included in the scope of the study into SL positioning

There were also a number of proposals for a possible compromise way forward and the moderator considers that the following approach might be worth to discuss in the Tuesday GTW:

Proposal 2: Discuss whether one or both of the following could be acceptable (in additional to proposal 1):

1. As part of the study, the spectrum and bandwidth needed to meet the accuracy requirements should be evaluated. When this evaluation is complete the necessity to add unlicensed spectrum to the Rel-18 study can be reviewed. [The aim here is to have better information on which to make a decision]
2. To assist the potential extension to unlicensed in a future release, add a statement to the objectives saying that "The SL positioning study should consider forward compatibility to potential future extension to unlicensed spectrum"

Summary on sidelink positioning objectives

Several comments were received regarding the terms "relative positioning" and "ranging" which has been discussed previously. Xiaomi explained their understanding based on TS 22.261 that ranging refers to estimating distance or angle, and relative positioning refers to distance and angle. To the moderator, this distinction seems quite subtle and very unlikely to have a substantive impact to the potential solutions that need to be studied. The moderators proposal is to leave the text unchanged.

Regarding the question of moving of the scenarios and use cases to the justification. only 3 companies commented, 2 in favour and one against. The moderator assumes that other companies find the current location of the text acceptable so no change has been made and the note in [] has been removed.

Although only commented by one company, the bullet "Recommend solutions, if any, to be specified in the normative phase [RAN1, RAN2]" has been removed. This seems to be a natural outcome of any study and so it seem reasonable to remove. It is also noted that the other objectives did not have a similar bullet.

The following changes have not been taken into account. Each comment is only made by one or two companies and the the moderator considers them unlikely to be acceptable based on previous discussions, or because they are expanding the scope of the work, etc:

- Removing the whole objective
- Deprioritising 'partial coverage' scenario and IIoT use case
- Removal of AOA/AOD in order to reduce the scope of work
- Adding support for RAT-independent positioning methods over SL [expansion of scope]

- Removal of 'RAT dependent' in the bullet " o Study of positioning methods (e.g. TDOA, RTT, AOA/D, etc) including combination of SL positioning measurements with other RAT dependent positioning measurements " [expansion of scope]

Other changes have been taken into account in the revised SID text.

3.3 Intermediate Round

Following the lengthy discussion on the Tuesday GTW, the proposal is to discuss the following way forward on unlicensed:

1. The study will not explicitly consider unlicensed spectrum
2. The study will evaluate the bandwidth requirements to meet the accuracy requirements
3. When the bandwidth requirements have been determined and the study of sidelink communication in unlicensed spectrum has progressed, it can be reviewed whether unlicensed spectrum can be considered in further work. Checkpoint at RAN#97 to see if sufficient information is available for this review.

Note that so far no changes have been proposed in the SID text. This will be proposed after receiving feedback to the proposed way forward above.

Companies are requested to comment constructively towards finding an acceptable way forward. Simply repeating arguments already made in the Initial Round is not productive.

Feedback Form 6: Unlicensed spectrum - Intermediate Round

1 – vivo Mobile Communication Co. We are fine with the moderator's suggestion based on online understanding.
2 – New H3C Technologies Co. We are fine with the moderator's proposal.
3 – China Mobile E-Commerce Co. We are supportive of the moderator's proposal.
4 – NTT DOCOMO INC. We think SL positioning for unlicensed should be discussed after discussion of SL communication for unlicensed is completed. However, considering the current situation, we can compromise to the proposed way forward.
5 – TELECOM ITALIA S.p.A. This is business as usual (to decide what to specify after a study phase)... It is ok to avoid explicit mention of unlicensed spectrum. And we have the same concern as DOCOMO.

However, in the SL enh discussion there is a checkpoint proposed in RAN#98.

Therefore the checkpoint also for this objective should be set to RAN#98, not #97.

6 – ZTE Corporation

We have the similar view as DOCOMO, and can accept moderator's proposal

7 – CATT

We are open to consider above proposal. We assume the bandwidth requirements in the above proposal is tightly related to the target accuracy requirement for SL positioning. For Rel-18, we suggest the target accuracy requirement for SL positioning is defined based on the positioning service 1 as defined in Table 7.3.2.2-1 of TR 38.845, i.e., horizontal accuracy of 10m and vertical accuracy of 3m. Further accuracy enhancements can be considered in Rel-19.

8 – DENSO CORPORATION

Agree with moderator's proposal. It is a proper procedure to standardise SL positioning over unlicensed bands.

9 – Huawei Tech.(UK) Co.. Ltd

We can accept the 3 points in the moderator's proposal as a compromise.

10 – CITC

We are fine with the moderator's proposals. We share the same concern as DOCOMO, TELECOM ITALIA and ZTE.

11 – Beijing Xiaomi Mobile Software

We think unlicensed spectrum is important to improve the sidelink positioning accuracy and fine with the proposals.

12 – ROBERT BOSCH GmbH

We appreciate the moderators input to find a good compromise. In our understanding, the outcome of the online discussion is avoid naming any kind of spectrum before bandwidth requirements are determined. Thus, we propose to remove

Spectrum: ITS, licensed, [unlicensed]

i.e.,

~~Spectrum: ITS, licensed, [unlicensed]~~

Instead, using the moderator's comment, we make the proposal to maybe add a full-text note, such as:

The study will evaluate the bandwidth requirements to meet the accuracy requirements. Initially, spectrum available in ITS and licensed band should be considered. When the bandwidth requirements have been determined and the study of sidelink communication in unlicensed spectrum has progressed, it can be reviewed whether unlicensed spectrum can be considered in further work. Checkpoint at RAN#97 to see if sufficient information is available for this review.

13 – Samsung R&D Institute UK

We don't support including 3) in the SID because we prefer to study/specify sidelink positioning in unlicensed spectrum in the next release.

14 – LG Electronics Inc.

Thanks for the discussion. Please see LGE's view below.

1. Agree to the text proposed with the understanding that the SID will include ITS and licensed spectrum.

2. Study should consider all the aspects of requirements such as the latency, the availability, the reliability, etc. as well as the accuracy. But they are already the scope of SI in our understanding. We don't need to study the "requirement" in terms of bandwidth in this sense. The bandwidth is just one of the system parameters for SL positioning. We suggest the following modification in wording.

- The study will evaluate the performance requirements (e.g. accuracy, latency, availability, etc.) in terms of system parameters (e.g. carrier frequency/SCS, bandwidth, antenna, etc).

3. According to the general statement above, the following modification is suggested.

- When the evaluation above has been finished and the study of sidelink communication in unlicensed spectrum has progressed, it can be reviewed whether unlicensed spectrum can be considered for SL positioning in further work taking into account the aspects related to SI/WI management. Checkpoint at RAN#97 to see if sufficient information is available for this review. Study scope and progress in Rel-18 SL communication in unlicensed spectrum shall not be affected by SL positioning.

15 – MediaTek Inc.

We agree with the moderator's way forward. Considering that availability of bandwidth is a strong motivation from the companies interested in SL-U positioning, we think it should be called out explicitly as suggested by points 2/3.

16 – InterDigital France R&D

We support the moderator's way forward.

17 – Nokia Denmark

We are fine with the moderator's proposal.

18 – SHARP Corporation

We support the moderator's proposals.

19 – Motorola Mobility Germany GmbH

Lenovo/Motorola Mobility :

The compromised way forward especially with respect to 2), is acceptable to us.

20 – Apple Benelux B.V.

We think that this compromise may be a good way forward.

(1) Want to clarify if the checkpoint will be captured in any official document/agreement e.g. Chairman's notes, minutes

(2) The checkpoint for Sidelink unlicensed and the sidelink unlicensed positioning should be synchronized to either RAN #97 or RAN #98

(3) Given the de-emphasis on spectrum, the bullet point "Spectrum: ITS, licensed, [unlicensed]" should be removed

21 – Ericsson LM

Ericsson: We maintain our view that unlicensed bands should not be included in the scope for Rel. 18. This should wait until support for unlicensed bands has been included for sidelink communication. Also the Rel. 18 scope needs to be kept at a reasonable level. Thus, we don't think there should be any further checkpoint to consider inclusion of unlicensed in Rel. 18. Note also that there is support for reporting Bluetooth measurements in unlicensed spectrum over LPP. What is missing is sidelink measurements in licensed bands.

22 – Sony Europe B.V.

We support the updated moderator's proposal.

23 – Qualcomm Incorporated

Based on the current situation and the online discussion, we support a proposal that includes the 3 items shown above.

24 – AT&T GNS Belgium SPRL

We support the compromise in the way forward as proposed by the moderator. It is reflective of the online discussion. We should capture the checkpoint for sidelink unlicensed positioning somewhere (if not in the SID, in the chair notes, etc.).

25 – Deutsche Telekom AG

We agree with the moderators proposal as outcome of the GTW discussion and echo the DOCOMO and TIM comment.

26 – TOYOTA Info Technology Center

We support the moderator's proposals.

27 – Volkswagen AG

The proposal sounds reasonable. It is expected that the checkpoints will be aligned with the dependencies to SLEvo and mentoined in the WID.

28 – Philips International B.V.

We agree with the compromise proposed by the moderator.

29 – Intel Corporation (UK) Ltd

We are fine with moderator's proposal

Companies are asked to provide comments and suggestions to the updated objectives.

Feedback Form 7: Sidelink positioning - Intermediate Round

1 – vivo Mobile Communication Co.

The following objective update can be considered. The downselection in RANP 97e does not need to be explicitly mentioned in the SID:

Study solutions for sidelink positioning considering the following: [RAN1, RAN2]

· Scenario/requirements

- Coverage scenarios to cover: in-coverage, partial-coverage and out-of-coverage
- Requirements: Based on requirements identified in TR38.845 and TS22.261 and TS22.104
- Use cases: V2X (TR38.845), public safety (TR38.845), commercial (TS22.261), IIOT (TS22.104)
- Spectrum: ITS, licensed~~, [unlicensed]~~

Study and evaluate performance and feasibility of potential solutions for SL positioning, considering relative positioning, ranging and absolute positioning: [RAN1, RAN2]

- **Evaluate bandwidth requirement to meet the accuracy requirements identified in the study[RAN1]**
- Study of positioning methods (e.g. TDOA, RTT, AOA/D, etc) including combination of SL positioning measurements with other RAT dependent positioning measurements (e.g. Uu based measurements) [RAN1]
- Study of sidelink reference signals for positioning purposes from physical layer perspective, including signal design, resource allocation, measurements, associated procedures, etc, reusing existing reference signals, procedures, etc from sidelink communication and from positioning as much as possible [RAN1]
- Study of positioning architecture and signalling procedures (e.g. configuration, measurement reporting, etc) to enable sidelink positioning covering both UE based and network based positioning [RAN2, including coordination and alignment with RAN3 and SA2 as required]

2 – China Mobile E-Commerce Co.

Regarding the comments from Nokia in the initial round, from the workload perspective, we think that it is reasonable to postpone some of the positioning techniques such as AoA/AoD. It may be argued that without supporting of AoA/AoD, the performance of angle estination may not be sufficient to meet the requirement of ranging/relative positioning identified for V2X/PS use cases. In our views, as we will study use cases and requirements in the study phase, we are open to postpone some of the positioning methods as long as the identified requirement can be satisfied.

3 – ZTE Corporation

We are supportive of vivo's suggestion.

Moreover, Rel-16/17 sidelink mainly focused on FR1, and it may not work well in FR2 due to lack of basic FR2 functionalities, e.g. beam management. That's why one study bullet of Rel-18 NR sidelink enhancement (excluding positioning and relaying) is on FR2 licensed spectrum. In our view, the same beam management mechanism should be used for both regular SL operation and SL positioning in FR2. So, to avoid colliding discussion between Rel-18 SL and positioning group, we suggest to specify SL positioning in FR2 after completing specifying regular SL communication. That is, to **prioritize FR1 over FR2 for SL positioning in Rel-18**

4 – CATT

5 – ROBERT BOSCH GmbH

We strongly disagree with Vivo's proposal, as it, in our understanding, ignores the outcome of yesterday's online discussion.

In our understanding, the outcome of the online discussion is avoid naming any kind of spectrum before bandwidth requirements are determined. Thus, we propose to remove

Spectrum: ITS, licensed, [unlicensed]

i.e.,

~~Spectrum: ITS, licensed, [unlicensed]~~

entirely from the objectives.

Instead, using the moderator's comment, we make the proposal to maybe add a full-text note to the objectives, such as:

The study will evaluate the bandwidth requirements to meet the accuracy requirements. Initially, spectrum available in ITS and licensed band should be considered. When the bandwidth requirements have been determined and the study of sidelink communication in unlicensed spectrum has progressed, it can be reviewed whether unlicensed spectrum can be considered in further work. Checkpoint at RAN#97 to see if sufficient information is available for this review.

6 – Samsung R&D Institute UK

We think that 'Scenario/requirements' should be moved into the justification section. It is clear that 'Scenario/requirements' are not objective to study in this item.

In addition, for the difference between ranging and relative positing, is it common understanding in this group that ranging definition in the TS 22.261 below means 'distance or direction' (it cannot be both distance and direction)?

Ranging: refers to the determination of the distance between two UEs and/or the direction of one UE from the other one via direct device connection.

If not, we think that it would be good to make clear during this discussion.

7 – LG Electronics Inc.

According to the direction discussed above, we need to remove '[unlicensed]' from Spectrum study. Other parts are fine with us.

8 – Beijing Xiaomi Mobile Software

We are fine with the objective.

9 – MediaTek Inc.

We think the objective is OK in its current form. We understand that the suggestion from vivo is not in line with what was concluded online, and we think we should proceed with the moderator's way forward rather than reopen discussion of the same issues.

On CATT's comment, we don't think it makes sense to exclude partial coverage, as this seems like a natural use case for sidelink positioning, where in-coverage UEs have known locations and can serve as references for an out-of-coverage UE. We also don't see a big gain from excluding this case (out-of-coverage cases raise most of the same challenges).

10 – Guangdong OPPO Mobile Telecom.

We are fine with the current version of the objective

11 – InterDigital France R&D

Except the treatment of ”[unlicensed]”, other parts of the objective are fine with us. Treatment of ”[unlicensed]” will depend on the outcome of the discussion above.

12 – SHARP Corporation

It is our understanding that during the SA1 normative work for Ranging as captured in TS 22.261, the ranging operation can provide **both** direction and distance, and further, direction includes horizontal direction and elevation direction. We think the definition for Ranging is clear as captured in TS22.261.

13 – Motorola Mobility Germany GmbH

Lenovo/Motorola Mobility :

We would like to reiterate our support for the inclusion of RAT-independent positioning methods, in order to fully support hybrid positioning for SL in out-of-coverage scenarios. Alternatively as a compromise, we would be open to the Removal of 'RAT dependent' in the bullet: "Study of positioning methods (e.g. TDOA, RTT, AOA/D, etc) including combination of SL positioning measurements with other ~~RAT dependent~~ positioning measurements (e.g. Uu based measurements)".

On another note, we think that RAN2 should be included in the above bullet as a supporting secondary WG group to support RAN1's work.

14 – Ericsson LM

We think removing SL AOA and SL AOD from the scope is a very reasonable way to reduce the scope of the Rel. 18 work and we hope that more companies will support this in the intermediate round. Note that the corresponding Uu features, DL AOA and UL AOD, have not yet been specified. Further more, UEs typically don't have antennas suitable for SL AOA/SL AOD/DL AOA/UL AOD. SL AOA/SL AOD/DL AOA/UL AOD could still be of interest for certain use cases, such as for UEs with antennas mounted on the roof of a car. Considering the large scope of the work this can preferably be left to a later release. We thus propose the following modification of the second sub-bullet under the SL positioning performance and feasibility study objective:

- Study of positioning methods based on SL timing and power measurements (e.g. TDOA, RTT~~, AOA/D~~, etc) including combination of SL positioning measurements with other RAT dependent positioning measurements (e.g. Uu based measurements) [RAN1]

15 – Qualcomm Incorporated

Assuming the issue with the unlicensed spectrum is addressed according to the 3 principles outlined above, we are OK with the remaining aspects of the current SID

16 – Deutsche Telekom AG

The multiple scenarios are complete nonsense !

We now have ony 2 types of spectrum: ITS and licensed.

So the scenarios are for **ITS**:

- **out-of-coverage** (IN what kind of coverage the UE should be ?)
    - or do we assume that a PLMN controls the ressource allocation for SL positioning in ITS spectrum a la mode 1 ?

For licensed:

- **in-coverage** (as this is the only scenario which is covered in SA1 TR22.855:
  - *[CPR-6] The 5G system shall be able to ensure that the use of Ranging, if in licensed spectrum, is only permitted in network coverage under the full control of the operator who provides the coverage*.)
  - we should also clarify that in licensed spectrum the SL positioning is ONLY permitted under full control of the operator who provides the coverage (see above)

It should also be clarified what this difference between relative positioning and ranging is ...

17 – Philips International B.V.

Apart from the changes needed to implement the compromise proposal on unlicensed spectrum, no other changes are needed or desired from our perspective.

18 – Intel Corporation (UK) Ltd

We prefer to remove wording "reusing existing reference signals, procedures, etc from sidelink communication and from positioning as much as possible" as it can be directly proposed at WG level and studied whether and what can be reused.

3.4 Summary from Intermediate Round

Summary on unlicensed for SL positioning

The overwhelming majority of companies either support or are at least willing to accept the proposed way forward that was proposed by the moderator after the Tuesday GTW discussion. 2 companies (Samsung and Ericsson) maintain the view that unlicensed should be excluded from any Rel-18 work. Based on the this response the moderator's proposal is to move ahead to capture the way forward within the SID text.

A number of companies provided their opinion on how to capture the way forward. Different views were expressed regarding:

1. Whether to keep the existing mention of licensed and ITS spectrum in the SID
2. Whether the checkpoint should be RAN#97 or RAN#98
3. Whether it is necessary to capture the third bullet of the way forward in the SID

The text included in the update of the SID captures all 3 elements of the way forward. The moderator's view is that we are not respecting the way forward unless the future review is clearly mentioned. The checkpoint has been kept as RAN#97 as this was suggestion by the RAN chair in the GTW and also was in the proposal that seemed to be agreeable to many companies. Of course, if at RAN#97 there is not enough information to review the situation then it can be postponed to the following meeting. The existing text referring to licensed and ITS spectrum is retained given that the note about the future review makes it clear that there is still a possibility that unlicensed could be added to the list.

Summary for Sidelink positioning objectives

Comments to the sidelink positioning objectives in this round were quite diverse, including the following:

- Remove AoA/AoD from the scope of the study
- Prioritise FR1 over FR2 Remove IIoT use cases
- Remove partial coverage use case
- Add RAT-independent positioning methods to the study
- Remove objective on ”reusing existing reference signals, procedures, etc from sidelink communication and from positioning as much as possible”

Some of these comments are repeated from previous rounds, and each proposal was from at most one or 2 companies. Based on this, it is difficult for the moderator to conclude that any of them should be included in the updated SID text.

In addition, there was some further discussion of the definition of ranging. As explained by some companies, the SA1 definition of ranging is that it is determining the distance and/or angle between 2 UEs. Given this, it seems that there is nothing incorrect with the current SID text that says ”considering relative positioning, ranging and absolute positioning ”

No changes to the Sidelink positioning objectives have been made in the updated SID other than those related the unlicensed discussion.

3.5 Final Round

Companies may provide any final comments to the updated SID text.

Feedback Form 8: Sidelink positioning - Final Round

1 – LG Electronics Inc.

Thanks for the summary and the update of SID. We’re generally fine with the updated SID with one comment. As commented in the intermediate round, we don’t want the progress or the direction of SL enhancement based on unlicensed band to be affected by the evaluation work related to the unlicensed band for SL positioning. So we suggest to add the following **clarification** to the Note of SID, or at least capture it in the meeting note.

- Note: When the bandwidth requirements have been determined and the study of sidelink communication in unlicensed spectrum has progressed, it can be reviewed whether unlicensed spectrum can be considered in further work. Checkpoint at RAN#97 to see if sufficient information is available for this review. **Study scope and progress in Rel-18 SL communication in unlicensed spectrum shall not be affected by SL positioning.**

2 – ZTE Corporation

We are fine with the latest formulation.

Some views for open issues:

- For ’Remove AoA/AoD from the scope of the study’, it is better not to add this resctriction. Otherwise, it is hard to get relative direction in out-of-coverage.

- We agree to prioritise FR1 over FR2
- We are fine to remove IIoT use cases
- It is better not to remove partial coverage use case. This is one important scenario in SL.
- Not to add RAT-independent positioning methods as workload is too large
- Not to remove objective on ”reusing existing reference signals, procedures, etc from sidelink communication and from positioning as much as possible”

3 – Guangdong OPPO Mobile Telecom.

We are supportive of the current version of SL positioning.

4 – ROBERT BOSCH GmbH

We support the inclusion of the compromise regarding unlic. spectrum. We are fine with the current version of the objectives

5 – MediaTek Inc.

We support the current version of this objective, and we understand that this update is in line with the agreed way forward. We agree with the moderator’s analysis regarding the additional comments listed above and think we should proceed with the current version.

6 – Huawei Tech.(UK) Co.. Ltd

The text added by the moderator starts with “Note: When the bandwidth requirements have been determined”, however there is no bandwidth requirement per se, there are only positioning requirements, as also pointed out by LGE. So we suggest revising as follows:

Note: When the bandwidth **needed to meet the identified accuracy** requirements have been determined…

Correspondingly, we suggest a similar revision to the objective:

- Evaluate bandwidth **needed** to meet the identified accuracy requirements [RAN1]

We assume that such evaluations will have to be done for each of the different accuracy requirements, e.g. set 1, 2, 3 and for various positioning methods.

7 – vivo Mobile Communication Co.

Fine with the version provided by the moderator.

8 – Samsung R&D Institute UK

We do not prefer to include the NOTE. However, if this is the majority view, we can accept this.

About relative positioning and ranging, we suggest to remove ranging and replace by relative positioning (including relative distance and/or relative direction). We think that this is clearer Please notice that this is to make clear SID.

9 – Beijing Xiaomi Mobile Software

We are fine with the version provided by moderator.

We disagree the suggestion from Samsung to remove ranging. Both ranging and relative positioning have specific definition in TS 22.261 and current description in SID is already very clear.

10 – InterDigital France R&D

We support the moderator's version of the SID.

11 – SHARP Corporation

We are fine with the version provided by moderator.

We also disagree with the suggestion from Samsung to remove ranging.

Both ranging and relative positioning have specific definition in TS 22.261 and the current description in the SID is clear.

12 – AT&T GNS Belgium SPRL

We agree with some of the views on having ranging and relative positioning separately distinguished in the objectives may be confusing since "ranging" is a **subset** of "relative positioning" per definitions in TS 22.261. Going back to our initial round suggestions, in terms of positioning techniques it is much clearer to simply state one of the following:

- relative positioning~~, ranging~~ and absolute positioning <or>
- relative positioning (e.g., ranging) and absolute positioning

On the other topics, we strongly prefer to keep the partial coverage use case as this is an important use case, along with in/out of coverage scenarios.

On AoA/AoD, we don't see a need to downscope the possible techniques at this stage. We prefer to keep this.

On the combination of measurements, we don't see the need to get into specific combination of measurements at this stage, since it is envisioned and already supported at least in LPP to report both RAT-dependent and RAT-independent (e.g., GNSS, sensors) measurements to the LMF. Therefore, we again suggest: Study of positioning methods (e.g. TDOA, RTT, AOA/D, etc) including combination of SL positioning measurements with other ~~RAT-dependent~~ positioning measurements (e.g. Uu based measurements). By the way, from the baseline text it suggests there might be other measurements, what are the RAT-dependent positioning measurements that aren't Uu-based?

Finally, we prefer not to remove objective on "reusing existing reference signals, procedures, etc from sidelink communicati and from positioning as much as possible" as this is a good starting point.

Thanks to the moderator for the efforts on this.

13 – Motorola Mobility Germany GmbH

Lenovo, Motorola Mobility :

Generally fine with the current stable SID text and inclusion of the moderator's way forward on the unlicensed aspect of SL Positioning. We also agree that partial coverage is an important scenario of consideration.

Ideally, we would have liked to have a mention of RAT-independent positioning in the SID objective text for the reasons mentioned in the initial and intermediate rounds. We share AT&T's view on the removal of

”RAT-dependent” under the combination of positioning measurements as the study would be more complete (rigorous) by investigating all positioning measurements, which can be effectively combined as opposed to only focusing on subset set of positioning network measurements (which can in any case only be supported in in-coverage scenarios).

14 – Nokia Denmark

We support that AoA/AoD should remain in scope for the study.

15 – CATT

We are in general fine with the latest version, although we prefer to reduce the SI scope, e.g., by removing IIOT use case.

The change proposed by Huawei is fine to us, since we have so far do not defined the bandwidth requirement for positioning accuracy requirements. Similarly, we suggest making the minor wording changes for the note:

“Note: When the required bandwidth ~~requirements~~ have been determined, ...”

16 – Qualcomm Incorporated

We think that given the de-emphasis on spectrum according to the 3 principles discussed before and the online discussion, the bullet point “Spectrum: ITS, licensed” is not needed.

17 – Sony Europe B.V.

We support the updated moderator’s proposal (v4).

18 – Volkswagen AG

With the inclusion of the note the compromise can be accepted.

19 – TOYOTA Info Technology Center

We support the latest version of the SID.

Regarding AoA/AoD, at the study phase, we prefer to keep AoA/AoD in the scope.

20 – Apple Benelux B.V.

We support the addition of the note to the objective.

21 – Intel Corporation (UK) Ltd

We are fine with the latest update

22 – Philips International B.V.

We support the current objective

23 – Ericsson LM

We are fine with the latest update

3.6 Summary from Final Round

There was wide support for the current wording of the objective including having the note to reflect the way forward concluded in the intermediate round. Only Samsung preferred not to keep it, but they could also accept the majority view.

Qualcomm preferred remove the bullet on spectrum but this has not been done. With the note included to reflect the way forward, it seems consistent to retain this bullet.

Samsung proposed to remove ”ranging” and replace with ”including relative distance and/or relative direction”. This has not been done as term ranging has been included in the text since the original summary document from the workshop in June and removal is unlikely to be agreeable at this stage (indeed already as comment by Xioami and Sharp)

AT&T and Lenovo suggested to remove RAT dependent from ”including combination of SL positioning measurements with other RAT dependent positioning measurements (e.g. Uu based measurements)”. This has not been done as it would imply an increase in scope which is not advisable at this stage of the discussion. This limit on the scope of the study should not be limiting to any eventual implementation which will be free to consider any information that may be available when determining a position estimate.

LG proposed to add to the note that ”Study scope and progress in Rel-18 SL communication in unlicensed spectrum shall not be affected by SL positioning.”. To the moderator this seems a reasonable expectation but was not added as no other company raised the necessity of this. Hopefully this can be manage by the good coordination of the respective WI rapporteurs.

One minor change was introduced to add ’needed’ to ” o Evaluate bandwidth requirement needed to meet the identified accuracy requirements [RAN1]”

4 Improved accuracy, integrity, and power efficiency

4.1 Initial Round

Companies are asked to provide comments and suggestions to the objectives on Improved accuracy, integrity, and power efficiency. A separate feedback form is provides for each of the sub objectives

Feedback Form 9: Integrity for RAT dependent positioning - Initial Round

1 – vivo Mobile Communication Co.
The workload of current scope is far beyond capacity of WG resources. We don’t see strong need for integrity enhancement. The whole item should be postponed to next release.
2 – Futurewei Technologies
Support

3 – CATT

We are fine to include objective for integrity for RAT dependent positioning as shown in SID, although we consider the support integrity for RAT dependent positioning is low priority for Rel-18.

4 – THALES

We are supportive of the objectives on Improved accuracy and integrity,

5 – Samsung R&D Institute UK

Just one question for clarification, what is the RAN1 role for the below bullet?

- Identify the error sources, failure modes, [RAN1, RAN2].

6 – Guangdong OPPO Mobile Telecom.

We are fine with this objective

7 – Deutsche Telekom AG

Improved accuracy (in well defined local and/or indoor deplyoments, not general wide-area) has higher prority than improved power efficiency and RAT dependent positioning integrity

8 – ZTE Corporation

Suppor

9 – Huawei Tech.(UK) Co.. Ltd

We suggest removing “failure modes” because it is not clear what that means, and even in Rel-17, study of it was not requested by RAN2 LS.

- Identify the error sources~~, failure modes,~~ [RAN1, RAN2].

10 – Beijing Xiaomi Mobile Software

We support the objective.

11 – TELECOM ITALIA S.p.A.

We support the objectives

12 – MediaTek Inc.

We are concerned about the size of the WI, and RAT-dependent integrity has the potential to be a difficult objective. As the comments in this discussion and previous rounds make clear, there is some uncertainty from companies about how RAN1 would attack the initial objective to understand the error sources and failure modes, so this seems like a risk of a time sink. So far we haven’t seen a strong requirement to drive this objective; we aren’t opposed to it in principle, but we think it’s lower priority than some of the other objectives and could be downscoped for this release.

13 – ROBERT BOSCH GmbH

Support

14 – New H3C Technologies Co.

we support this objective

15 – Intel Corporation (UK) Ltd

For the sake of RAN1 workload reduction and considering that new positioning solutions may be introduced in Rel.18, we are open postponing of integrity work to the next release.

16 – Telia Company AB

Objective is ok for us.

17 – InterDigital France R&D

We support the objective. The framework for RAT-independent integrity can be the starting point for this study.

18 – Apple Benelux B.V.

We think that this objective could be postponed to the next release as a way to reduce the overall workload in Rel-18

19 – InterDigital France R&D

We would like to make a correction for a typo in our previous input.

We support the objective. The framework for GNSS positioning integrity can be the starting point for this study.

20 – Motorola Mobility Germany GmbH

Lenovo, Motorola Mobility :

We are fine with the updated objective text as this forms part of the improved integrity goal in Rel-18.

21 – Qualcomm Incorporated

Even though integrity is lower priority from our side, we can accept the package proposal for the “improved accuracy, integrity, power efficiency”

22 – VODAFONE Group Plc

If there are workload issues then this could be postponed to a later release (as we see GNSS as being used outdoors and RAT dependent solutions being used indoors - and indoors it may be easier to ensure the integrity of the RAT signals by other means.)

23 – SHARP Corporation

We support the objective.

24 – Sony Europe B.V.

Support.

This part ”Identify the error sources, failure modes” can be led by RAN2.

25 – Philips International B.V.

We support this objective. It is important to consider the integrity of the RAT dependent positioning and improve the reliability of the position estimations.

26 – AT&T GNS Belgium SPRL

We support this objective, but understand the scope is quite broad. Given the framework that was created for GNSS integrity in Rel-17, we should state that this will be used as a starting point. If there is a general framework for e.g., signalling support, it could apply to both RAT-dependent and other non-GNSS RAT-independent positioning methods.

27 – Ericsson LM

3GPP should continue the Integrity work in Rel-18. Providing Integrity for GNSS SSR message will be mature as part of Rel-17, while some parts can be remaining (e.g. GNSS local environment such as jamming, spoofing, multipath details). Then the same concept; i.e the Integrity KPIs etc. can be applied for RAT dependent positioning method. Further RTCM input can be taken for OSR Integrity discussion in Rel-18. Integrity for RAT-independent and RAT-dependent positioning is low hanging fruit which should be continued in Rel-18.

28 – ESA

We think the work carried out by RAN2 on GNSS integrity can be leveraged on for RAT-dependent integrity. In addition, we would like to emphasise that there is need to further enhance also GNSS integrity beyond Release 17. Therefore, we support including integrity for RAT-dependent and RAT-independent on the list with objectives for Rel18 positioning works.

Feedback Form 10: PRS/SRS bandwidth aggregation - Initial Round

1 – vivo Mobile Communication Co.

RAN1 has already studied this issue. It is not necessary to study again in RAN1. This could be led by RAN4.

2 – Futurewei Technologies

Support. Also ok if RAN4 leads this.

3 – ZTE Corporation

Support. We are also ok if RAN4 leads this.

4 – CATT

RAN1 has studied PRS/SRS bandwidth aggregation in Rel-17 and identified that there is a need for RAN4 to study the feasibility of PRS/SRS bandwidth aggregation. There is no need for RAN1 to study it again in Rel-18. Our suggestion is that RAN4 should lead the study of accuracy improvement based on PRS/SRS

bandwidth aggregation for intra-band carriers. RAN1 may lead the normative work if RAN4 decides that it is feasible to support PRS/SRS bandwidth aggregation for intra-band carriers.

Also, during the SI, RAN2 and RAN3 may not need to be involved in PRS/SRS bandwidth aggregation positioning in our view.

The updated objectives from us as follows,

- Study solutions for accuracy improvement based on PRS/SRS bandwidth aggregation for intra-band carriers[~~RAN1,~~ RAN4~~, RAN2, RAN3~~]:
  - RAN4 to consider implications of PRS/SRS bandwidth aggregation (e.g. timing errors, phase coherency, frequency errors, power imbalance, etc).

5 – Nokia Denmark

Suggestion to make this RAN4 led:

- Study solutions for accuracy improvement based on PRS/SRS bandwidth aggregation for intra-band carriers[RAN1, RAN4, RAN2, RAN3]:
  - RAN4 to consider implications of PRS/SRS bandwidth aggregation (e.g. timing errors, phase coherency, frequency errors, power imbalance, etc).

6 – NTT DOCOMO INC.

Support and ok with RAN4-led.

7 – THALES

Support. It is fine if RAN4 leads this

8 – Samsung R&D Institute UK

Just one question for clarification. Is the bandwidth aggregation is only for RRC connected mode, or could allow RRC inactive + RRC connected?

9 – China Mobile E-Commerce Co.

We share similar views as other companies that as SRS/PRS carrier aggregation has been studied in R17 SI phase, RAN1 does not need to do it again. We support RAN4 to lead it.

10 – Deutsche Telekom AG

Support

11 – Guangdong OPPO Mobile Telecom.

Considering the limited TU capability (i.e., 3TU), the current scope is too large and some further down-scoping is needed for the accuracy enhancement, e.g., down-selection between PRS/SRS bandwidth aggregation and NR carrier phases.

In Rel-17, there were evaluations for the PRS/SRS bandwidth aggregation. The main concern is about the feasibility. During R17 discussions, both UE vendors and NW vendors doubted the feasibility for UE and

gNB, respectively. Thus, the study should focus on the feasible and RAN4 should be the leading WG. Thus, if the objective is included, we suggest the following modification

Study **the feasibility and** solutions for accuracy improvement based on PRS/SRS bandwidth aggregation for intra-band carriers[**RAN4,** RAN1, ~~**RAN4,**~~ RAN2, RAN3]:

· RAN4 to consider implications of PRS/SRS bandwidth aggregation (e.g. timing errors, phase coherency, frequency errors, power imbalance, etc).

12 – Huawei Tech.(UK) Co.. Ltd

We suggest to only task RAN4 if this objective (and the whole item) is converted to a study, since RAN1 study is already complete. We suggest the following objective instead:

- Study feasibility of PRS/SRS bandwidth aggregation (e.g. timing errors, phase coherency, frequency errors, power imbalance, etc) for solutions for accuracy improvement based on PRS/SRS bandwidth aggregation for intra-band carriers documented in TR38.857 [RAN4]

13 – Beijing Xiaomi Mobile Software

We agree with other companies that this objective can be RAN4-led.

14 – TELECOM ITALIA S.p.A.

if the objective is to be kept in scope, ok to leave it to RAN4 only, pending there is enough capacity in RAN4.

Clearly if there is no room in RAN4, the objective should be dropped.

15 – MediaTek Inc.

We have some doubt about the real applicability of this objective, considering typical deployments: Intra-band contiguous deployments are limited, and the benefit in other scenarios is less clear. We see this as a candidate for downscoping in this release, but if it is pursued, the level of effort should be limited.

16 – LG Electronics Inc.

We support PRS/SRS bandwidth aggregation, also we are fine if RAN4 leads this.

17 – New H3C Technologies Co.

Support it if only RAN4 is involved

18 – Intel Corporation (UK) Ltd

According to the objective description: “RAN4 to consider implications of PRS/SRS bandwidth aggregation (e.g., timing errors, phase coherency, frequency errors, power imbalance, etc.)”), we think this objective can be led directly by RAN4 and are open to change leading WG. From physical layer perspective, PRS/SRS bandwidth aggregation is beneficial and does not require additional RAN1 study.

19 – InterDigital France R&D

We support the objective.

20 – Apple Benelux B.V.

We are fine with the objective and if it is RAN4 led

21 – Motorola Mobility Germany GmbH

Lenovo, Motorola Mobility :

We are fine to prioritize this objective for improved accuracy in Rel-18.

22 – Qualcomm Incorporated

We support the objective. We prefer to keep RAN1 as the first Working Group as shown in the current draft WID. We acknowledge that RAN4 needs to consider the RF-related implications, which is captured in the subbullet already, so we don't see the necessity to this doesn't mean that RAN4 should be the main Working Group for the study.

23 – SHARP Corporation

Support and are ok with RAN4-led.

24 – Sony Europe B.V.

RAN1 has studied during Rel-17 study item. At this stage, it should be led by RAN4 as it is related to their expertise (e.g., on the impact of imperfections, such as timing errors, phase coherency, frequency errors, power imbalance)

25 – Philips International B.V.

Agree with Mediatek. Is potential candidate for downscoping.

26 – Ericsson LM

Given the large scope of this SID and the complexity and cost involved in intra-band PRS bandwidth aggregation, we propose to limit the scope to intra-band, **contiguous** PRS bandwidth aggregation.

Feedback Form 11: NR carrier phase - Initial Round

1 – vivo Mobile Communication Co.

We don't think RS should be part of the study.

- Study solutions for accuracy improvement based on NR carrier phase measurements [RAN1, RAN4, RAN2, RAN3]
  - ~~Reference signals,~~ physical layer measurements, physical layer procedures to enable positioning based on NR carrier phase measurements for both UE-based and UE-assisted positioning [RAN1]
  - Focus on reuse of existing PRS and SRS~~, with new reference signals only considered if found necessary~~
  - Signalling for configuration and measurement reporting [RAN2, RAN3]

2 – Futurewei Technologies

This has been studied in the past without further proceeding. Our preference is to allocate resources and TU for other enhancements.

3 – ZTE Corporation

We are OK with the current wording, and can also accept vivo's suggestion

4 – DanKook University

We strongly support including discussion on new PRS signal in the scope of the carrier phase positioning study.

We believe little can be achieved just by using Rel-17 PRS signal for achieving the goal of centimeter grade accuracy. The theoretical bound and experimental study showed that it is hard to achieve more than a meter accuracy using the Rel-17 PRS. Rather, PTRS type block signal may be appropriate because it is designed for phase tracking and good for applying the 'periodogram' style repetition method for improving SNR. We have mathematical, simulation, and field test results to present in the study to prove this argument. Therefore, a broad range of proposals on different approaches of signaling and phase measurement should be open and discussed during the study phase.

Further, we suggest deleting the limiting term 'only considered…' in the 3rd sub-bullet. It only suppresses innovative suggestions.

- Study (for study phase of 9 months and, if found beneficial, specify solutions for accuracy improvement based on NR carrier phase measurements [RAN1, RAN4, RAN2, RAN3]
  - Reference signals, physical layer measurements, physical layer procedures to enable positioning based on NR carrier phase measurements for both UE-based and UE-assisted positioning [RAN1]
  - Focus on reuse of existing PRS and SRS, with new reference signals ~~only considered~~ if found necessary
  - Signaling for configuration and measurement reporting [RAN2, RAN3]

5 – Nokia Denmark

We see NR carrier phase positioning as the top priority for positioning enhancement due to its unique ability to create new commercial value by bringing a step-change in accuracy, especially indoors

6 – CATT

In our view, NR carrier phase positioning is one of the most important objectives in Rel-18. We support the objective for carrier phase positioning in the draft SID.

Also, during the SI, RAN2 and RAN3 may not need to be involved in NR carrier phase positioning in our view.

7 – NTT DOCOMO INC.

We support the objective and slightly prefer vivo's updated one. Considering the current large scope, Rel-18 may be better to focus on reuse of existing PRS and SRS.

8 – Samsung R&D Institute UK

We suggest that NR carrier phase measurements can be studied both Uu and sidelink. For Uu positioning, the benefit from NR carrier phase measurements is not clear since LOS cannot be guaranteed in cellular communication environments.

We could add a note saying:

Note: carrier phase based method could apply to sidelink if found beneficial

9 – China Mobile E-Commerce Co.

We are supportive of this objective.

Regarding the reference signal part, we are open to include it. Note that using carrier phase measurement to improve the accuracy is insensitive to BW of the reference signals, and with the potential enhancement of reference signals, the solution may be reused by Redcap UE positioning, if needed.

10 – Deutsche Telekom AG

We support and see this important for deplyoment scenarios where improved pos is required (i.e. indoor industrial for example)

11 – Guangdong OPPO Mobile Telecom.

Considering the TU limited capability (i.e., 3TU), the current scope of R18 positioning is too large, and we suggest that this objective be down-scoped in order to keep a manageable SID based on the following reasons:

- There will be a large workload for NR carrier phase based positioning. Considering the limited TUs, it should be deprioritized.
- From R16/R17, there were some discussions on this feature. That is to say, it was already been discussed for at least two releases. However, no progress was achieved
- According to the evaluation of R16/R17, the bottlenecks of positioning accuracy are NLOS and timing error. But, NR carrier phase based positioning cannot address these bottlenecks. That is to say, the performance of carrier phase measurement in cellular system with rich multipath is not justified at all.

12 – Beijing Xiaomi Mobile Software

Based on the previous study, the carrier phase positioning will not achieve the high positioning accuracy in the NLOS environments, and there are two different objectives for improved positioning accuracy, moreover, the current scope is too large based on the limited TU, so we think the carrier phase positioning can be treated with low priority.

13 – Huawei Tech.(UK) Co.. Ltd

We suggest removing reference signaling design from the SID scope, given the limited TU and large scope. Only Rel-15/Rel-16/Rel-17 reference signals should be considered.

- ~~Reference signals,~~ physical layer measurements, physical layer procedures to enable positioning based on NR carrier phase measurements for both UE-based and UE-assisted positioning [RAN1]
- Focus on reuse of existing PRS and SRS~~, with new reference signals only considered if found necessary~~
- Signalling for configuration and measurement reporting [RAN2, RAN3]

14 – TELECOM ITALIA S.p.A.

We support this objective and think it is important in industrial applications (therefore also solving RedCap positioning).

Of course we need to take into account the impact on RAN4

15 – MediaTek Inc.

We think this is OK as a study objective, and for the study phase we would prefer to leave open the possibility of needing new reference signals (which of course would only be specified if found to be necessary).

16 – LG Electronics Inc.

We support NR carrier phase as the top priority for improved accuracy. Also, we support the objective for NR carrier phase in the draft SID.

17 – ROBERT BOSCH GmbH

We are supportive considering NR carrier phase positioning.

18 – TELEFONICA S.A.

We support carrier phase positioning to be part of Rel-18. Accuracy enhancements are required for indoor industrial scenarios

19 – New H3C Technologies Co.

We are supportive for this objective without any enhancement on reference signal.

20 – Locaila

We support studying new reference signal including PRS in the scope of NR carrier phase positioning.

We have a question for the companies (vivo, ZTE, Huawei..), whether they have any evidence that centimeter grade accuracy can be achieved by reusing the previous reference signals and they can submit the result in the study.

If so, that's good. However previous study showed that it is very unlikely to see improvement with current PRS design and the carrier phase method based on it.

We may need to explore new approach.

There is no harm to invite new ideas in the study phase.

The main purpose of the study is to use it for reference.

Carrier phase technique has already been accepted in the industry and commercial products are available in the market.

If there's any good idea for competing with existing products, why don't we learn a new idea?

21 – Intel Corporation (UK) Ltd

For the sake of scope reduction, it is recommended to preclude study on introduction of new reference signals for carrier phase measurements in Rel.18.

22 – Telia Company AB

We support NR carrier phase positioning objectives in the draft SID. NR carrier phase positioning should be integral part of Release 18 and especially due to future increased indoor location accuracy requirements such as industrial and factory use cases.

23 – Apple Benelux B.V.

As this has not been addressed in 3GPP up till now, before being introduced, the relative performance compared with the existing positioning schemes should be investigated in both LOS and NLOS environments. Unless there is a compelling reason to add this method, to reduce work-load consider down-selecting this objective. Removal of the new reference signals can also be considered.

24 – InterDigital France R&D

Our first preference is to remove this objective from the SID due to large coverage of the SID. Similar to OPPO, this study may require considerable amount of time for the study.

The second preference is to limit the scope of the study, i.e., no new design of RS is considered and we focus on the existing RS and the study focuses only on Uu positioning.

25 – Verizon UK Ltd

Supportive. We see accuracy enhancement as the top priority for R18. Among all techniques we think NR carrier phase positioning is the one most likely delivers the performance we have in mind. We need a step-change in accuracy as Nokia said, especially for IIOTs and indoors.

26 – TELENOR ASA

Several use cases would benefit from improved positioning accuracy. Hence we support NR carrier phase positioning.

27 – Motorola Mobility Germany GmbH

Lenovo, Motorola Mobility :

Our view is to deprioritize this objective for improved accuracy in Rel-18, considering the workload. PRS/SRS bandwidth aggregation can suffice with regard to the improved accuracy objectives.

28 – Qualcomm Incorporated

Even though NR carrier phase measurements are lower priority from our side, we can accept the package proposal for the "improved accuracy, integrity, power efficiency"

29 – VODAFONE Group Plc

Inline with other operators we support carrier phase positioning to be part of Rel-18. High accuracy enhancements are required for indoor industrial scenarios.

30 – SHARP Corporation

We support NR carrier phase for improved accuracy.

31 – Sony Europe B.V.

RAN1 has studied this topic during Rel-17 SI and the scope of Rel-18 is already too large.

We propose to down scoped this topic, so that we can spend more efforts in other areas (e.g. sidelink positioning).

32 – Orange

We support carrier phase positioning, improving positioning in industrial environment is requested by the market.

33 – Philips International B.V.

This could be part of a study to determine the potential accuracy benefits. Given the Line-of-Sight requirement and that it likely works best for short distances it may be useful to reduce the scope only to sidelink for initial study, if workload is an issue.

34 – Ericsson LM

The sub-objective "Signalling for configuration and measurement reporting [RAN2, RAN3]" is more appropriate for normative work and should be removed for the SI phase.

Feedback Form 12: LPHAP - Initial Round

1 – vivo Mobile Communication Co.

Fine with this part, with RAN2 leading the work.

2 – Futurewei Technologies

Support

3 – CATT

We are fine with the objective for LPHAP in the draft SID.

4 – CITC

We support the objective for LPHAP in the draft SID.

5 – Samsung R&D Institute UK

Just one question for clarification. How to define the power consumption evaluation methodology/scenario, together with the positioning requirement?

6 – Deutsche Telekom AG

Support but with lower prio (see our input above)

7 – Guangdong OPPO Mobile Telecom.

We are fine with the current version of this objective.

8 – ZTE Corporation

We are generally fine. But if some companies still have concern on workload or on vague scope for this item, we suggest limiting the potential LPHAP study or enhancement on RRC_INACTIVE and/or RRC_IDLE state

9 – Huawei Tech.(UK) Co.. Ltd

No need to have "if found beneficial", since the condition is the judgement based on outcome of the study. In addition, we think that the use case 6 in TS 22.104 could serve as the baseline for evaluation, and could help focus the work within the limited TUs available.

- Study the requirements on LPHAP as developed by SA1 and evaluate whether existing RAN functionality can support these power consumption and positioning requirements. Based on the evaluation, and~~, if found beneficial,~~ study potential enhancements to help address any limitations [RAN2, RAN1]
  - Note: Use case 6 of TS 22.104 is considered as the baseline use case for evaluation.

We would then suggest adding the details of use case 6 in the justification section. For the example, the justification for LPHAP can revised as below:

SA1 has introduced requirements for LPHAP (Low Power High Accuracy Positioning) for industrial IoT scenarios including use cases such as massive asset tracking, AGV tracking in industrial factory and person localization in danger zones. Requirements are for high accuracy, extreme low power consumption with battery life sustainable up to one or more years. A typical scenario of interest is use case 6 as defined TS 22.104, which corresponds to tracking of workpiece (in- and outdoor) in assembly area and warehouse with the target accuracy of <1m, the positioning interval of 15-30 seconds, and the battery life of 6-12 months. While Rel-17 NR positioning has introduced support for positioning in RRC_IDLE/INACTIVE states, there is a need to evaluate whether and how the current system allows LPHAP requirements to be met.

10 – Beijing Xiaomi Mobile Software

We are fine with the current version of the objective.

11 – MediaTek Inc.

We are in general OK with this objective. We understand that the "if found beneficial" condition was added to clarify that we do not pre-commit to pursue any enhancements; the evaluation may conclude that existing RAN functionality is adequate and nothing new needs to be worked on. Without this phrase, the wording seems to guide the WGs to study the potential enhancements unconditionally.

12 – New H3C Technologies Co.

we are fine with this objective.

13 – Intel Corporation (UK) Ltd

For the sake of scope reduction, it is recommended either to limit the scope to RAN2 led objective or even consider to down-scope LPHAP studies from Rel.18

14 – Telia Company AB

We see that this should be with lower priority compared to NR carrier phase positioning.

15 – InterDigital France R&D

Due to large scope of the SID, we have similar view as ZTE; focus on further enhancement on RRC IN-ACDTIVE *and* RRC IDLE state in the LPHAP study.

16 – Motorola Mobility Germany GmbH

Lenovo, Motorola Mobility :

Supportive of the updated LPHAP objective text with the focus on achieving high accuracy positioning and power efficiency in Rel-18. We are also fine if the enhancement considers RRC_INACTIVE positioning to narrow down the scope. Perhaps, this could be mentioned in the objective text as guidance.

17 – Qualcomm Incorporated

OK with the suggested objective and the modification shown in changemarks

18 – VODAFONE Group Plc

We are generally supportive of this objective.

19 – SHARP Corporation

We support the objective for LPHAP

20 – Sony Europe B.V.

We support the objective.

21 – Philips International B.V.

We agree with ZTE about RRCINACTIVE and RRC_IDLE

22 – Ericsson LM

There are 9 use cases captured in 22.104 for LPHAP. To shorten the study, we propose to at least shorten the list to something manageable, ideally pick a single use case.

4.2 Summary from Initial Round

Note that an overall summary addressing potential downscoping is provided at the end of this section

Summary for integrity

Samsung raised the question on what is the expected role of RAN1. The moderator understands that RAN1 will have a role in determining error sources. Error sources may arise from both physical layer and protocol layer considerations so it seems both RAN1 and RAN2 will need to be involved. The moderators thinks that it may be difficult to say that RAN1 and RAN2 is the lead group on this objective, and no change has been made.

The 'failure modes' has been removed (the moderator also does not understand what this refers to)

Summary for PRS/SRS aggregation

A large number of companies indicated support for this objective to be lead by RAN4, and a number of those suggested that RAN1 does not need to be involved in the study as they already studied in Rel-17. Only one company preferred to keep RAN1 as the lead group. The SID has been updated to make this a RAN4 objective.

One company (Samsung) raised the question whether this objective is applicable for Inactive as well as Connected. At least the moderator's assumption is that this would only be application for Connected as this is the only sate in which CA can be configured. This question will be asked to all as part of the Intermediate Round.

One company (Ericsson) suggested to limit the objective to contiguous carriers. This was proposed by the moderator in the last discussion but was not agreeable and so the change has not been include in the updated SID.

Summary for carrier phase

A number of companies made the suggestion that the scope could be reduce to some degree by limiting the study to the existing PRS/SRS only. At the same time a number of companies expressed the view that the existing RS will be very limiting to the performance of carrier phase positioning. The moderator proposed to discuss this potential scope reduction in the Tuesday GTW:

Proposal 1: Discuss whether the scope of the carrier phase study can be reduced by limiting the study to the existing PRS/SRS only

2 companies commented that the RAN2/3 objective is not necessary for the study item and this has been removed from the SID.

Summary for LPHAP

Huawei proposal to point out one specific use case in the justification text has been included. A question for the next phase is whether the study should focus on this use case only in order to help control the work.

Proposal 2: The study only focuses on use case 6 in TS 22.104 as a representative use case in order to limit the scope of the study

A few companies (ZTE, IDC, Moto, Philips) suggested to limit the scope to enhancements on RRC_INACTIVE and/or RRC_IDLE state. This question should also addressed in the next phase.

Proposal 3: The scope of the study is limited to enhancements on RRC_INACTIVE and/or RRC_IDLE state

One company (Huawei) suggested to remove the if found beneficial' and another company (MedtiaTek) prefer to keep it. This aspect was discussed last time and the phase to added to cover the possibility that the study could conclude that existing functionality is sufficient to mee the requirements. Therefore, this change has not been included in the updated SID.

Samsung questioned how to define evaluation methodology to consider power consumption and positioning. The moderator considers this is a valid question but more likely one that will have to be addressed in the study rather than in the SID.

Overall summary on Improved accuracy, integrity, and power efficiency

All of the 4 sub objectives have wide support, and they all have a few companies (at most 8 companies for any one item) proposing that the item should be removed or can be deprioritised. From the moderator point of view it is very difficult to propose one or more items to be a removed from the SI scope. Overall status and proposals to be discussed in Tuesday GTW:

- **Integrity**
  - No proposal for reducing the scope of this objective
- **PRS/SRS aggregation**
  - Study to be conducted in RAN4 only with no RAN1/2/3 work. [This had very wide support and so have been directly applied to the draft SID and is not a proposed to be discussed in the GTW]
- **Carrier phase**
  - **Proposal 1:** Discuss whether the scope of the carrier phase study can be reduced by limiting the study to the existing PRS/SRS only
  - Objective relating to RAN2/3 removed from the study [This been directly applied to the draft SID and is not a proposed to be discussed in the GTW]
- **LPHAP**
  - **Proposal 2:** The study only focuses on use case 6 in TS 22.104 as a representative use case in order to limit the scope of the study
  - **Proposal 3:** The scope of the study is limited to enhancements on RRC_INACTIVE and/or RRC_IDLE state

4.3 Intermediate Round

Improved accuracy, integrity, and power efficiency was not discussed during the Tuesday GTW. Therefore the 3 proposals from the Initial Round should be discussed during the Intermediate round. Further comments on the updates SID may also be provided.

Feedback Form 13: Integrity for RAT dependent positioning - Intermediate Round

1 – vivo Mobile Communication Co.

We would like to clarify that the whole item is led by RAN2 including both the first subbullet and the second subbullet.

RAN1 is crowded considering we add another bullet (bandwidth evaluation before RANP #97e) after first round of discussion. The RAN1 work of identification of error source should be started later after the RAN2 work started.

- Study solutions for Integrity for RAT dependent positioning techniques [RAN2, RAN1]:
  - Identify the error sources, ~~**[RAN1, RAN2]**~~.
  - Study methodologies, procedures, signalling, etc for determination of positioning integrity for both UE-based and UE-assisted positioning ~~**[RAN2, RAN1]**~~

2 – New H3C Technologies Co.

We suggest removing below PRS/SRS description because existing PRS and SRS will be used and new RS needn't be considered based on initial round discussion.

- Study solutions for accuracy improvement based on NR carrier phase measurements [RAN1, RAN4]
  - Reference signals, physical layer measurements, physical layer procedures to enable positioning based on NR carrier phase measurements for both UE-based and UE-assisted positioning [RAN1]
  - ~~Focus on reuse of existing PRS and SRS, with new reference signals only considered if found necessary~~

3 – New H3C Technologies Co.

We are fine with current description on Integrity for RAT dependent positioning

4 – China Mobile E-Commerce Co.

We are supportive of the current objective.

5 – ZTE Corporation

We are fine with the current objective, and also fine with vivo's suggestion.

6 – CATT

We are fine with the modified objective for integrity for RAT dependent positioning, although we consider the objective is of low priority for Rel-18.

7 – Swift Navigation

Further to the Phase 1 comments from Ericsson, AT&T, ESA and InterDigital we agree that the work already undertaken on RAT-Independent GNSS positioning integrity should be leveraged and extended to support RAT-Dependent integrity. We suggest a third sub-bullet could be added to the objectives to be more explicit and we propose the following (in **bold**):

- Identify the error sources [RAN1, RAN2].

- Study methodologies, procedures, signalling, etc for determination of positioning integrity for both UE-based and UE-assisted positioning [RAN2, RAN1]
- **Extend on the concepts and principles being developed for RAT-Independent GNSS positioning integrity**

8 – Huawei Tech.(UK) Co.. Ltd

We are ok with the modification from the moderator in v3 of the draft SID for the objective on Integrity for RAT dependent positioning.

9 – Beijing Xiaomi Mobile Software

We are fine with the objective in v3 of the draft WID.

10 – Intel Corporation (UK) Ltd

Comment from the moderator: Swift suggested to add a bullet to say " Extend on the concepts and principles being developed for RAT-Independent GNSS positioning integrity". To the moderator this seems like a reasonable aim although the wording would be more appropriate for a normative phase than a study. Instead I would suggest to include the text "Focus on reuse of concepts and principles being developed for RAT-Independent GNSS positioning integrity ".

It would be helpful if companies that are still to comment could provide their views on this addition. Thanks you.

11 – ROBERT BOSCH GmbH

We are supportive of the objective with respect to integrity. We also support the moderators comment above, adding the focus on reusing concepts developed for RAT-Independent GNSS pos. integrity.

12 – MediaTek Inc.

We think the structure of the integrity objective is basically OK, although we still have workload concerns. Two comments on specific points raised above:

- The identification of error sources **cannot start in RAN2, as already decided by RAN2 in Rel-17.** We understand the motivation to ease the load on RAN1, and we have some concern about this RAN1 work, but RAN1 is where the relevant expertise lives. If we want to do this work, RAN1 must accept the workload of identifying the error sources.
- We support the added text to focus on reuse of the principles from GNSS integrity. However, we think it codifies what the WGs would most likely do anyway–it doesn't cause a big reduction in work but just helps to clarify the direction.

Based on the experience in RAN2 with GNSS integrity, where there was significant GNSS expertise and prior work in integrity available to leverage, we think this objective will take a lot of discussion in the WGs.

13 – InterDigital France R&D

We are ok with the suggested text from the moderator, "Focus on reuse of concepts and principles being developed for RAT-Independent GNSS positioning integrity ".

14 – Guangdong OPPO Mobile Telecom.

We are fine with the current version of this objective.

15 – SHARP Corporation

We support the objective as found in V3

16 – Motorola Mobility Germany GmbH

Lenovo, Motorola Mobility :

Support

17 – Apple Benelux B.V.

We think the SID in its current form is too large and this is a good candidate for down-scoping

18 – Ericsson LM

Our view is that Rel 18 shall study and work on both RAT independent (GNSS) and RAT dependent integrity, both as natural extensions to Rel 17.

- For RAT independent integrity, the focus should be to study and work on OSR-based integrity leveraged from RTCM SC 134 work, and on GNSS local environment feared events (spoofing, jamming, multipath)
- For RAT dependent integrity, the focus should be to study and work on identifying error sources and characteristics, measurements, processes and assistance data

19 – Sony Europe B.V.

In rel-18, we should focus on integrity for RAT dependent. We are fine with the updated moderator's proposal (v3).

20 – Qualcomm Incorporated

We can accept the modified objective for integrity for RAT dependent positioning, although we consider the objective of low priority.

21 – AT&T GNS Belgium SPRL

Regarding the moderator's updated comments, given the framework and procedures that were created for GNSS positioning integrity in Rel-17, we should state that this will be re-used to the extent possible. The aim is to reduce the workload. This applies to integrity for both RAT-dependent and RAT-independent positioning methods.

22 – Deutsche Telekom AG

We support this

23 – Philips International B.V.

We agree with the current objectives in v3. It is important to consider the integrity of the RAT dependent positioning and improve the reliability of the position estimations. We are not against adding something about RAT-independent GNSS position integrity, however we think it would better to insert the words ”if possible”, e.g. ”Focus, if possible, on reuse of concepts and principles being developed for RAT-Independent GNSS positioning integrity”

24 – Intel Corporation (UK) Ltd

We are OK with proposed changes. We are also open postponing objective to Rel.19.

Feedback Form 14: PRS/SRS bandwidth aggregation - Intermediate Round

1 – vivo Mobile Communication Co.

We are fine with current formulation.

2 – New H3C Technologies Co.

We suggest removing below PRS/SRS description because existing PRS and SRS will be used and new RS needn’t be considered based on initial round discussion.

- Study solutions for accuracy improvement based on NR carrier phase measurements [RAN1, RAN4]
  - Reference signals, physical layer measurements, physical layer procedures to enable positioning based on NR carrier phase measurements for both UE-based and UE-assisted positioning [RAN1]
  - ~~Focus on reuse of existing PRS and SRS, with new reference signals only considered if found necessary~~

3 – New H3C Technologies Co.

We are fine with current description on PRS/SRS bandwidth aggregation

4 – China Mobile E-Commerce Co.

We support the study to be conducted in RAN4.

5 – NTT DOCOMO INC.

We are fine with the current objective.

6 – CATT

We are fine with the modified objective for positioning with PRS/SRS bandwidth aggregation.

7 – ZTE Corporation

We are fine with current formulation.

8 – Huawei Tech.(UK) Co.. Ltd

We support the modification from the moderator in v3 of the draft SID for the objective on PRS/SRS bandwidth aggregation.

To answer a point in the moderator's summary, in our view PRS/SRS aggregation is intended for connected mode UEs.

9 – Beijing Xiaomi Mobile Software

We are fine with the current objective.

10 – ROBERT BOSCH GmbH

We are fine with the current objective

11 – Samsung R&D Institute UK

We are O.K for RAN4 to lead this issue. However, we think that RAN1 study is necessary at least for PRS/SRS resource configuration and some other PHY layer procedure.

12 – MediaTek Inc.

We can accept this objective under RAN4 leadership.

13 – InterDigital France R&D

We are ok with the current objecdtive.

14 – Guangdong OPPO Mobile Telecom.

We support study this objective in RAN4 with the focus on feasibility.

However, RAN1 still needs to be involved. For example, RAN4 may give some input on the typical/recommended value(s) of timing difference between aggregated carriers, and then RAN1 evaluates the performance based on RAN4 input.

We are also fine with Ericsson's proposal on the contiguous carriers (if it can be agreed).

15 – SHARP Corporation

Support the objective and are ok with RAN4-led.

16 – Motorola Mobility Germany GmbH

Lenovo, Motorola Mobility :

We are fine to enable RAN4 to lead this work.

17 – Apple Benelux B.V.

We are fine with the objective

18 – Ericsson LM

To leave the PRS/SRS aggregation study to RAN4 only is fine with us.

19 – Sony Europe B.V.

We are fine this topic is to studied and led by RAN4.

20 – Telia Company AB

We are ok with this.

21 – Qualcomm Incorporated

As some other companies pointed out, we can accept that RAN4 leads this issue, however, RAN1 should still be kept in this bullet, as additional study may be needed (performance evaluation after RAN4 has provided some characterization of the timing/phase errors, how such a feature could be configured, etc). So we still think that RAN1 should be kept in the SI objective and not completely remove it.

22 – Deutsche Telekom AG

Move to RAN4

23 – Philips International B.V.

We are fine with current formulation in v3.

24 – Intel Corporation (UK) Ltd

We are supportive it as RAN4 led objective

Feedback Form 15: NR carrier phase - Intermediate Round

1 – vivo Mobile Communication Co.

Still prefer to delete the new RS part to make the work managable.

- Study solutions for accuracy improvement based on NR carrier phase measurements [RAN1, RAN4]
  - **~~Reference signals,~~** physical layer measurements, physical layer procedures to enable positioning based on NR carrier phase measurements for both UE-based and UE-assisted positioning [RAN1]
  - Focus on reuse of existing PRS and SRS**~~, with new reference signals only considered if found necessary~~**

2 – New H3C Technologies Co.

We suggest changing PRS/SRS description as below because existing PRS and SRS will be used and new RS needn't be considered based on initial round discussion.

- Study solutions for accuracy improvement based on NR carrier phase measurements [RAN1, RAN4]
  - ~~Reference signals,~~ physical layer measurements, physical layer procedures to enable positioning based on NR carrier phase measurements for both UE-based and UE-assisted positioning with reuse of existing PRS and SRS [RAN1]

- ~~Focus on reuse of existing PRS and SRS, with new reference signals only considered if found necessary~~

3 – China Mobile E-Commerce Co.

We understand the intention of reusing PRS/SRS to limit the workload. In our views, however, one advantage of carrier phase measurement is that it provides the possibility to improve the positioning accuracy irrespective of the BW of the reference signal. If the existing PRS/SRS is reused, large BW may still be required to obtain accurate estimation of integer multiple of propagation delay. That is the reason why we are open to include solutions of reference signals to achieve higher accuracy with limited BW, which can also be reused as the potential solution for Redcap UE positioning, and hence limit the workload from another perspective. During the study phase, if evaluation shows that existing PRS/SRS is enough, then we can preclude designing of new reference signals in the WI phase.

4 – LG Uplus

As China Mobile said, we also open to discuss new PRS/SRS in SI phase. Even though we understand the concern from workloads, it is too early to preclude new approach in SI as this part came somewhat stable until RAN94E.

5 – ETRI

We also have interest on carrier-phase positioning as a means to achieve improved accuracy, and we prefer to keep open the possibility of studying the new RS and its impact on performance. It may also be good to further clarify the intention of the ”existing PRS/SRS”, e.g., whether it means just RS pattern or whole resource configuration framework.

6 – CATT

We are fine with the modified objective for NR carrier phase positioning. We consider the objective has the highest priority for Rel-18.

7 – ZTE Corporation

We are fine with the current formulation, and can be also OK to not study new reference signal considering the workload

8 – DanKook University

We believe that the performance goal of centimeter-level accuracy cannot be achieved by simply reusing current PRS, SRS design. It is essential opening the discussion of this study to new approach if sufficient gain can be expected. The issue should be focused on how we can best utilize the carrier phase method in 3GPP system. We can provide initial evaluation result between different RS schemes. We may need to rethink the PRS design if there is clear advantage.

9 – Huawei Tech.(UK) Co.. Ltd

For proposal 1:

Proposal 1: Discuss whether the scope of the carrier phase study can be reduced by limiting the study to the existing PRS/SRS only

We prefer to reuse the existing RS, combined with the phase reporting for the first path, as discussed in Rel-17 (but not introduced). It can be proven theoretically equivalent to the carrier phase measurement, which has already been verified in the UL AoA positioning method. In UL AoA, the phase change between antenna elements can be used to estimate the UL AoA that utilizes the travelling distance difference between antenna elements at a TRP in terms of wavelength from a specific incident angle for a UE.

Even with the existing RS, there could be a lot of aspects to study, including how to overcome the real implementation limits of UE/gNB, how to resolve the integer ambiguity, etc.

Any new architectures for UE/gNB to support carrier phase based positioning that motivates a new reference signal design (e.g. using a separate PLL for reception of a time-contiguous sinusoid) should be verified by RAN4 first, and can be postponed to later releases.

We are fine to remove RAN2 and RAN3 from the involved WGs for this objective since those aspects only need to be dealt with in the subsequent WI phase.

10 – Beijing Xiaomi Mobile Software

We prefer to only study the existing PRS/SRS.

11 – Samsung R&D Institute UK

As commented by other companies in the previous discussion, carrier phase measurement was already been discussed for at least two releases (R16/R17) and no progress was achieved since the bottlenecks of positioning accuracy are NLOS and timing error. However, the carrier phase based positioning cannot address these bottlenecks.

As we suggested in the previous discussion, NR carrier phase measurements can be studied both Uu and sidelink. Does reusing the existing PRS/SRS mean that use of carrier phase measurements is excluded for sidelink? We think that the use of carrier phase measurements in sidelink can be beneficial than Uu.

If the carrier based positioning is only for Uu, we think that this should be deprioritized in the scope.

12 – KT Corp.

KT has strong concerns that reusing existing PRS/SRS would not give desired level of accuracy. Also strong advantage of NR carrier phase is that large BW is not required for the higher accuracy which cannot be achieved when existing PRS/SRS is reused. KT cannot accept limiting the scope to only reuse the existing PRS/SRS.

13 – MediaTek Inc.

We support this objective in the current form. We think impact to the RSs should not be excluded at this stage, though of course we may later decide to only reuse the existing RSs in normative work.

14 – Locaila

We support including a study on the new reference signal.

Reading the past discussion, we have a feeling that many companies actually talk about different TDoA, not the real carrier phase technique.

The key of the discussion should be focused on how we can deliver and measure fine-grain phase information.

PRS is designed for sample correlation method.

It is intrinsically a discrete time domain entity.

Whereas, phase is a continuous, frequency domain entity.

The accurate angular information can be better preserved when we use a continuous sinusoidal waveform. There is an appropriate form of symbol structure for this purpose, but PRS is never close to this shape.

If people want to stick to the past scheme, they are losing the real aspect of the carrier phase technique.

Little can be obtained in Rel-18 except for another TDoA.

15 – InterDigital France R&D

We support to limit the scope to existing RS to reduce workload. A way forward may be to come back in a future meeting for checking the status of the study. If the interim outcome of the study identifies a need for new RS, the SID can be modified to investigate the design of the new RS for phase-based measurements.

16 – Guangdong OPPO Mobile Telecom.

As we commented several times, we have some concern on NR carrier phase positioning due to the following reasons:

- There will be a large workload for NR carrier phase based positioning. Considering the limited TUs, it should be deprioritized.
- From R16, there were some discussions on this feature. That is to say, it was already been discussed for at least two releases. However, no progress was achieved. It does not make sense to repeat the discussion.
- The carrier phase positioning cannot provide better performance than the timing-based positioning methods which are already supported in NR in cellular systems with rich multipath. According the evaluation of R16/R17, the bottleneck of NR positioning accuracy is the NLOS and timing errors at both TRP/UE sides. But, NR carrier phase based positioning is not capable to address those bottlenecks. The performance of carrier phase measurement in cellular system with rich multipath is doubtable.

Thus, in order to keep a manageable scope for R18 positioning, NR carrier phase positioning should be removed.

17 – Motorola Mobility Germany GmbH

Lenovo, Motorola Mobility :

We are supportive to reduce the scope as a compromise for reduced workload, but as the moderator noted, the performance limitation of reusing PRS/SRS may not result in fully realizing the potential benefits of the feature. The motivation of such a study in the first place could be then questionable.

18 – Apple Benelux B.V.

Removal of RAN2/RAN3 objective in the updated proposal is fine with us. Also, removal of “reference signal” and the second bullet could help with the work-load issue.

19 – Ericsson LM

We are pro to proposal 1, limiting the study to the existing PRS/SRS only. We think carrier phase based positioning methods can effectively be introduced by adding phase reporting of paths/peaks as part of the current measurement reporting framework over LPP/NRPPa.

20 – Sony Europe B.V.

We still have a concern that the overall NR pos rel-18 scope is still relatively large and limited time unit. Our main preference is to deprioritize NR carrier phase topic. If studying this topic is still the way to go, we prefer to limit the scope, i.e., study NR carrier phase based on the existing PRS/SRS only.

21 – Qualcomm Incorporated

For Proposal 1: It can be acceptable as a way to reduce the workload, but we could be OK keeping the proposal of the SID as is.

22 – Verizon UK Ltd

We prefer keeping the SID as is. Worried about a half-baked solution when the majority of effort is already made. As a company thinking CJT, we think maybe in some controlled scenarios, synchronization and NLOS may not be blocking issues.

23 – Deutsche Telekom AG

This is one of the most interesting improvements, but if we are to restrcitive, we can not get the gains. Seeing the workload we think this is a candidate for removal but only if other lower prio work has been dropped (like some sidelink pos aspects commented early one) or power efficiency.

24 – Philips International B.V.

We are fine with the current formulation in v3, and would also be OK to not study new reference signal considering the workload

25 – VODAFONE Group Plc

We would prefer to included the study of new reference signals, but, we are open to phasing across releases if this is required for work load reasons.

26 – Intel Corporation (UK) Ltd

To reduce workload/scope we suggest limiting the study to existing reference signals.

Feedback Form 16: LPHAP - Intermediate Round

1 – vivo Mobile Communication Co.

Fine with current formulation.

2 – New H3C Technologies Co.

we are fine with current description.

3 – China Mobile E-Commerce Co.

We are fine to limit the use case and study scope.

4 – CATT

We are fine with the modified objective for LPHAP.

5 – ZTE Corporation

The current scope is too broad, we suggest limiting the potential LPHAP study or enhancement on RRCINACTIVE and/or RRCIDLE state. Otherwise, it will cause a lot of diverse discussion since any kind of components/signaling/procedures can impact power consumption.

6 – CITC

We are supportive of current proposals for LPHAP.

7 – Huawei Tech.(UK) Co.. Ltd

We are fine with the two proposals for the purpose of word load reduction.

Proposal 2: The study only focuses on use case 6 in TS 22.104 as a representative use case in order to limit the scope of the study

Proposal 3: The scope of the study is limited to enhancements on RRC*INACTIVE and/or RRC*IDLE state

8 – Beijing Xiaomi Mobile Software

We support current objective.

9 – Intel Corporation (UK) Ltd

Comment from the moderator: So far several companies have just indicated 'OK' to the current wording of the objective without giving an explicit response to the 2 proposals from the Initial Round. It is difficult for the moderator to assess whether this means they take a don't care position on the 2 proposals, or whether they have a strong view to keep the current wording. It would be helpful to the moderator if companies could give clear views on the 2 proposals. Thank you.

10 – Beijing Xiaomi Mobile Software

We also support the moderator's proposals.

11 – Samsung R&D Institute UK

Proposal 2 below is O.K. However, Proposal 3 seems unnecessary because the target device may not be a UE in inactive and idle state.

Proposal 2: The study only focuses on use case 6 in TS 22.104 as a representative use case in order to limit the scope of the study

Proposal 3: The scope of the study is limited to enhancements on RRC*INACTIVE and/or RRC*IDLE state

12 – MediaTek Inc.

We support the two proposals.

13 – ZTE Corporation

@Samsung, for proposal 3, the motivation is to reduce power consumption to which the most cases are for UEs in RRC inactive or idle. In our view, at least some potential enhancement for UE in RRC inactive state, e.g. MT-LR should be supported in Rel-18. What kind of potential solutios are in your mind for UEs in RRC connected state since you don't support the proposal 3.

14 – InterDigital France R&D

We support the moderator's proposals below.

Proposal 2: The study only focuses on use case 6 in TS 22.104 as a representative use case in order to limit the scope of the study

Proposal 3: The scope of the study is limited to enhancements on RRC*INACTIVE and/or RRC*IDLE state

15 – SHARP Corporation

We support Proposal 2 and Proposal 3 as provided by the moderator.

16 – Motorola Mobility Germany GmbH

Lenovo, Motorola Mobility :

We are fine to support the Moderator's Proposal 2 and 3 relating to LPHAP.

17 – CATT

We also support Proposal 2 and Proposal 3 as provided by the moderator.

18 – Apple Benelux B.V.

We are fine with the objective overall. However, although there is a discussion on limiting the use case in the justification section, it is not captured in the objective. The limitation should be reflected in the objective.

19 – Ericsson LM

We are supportive of proposal 2, to focus on use case 6 in TS 22.104 as a representative use case in order to limit the scope of the study. As a consequence, we also think the LPHAP study could be limited to RAN2

20 – Sony Europe B.V.

We are fine with the updated moderator's proposal.

21 – Qualcomm Incorporated

For Proposal 2: We don't see the necessity to focus on a single use-case and we prefer to not limit the scope for that only usecase.

For Proposal 3: We prefer to not limit the scope of the study to RRC-Inactive/RRC-Idle only.

22 – Deutsche Telekom AG Interesting, but very low priority for us compared to other parts of this work item
23 – Nokia Denmark For proposal 2, it is not clear yet that use case 6 is the primary one to focus on. At most, it is one example. The selection of appropriate use case(s) needs to be checked in the study. For proposal 3, we are OK to focus on Idle and Inactive.
24 – Philips International B.V. For release 18, we are ok with both proposals to reduce the scope proposed by the moderator
25 – Intel Corporation (UK) Ltd We think that scope can be limited to RAN2 objective only (i.e., RAN1 can be removed together with power consumption studies). We are supportive of moderator's Proposal #3: "The scope of the study is limited to enhancements on RRC_INACTIVE and/or RRC_IDLE state"

4.4 Summary from Intermediate Round

Summary for integrity

Most companies find the current wording of the objectives acceptable.

There were some comments about the role of RAN1 in this work. It seems clear that RAN1 need to be involved in the identification of error sources (first bullet). To the moderator it is not fully clear whether RAN1 needs to be involved in the second bullet and they have been removed in the updated SID text. Hopefully this is acceptable.

Regarding the proposal from Swift to focus on reuse of concepts from the Rel-17 Integrity work, this received support from a number of companies. To the moderator this seems like a reasonable aim and so the text has been included in the updated SID.

Summary for PRS/SRS aggregation

The objective wording seems to be very widely supported or at least accepted. 3 companies (OPPO, Samsung, Qualcomm) has the view that some RAN1 involvement may still be required in the study. Based on these responses no change has been made to this objective in the updated SID.

Summary on carrier phase

Differing views were expressed regarding proposal 1 on limiting the scope to existing RS only. The proposal to limit to existing RS is to help manage workload and some companies are of the view that existing RS can be suitable. The concerns with this approach are that it might severely limit the positioning accuracy achievable. Based on the comments received the moderator's view is that we do not have the confidence that existing RS are sufficient for carrier phase based positioning and hence it would be reasonable not to exclude it from the study at this time. Note that there is already a statement that reuse of existing RS is the focus and hence there will be a high bar on introducing any new RS. Based on these responses no change has been made to this objective in the updated SID.

In response to Samsung's comment, the current wording of the carrier phase study does not preclude sidelink. However, it would be natural to assume that the study would start from and focus on Uu, given that the study on sidelink based positioning would be happening in parallel.

Summary for LPHAP

Both proposal 2 and 3 received widespread support and have been included on the updated SID text.

One company did not want to limit to a single use case and another company wanted the study to be able to consider whether use case 6 is the most appropriate one. One possibility is to add a note to the text to say that the selected use case can be checked during the early phase of the study, but this has not yet been included in the text.

Only one company expressed the view that the study should not be limited to Idle/Inactive

2 companies proposed that the study could be limited to RAN2. Looking at the current objective, the moderator thinks that it would be reasonable for this study to be done solely by RAN2. Hence RAN1 has been removed from the updated SID text.

4.5 Final Round

While acknowledging that not every company will be completely happy with the current objectives for "Improved accuracy, integrity, and power efficiency", the moderator considers that the text should now be quite stable. At this stage, significant changes to the objectives are not likely to be agreeable without very wide support - companies are recommended to avoid repetition of such proposals made in previous rounds.

Companies may provide any final comments to the updated SID text.

Feedback Form 17: Improved accuracy, integrity, and power efficiency - Final Round

1 – ROBERT BOSCH GmbH
we are ok with the objective text wrt. "Improved accuracy, integrity, and power efficiency"
2 – Huawei Tech.(UK) Co.. Ltd
For LPHAP, we have two additional comments: 1. RAN1 should be added as responsible WG, since RAN2 have never evaluated UE battery life, for which evaluations have always been done by RAN1 in past studies. Evaluations of positioning accuracy are also conducted by RAN1. The combination of the two needs to be evaluated by RAN1. We do not understand the assessment by the moderator that RAN1 does not need to be involved in this study objective. How would RAN2 assess the battery life achieved by the UE? 2. TS 22.10 should be corrected to TS 22.104 in the use case subbullet.
3 – vivo Mobile Communication Co.
Considering the evaluation work in RAN1 at the beginning of Rel-18 is compelling, and also consider the whole work is led by RAN2, we would like to confirm the understanding that the RAN1 work starts after RANP #96e or later.

- Study solutions for Integrity for RAT dependent positioning techniques [RAN2, RAN1]:
  - Identify the error sources, [RAN1, RAN2].
  - Study methodologies, procedures, signalling, etc for determination of positioning integrity for both UE-based and UE-assisted positioning [RAN2]
  - Focus on reuse of concepts and principles being developed for RAT-Independent GNSS positioning integrity
  - **RAN1 work starts after RANP #96e or later.**

4 – Nokia Denmark

We agree with Huawei that RAN1 needs to be involved.

We do think that an initial consideration of the use case should be performed, as it is not fully clear why this particular use case is the most suitable to focus on out of the nine listed in 22.104. Note also that there is a missing "4" in the TS number.

5 – Samsung R&D Institute UK

For LPHAP, we think RAN1 should be kept. In our understanding, most companies were fine with previous round of discussion which RAN1 is included. In the intermediate round summary, there is only one company comment for this, at the very last comment. We don't think it's fair to remove RAN1.

Technically, although the detail evaluation and solutions are not determined yet, subject to the actual study.No matter it is resource configuration change, or power control change, it will be all related to RAN1 in our understanding.

6 – Beijing Xiaomi Mobile Software

We are fine with the current objective.

7 – LG Uplus

Thanks for leading the discussion. Most of the parts are fine and it seems reasonable to consider RAN1 for LPHAP as companies indicated.

8 – InterDigital France R&D

We support the moderator's version of the objective.

9 – ZTE Corporation

We support the current objective.

10 – AT&T GNS Belgium SPRL

We are fine with the moderator's objectives. Thank you for the efforts.

11 – Motorola Mobility Germany GmbH

Lenovo, Motorola Mobility :

Supportive of the current objective text on improved accuracy, integrity, and power efficiency.

- However, according to the objectives on carrier phase positioning, it is still unclear what RAN4's contribution will entail, e.g., test cases, performance and measurement requirements? (In other objectives, we already clearly defined the role of each WG, with the exception of RAN4 in this particular objective).
- On LPHAP, we share Huawei's' view and are wondering if RAN1 is rather best suited to perform the power consumption evaluations. It is also unclear on what basis will RAN2 perform the stated evaluation in the objective text, e.g., will it be an analytical or simulation-based evaluation (which may be highly unlikely)? We would still prefer to keep RAN1 involvement as a supporting WG.

12 – Qualcomm Incorporated

On PRS/SRS Aggregation:

· We think that RAN1 involvement is required in the study for the reasons already described. During the Rel-17 SI, RAN1 only performed some evaluations, without considering PRS/SRS resource configuration, procedures, and without considering common values on the RF timing/phase misalignments. For example, if RAN4 progresses in the study, and determines that X nsec across-CC timing misalignment is feasible, how would 3GPP conclude that this feature results to accuracy enhancements without positioning-level simulations? RAN1 is the WG that performs such positioning-level simulations and RAN1 would need to incorporate in the study item conclusions the positioning accuracy achieved with those values of timing/phase errors.

On LPHAP:

- We disagree that only RAN2 should be involved. Power consumption analysis & evaluation can happen in RAN1, as it was the case of other Power SI/WIs; as it was the case in the previous release (RAN1 was the WG that did the preliminary evaluation of power consumption during Rel-17). RAN1 should be kept in the objective.
- We still disagree to limit the scope to a single use-case. How would limiting to this specific use-case reduce the study scope? We suggest to only keep in the justification that "use case 6" is a typical example of interest, and to not limit the study on the single usecase in the SID objectives.

13 – CATT

We support the moderator's version of the objectives.

14 – Sony Europe B.V.

We support the updated moderator's proposal (v4). It seems there is a typo/incomplete text in v4, LPHAP section. The spec should be TS 22.104.

15 – VODAFONE Group Plc

thanks, happy with the moderator's proposal for this objective

16 – Verizon UK Ltd

We are supportve of the updated proposal.

17 – Intel Corporation (UK) Ltd

We are fine with the latest update. Minor editorial suggestions from our side for integrity part:

”~~Focus on~~ **Strive to** reuse ~~of~~ concepts and principles being developed for RAT-Independent GNSS positioning integrity**, where it is possible/applicable**”

18 – Apple Benelux B.V.

We welcome the added focus/limitations in the integrity and LPHAP objectives and have no further comments on the PRS/SRS aggregation and NR carrier phase objectives.

19 – Philips International B.V.

We still would prefer to insert the words ”if possible” in the sentence about reuse of GNSS positioning integrity, e.g. ”Focus, if possible, on reuse of concepts and principles being developed for RAT-Independent GNSS positioning integrity”, but if no-one else supports it, then we are ok to let it go.

20 – Ericsson LM

We are fine with the latest update

21 – Nokia Denmark

We believe the option is to keep RAN1 if the evaluations needs to assess accuracy and power consumption requirements.

4.6 Summary from Final Round

Several companies commented that RAN1 should be involved in the LPHAP study and this has been added back.

Nokia and Qualcomm commented on the single use case for LPHAP. This has not been removed but a sentence has been added to allow the choice of the case to be reviewed. To the moderator, this seems reasonable as the choice of use case has not been discussed in any detail during our discussions.

Intel, Philips both proposed slight rewording of the note on reuse of existing principles. Trying to keep the changes as minimal as possible, this has been addressed by adding a ’where possible’ at the end of the sentence,

Lenovo made the observation that the RAN4 role in the carrier phase objective has not been explicitly described. This is true and the RAN4 role has not been discussed so far. Given the lack of discussion so far the moderator’s proposal is to remove RAN4, and companies can consider whether a SID update may be needed in future.

Vivo suggested to add ” RAN1 work starts after RANP #96e or later” to the integrity objective. This has not been added as no other company raised the necessity of this. Hopefully this can be managed by the good coordination of the WI rapporteur and WG chairs.

Several other comments were received from a single company, many of which were repeat comments from the previous rounds. No changes have been made to the updated SID for these comments.

5 Positioning support for RedCap UEs

5.1 Initial Round

Companies are asked to provide comments and suggestions to the objectives on Positioning support for RedCap UEs

Feedback Form 18: RedCap positioning - Initial Round

1 – vivo Mobile Communication Co.

Considering the large amount of evaluation work in RAN1, it should start later than other work. RAN4 could start the work first as the leading WG.

2 – Futurewei Technologies

Support. Also ok if RAN4 leads this

3 – CATT

There is no need to include RedCap positioning in the SI in our view. RedCap positioning can be included directly in WI.

In the proposed WID objective, both RAN1 and RAN4 works on the evaluate positioning performance of existing positioning procedures and measurements with RedCap UEs.The duplication seems to be unnecessary. In our understanding, RAN4 needs always to go through the simulation evaluation procedure when defining the performance requirements for positioning measurements, thus it seems there is no need for RAN1 to be involved in the simulation evaluation. Thus, we suggest that RedCap positioning can be handled by RAN2 and RAN4. RAN1 does not need to be involved.

The updated objectives from us as follows,

- *Positioning support for RedCap UEs, considering the following:*
  - *Evaluate positioning performance of existing positioning procedures and measurements with RedCap UEs[~~RAN1,~~ RAN4]*
  - *Based on the evaluation, assess the necessity of enhancements and, if needed, identify enhancements to help address limitations associated with RedCap UEs [~~RAN1,~~ RAN2]*
  - *~~Define core and performance requirements for positioning measurements performed by RedCap UEs [RAN4]~~*

4 – NTT DOCOMO INC.

Assuming WI part will be discussed further after this SI is completed, we are fine with the current text including first and second sub-bullets.

5 – Samsung R&D Institute UK

We want to make clear for the below. What is the RAN1 and RAN4 role for evaluating the performance?

- Evaluate positioning performance of existing positioning procedures and measurements with RedCap UEs[RAN1, RAN4]

In addition, target requirements and specification impacts for RedCap positioning are not clear. In this situation, how can we decide the necessity of enhancement?

Also, we need to make clear that RedCap UE is for Rel-17 and not for Rel-18.

6 – Guangdong OPPO Mobile Telecom.

Positioning is an important feature for RedCap UEs and the typical scenarios. We support the objective and are fine with the current version.

7 – China Mobile E-Commerce Co.

We share similar views as vivo and CATT that the current scope is far beyond what we can handle within 3 TUs. As we commented under carrier phase section, since some potential solutions can be reused, at least the RAN1 work of the second bullet can be postponed at this stage.

8 – Deutsche Telekom AG

We are not clear what is specific for REDCAP .. if it is onyl the CBW supported, then the limited devices will have limited accurary. We do not see that we should develop something specific for REDCAP in contrast to reuse what is defined for other devices. Most be clarified what the aim on this is ...

9 – ZTE Corporation

We also think it is unnecessary to let both RAN4 and RAN1 involve the simulation. Perhaps, RAN4 can define the requirement first, then RAN1 can do simulation and check if some enhancements are needed.

10 – Huawei Tech.(UK) Co.. Ltd

We think that RedCap positioning could be carried out directly as a WI without study phase. According to the email discussion of [RAN94e-R18Prep-06], the objective of RedCap positioning is quite clear and specific, which is suitable to be handled as a work item. However, if the whole item is a study item, then it is fine to progress on the RedCap solutions as part of the study first.

11 – Beijing Xiaomi Mobile Software

For the simulation, both RAN1 and RAN4 should be involved and the Redcap positioning accuracy can be evaluated. So we support the current version of the objective.

12 – TELECOM ITALIA S.p.A.

several comments:

- we share the concern of DT: why need to develop something specific, therefore further fragmenting the market and increasing costs
- why the duplication of simulation work in RAN1 and RAN4?

as a general statement, we suggest to drop this objective and reuse techniques already defined by 3GPP for other types of devices

13 – MediaTek Inc.

The evaluation phase is OK to pursue, but we should not commit now to working on further enhancements. With the concerns about the size of the WI, we should only go on to work on enhancements if it is clear from the evaluation that they are really necessary, and we can consider the scale of further work after the evaluation results are in.

14 – LG Electronics Inc.

We support RedCap positioning, also we are fine if RAN4 leads this.

15 – New H3C Technologies Co.

The motivation of enhancement on redcap UE isn't clear and first of all, the proponent need clarify it.

16 – Intel Corporation (UK) Ltd

We are OK with the current objective. RAN1 has already provided a lot of NR positioning studies and the objective on RedCap enhancements does not seem to require significant extra efforts

17 – Telia Company AB

We agree with DT and TIM on the question raised developing something specific for RedCap devices and so fragmenting the market.

We agree also with dropping the objective specifically for RedCap devices.

18 – Verizon UK Ltd

We support RedCap positioning and are fine with objective. We want the performance of positioning of RedCap UEs to be on par with that regular NR UEs in terms of accuracy, latency, power consumption.... and everything. With the limitations of RedCap, do we know now for certain if it is the case? If yes, we can drop the objective. Otherwise, we should keep it.

Also we don't know the result of the study enough now to see it as something that will fragment the market. We can discuss the factor after the evaluation when the candidate techniques have been identified.

19 – Apple Benelux B.V.

We are fine RedCap positioning starting as a study item. We think that there needs to be a discussion on whether there are different performance requirements for RedCap UEs and if so, what they are before the evaluation phase by RAN1/RAN4. On the issue of down-scoping, we prefer setting the objectives in the Improved accuracy, integrity, and power efficiency section as lower priority to this objective.

20 – Motorola Mobility Germany GmbH

Lenovo, Motorola Mobility :

Generally fine with the updated RedCap positioning objective text.

21 – Qualcomm Incorporated

OK with the objective

22 – VODAFONE Group Plc We are supportive of indoor positioning for RedCap devices - but I will leave other companies to debate what work is needed to deliver this in rel 18.
23 – Sony Europe B.V. Support and it should be RAN1-led as we need to investigate positioning enhancement techniques.
24 – Philips International B.V. We support redcap positioning, but agree with CATT's proposal to clarify the subbullets.

5.2 Summary from Initial Round

Quite diverse comments were received which is surprising when the objectives seemed quite stable after the last discussion.

A number of companies commented about the need to clarify the roles of RAN1 and RAN4, and different views were expressed about whether RAN1 or RAN4 should be the lead group. Based on previous discussions, the moderator understands that RAN4 are the group responsible for measurement accuracy but they do not have simulation capability to evaluate positioning performance. Therefore, for the first bullet, the moderator's understanding is that RAN4 needs to evaluate measurement accuracy based on the BW limitations of RedCap UEs, and RAN1 needs to evaluate the impact of the measurement accuracy to the positioning performance. This has been reflected in the SID as follows:

- Evaluate positioning performance of existing positioning procedures and measurements with RedCap UEs[RAN1, RAN4]
    - Evaluate measurement accuracy achievable with RedCap UEs [RAN4]
    - Evaluate impact of measurement accuracy to the positioning performance [RAN1]

Regarding the second bullet, a number of companies suggest to not consider any enhancements for RedCap UEs to improve their positioning performance - the consequence would be that the positioning performance will just be what it is given the reduced measurement accuracy. The moderator acknowledges that this would also remove some workload from RAN1 and enable the work to be fully within RAN4 domain. This possibility has been discussed in previous discussions and up to now has not been acceptable. No change has been made to this objective in the SID text, but other companies can comment in the Intermediate Round whether this would be acceptable.

Samsung asked how it will be possible to decide the necessity of enhancements given that there are no positioning requirements specific to RedCap UEs. This was discussed during the last discussion and the moderator understands that the decision on enhancements will be a subjective assessment given that accuracy that might achieved with and without the enhancement, rather than a hard decision based on whether requirements can be met. No change has been made to this objective in the SID text.

5.3 Intermediate Round

Companies are asked to provide comments and suggestions to the updated objectives. Companies can also comment on whether keep the objective to study enhancements.

Feedback Form 19: RedCap positioning - Intermediate Round

1 – vivo Mobile Communication Co.

From work load management perspective, we prefer RAN4 to lead the Redcap work. The RAN1 part should be started after RAN4 starts.

Also in the main bullet the support should be deleted to make the description neutral.

Positioning ~~**support**~~ for RedCap UEs, considering the following:

- Evaluate positioning performance of existing positioning procedures and measurements with RedCap UEs[~~**RAN1,**~~ RAN4**, RAN1**]
  - Evaluate measurement accuracy achievable by RedCap UEs [RAN4]
  - Evaluate impact of measurement accuracy to the positioning performance [RAN1]

2 – New H3C Technologies Co.

we are fine with current description with VIVO's modification

3 – China Mobile E-Commerce Co.

We share similar views as vivo on the leading WG and working timeline of RAN1 part, and fine with the modification.

Regarding the original 2nd bullet, we share different understandings as the moderator. We believe that if performance gap if identified, solutions such as carrier phase measurement under improved accuracy, integrity, and power efficiency objective, which is insensitive to the BW can be reused as the solution for Redcap UE positioning as well, and therefore, we prefer not to include the original 2nd bullet at the current stage.

4 – TELECOM ITALIA S.p.A.

In our opinion the objective could be dropped.

Said that, we think the proposal is a possible way forward, but it presents some major concerns:

- RAN4 is overloaded
- RAN4 will be heavily involved in Rel 17 completion formally until Dec. 2022 (RAN#98), practically much longer

I am not sure RAN4 will be able to work on the topic during the study phase of this activity.

In general stating that RAN1 is overloaded and moving the work to a group much more overloaded is nonsense, sorry.

5 – CATT

We share the similar view as the Moderator that RAN4 is that RAN4 is the group responsible for measurement accuracy requirements. In addition, we may not have to go thought system simulation on positioning performance first before considering potential positioning enhancements for RedCap UEs, since the measurement accuracy is directly related to the positioning accuracy. Thus, our suggestion is that RAN4 to evaluate measurement accuracy requirements first, and then based on the evaluation, consider the necessity of enhancements.

Suggested changes:

Positioning support for RedCap UEs, considering the following:

- Evaluate positioning performance of existing positioning procedures and measurements with RedCap UEs[~~RAN1,~~ RAN4]
  - Evaluate measurement accuracy achievable by RedCap UEs [RAN4]
  - ~~Evaluate impact of measurement accuracy to the positioning performance [RAN1]~~
- Based on the evaluation, assess the necessity of enhancements and, if needed, identify enhancements to help address limitations associated with for RedCap UEs [RAN1, RAN2]

6 – ZTE Corporation

To be honest, we don't see much difference between the follow bullets at least from the wording it self. We think RAN4 may not need to do any simulation, the job of RAN4 is to define the accuracy requirement as CATT mentioned. Here is our suggestion

- ~~Evaluate~~ **Define** measurement accuracy **requirement** ~~achievable by~~ **for** RedCap UEs [RAN4]
- Evaluate impact of measurement accuracy to the positioning performance [RAN1]

7 – Huawei Tech.(UK) Co.. Ltd

We don't support removing the objective to identify positioning enhancements for RedCap positioning, and support to keep it as in the revised draft WID (the second bullet), as discussed in previous discussion and supported by a lot of companies.

We are fine with the additional 2 sub-bullets proposed by the moderator.

8 – Beijing Xiaomi Mobile Software

We are fine with the current objective.

9 – Samsung R&D Institute UK

Thanks for the moderator's feedback below.

the decision on enhancements will be a subjective assessment given that accuracy that might achieved with and without the enhancement, rather than a hard decision based on whether requirements can be met.

However, we still think that without clear target requirements for RedCap positioning, this may not be a meaningful work. Since this is not clear and considering work load, we think that this should be deprioritized in the scope.

10 – MediaTek Inc.

We are OK in principle with the evaluation, and we agree with other companies that it should be led by RAN4. We see this objective as a lower priority on the whole, and if the RAN4 work is a big concern we could consider deprioritising it.

11 – Guangdong OPPO Mobile Telecom.

We are fine with the objective

12 – Nokia Denmark

We are fine with the objective

13 – LG Electronics Inc.

We are fine with the objective.

14 – Motorola Mobility Germany GmbH

Lenovo, Motorola Mobility :

We are supportive to commence RAN1 work contingent on the outcome RAN4's measurement accuracy evaluation. We are wondering if the description needs to include RAN4 checkpoints as notes to serve as further guidance.

15 – Apple Benelux B.V.

We are overall fine with the objective and are fine with Vivo's update. Also, there is a need to identify the measurement accuracy then investigate the impact and RAN1 may have to start after RAN4.

16 – Ericsson LM

We support the proposed wording in the SID.

We agree with the moderator that decisions on enhancements will have to be subjective assessments, rather than hard decisions based on whether requirements can be met. RedCap UEs are supposed to be low cost and low complexity and thus, performance will have to be balanced versus cost and complexity. There exist potential use cases with a large range of requirement levels. It will be possible to support some but not all of these use cases at reasonable cost and complexity.

One related aspect of low cost and low complexity devices is to extend the current Bluetooth support in 3GPP LPP with the AoA/AoD parts recently introduced in Bluetooth v 5.1. This implies minor 3GPP LPP enhancements by RAN2.

17 – Sony Europe B.V.

We support the updated proposal (v3). We don't agree with the suggestion(by a/some company(s) to remove the objective to identify positioning enhancements.

18 – Qualcomm Incorporated

We are OK with the split of workload between RAN1, RAN4 that is proposed by the moderator.

However, it is not acceptable to us to remove the bullet on identifying potential enhancements for redcap UEs: It is a study phase, and the evaluation could also lead to a set of enhancements that may be important to be considered during the work phase.

19 – Verizon UK Ltd

No strong opinion on how to study and workload split etc but we perfer to the end, we can make RedCap positioning performance at the same level with regular UE's, maybe with some reasonable "cost" of network resoruce (prefer not of course).

20 – Deutsche Telekom AG

As in the initila round: no need for something specfic .. should be dropped from Rel-18 in the interest of workload !

21 – Philips International B.V.

We are fine with the formulation in v3.

22 – Intel Corporation (UK) Ltd

We propose the following changes:

- RedCap UEs[RAN1, ~~RAN4~~]
  - ~~Evaluate measurement accuracy achievable with RedCap UEs [RAN4]~~
  - ~~Evaluate impact of measurement accuracy to the positioning performance [RAN1]~~
  - Evaluate potential enhancements for RedCap UEs in terms of NR positioning accuracy improvement [RAN1]"

We believe that study on potential enhancements for RedCap UEs, justify RAN1 as a leading WG. RAN4 objectives can be added during WI stage once RAN1 concludes on potential enhancements.

5.4 Summary from Intermediate Round

Majority of companies are OK with the current wording of the objectives. The proposal to remove the sub objective on RAN1 to evaluate enhancements was not widely supported and no change has been made in this respect.

There were come comments that the WG leadership should be RAN4 and one proposal that the RAN4 sub bullet could be completely removed. The moderator's understanding is that RAN1 work is clearly the largest part of this study, particularly as the sub bullet on enhancements is remaining in the SID, and hence it makes sense for RAN1 to be the lead group. Furthermore, the initial RAN4 work to evaluate measurement accuracy achievable by RedCap UEs should be a relative small task, so the overall RAN4 workload from this study should be low. Obviously in the follow on normative WI, the RAN4 task will be larger.

CATT suggest that the second sub bullet can be removed as RAN1 might not need to do simulation to determine the positioning accuracy. Moderator's view is that it is better to include this. If RAN1 can do the evaluation without any new simulation effort then this is of course OK.

ZTE suggested to reword the RAN4 work to 'define requirements'. The moderator thinks this is not an appropriate objective for a SI. If there is the possibility for enhancements then it doesn't make sense for RAN4 to define requirements until any Rel-18 enhancements are defined. Hence ,for the study, only an initiate assessment of measurement accuracy is needed.

No changes have been made to the RedCap objectives in the updated SID.

5.5 Final Round

While acknowledging that not every company will be completely happy with the current objectives for RedCap positioning, the moderator considers that the text should now be quite stable. At this stage, significant changes to the objectives are not likely to be agreeable without very wide support and companies are recommended to avoid repetition of such proposals made in previous rounds.

Companies may provide any final comments to the updated SID text.

Feedback Form 20: RedCap positioning - Final Round

1 – CMDI

For objective "Based on the evaluation, assess the necessity of enhancements and, if needed, identify enhancements to help address limitations associated with for RedCap UEs [RAN1, RAN2]", it is better and proposed to note that the onging study for improved accuracy in in parallel in this R18 SID should be taken into account for evaluation.

2 – New H3C Technologies Co.

We are fine with the updated SID.

Please include H3C in the list of supporting IM.

3 – vivo Mobile Communication Co.

We prefer a staggered start of evaluation work in RAN1 otherwise it would be challegening for RAN1 research resources to provide sufficient evalution results. For Redcap related evaluation we prefer to start after RANP #96e or later.

- Positioning support for RedCap UEs, considering the following:
  - Evaluate positioning performance of existing positioning procedures and measurements with RedCap UEs[RAN1, RAN4]
    - Evaluate measurement accuracy achievable by RedCap UEs [RAN4]
    - Evaluate impact of measurement accuracy to the positioning performance [RAN1]
    - **RAN1 work starts after RANP #96e or later.**

4 – Samsung R&D Institute UK

First of all, thank you very much for moderator's great efforts on this issue and we would like to emphasize that our intention is to make WID more clear in order that the work scope is manageable. Also, we have understood that main purpose of this email discussion is to achieve it.

From this point of view, we are still not clear about moderator's assessment regarding "the decision on enhancements will be a subjective assessment given that accuracy that might achieved with and without the enhancement, rather than a hard decision based on whether requirements can be met.", because it is highly possible that different proposals from different companies can provide different level of accuracy improvement and different level of specification impact. In such a case, we are afraid that many proposals will be on the table and we have to spend lots of time to select some of them, which will increase workload unnecessarily. So, we would like to hear moderator's opinion on this.

In addition, for the below two bullets, does this mean the parallel evaluation work both in RAN4 and RAN1?

- Evaluate measurement accuracy achievable by RedCap UEs [RAN4]
- Evaluate impact of measurement accuracy to the positioning performance [RAN1]

For the above, we are not clear on moderator's assessment in the summary regarding "Moderator's view is that it is better to include this. If RAN1 can do the evaluation without any new simulation effort then this is of course OK." If there no clear motivation for RAN1 evaluation work, this need to be removed. Otherwise, the necessity of the second bullet should be clear.

5 – Beijing Xiaomi Mobile Software

We support the updated version provided by moderator. We think the two sub-bullets of the first bullet are necessary, it clearly clarifies the work for RAN1 and RAN4.

6 – Motorola Mobility Germany GmbH

Lenovo, Motorola Mobility :

Supportive of the RedCap objective text.

7 – Qualcomm Incorporated

We support the current Redcap objectives

8 – CATT

In our view, there is no need for both RAN1 and RAN4 to work on the simulation evaluation n order to assess the necessity of enhancements, during the SI. If the common view is that RAN1 needs be involved in the simulation evaluation, then we would suggest to consider reducing RAN4 workload RAN4 by removing the sub-bullet "Evaluate measurement accuracy achievable by RedCap UEs [RAN4]".

9 – Sony Europe B.V.

We support the updated moderator's proposal (v4). In case RAN4 workload is an issue, we think RAN1 can still perform performance evaluation. We did this during Rel-17 study item.

10 – VODAFONE Group Plc

We support the current Redcap objectives

11 – Philips International B.V.

We support the current objective

12 – Apple Benelux B.V.

We are fine with the current objectives

13 – Intel Corporation (UK) Ltd

We assume that the intention of SI objective is to check whether potential enhancements can facilitate higher positioning accuracy of RedCap UEs. We have concern to have RAN4 as a leading WG and especially dependency of RAN1 work on RAN4 objective. Considering that RAN4 may only start work at a later stage comparing to RAN1, that may affect overall timeline of the study. In addition, we are not clear why RAN1 needs RAN4 input on achievable measurement accuracy. For RAN1 it should be straightforward to provide baseline positioning performance for RedCap UEs and check if any potential enhancements bring accuracy benefits. Based on above arguments, we propose the following changes:

- RedCap UEs[RAN1, ~~RAN4~~]
  - ~~Evaluate measurement accuracy achievable with RedCap UEs [RAN4]~~
  - ~~Evaluate impact of measurement accuracy to the positioning performance [RAN1]~~
- Evaluate potential enhancements of NR positioning for accuracy improvement of RedCap UEs [RAN1]

14 – Ericsson LM

We are fine with the latest update

5.6 Summary from Final Round

Samsung commented on the decision process to agree enhancements for RedCap. The moderator can agree with Samsung's concern that it may be time consuming for the WGs to select enhancements without clear positioning requirements with RedCap UEs. However, in previous rounds there were concerns with included a sub-objective to decide a set of requirements at the start of the study. Consequently, we have the current situation where the decisions on enhancements will be somewhat subjective. It seems not practical to go back on this discussion at this stage.

Intel, CATT, Sony think that the RAN4 bullet can be removed as RAN1 can do the evaluation of measurement performance of RedCap UEs. This would remove some workload from RAN4. This change has been made in the revised SID text by moving RAN4 from the first bullet and deleting the 2 sub bullets (without RAN4 involvement there is no need to try to split the work into 2 separate tasks). This change is tentatively proposed. If concerns are raised then we should revert back to the previous form of the objectives which are known to be quite widely acceptable.

Vivo suggested to add " RAN1 work starts after RANP #96e or later". This has not been added as no other

company raised the necessity of this. Hopefully this can be managed by the good coordination of the WI rapporteurs and WG chair.

6 Other aspects of the SID

6.1 Initial Round

Companies are asked to provide comments and suggestions to any other aspect of the SID. Note that no new positioning enhancements will be discussed for inclusion in the SID at this stage of the process.

Feedback Form 21: Other aspects of the SID - Initial Round

1 – DanKook University Please include 'DanKook University' in the list of supporting IM.
2 – Samsung R&D Institute UK Just one question for clarification. Is the current formatting intentionally to make the whole item to be a study item instead of the SI phase in one WI?
3 – Deutsche Telekom AG The entire topic still seems to be far to large ... All aspects, but SL and REDCAP aspects in particular need to be down-scoped significantly (as per our suggestion)
4 – Huawei Tech.(UK) Co.. Ltd The title of the TR is the same as TR 38.857. Does it imply that the same TR is reused for the SID? We prefer either one the following two methods. Method 1: A new TR titled "Study on NR SL positioning" to capture the study outcome of the SL positioning objective, and TR 38.857 is updated to capture the study outcome of other improved Uu positioning objectives. Method 2: A new TR titled "Study on expanded and improved positioning" to capture the study outcome of all positioning objectives. If it is a SID, then the "WID includes a" table at the start should be empty Section 2.3 could list the Rel-16/17 SL work items (5G-V2X*NRSL, NR*SL_enh); or at least Rel-16. Since the whole item is now considered as a study, we suggest that for each of the main objectives there is a sub-bullet asking for recommending solutions, if any, to be specified in the normative phase. This is currently only present under the objective on sidelink positioning.

5 – TELECOM ITALIA S.p.A.

- propose to drop sidelink and redcap-related objectives in order to have a manageable project.
- The impact on RAN4 should clearly identified (in terms of TUs and required resources)

6 – Locaila

Please include 'Locaila' in the list of supporting IM.

7 – Intel Corporation (UK) Ltd

In our view, it is desirable to discuss potential scope reduction at least by refining the NR positioning objectives for improved accuracy, integrity, and power efficiency.

8 – Apple Benelux B.V.

There is an objective on positioning in NTN that is under discussion. We may need to have a discussion on what the relationship of that objective is to the current SID.

9 – VODAFONE Group Plc

We support downscoping to make the work manageable.

10 – Sony Europe B.V.

In our view, all of the study item outcomes will be captured in a TR document.

11 – Ericsson LM

Generally, we think the scope of this SID is very large. In order to have a high quality output, it's better to limit the scope and leave some aspects to future releases.

12 – AT&T GNS Belgium SPRL

We support this SI with the additional modifications:

- Acronym: Since this is a study item, the acronym needs to start with FS
- Remove check marks for core and performance parts
- There is some guidance text in {{ }} that can be removed
- Section 8: To match the text in the objectives, SA2 should be added.

We strongly support the SL positioning objectives as a follow-on of the RAN-led study item. For the other objectives, we may also consider having some defined as a 2nd priority.

13 – Fraunhofer IIS

Please include both "Fraunhofer IIS" and "Fraunhofer HHI" in the list of supporting IM.

6.2 Summary from Initial Round

To response to Samsung's question, it is intentional that this is now a Study Item rather than a Work Item with study phases for some objectives. This is as per the RAN Chair's "Summary for RAN Rel-18 Package" in RP-213469 that was endorsed in the Monday GTW.

The SI title needs to be considered. The draft SID has the title "Study on NR Positioning Enhancements" but very little thought went into this when it was drafted. The proposal from Huawei is "Study on expanded and improved positioning" which seems reasonable to the moderator. The TR title will be aligned with the SI title once agreed.

6.3 Intermediate Round

Companies are asked to:

- Comment on the proposed title "Study on expanded and improved positioning"
- Indicate if the would like their name added to the supporting company list

Feedback Form 22: Other comments - Intermediate Round

1 – vivo Mobile Communication Co. Fine with the title "Study on expanded and improved positioning". And also please include vivo as the supporting company.
2 – New H3C Technologies Co. Please include H3C in the list of supporting IM.
3 – Huawei Tech.(UK) Co.. Ltd We support the proposed SID title and subsequently aligning the TR title.
4 – Apple Benelux B.V. We are okay with the proposed title update.
5 – Ericsson LM Ericsson is still a supporting company
6 – Sony Europe B.V. We are fine with the updated title and SONY is one of the supporting companies.
7 – AT&T GNS Belgium SPRL We don't have a strong view on the title. If a new title is agreeable, please update where appropriate in the SID. AT&T is a supporting company.

8 – Motorola Mobility Germany GmbH Lenovo, Motorola Mobility : Ok with the revised title of the SID. Please indicate Lenovo and Motorola Mobility as supporting companies.
9 – FirstNet FirstNet supports study on expanded and improved positioning for public safety needs. Please add FirstNet as a supporting company.
10 – Philips International B.V. Please add Philips as a supporting company
11 – Classon Consulting for FUTUREWEI please add FUTUREWEI as a supporting company.

6.4 Summary from Intermediate Round

The title of the SID has been updated to ”Study on Expanded and Improved NR Positioning”. Note that ’NR’ was added compared to the suggestion from the Initial Round. Hope this is acceptable.

Company names have been added as supporting companies.

6.5 Final Round

Companies may continue to indicate if they would like to add their name as a supporting company, or make other comments on the SID.

Feedback Form 23: Other comments - Final Round

1 – ZTE Corporation Please add ZTE as a supporting company
2 – DENSO CORPORATION We would appreciate if ”DENSO CORPORATION” could be added as a supporting company. Thanks!
3 – Beijing Xiaomi Mobile Software Please add Xiaomi as a supporting company.
4 – NTT DOCOMO INC. Please add ”NTT DOCOMO” as a supporting company.

5 – MediaTek Inc. Please add MediaTek Inc. as a supporting company.
6 – Nokia Denmark Please add Nokia and Nokia Shanghai Bell as supporting companies
7 – TELECOM ITALIA S.p.A. We have serious concerns with the workload of this study and the foreseen impact on RAN4. The current version is not acceptable and as usual the fish market concept is the winner solution
8 – InterDigital France R&D Please add ”InterDigital” as one of the supporting companies.
9 – SHARP Corporation Please add ”Sharp Corp.” as a supporting company.
10 – ROBERT BOSCH GmbH Thanks moderator. Please add Robert Bosch GmbH in the list of supporting companies.
11 – Honor Please add “HONOR” to the list of supporting companies. Thanks.
12 – AT&T GNS Belgium SPRL We continue to support this SI. Thanks to the moderator and efforts from everyone.
13 – Telia Company AB We thank the moderator and please add **Telia Company** to supporting company list. Thank you.
14 – Ericsson LM Please add Ericsson as supporting company

6.6 Summary from Final Round

Supporting companies added as requested

7 Conclusion

The updated SID from this discussion is provided in RP-213561.

Note that the updated SID contain the tentative change to the RedCap objective as described in section 5.6.

The moderators proposal is that if this is not acceptable to all then the objectives are reverted back to the previous from which had quite wide support.