**3GPP TSG RAN WG1 Meeting #109-E R1-220xxxx**

**e-Meeting, May 9th – May 20th, 2022**

**Source: Moderator (Intel Corporation)**

**Title: FL summary #2 on SL positioning scenarios and requirements**

**Agenda item: 9.5.1.1**

**Document for:** **Discussion and Decision**

# Introduction

This document presents a summary of submitted contributions to AI 9.5.1.1 (“SL positioning scenarios and requirements”).

[109-e-R18-Pos-02] Email discussion on SL positioning scenarios and requirements by May 20 – Debdeep (Intel)

* Check points: May 16, May 20

The Rel-18 SI on expanded and improved NR positioning, the following objective is provided in regarding studies on support of SL positioning, of which the first two objectives, highlighted below, are discussed under this agenda item.

|  |
| --- |
| * 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 * Identify specific target performance requirements to be considered for the evaluation based on existing 3GPP work and inputs from industry forums [RAN1] * Define evaluation methodology with which to evaluate SL positioning for the uses cases and coverage scenarios, reusing existing methodologies from sidelink communication and from positioning as much as possible [RAN1]. * Study and evaluate performance and feasibility of potential solutions for SL positioning, considering relative positioning, ranging and absolute positioning: [RAN1, RAN2]   + Evaluate bandwidth requirement needed to meet the identified accuracy requirements [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]   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. |

Based on the submitted contributions to RAN1 #109-E meeting, the discussion points are categorized into the following topics:

* Network coverage scenarios for SL positioning
* Target use-cases and bands for SL positioning
* Operation scenarios involving SL positioning
* Technical requirements for the target use-cases for SL positioning

**For the fourth round of discussions, please provide your inputs in response to the Proposals tagged with ‘FL4’ latest by Wednesday, May 18th, 21:00 UTC.**

Please follow the naming convention in this example:

* *SLPosScenReq\_FLS-v000.docx*
* *SLPosScenReq\_FLS-v001-CompanyA.docx*
* *SLPosScenReq\_FLS-v002-CompanyA-CompanyB.docx*
* *SLPosScenReq\_FLS-v003-CompanyB-CompanyC.docx*

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

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

To avoid excessive email load on the RAN1 email reflector, please note that there is NO need to send an info email to the reflector just to inform that you have uploaded a new version of this document. Companies are invited to enter the contact info in the table below.

## FL1 Question 1-1

* *Please consider entering contact info below for the points of contact for this email discussion:*

|  |  |  |
| --- | --- | --- |
| **Company** | **Point of contact** | **Email address** |
| ZTE | Chuangxin Jiang | jiang.chuangxin1@zte.com.cn |
| CATT | Xiaotao Ren | renxiaotao@catt.cn |
| CMCC | Jingwen Zhang | zhangjingwen@chinamobile.com |
| vivo | Yuanyuan Wang | yuanyuan.wang.txyj@vivo.com |
| Huawei, HiSilicon | Jinhuan Xia | Jinhuan.xia@huawei.com |
| Lenovo | Xiaodong Yu | yuxd1@lenovo.com |
| Spreadtrum | Zhenzhu Lei | reven.lei@unisoc.com |
| OPPO | Teng Ma | mateng1@oppo.com |
| InterDigital | Fumihiro Hasegawa | fumihiro.hasegawa@interdigital.com |
| Qualcomm | Gabi Sarkis | gsarkis@qti.qualcomm.com |
| Futurewei | George Calcev | gcalcev@futurewei.com |
| Samsung | Cheolkyu | ck13.shin@samsung.com |
| NEC | Ying Zhao | zhao\_ying@nec.cn |
| Sony | Basuki Priyanto | basuki.priyanto@sony.com |
| Xiaomi | Zhao Qun | zhaoqun1@xiaomi.com |
| LGE | Woo-Suk Ko | woosuk.ko@lge.com |
| Nokia, NSB | Torsten Wildschek | torsten.wildschek@nokia.com |
| Locaila | JongPhil Park | Pjphil87@locaila.com |
| NTT DOCOMO | Shohei Yoshioka | shohei.yoshioka@docomo-lab.com |
| CEWiT | Abhijeet Masal | abhijeetmasal@cewit.org.in |
| Ericsson | Florent Munier | [Florent.munier@ericsson.com](mailto:Florent.munier@ericsson.com) |
| FirstNet | Eshwar Pittampalli | Eshwar.pittampalli@firstnet.gov |
| AT&T | Jerome Vogedes | [Jerome.Vogedes@att.com](mailto:Jerome.Vogedes@att.com) |
| Philips | Rob Davies | [Rob.davies@philips.com](mailto:Rob.davies@philips.com) |
| Toyota ITC | Takayuki Shimizu | takayuki.shimizu@toyota.com |
| Bosch | Maximilian Stark | [maximilian.stark2@de.bosch.com](mailto:maximilian.stark2@de.bosch.com) |
| Intel | Debdeep Chatterjee | debdeep.chatterjee@intel.com |

# Network coverage scenarios

Most submitted contributions to this agenda item indicate that all three NR network coverage scenarios are included in the scope of the study:

* In coverage (IC)
* Partial coverage (PC)
* Out of coverage (OOC).

As can be observed from the SID objectives, this is consistent with the SI objective for SL positioning.

However, there are some further views regarding potential (de-)prioritization of the different coverage scenarios.

In particular, reference [9] proposes to prioritize only out of coverage scenarios over the other two. Reference [13] proposes to prioritize in-coverage scenarios. [28] proposes “Evaluations of positioning performance in partial coverage scenarios should not be performed”, while [22] suggests that partial coverage scenarios be studied and evaluated with a second priority.

On the other hand, multiple contributions propose to study and evaluate all three network coverage scenarios for SL positioning.

In relation to different use-cases, it is expected that not all network coverage scenarios may apply for all use-cases. For example, it would be reasonable to expect that commercial use-cases may be limited to in-coverage scenarios only. This is discussed further in Section 3.

## FL1 Question 2-1

* *Please share your views on the following options for handling of different network coverage scenarios for studies on SL positioning:*
  + ***Option 1:*** *All network coverage scenarios (in-coverage, partial coverage, and out-of-coverage) are studied/evaluated at same priority level.*
  + ***Option 2:*** *Studies of in-coverage and out-of-coverage scenarios are prioritized during the SI.*
  + ***Option 3:*** *Studies of in-coverage scenarios are prioritized during the SI.*
  + ***Option 4:*** *Studies of out-of-coverage scenarios are prioritized during the SI.*
  + ***Option 5:*** *Other option(s)*

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| **Company** | **Preferred option** | **Comments** |
| ZTE | Option 2 | We are also open to study all network coverage scenarios from specification perspective, but only evaluate in-coverage and out-of-coverage. Hence, we suggest removing ‘/evaluated’ in Option 1. |
| CATT | Option 4  Or  Option 2 | In our point of view, the main task of Rel-18 sidelink positioning should be finding the positioning solution for UEs in out-of-coverage and evaluating its positioning performance. |
| CMCC | Option 2 | To limit the heavy workload, we prefer to first focus on in-coverage and out-of-coverage, as the evaluation and physical layer design may be more complicated than the other two scenarios. In addition, considering V2X and IIoT use cases that we are interested in, in-coverage and out-of-coverage scenarios are more common and typical. |
| vivo | Option 4 |  |
| Huawei, HiSilicon | option 5 | By Option 5 we mean from evaluation perspective, we don’t specifically need to consider the coverage situation because accuracy target is independent of coverage situation. However, from solution perspective, we will further look into what positioning methods will be applied to which coverage scenario which will be studied in AI9.5.1.3 |
| Lenovo | Option 1 | We would like to study/support all network coverage scenario with considering various use cases and positioning calculation entity. From sidelink point of view, there is no need to additionally exclude partial coverage scenario. It doesn't cause too much workload. |
| Spreadtrum | Option 2 |  |
| OPPO | Option 1 | All three network coverage scenarios IC, OoC as well as partial coverage should be studied/evaluated at same priority level. For absolute positioning, multiple UEs may be involved for communication and positioning. If only IC and OoC are supported, it requires that all the relative UEs should be within the same coverage scenario, which seems too restrictive and may also limit the application of the SL positioning functionality. |
| InterDigital | Option 3 | We prefer to prioritize the study of in-coverage scenario since we can reuse the existing design of NR Uu positioning for resource allocation. For example, for IC scenario, SL-PRS resource can be handled by the network (e.g., LMF or gNB), which is similar to the NR Uu positioning. After having progress in IC, we can further study OOC and PC scenarios. |
| Qualcomm | Option 2 + Option 5 | We think the choice of coverage should depend on the evaluated scenario, e.g. for V2X, out-of-coverage is prioritized since that would be the most likely mode of deployment.  In IIoT, in-coverage should be the highest priority. |
| Futurewei | Option 1 | We would like to study and support all network coverage. Regarding the “/evaluation” part in Option 1, may not be needed for all scenarios. |
| Samsung | Option 2 |  |
| NEC | Option 2 | Definition of partial coverage and how to implement it in simulation are not as clear as other two coverage scenarios, therefore, we prefer to prioritize in and out-of-coverage cases which have more general application. |
| Sony | Option 3 | In reality, we consider in-coverage is the most commonly used use-cases. It should be prioritized. |
| xiaomi | Option 1 with comment | As WID stated, sidelink positioning/ranging in all the coverage scenarios shall be supported, so no need to further prioritize the study among the scenarios. But considering that most popular use cases are for IC or OOC scenario, we support to perform evaluation only for IC and OOC scenarios. In addition, it is allowed that some positioning solutions can be applied only for specific coverage scenario |
| LGE | 4 | We prefer option 4 because the out-of-coverage scenarios are the most important and unique feature of the sidelink positioning, which cannot be provided by Uu link based positioning.  In addition, when the solutions for the out-of-coverage scenarios are studied, we need to focus on the common solutions that can be applied to all the use cases. |
| Nokia, NSB | Option 2 | All coverage scenarios should be studied; however, for evaluation, we can focus on the most relevant coverage scenario for the use case (e.g. out of coverage for V2X) |
| Locaila | Option 4 or Option 2 | Considering hard workload, out of coverage scenarios should be studied as the first prioritization. And then, Other scenarios can be additionally studied. |
| NTT DOCOMO | Option 1 |  |
| Sharp | Option 2 | We would like to first study IC and OoC scenarios with the priority for the evaluation. |
| CEWiT | Option 1 or  Option 5 | Partial coverage will make more sense in V2X scenario can be evaluated at least in V2X case. So, we prefer to keep it for at least V2X case. In this sense option 5 we prefer |
| Ericsson | Option 2 | We see partial coverage as a special case of out-of-coverage where the LMF in the network is reachable (e.g. LMF assists SL positioning), or for when the DL PRS is in-coverage while the LMF connection relies on a relaying UE. Either way, we think the evaluation for in-coverage and out of coverage would also be valid for the partial coverage case. |
| Apple | Option 2 | Based on the heavy workload, priority should be given to evaluation/studies for the in-coverage and out-of-coverage scenarios. |
| FirstNet | Option 4 | The primary objective of the task is to determine the position of first responder UEs in out-of-coverage with desired accuracy. |
| Moderator |  | Summary of received responses:   * **Option 1:** Lenovo, Oppo, Futurewei, DCM, CeWiT **(6)** * **Option 2:** ZTE, CATT, CMCC, SPRD, QC, SS, NEC, Nokia, Locaila, Sharp, E//, Apple **(12)** * **Option 3:** IDC, SONY **(2)** * **Option 4:** CATT, vivo, LGE, Locaila, FirstNet **(5)** * **Option 5:** HW-HiSi, QC, CEWiT **(3)**   The received responses indicate a significant interest in focusing on in-coverage and out-of-coverage scenarios.  Here, it should be clarified that Options 2 through 4 do not intend to down-scope from the original scope in the SID but is aimed primarily to guide the focus of the studies and evaluations. For example, if we go with Option 2, then it does not imply that partial coverage scenario is not considered, just that the group will focus primarily on the other two scenarios with the understanding that the solutions developed for in-coverage and out-of-coverage can be used/adapted for partial coverage scenarios. Certainly, some specific details may need to be sorted out for partial coverage scenarios eventually for normative specification support, and that would be addressed based on identified issues/considerations.  Also, some companies indicated that relevance of choice of scenarios may further depend on the use-case. This is indeed the expectation and is the subject of discussion related to Proposal 3-3.  With this understanding, the following updated proposal FL2 Proposal 2-1 is provided below. |

## FL2 Proposal 2-1

* *Studies of in-coverage and out-of-coverage scenarios are prioritized during the SI.*
* *Note: This includes at least evaluations and is not intended to down-scope support of SL positioning for partial coverage scenarios.*

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| **Company** | **Preferred option** | **Comments** |
| ZTE | Support |  |
| Futurewei | Support | In the note “*at least evaluations and*” part is not necessary and may be interpreted that this thread mandates evaluations rather than scenarios and requirements. The evaluations are covered in 9.5.1.2 |
| CATT | Support |  |
| vivo |  | We also think the evaluation can be independent of coverage. So, can we revise the proposal as follows? FL2 Proposal 2-1  * *Studies of in-coverage and out-of-coverage scenarios are prioritized during the SI.* * *Note: This ~~includes at least evaluations and~~ is not intended to down-scope support of SL positioning for partial coverage scenarios.* |
| Samsung | OK |  |
| AT&T | Support | We support the proposal, but suggest a slight rewording to the Note as follows:   * *Note: This prioritization is not intended to down-scope support of SL positioning for partial coverage scenarios, but to provide guidance for, e.g., performance evaluations.* |
| LGE | Support | Our preference is to prioritize OOC, but accept the proposal for progress. |
| NEC | Support |  |
| CMCC | Support |  |
| Philips | Support with comments | Prefer wording suggested by Vivo or AT&T. |
| DCM | OK | Not our preference, but accept for progress. |
| Huawei, HiSilicon | Ok |  |
| Xiaomi | OK |  |
| Lenovo |  | We can accept that, only from evaluation point of view, the in-coverage and out-of-coverage scenarios are prioritized.  But all three coverage scenarios should be studied at same priority level, the potential solutions should be applied for each coverage scenario.   * *~~Studies~~ Evaluates of in-coverage and out-of-coverage scenarios are prioritized during the SI.* * *Note: This includes ~~at least~~ only evaluations and is not intended to down-scope support of SL positioning for partial coverage scenarios.* |
| OPPO | Not support | We still think Partial coverage, as the most typical coverage scenario in V2X, should be taken into account for study / evaluation, which can provide a comprehensive analysis on the V2X use case. |
| FirstNet | Support | Support AT&T’s revision of the Note. |
| InterDigital | Ok with comments | We prefer to focus on IC, but accept the direction for progress. We prefer the wording from vivo. |
| Toyota ITC | OK |  |
| Nokia, NSB | OK |  |
| Qualcomm | Agree |  |
| Spreadtrum | Support |  |
| Moderator |  | Summary of received responses:   * Most responses support the FL proposal, with some suggestions options for rephrasing. * One response (OPPO) does not agree as they think partial-coverage scenarios should be studied as well.   The moderator would like to emphasize part of the message in the note that the proposal is only about prioritization of the studies for in-coverage and out-of-coverage and does not preclude studies on partial-coverage scenarios. Thus, developed solutions need to work for partial-coverage scenarios; only that the evaluations can rely on individual analyses for in-coverage and out-of-coverage scenarios.  Certainly, companies can bring any results for partial-coverage scenarios, and *at least from the perspective of this proposal*, studies on any specific aspect or design detail for partial-coverage scenarios can be performed if can be motivated.  Thus, the moderator would like suggest to consider the updated proposal in FL3 Proposal 2-1 with the update on the Note from AT&T. |

## FL3 HP Proposal 2-1

* *Studies of in-coverage and out-of-coverage scenarios are prioritized during the SI.*
* *Note: This prioritization is not intended to down-scope support of SL positioning for partial coverage scenarios, but to provide guidance for, e.g., performance evaluations.*

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| **Company** | **Comments** |
| CATT | Support |
| ZTE | Support |
| Samsung | OK |
| vivo | OK |
| Lenovo | OK |
| FirstNet | Support. Out-of-coverage scenarios are of highest priority for public safety. |
| NEC | Support |
| OPPO | Thanks FL for the clarification, and we can live with the proposal. |
| AT&T | Support |
| Huawei, HiSilicon | We still do not understand why the evaluation should consider the coverage condition. Does it make any difference in the evaluation when the UE is in coverage or out of coverage?  In addition, as per guidance from the Chair, this email thread also covers the use cases/scenarios for evaluation, any proposal should be clear that the selection, if any, of the use cases and coverage scenarios are for the purpose of evaluation.  All use cases and coverage scenarios are supposedly supported according to the SID.  It should be like:   * *For the purpose of evaluation, in-coverage and out-of-coverage scenarios are prioritized during the SI.* * *Note: This prioritization is not intended to down-scope support of SL positioning for partial coverage scenarios.* |
| InterDigital | Support |
| Futurewei | Support |
| Bosch | Support |
| Qualcomm | OK |
| Ericsson | Support |
| Nokia, NSB | OK |
| Locaila | Support |
| Spreadtrum | Support |
| LGE | Support |
| CMCC | Support |
| Xiaomi | OK |
| Toyota ITC | OK |
| Sharp | Support |
| SONY | Support |
| Moderator | Summary of received responses:   * All, except one, responses indicate support/acceptance of the proposal. * One response (HW-HiSi) prefers to emphasize further that the prioritization is for evaluation purposes only.   From the Moderator’s perspective, the proposed version that clarifies that the prioritization is as “guidance for, e.g., performance evaluations” certainly includes evaluations, but is also consistent with some of the prioritizations considered beyond evaluations, e.g., as part of discussions in AI 9.5.1.3 (Solutions for SL positioning).  However, if all other companies may be fine with the version from HW-HiSi, we could go with that as well.  Accordingly, both versions are captured in updated FL4 HP Proposal 2-1 and we can possibly decide based on majority preference. |

## [CLOSED] FL4 HP Proposal 2-1

* *To be down selected from:*
  + *Alt 1:*
    - *Studies of in-coverage and out-of-coverage scenarios are prioritized during the SI.*
    - *Note: This prioritization is not intended to down-scope support of SL positioning for partial coverage scenarios, but to provide guidance for, e.g., performance evaluations.*
  + *Alt 2:*
    - *For the purpose of evaluations, in-coverage and out-of-coverage scenarios are prioritized during the SI.*
    - *Note: This prioritization is not intended to down-scope support of SL positioning for partial coverage scenarios.*

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| **Company** | **Preferred Alt.** | **Comments** |
| Moderator |  | During GTW on May 17th, 2022, the following was agreed.  **Agreement**  For the purpose of evaluations, in-coverage and out-of-coverage scenarios are prioritized during the SI.   * Note: This prioritization is not intended to down-scope support of SL positioning for partial coverage scenarios. |
|  |  |  |

# Target use-cases and bands for SL positioning

Following from the SID and TR 38.845 , TS 22.261 , and TS 22.104 , the target use-cases for SL positioning can be broadly classified into four categories:

* V2X use-cases (primary ref: TR 38.845)
* Public safety use-cases (primary ref: TR 38.845)
* Commercial use-cases (primary ref: TS 22.261)
* IIoT use-cases (primary ref: TS 22.104).

In general, views expressed in most contributions are aligned with the above set of target use-cases, with some specific views on potential prioritization of some of the use-case over others. Towards this,

* reference [8] suggests prioritizing V2X and public safety use-cases;
* reference [9] proposes to prioritize V2X and IioT use-cases;
* reference [22] proposes to study V2X use-case as first priority and IioT use-case as second priority;
* reference [27] proposes: “*Define a subset of the potential use cases for the evaluation of the potential solutions. The subset(s) may be grouped according the specification impact”.*

## FL1 Question 3-1

* *Please share your views on the following options for target use-cases for studies on SL positioning:*
  + ***Option 1:*** *All four identified use-cases (V2X, public safety, commercial, and IioT) are studied/evaluated at same priority level.*
  + ***Option 2:*** *Studies on V2X and public safety use-cases are prioritized during the SI.*
  + ***Option 3:*** *Studies on V2X and IioT use-cases are prioritized during the SI.*
  + ***Option 4:*** *Studies on V2X use-cases are prioritized during the SI.*
  + ***Option 5:*** *Other option(s).*

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| **Company** | **Preferred option** | **Comments** |
| ZTE | Option 3 or Option 4 | Considering the high workload, we more prefer option 4 or option 3. The corresponding simulation work will be easier. |
| CATT | Option 3 | Since the positioning requirements of V2X use cases from 5GAA and IioT use cases from verticals are more urgent, V2X use cases and IioT use cases should have higher priority than the other two kinds of use cases. |
| CMCC | Option 3 | In general, we are open for all use cases, however, due to the limited workload, we prefer to consider two evaluation cases at most. We prefer V2X and IioT use cases, which are more promising in applications. |
| Vivo | Option 4 | Considering the high workload and limited time for the new SL channel model calibration, we prefer option 4 |
| Huawei, HiSilicon | Option4 or option 5 | Similar issue. If the study is for the solution, we assume the SLP solution should be in general applicable to all cases.  If we are talking about the evaluations only, we prefer to have V2X (first priority) and commercial (second priority) use cases. |
| Lenovo | Option 1 | We prefer to study all use cases. I.e., V2X, public safety, commercial, and IioT.  To consider the potential workload, RAN1 is encouraged to select 1 or 2 representative commercial ranging use cases (stated in [TS 22.261, 6]) based on the stringent requirement:   * Smart TV Remote * Picture and video sharing based on ranging results and * Distance based smart device control * Smart Vehicle Key * Touchless Self-checkout Machine Control * Hands Free Access * Smart Transportation Metro/Bus Validation * Ranging of UE’s in front of vending machine * Finding Items in a supermarket * Distance based intelligent perception for public safety * Long Distance Search * Long range approximate location |
| Spreadtrum | Option 2 |  |
| OPPO | Option 2 or Option 3 | By considering the total workload, at least V2X should be studied as the first prioritization. Besides, public safety or IioT can be additionally studied. |
| InterDigital | Option 3 | We believe that RAN1 should limit the number of use cases to study to reduce workload. We support V2X and IioT as two use cases to further study due to their applicability. |
| Qualcomm | Option 1 | Our view is to follow the SID, which already listed all four use-cases. |
| Futurewei | Option 5 | We should aim to study all the cases specified in SID. In our view, depending on workload, the priority order should be V2X, public safety, IioT and commercial. |
| Samsung | Option 2 | Considering work load, Option 1 is not preferred. Option 2 looks OK. The solutions developed with Option 2 can be applied also for commercial and IIOT. |
| NEC | Option 4 | We think all use cases can be considered and even evaluated if companies have such capability. However, from reduction of workload perspective, we prefer to focus on V2X use case at first. |
| Sony | Option 4 | This SI has high work-load. V2X is the most urgent one (i.e., request from 5GAA) and matured one. |
| Xiaomi | Option 1 | As all the four use cases are included in the WID, we do not see why we can deprioritize some use case at WG level. |
| LGE | 2 | We prefer to prioritize V2X and public safety use cases during the SI. It is aligned with the work done in RAN study item, and reduces the work load that can be caused by the divergent use cases. Other use cases can be covered by focusing on the development of the common operations across all the use cases. |
| Nokia, NSB | Option 1 | The SID targets all 4 use cases for study. |
| Locaila | Option 2 or Option 4 | We prefer option 2. But, considering hard workload, we also open to Option 4. |
| NTT DOCOMO | Option 1 | According to SID |
| Sharp | Option 3 | We are open for the identified four use cases. But considering the workload, we would like to have more priority with V2X and IioT. |
| CEWiT | Option 3 | We are okay for public safety to study in SI but evaluation is not necessary for it. |
| Ericsson | Option 1 | We agree we should follow the SID in terms covering all use cases, but we think that focusing on the most stringent use cases accuracy targets for each given scenario would be enough, since our goal is to investigate solutions that would satisfy all use cases. |
| Apple | Option 3 | We would lie priority to be given to the V2X and IioT use cases. |
| FirstNet | Option 2 | Public Safety (PS) use-cases are to be prioritized during the SI. BTW, the solutions developed for PS indeed could be used for commercial and other use cases. |
| Moderator |  | Summary of received responses:   * **Option 1:** Lenovo, QC, Xiaomi, Nokia, DCM, E//, [Sharp], [Futurewei], [HW-HiSi] (**6 + [3]**) * **Option 2:** SPRD, OPPO, IDC, SS, LGE, Locaila, FirstNet **(7)** * **Option 3:** ZTE, CATT, CMCC, OPPO, Sharp, CEWiT, Apple **(7)** * **Option 4:** ZTE, HW-HiSi (prioritize V2X for evaluations), NEC, SONY, Locaila, [Futurewei] **(5 + [1])** * **Option 5:** HW (solutions should support all use-cases), Futurewei (“all, with priority order: V2X, public safety, IioT and commercial”) **(2)**   ***Note:*** *Companies listed in brackets are based on Moderator’s interpretation of their comments in addition to their explicitly indicated preference.*  The group is rather evenly divided across the Options 1 through 4. Again, there is no intention to down-scope any use-case already identified as part of the SID but only to provide further guidance and focus our efforts on the studies, primarily involve evaluation efforts.  The other consideration is in terms of prioritization of some of the target requirements. For instance, if certain use-cases are deprioritized, the corresponding requirements may not be considered as primary focus of our studies. This would only have material impact if the affected use-cases have requirements that are more demanding than those prioritized for the study. Thus, one approach could be to pick the most demanding requirements for a given scenario. Another could be to harmonize the requirements across two or more use-cases to reduce evaluation efforts – e.g., commercial and public safety. This last aspect is considered further in Sections 5.3 and 5.4.  On the other hand, it may be useful to consider multiple sets of requirements and eventually make observations contrasting satisfying one or more of such requirements, e.g., V2X requirements per set 2 or set 3 (cf. Proposal 5.2-1). Hence, this aspect may need further deliberations.  Therefore, considering all inputs, FL2 Proposal 3-1 is recommended. |

## FL2 Proposal 3-1

* *All four identified use-cases (V2X, public safety, commercial, and IioT) are studied/evaluated at same priority level* 
  + *FFS: For a given scenario that may be relevant to more than one use-case, the use-case with the most demanding requirements is prioritized in determining target positioning/ranging accuracies.*
* *Note: This includes at least evaluations and is not intended to down-scope support of SL positioning for any use-case identified in the SID.*

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| **Company** | **Preferred option** | **Comments** |
| ZTE | No | I see more companies prefer prioritizing V2X use cases. At least from evaluation perspective which is ongoing in AI 9.5.1.2, V2X evaluation as baseline is supported by all companies, but other use cases is very likely optional. |
| Futurewei | Support | Our understanding is that all scenarios should be studied as per SID. We suggest to remove “includes at least evaluations and“ from the note. This thread does not define the evaluations. The first bullet already mentions “/evaluated” |
| CATT | V2X+IioT | To reduce the work load and considering the requirements from verticals, V2X use cases and IioT use cases should have higher priority than the other two kinds of use cases |
| vivo | No | Same view as ZTE, and we can not accept the FFS bullet. |
| Samsung |  | If there is no intention to down-scope any use-case already identified as part of the SID as in note, we prefer to select one or two use case(s) to reduce work load. |
| AT&T | Support | At this stage, we think that we should follow the SID and keep all of the use cases identified at equal priority, including for the evaluations as some scenarios are relevant to more than one use case. If we find that prioritization is necessary in the future, we should, at a minimum, address the use cases as defined in the RAN-led SI and TR 38.845, which aligns with Option 2 (V2X and Public Safety). |
| LGE | Not support | We agree with ZTE. Evaluation of all the use cases requires too high work load to be completed in SI. We prefer to prioritize the V2X use case while focusing on the common part that can be applied for all use cases. With the same reason, instead of most demanding requirement that could be limited to a specific use case, the intersection of the requirements that are common to all the use cases needs to be prioritized. |
| NEC | V2X | Although we agree with all use cases can be studied, considering reduction of workload and limited time, we prefer to focus on V2X use case at first. |
| CMCC | See comments | We can accept to include all four use cases for study, as basically, the SL positioning methods and solutions may not be use case specific. However, for evaluation, we cannot accept to evaluate all four at the same priority. As commented by ZTE and other companies, the workload would be too high. Prefer to down-select to 1 or 2 use cases for evaluation. If only 1 is considered as baseline evaluation use case, then it should be V2X, if 2 use cases are selected, we prefer V2X and IioT. |
| Philips | Support | Agree with the wording suggestion of Futurewei. We do not agree with some other companies to deprioritize Public Safety, IioT and commercial use cases. |
| DCM | Support | Agree with ATT’s comment. |
| Huawei, HiSilicon |  | This AI is targeting use cases and requirements. Whether and how to evaluate should be treated in 9.5.1.2. In addition, for evaluation, given different companies have different views and V2X should be the one agreeable to all. For evaluation purpose, it makes more sense to agree on a basic use case i.e. V2X for evaluation calibration. Other use case can be optional and up to companies to report. |
| Xiaomi | Support | We support to follow SID and keep all use cases with equal priority. |
| Lenovo | Support |  |
| OPPO | Not support | We share the same view of ZTE. Studying/evaluating all four use cases has much heavy work load. As mentioned in the first round of discussion, at least V2X use case should be prioritized. |
| FirstNet |  | We should follow the SID and keep all public safety use cases with high priority. |
| InterDigital |  | We prefer to prioritize V2X and IioT for evaluation to reduce the workload. However if the majority prefers to evaluate all scenarios at the same priority level, we can accept the majority view.  Please change the summary of our supported option. We support Option 3 not Option 2. |
| Toyota ITC | OK |  |
| Nokia, NSB | OK | We can remove the Note since the proposal is to study/evaluate all four identified use cases at same priority level. |
| Qualcomm | Agree |  |
| Moderator |  | Summary of received responses:   * The group is equally divided, with 10 responses indicating support for FL2 proposal 3-1 while another 10 responses indicating preference towards some sort of prioritization (with different views on the ones to prioritize, except for V2X), at least for evaluations. * It has been also commented in one response (HW-HiSi) that, “whether and how” to evaluate use-cases and scenarios would be left to AI 9.5.1.2. This is aligned with the moderator’s understanding and in fact, expected to be conveyed via the note.   Based on responses received, the proposal is updated as in FL3 Proposal 3-1 (copied below with change-marks; clean version below).   * *All four identified use-cases (V2X, public safety, commercial, and IioT) are to be studied as part of RAN1 studies in Rel-18 on SL positioning* * *Note: This does not preclude potential (de-)prioritization of any use-case for evluations as part of discussions in AI 9.5.1.2.* |

## FL3 HP Proposal 3-1

* *All four identified use-cases (V2X, public safety, commercial, and IioT) are to be studied as part of RAN1 studies in Rel-18 on SL positioning*
* *Note: This does not preclude potential (de-)prioritization of any use-case for evluations as part of discussions in AI 9.5.1.2.*

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| **Company** | **Comments** |
| CATT | To reduce the work load and considering the requirements from verticals, V2X use cases and IioT use cases should have higher priority than the other two kinds of use cases |
| ZTE | We prefer CATT’s views more. But we can accept the first bullet.  **Per Mr. Chair’s guidance, whether to prioritize use cases for evaluation will be discussed in this agenda**. |
| CEWiT | Support. |
| Samsung | According to Chairman’s guidance, we need to discuss about the priority for evaluations among the 4 use cases in this agenda item. As we commented, we prefer to select one or two use case(s) to reduce work load. If the current proposal is not modified, this is the same as SID as   * 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 |
| Vivo | Same view as ZTE and Samsung |
| Lenovo | Support. |
| FirstNet | Agree with the conclusion that all four identified use-cases are to be studied. However, public safety use cases are to be treated at the highest priority. |
| NEC | As mentioned by ZTE, prioritization should be discussed here and we support to prioritize V2X (potentially with IIoT) as baseline. We suggest to add a note saying that other use cases can also be studied. |
| OPPO | As several companies mentioned in previous discussion, the work load would be very high if four use cases are all fully studied. We would like to suggest that at least V2X is prioritized. |
| AT&T | Support. However, if we find that prioritization is necessary in the future, we should, at a minimum, address the use cases as defined in the RAN-led SI and TR 38.845, i.e., V2X and Public Safety. Small typo in the note: *evluations* -> evaluations |
| Huawei, HiSilicon | OK, but we assume this bears no difference from the SID, or it is rather for confirming the SID. |
| InterDigital | We have the similar view as Samsung and ZTE. |
| Futurewei | Support, additional prioritization is needed. |
| Bosch | We don’t support the note in the proposal. Also considering all four classes of use cases similarly results in a too high work load. In our view, both V2X and IIot use cases need to be prioritized. |
| Qualcomm | We propose to remove the note and put all cases on equal footing as in the SID.   * *All four identified use-cases (V2X, public safety, commercial, and IioT) are to be studied as part of RAN1 studies in Rel-18 on SL positioning* * *~~Note: This does not preclude potential (de-)prioritization of any use-case for evluations as part of discussions in AI 9.5.1.2.~~* |
| Ericsson | Support. De-prioritization of use cases listed in the WID should not be done by RAN1. However, we agree we should discuss the scope of evaluation of each of the 4 use case listed in SID within AI 9.5.1.2. |
| Nokia | Since the chair has already clarified that the prioritization for evaluations among the 4 use cases to be discussed under 9.5.1.1, we can remove the Note. |
| Locaila | We share similar view with AT&T. |
| LGE | We still prefer to prioritize V2X and (if possible) public safety, which is helpful for work load reduction and aligned with the RAN positioning SI discussion. |
| CMCC | OK |
| Xiaomi | Support. For evaluation, at least absolution/relative positioning in V2X cases and ranging in commercial cases shall be prioritized. |
| Sharp | Support. Similar view with Ericsson. |
| SONY | Support but Prioritization is needed (particularly V2X case) |
| Moderator | Summary of received responses:   * While slight majority of responses (12+ responses) are supportive or can accept the FL proposal, there are also views expressed suggesting further prioritization of use-cases for evaluations. * Some responses (SS, HW-HiSi, others) indicate that the proposal is same as scope defined in SID.   To clarify, this proposal is indeed to confirm that all four use-cases are considered for overall studies by RAN1, that is, RAN1 will not perform any prioritization of use-cases for overall studies.  However, further prioritization of use-cases for evaluations can be discussed as the next step and a new proposal **FL4 HP Proposal 3-4** is now added towards this. |

## [CLOSED] FL4 HP Proposal 3-1

* *All four identified use-cases (V2X, public safety, commercial, and IIoT) are to be studied as part of RAN1 studies in Rel-18 on SL positioning.*

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| **Company** | **Comments** |
| Moderator | Based on discussions and decisions during GTW session on May 17th, 2022, the proposal can be seen superseded by FL4 HP Proposal 3-3 and discussion on FL4 HP Proposal 3-1 can be stopped. |
|  |  |

It is observed in multiple contributions that, for V2X use-cases, NR bands n47 (primarily) and n38 (in some regions) are the available bands for dedicated V2X-related operations, and both are subject to a maximum bandwidth (BW) of 40 MHz with smaller bandwidths in various regions.

Further, reference proposes to deprioritize consideration of FR2 bands.

On the other hand, several contributions suggest consideration of both FR1 and FR2 bands (across different use-cases and scenarios) with maximum possible BWs supported for SL operations, at least from the perspective of RAN1 specifications.

*Note that exact assumptions on bandwidth for SL positioning evaluations are expected to be discussed as part of AI 9.5.1.2 (Evaluation methodology for SL positioning).*

## FL1 Question 3-2

* *Please share your views on the following options for considered frequency ranges and bands for studies on SL positioning:*
  + ***Option 1:*** *Both FR1 and FR2 bands (with BWs up to 100 MHz and 400 MHz respectively) are considered in the study. For V2X use-cases, maximum BW of 40 MHz is considered.*
  + ***Option 2:*** *Deprioritize FR2 bands during the SI. For V2X use-cases, maximum BW of 40 MHz is considered.*
  + ***Option 3:*** *Other option(s).*

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| **Company** | **Preferred option** | **Comments** |
| ZTE | Option 2 with revision | We more prefer option 2 as the basic V2X functionality in FR2 is not complete yet. However, we think it is worth to study 100MHz from specification perspective as it is feasible in licensed bands. |
| CATT | Option 2 | Considering the sidelink beam management mechanism has not been introduced in NR V2X, and it may be discussed in Rel-18 sidelink evolution work item, we prefer the potential solutions investigation and performance evaluation should focus on FR1 bands and ITS bands(for V2X use caes) in Rel-18. |
| CMCC | Option 2 | As no baseline for sidelink operation in FR2 has been defined yet in sidelink, we prefer deprioritize FR2 band in this release, and focus on FR1. |
| Vivo | Option 2 | Same view as CATT and CMCC |
| Huawei, HiSilicon | Option 2 | Given the available bandwidth for V2X is up to 40MHz, we should focus on 40MHz bandwidth for SLP evaluation. |
| Lenovo | Option 2 | We prefer to firstly study on licensed band SL Positioning for FR1. For FR2, it can be further evaluated based on ongoing FR2 SL enhancements in separate SI. |
| Spreadtrum | Option 2 |  |
| OPPO | Option 1 | We think both FR1 and FR2 bands should be considered. Although beam management is not supported on FR2 in R16 NR V2X, R16 NR SL still can operate on FR2 which has been agreed to support/design. Especially considering the limited BW for V2X in FR1, FR2 can provide wider and competitive BW for V2X, which make it reasonable to consider both FR1 and FR2. |
| Interdigital | Option 2 | Given that FR2 has not been well-studied in NR V2X (e.g., study of FR2 is one of the objectives for R18 NR V2X), we prefer to deprioritize FR2 from our study. We agree that, for V2X, the maximum BW is 40MHz. |
| Qualcomm | Option 3  (modified Option 1) | We do not agree with limiting V2X bandwidth to 40 MHz. Part of the SID is to evaluate the bandwidth needed to meet requirements and that should be the starting point. Once RAN1 identifies how much bandwidth is needed, then we can consider how that bandwidth can be realized.  We propose the following:  *Both FR1 and FR2 bands (with BWs up to 100 MHz and 400 MHz respectively) are considered in the study.* |
| Futurewei | Option 2 | We should give priority to SL Positioning for FR1. |
| Samsung | Option 2 |  |
| NEC | Option 2 | OK for option 1 but agree with ZTE that 100 MHz should be considered since there is a potential chance that unlicensed band will be considered with progress of sidelink as mentioned in the note of objectives. |
| Sony | Option 2 | Focus and use the discussion time to discuss FR1. |
| Xiaomi | Modified option 1 | We support to include FR2 in the study. Also, at least for bandwidth requirement evaluation purpose, 100MHz FR1 and 400MHz FR2 bandwidth can be considered for V2X use cases. |
| LGE | 3 | We prefer to modify the option 1 as follows. For V2X use cases, a new band n79 was introduced recently in the licensed spectrum, which support up to 100MHz. So we don’t need to limit the max. BW for V2X as 40MHz.  On the other hand, FR2 needs to be studied to support angle-based sidelink positioning, which comprises one of the relative positioning features.  As a conclusion, we suggest the following option.   * + ***Option 3:*** *Both FR1 and FR2 bands (with BWs up to 100 MHz and 400 MHz respectively) are considered in the study. For V2X use-cases, maximum BW of 100 MHz is considered.* |
| Nokia, NSB | Option 2 |  |
| Locaila | Option 2 | We prefer to study on FR1 band first. |
| NTT DOCOMO | Option 2 | Same view with CMCC and others. |
| Sharp | Option 2 |  |
| CEWiT | Option 3 | We do not want to limit the evaluation of V2X positioning to 40 MHz. With license band for in coverage with 100MHz is possible and should be include in evaluation. |
| Ericsson | Option 1 or 2 | If hybrid methods (using Uu RSs as well as SL RSs) are considered, option 1 should be applicable. If we only consider the sidelink signals, option 2. |
| Apple | Option 2 |  |
| FirstNet | Option 2 |  |
| Moderator |  | Summary of received responses:   * Option 1: OPPO, QC (w/o restrictions on max BW for V2X), Xiaomi (w/o restrictions on max BW for V2X), LGE (w/o restrictions on max BW for V2X), CEWiT (w/o restrictions on max BW for V2X), E// (if hybrid methods are considered) **(6)** * Option 2: ZTE (w/o restrictions on max BW for V2X), CATT, CMCC, vivo, HW-HiSi, Lenovo, SPRD, IDC, Futurewei, SS, NEC, SONY, Nokia, Locaila, DCM, Sharp, E//, Apple, FirstNet **(19)**   There seems to be a clear preference across companies to prioritize FR1 bands. Several responses also highlight that, considering availability of 100 MHz BW for V2X in licensed band n79, it is not necessary to limit BW for V2X use-cases to 40MHz. It was also pointed out that one of the tasks for RAN1 is to evaluate for required BW to satisfy positioning accuracy requirements, and thus, limiting to 40 MHz may not be consistent with such a study.  Accordingly, FL2 Proposal 3-2 is suggested for further consideration. |

## FL2 Proposal 3-2

* *For Rel-18 studies on SL positioning:*
  + *FR1 bands with maximum BW of 100 MHz are prioritized.*

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| **Company** | **Preferred option** | **Comments** |
| ZTE | Support |  |
| Futurewei | Support |  |
| CATT | Support |  |
| vivo | No | We observe the majority support option 2. So, we suggest revising the agreement as follows:   * *For Rel-18 studies on SL positioning:*   + *FR1 bands with 40 MHZ are prioritized.*   + *FFS FR1 bands with 100 MHZ.* |
| Samsung | OK |  |
| AT&T | Support | We are ok with the FL Proposal, especially if we only consider SL positioning reference signals, FR2 can be deprioritized. Similar to the previous Ericsson comment, if Uu + SL hybrid approaches are in considered, FR2 may be applicable. |
| LGE | Support |  |
| NEC | Support |  |
| CMCC | OK |  |
| Philips | OK |  |
| DCM | OK |  |
| Huawei, HiSilicon |  | We agree with vivo’s revision. |
| xiaomi |  | We still think FR2 band 400MHz shall also be considered. It would be more acceptable to chang “are prioritized” into “are considered”. |
| Lenovo | Support |  |
| InterDigital | Not support | We support the revised version from vivo.  We prefer to prioritize FR1 band of maximum 40MHz. 100MHz can be FFS. |
| Toyota ITC | OK |  |
| Nokia, NSB | OK |  |
| Qualcomm |  | In our view, it is still important to evaluate FR2 as well.   * *For Rel-18 studies on SL positioning:*   + *FR1 bands with maximum BW of 100 MHz are ~~prioritized~~studied.*   + *FR2 bands with maximum BW of 400 MHz are studied.* |
| Spreadtrum | Support |  |
| Moderator |  | Summary of received responses:   * Most responses are fine with the FL proposal. * Three responses (vivo, HW-HiSi, IDC) prefer to keep 100 MHz for FR1 bands as FSS * Two responses (Xiaomi, QC) propose to include FR2 bands as well.   Given the explicit objective of evaluating bandwidth requirements for NR SL positioning solutions to achieve target accuracy, it would be arbitrary to limit BW to 40 MHz in FR1 for SL positioning evaluations. The first sub-bullet could be generalized further to say “studied” instead of “prioritized”. This clearly leaves further room for any future (de-)prioritization as necessary and justified.  The consideration of FR2 bands has very limited support, primarly due to rudimentary spec-support for SL operations in FR2 due to lack of beam management. However, considering that at least three companies showed interest in FR2 evaluations across the two rounds of discussions, this is now listed as an FFS for now.  Based on the received feedback and explanations above, the proposal is updated as in FL3 Proposal 3-2. |

## FL3 HP Proposal 3-2

* *For Rel-18 studies on SL positioning:*
  + *FR1 bands with maximum BW of 100 MHz are studied.*
  + *FFS: FR2 bands with maximum BW of 400 MHz*

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| **Company** | **Comments** |
| CATT | Support |
| ZTE | Support |
| CEWiT | Support with removal of FFS. We would like to emphasize that study of FR2 is necessary so FFS should be removed. |
| Samsung | OK |
| vivo | Firstly, whether the bandwidth is defined for evaluation, if it is, the evaluation needs to be added in main-bullet.  In addition, anyway, the supported bandwidth for SL based on TS 38.101 is 40 M and should be the baseline at least.    So, we suggest revising the agreement as follows:   * *For ~~Rel-18 studies~~ evaluation on SL positioning:*   + *FR1 bands with 40 MHZ as a baseline.*   + *FR1 bands with maximum BW of 100 MHz can be optionally evaluated ~~studied~~.*   + *FFS: FR2 bands with maximum BW of 400 MHz* |
| Lenovo | Support. |
| FirstNet | Support |
| NEC | Support |
| OPPO | OK |
| AT&T | Support. |
| Huawei, HiSilicon | The proposal is not clear.  Is it the intention to say that RAN1 will study the FR1 bands that has the maximum 100MHz channel bandwidth, which actually excludes band n47.  Based on our interpretation, the proposal may be that   * *For Rel-18 studies on SL positioning:*   + *FR1 bands are studied*     - *The maximum bandwidth considered for the purpose of SL positioning evaluation is 100MHz.*     - *The actual bandwidth in the evaluation of a use case will be reviewed case by case in the evaluation methodology.*   + *FFS: FR2 bands with maximum BW of 400 MHz*     - *The maximum bandwidth considered for the purpose of SL positioning evaluation is 400MHz.* |
| InterDigital | Ok |
| Futurewei | Support |
| Bosch | We support the proposal. In our understanding at least FR1 studiying a maximum BW of 100 MHz should be suitable to all proposed use cases including V2X.  Available bandwidth known as of now, should not limit our investigation of bandwidth requirements for identified (prioritized) use cases. |
| Qualcomm | Like CEWiT, we also propose to remove the word “FFS”. To avoid the ambiguity pointed out by Huawei, “bands” could be replaced with “operation”   * *For Rel-18 studies on SL positioning:*   + *FR1 ~~bands~~ operation with maximum BW of 100 MHz ~~are~~ is studied.*   + *~~FFS~~: FR2 ~~bands~~ operation with maximum BW of 400 MHz ~~are~~ is studied.* |
| Ericsson | OK to the proposal for the same of progress, but we will need have further agreements to limit banwidth in e.g. ITS band evaluation. |
| Nokia, NSB | OK; Qualcomm’s wording is clearer |
| Locaila | We agree with vivo’s revision. |
| Spreadtrum | Support |
| LGE | Support for progress. |
| CMCC | We are fine with the first bullet.  Regarding the 2nd bullet, as summarized by FL, majority of companies do not want to touch FR2 as specification work of FR2 operation in SL is not started yet. Without baseline solutions in FR2 such as beam management, we really doubt the significance and benefit of studying FR2 in SL positioning. |
| xiaomi | Support for progress. We prefer to remove FFS. |
| Toyota ITC | OK |
| Sharp | Support |
| SONY | Support VIVO’s modification |
| Moderator | Summary of received responses:   * Majority (around 20) responses are supportive or can accept the proposal, subject to some re-phrasing for clarity. * Four responses (vivo, E//, Locaila, SONY) indicate preference to consider ITS band limitations, i.e., till 40 MHz. * Three responses (CEWiT, QC, Xiaomi) propose to remove “FFS” from the FR2 bullet.   @vivo and others preferring to consider limitations for ITS bands:   1. While V2X is currently limited to max of 40 MHz in RAN4 specs, as pointed out in the previous round, n79 band with max BW of up to 100 MHz are recently available for V2X. 2. From perspective of RAN1 specs, up to 100 MHz is supported for SL 3. One of the objective is to ascertain BW requirements for SL positioning, and applying a limit of 40 MHz may be undesirable for a complete study towards addressing the objective.   In view of the above, the first bullet is re-phrased as in **FL4 HP Proposal 3-2** to say “can be considered” from the perspective of scenario/requirements. Any further selection of “typical BW assumptions”, *if needed*, could possibly be considered as part of AI 9.5.1.2 as part of EVM.  For the FR2 issue, it seems rather difficult to commit to it at this point since a significant majority of companies prefer to focus on FR1 bands. Thus, keeping it as FFS would be the most reasonable option for now. |

## [CLOSED] FL4 HP Proposal 3-2

* *For Rel-18 studies on SL positioning:*
  + *Operation in FR1 bands with channel bandwidths of up to 100 MHz can be considered.*
  + *FFS: Operation in FR2 bands with channel bandwidths of up to 400 MHz can be considered.*

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| **Company** | **Comments** |
| Moderator | During GTW on May 17th, 2022, the following was agreed.  **Agreement**  For evaluations for SL positioning:   * Operation in FR1 with channel bandwidths of up to 100 MHz are considered. * Optional: Operation in FR2 with channel bandwidths of up to 400 MHz are considered. |
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Regarding potential limitations/combinations of target use-cases and network coverage scenarios, TR 38.845 and TS 22.104 indicate that V2X, public safety, and IIoT use-cases are relevant to both in-coverage and out-of-coverage scenarios, and consequently, also relevant to partial coverage scenarios. However, for commercial use-cases, it may be reasonable to limit to in-coverage scenarios only.

## FL1 Proposal 3-3

* *For V2X, public safety, and IioT use-cases, all three network coverage scenarios are in-scope.*
* *Commercial use-cases for SL positioning are limited to in-coverage scenarios only.*

*Please share your views on the above proposal.*

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| **Company** | **Comments** |
| CATT | We prefer to de-prioritize the partial coverage scenario for all use cases, in order to reduce the work load of the group.  The updated proposal as follows, Updated FL1 Proposal 3-3  * *For V2X, public safety, and IioT use-cases, only in-coverage and out-of-coverage ~~all three network coverage~~ scenarios are in-scope.* * *Commercial use-cases for SL positioning are limited to in-coverage scenarios only.* |
| CMCC | As I mentioned in the questions above, to limit the workload, we prefer to consider up to two use cases. |
| Vivo | We prefer to de-prioritize Commercial use-cases  The updated proposal as follows, Updated FL1 Proposal 3-3  * *For V2X, public safety, and IioT use-cases, all three network coverage scenarios are in-scope.* * *~~Commercial use-cases for SL positioning are limited to in-coverage scenarios only.~~* |
| Huawei, HiSilicon | SID has already demonstrated they are in-scope, the discussion for this agenda we assume should indicate which scenarios and requirements we should look at for evaluations. Note also that Table 7.9-1 from TS 22.261 (Table 1 in 5.1 below) specifies that the ranging requirements are not limited only to IC. In addition, the suggested proposal is covered by the discussions in Question 2-1 and 3-1 |
| Lenovo | As mentioned in Question 3-1, we can firstly select 1 or 2 representative commercial ranging use cases (stated in [TS 22.261, 6]), and then we can further determine whether to limit the coverage scenario to in-coverage scenarios for commercial use cases. Furthermore, coverage scenarios are also a separate KPI for commercial ranging and all scenarios are considered according to Table 7.9-1 of TS22.261. |
| OPPO | This proposal is not clear for its motivation. If the intention of this proposal is to discuss the scenario of different use cases, it is fine. But as in Q3-1, not all use cases can be considered as in this SI as mentioned by many companies. We are not sure if this proposal should keep all the 4 use cases of V2X, public safety, IioT and commercial, or it can be only focused on the coverage scenarios. |
| Interdigital | We prefer to discuss which use cases to consider first. As stated in our answer to the previous question (i.e., question 3-1), we prefer to prioritize V2X and IioT. We prefer to deprioritize coverage scenario of other use cases (e.g., commercial, public safety).  Regarding coverage scenario, we prefer to study IC first. When we have progress for IC, we can further study other coverage scenario (e.g., OOC and PC). |
| Qualcomm | First, we would like to ask for clarification of the proposal. Is it about evaluation? If not, then how would it impact the SI?  We disagree with the proposal if it is about evaluations. The typical case for V2X deployments is out-of-coverage. It is also unclear how evaluations of partial coverage would be performed in RAN1 in general and more details would be needed on that. In-coverage is important for IioT, whereas public safety use-cases need to consider both. While we think that both in-coverage and out-of-coverage are important for commercial use cases, we can compromise to focus on in-coverage only.  We propose the following:  *For evaluations:*   * *For V2X use-cases, consider out of coverage scenarios only.* * *For public safety, consider out of coverage and in coverage scenarios.* * *For commercial use-cases, consider in coverage scenarios.* * *For IioT use-cases for SL positioning consider in-coverage scenarios only.* |
| Futurewei | All the coverage cases and use cases are part of SID scope, therefore all use cases should be studied in all three coverage scenarios. For evaluation purposes, we may select a smaller subset. |
| Samsung | Is the intension of this proposal to reduce work load for evaluation? Then, we think that it would be better to discuss directly for Question 3-1. |
| NEC | We think this proposal might be redundant considering Q3-1 and 3-2. |
| Sony | The use-cases in SID are very wide. Due to the TU limitations, we consider to limit the use-cases (e.g., 1-2), in which we should prioritize at least V2X in-coverage scenario. |
| Xiaomi | All the coverage scenarios and use cases are included in the WID and none is out of the scope. If this proposal is only for evaluation to be performed in the study, we agree that we can select a subset of use case/scenario to evaluate. |
| LGE | We don’t think a specific network coverage scenario depends on a specific use case. We support all three network coverage scenarios for all the use cases as a SI scope. For example, even in the out-of-coverage area, a location-based service should be able to be provided. Prioritization of some coverage and scenarios is a different story. |
| Nokia, NSB | All coverage scenarios should be studied; however, for evaluation, we can focus on the most relevant coverage scenario for the use case (e.g. out of coverage for V2X, in-coverage for commercial). |
| Locaila | We think that this proposal should be discussed in question 3-1. |
| Sharp | We would like to first discuss the use cases in Proposal 3-1. |
| CEWiT | Looks like 3.3 is ahead if its time. We expect it will get derived based proposal 2.1 and 3.1 consensus. Just to reiterate we support all coverage for V2X and public safety to study but limit evaluations for in coverage and out of coverage. For IioT limit it to in coverage only. |
| Ericsson | We think the question 2-1 already answers this proposal. In our view, in and out of coverage should be evaluated for the most stringest requirements in considered use cases.  We are ok with the proposed evaluations from Qualcomm, with the addition of V2X in covereage, where Uu signals could also be leveraged. |
| Apple | It should be clarified if this proposal is about evaluations or about the scope of the SI and a decision on 3-1 should be made before we discuss this proposal in detail. |
| FirstNet | From public safety point of view, out-of-coverage scenario should be evaluated with most strict performance/accuracy requirements. |
| Moderator | Summary of received responses:   * Several responses request to clarify if the proposal is for evaluations or the scope of the SI itself. * Some responses indicate preference to wait until Proposal 3-1 is resolved. * Some responses prefer to deprioritize partial coverage cases for evaluations as there are questions on how partial coverage may be modelled. * There is a proposal to limit V2X to out-of-coverage, but there are also views that V2X for in-coverage scenarios should be evaluated, especially in context of hybrid schemes. * Several responses indicate preference to limit focus to in-coverage scenarios for evaluations of commercial and IioT use-cases. * There are also comments to deprioritize commercial use-cases altogether.   Some clarifications:   * The proposal is primarily for evaluations and not intending to change the scope of the SI. *The main motivation is to focus investigations and evaluations for the most relevant scenarios for a given use-case.* * Potential de-prioritization of evaluations for partial-coverage and commercial use-cases are discussed in Proposals 2-1 and 3-1 respectively. If such de-prioritization is agreed, then they will be considered in the context of the current proposal automatically. * Just to note, modelling of partial-coverage scenarios can be done if agreed, e.g., it was considered in TR 36.843, but it will likely require additional discussions and decisions in RAN1 for SL positioning evaluations.   Considering the received feedback, FL2 Proposal 3-3 is proposed below. |

## FL2 Proposal 3-3

* *For evaluations for SL positioning:*
  + *For V2X and public safety use-cases, at least in-coverage and out-of-coverage scenarios are considered.*
  + *For IioT and commercial use-cases, at least in-coverage scenarios are considered.*
  + *FFS: partial-coverage scenarios (pending decision for FL2 Proposal 2-1)*
* *Note: the above is subject to any potential (de-)prioritization of any use-cases (cf. FL2 Proposal 3-1).*

|  |  |  |
| --- | --- | --- |
| **Company** | **Preferred option** | **Comments** |
| ZTE | OK |  |
| Futurewei | Support |  |
| CATT | Support |  |
| vivo |  | For us, evaluation can be independent of coverage, it may only need to restrict relative only, or relative and absolute positioning for evaluation. In addition, for the coverage discussion, we think proposal 2-1 is enough. |
| Samsung | OK |  |
| AT&T | Support, but | We think the Note is not necessary. |
| LGE | Support | Though we prefer to prioritize OOC to IC, we can accept the proposal for progress. |
| NEC | Support |  |
| CMCC | Support |  |
| Philips |  | Although we prefer to also cover partial coverage scenarios, we are ok to go with the majority on this. |
| DCM | OK |  |
| Huawei, HiSilicon | No | We do not need make any agreement for evaluation, which belongs to 9.5.1.2. Moreover, we still don’t follow why the use case has to be bounded to the coverage scenario. Evaluating whether requirement is met should be in general independent of the coverage scenarios. |
| Xiaomi | OK | Although we think OOC scenario is important for commercial use case, we can accept the proposal if this is majority view. |
| Lenovo | Support |  |
| OPPO | Comment | For V2X, we still think partial coverage should be taken into account for study and evaluation. |
| FirstNet | Support |  |
| InterDigital | Support |  |
| Toyota ITC | OK |  |
| Nokia, NSB | OK |  |
| Qualcomm |  | As a compromise to limit the work and to prioritize the most likely deployment scenarios, we propose to make in-coverage V2X evaluations optional. Out of coverage support must be addressed for V2X and the is more difficult of the two cases.   * *For evaluations for SL positioning:*   + *For V2X ~~and public safety~~ use-cases, at least in-coverage (optional) and out-of-coverage (baseline) scenarios are considered.*   + *For ~~V2X and~~ public safety use-cases, at least in-coverage and out-of-coverage scenarios are considered.*   + *For IioT and commercial use-cases, at least in-coverage scenarios are considered.*   + *FFS: partial-coverage scenarios (pending decision for FL2 Proposal 2-1)* * *Note: the above is subject to any potential (de-)prioritization of any use-cases (cf. FL2 Proposal 3-1).* |
| Spreadtrum | Support |  |
| Moderator |  | Summary of received responses:   * All companies, except two, support the FL proposal in general. * Two responses (HW-HiSi, vivo) indicates that all scenarios can be generally applicable for all use-cases and wonders if this is in-scope for the current agenda. * One response (OPPO) indicates preference to consider partial coverage scenario for V2X use-cases. * In addition, towards enabling some workload management, one response (QC) suggests to focus on OOC as baseline and in-coverage as optional for V2X use-cases.   @HW-HiSi, vivo: This agenda is on scenarios and requirements and connecting the two is within scope of this agenda. While in general, all use-cases may apply to all scenarios, it is rather clear that not all use-cases have equal relevance for each scenario, at least from perspective of RAN solutions for SL positioning, and especially if this can help focus RAN1 studies better.  This is also evident from various proposals in contributions submitted to this agenda that observes/suggests possible prioritization of scenarios for different use-cases.  @OPPO: Partial-coverage scenarios are currently identified as FFS in context of current proposal, and can be incorporated based on decision for FL Proposal 2-1.  *Please note that these bullets are listed with “at least”, and thus, no combination is precluded as such.*  @QC: While the consideration to aid workload management is appreciated, given multiple companies prefer to consider in-coverage scenarios for V2X use-cases as well it may be better to first agree on the basic use-case to scenarios of primary interest first. Further decisions on “baseline” vs. “optional” categorization for evaluations could be had subsequently, e.g., in AI 9.5.1.2.  Based on the received feedback and explanations above, the same proposal, with deletion of the Note, is suggested for re-consideration. |

## FL3 HP Proposal 3-3

* *For evaluations for SL positioning:*
  + *For V2X and public safety use-cases, at least in-coverage and out-of-coverage scenarios are considered.*
  + *For IioT and commercial use-cases, at least in-coverage scenarios are considered.*
  + *FFS: partial-coverage scenarios (pending decision for FL2 Proposal 2-1)*

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| **Company** | **Comments** |
| CATT | Support |
| ZTE | Support |
| CEWiT | Support |
| Samsung | OK |
| vivo | Sorry, we don’t know why out of coverage is not considered at least for IioT or commercial use cases since the agenda is for SL evaluation. |
| Lenovo | Support. |
| FirstNet | Support. For public safety, out-of-coverage scenarios have higher priority than in-coverage scenarios. |
| NEC | We can agree on proposal 3-1 first before discussing this proposal. |
| OPPO | OK |
| AT&T | Support |
| Huawei, HiSilicon | We still do not see any link between the coverage scenario and the evaluation.  For the sake of progress, we would like to add the Note below.   * *For evaluations for SL positioning:*   + *For V2X and public safety use-cases, at least in-coverage and out-of-coverage scenarios are considered.*   + *For IioT and commercial use-cases, at least in-coverage scenarios are considered.*   + *FFS: partial-coverage scenarios (pending decision for FL2 Proposal 2-1)*   + *Note: the coverage scenario(s) associated with each use case may have no impact on the evaluation methodology, which should be reviewed case by case.* |
| InterDigital | Support |
| Futurewei | OK |
| Bosch | At least Iiot both in-coverage and out-of-coverage are considered. |
| Qualcomm | We can accept the proposal for progress though we still think that out-of-coverage is of higher priority in V2X scenarios. |
| Ericsson | We think the proposal is ok, but if this proposal is agreed, maybe “FL3 HP Proposal 2-1” is not needed. |
| Nokia, NSB | OK |
| Locaila | Support. |
| Spreadtrum | Support |
| LGE | We think some prioritization may be necessary considering the work load. In this aspect, we prefer to keep the note. |
| CMCC | Support |
| xiaomi | OK |
| Toyota ITC | OK |
| Sharp | Support |
| SONY | Support |
| Moderator | Summary of received responses:   * Majority (around 22) responses indicate support or acceptance of the FL proposal. * Two responses (vivo, Bosch) prefer to also add OOC for IIoT use-cases. * One response (NEC) prefers to wait until Proposal 3-1 is resolved. * One response (HW-HiSi) questions if evaluations may be impacted by consideration of coverage scenarios and proposes to add a Note to that effect.   @ vivo, Bosch: Considering current situation, it looks difficult to prioritize additional scenarios. However, companies are always welcome to bring results for the cases not listed in this proposal (hence, the “at least”) as the corresponding studies are expected to be well in-scope.  @ HW-HiSi: With the absence of network coverage, even if the deployment setup is reused, positioning methods and targets (e.g., relative vs. absolute positioning in some cases) may not be the same between in-coverage and OOC scenarios, depending on modelling, timing errors may be different across UEs within and outside of NW coverage, etc. Thus, in general, performance for in-coverage and OOC may differ, depending on particular assumptions considered.  Thus, although some common aspects of evaluation methodology may be shared across in-coverage and OOC, there are fundamental differences per definition of the coverage scenarios and depending on other assumptions and positioning methods considered, associated technical challenges and performance may vary. |

## [CLOSED] FL4 HP Proposal 3-3

* *For evaluations for SL positioning:*
  + *For V2X and public safety use-cases, at least in-coverage and out-of-coverage scenarios are considered.*
  + *For IIoT and commercial use-cases, at least in-coverage scenarios are considered.*
  + *FFS: partial-coverage scenarios (pending decision for FL2 Proposal 2-1)*

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| **Company** | **Comments** |
| Moderator | During GTW on May 17th, 2022, the following was agreed.  **Agreement**  For evaluations for SL positioning:   * For V2X and public safety use-cases, at least in-coverage and out-of-coverage scenarios are considered. * For IIoT and commercial use-cases, at least in-coverage scenarios are considered. |
|  |  |

As discussed in context of Proposal 3-1, for evaluation purposes, potential prioritization of use-cases in view of enabling workload management is considered in the next proposal.

## [NEW] FL4 HP Proposal 3-4

* *For evaluations for SL positioning in Rel-18:*
  + ***Opt 1:*** *V2X use-cases are prioritized.*
  + ***Opt 2:*** *V2X and public safety use-cases are prioritized.*
  + ***Opt 3:*** *V2X and IIoT use-cases are prioritized.*
  + ***Opt 4:*** *V2X, public safety, and IIoT use-cases are prioritized.*
  + *Opt 5: Other option(s), please clarify.*

*Please share your preferred option for the above.*

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| **Company** | **Preferred Opt.** | **Comments** |
| CATT | Opt 3 | To reduce the work load and considering the requirements from 5GAA and verticals, V2X use cases and IioT use cases should have higher priority than the other two kinds of use cases. |
| OPPO | Opt 1 | To study / evaluate all four use cases seems too much heavy workload. By now from the discussion, at least V2X use case is not excluded by any company. We would like to suggest that V2X use case can be prioritized. For public safety and IIoT use cases, either one or both can be optional.   * *For evaluations for SL positioning in Rel-18:*   + *V2X use-cases are prioritized.*   + *Optional: public safety use cases and/or IIoT use cases.* |
| Samsung | Opt 2 |  |
| vivo |  | We understand different companies have different priorities, but, it seems everyone agrees that V2X can be one of the baselines for evaluation. So, can we agree that two use cases are selected as a high priority for evaluation, one is V2X, and another is FFS? Or can we agree that V2X use-cases are prioritized for evaluation first？ |
| xiaomi |  | From our point of view, at least ranging for commercial use case shall be included in the evaluation. Ranging requirements for commercial use cases has been studied in SA1 and have been clearly capatured in TS 22.262, while for other use cases only absolute/relative positioning requirements are defined. To study the potential solutions for sidelink ranging, evaluation for commercial use cases would be necessary.  To make progress, a potential compromised solution is as following:   * *For evaluations for SL positioning in Rel-18:*   + *For ranging, commercial and V2X use cases are prioritized*   + *For absolute/relative positioning, V2X and IIoT use-cases are prioritized* |
| LGE | 1 and 2 | Our first priority is Opt 1, which is most important use case and the relevant simulation environments are well estabilised. But as commented before, since public safety use case was also discussed in RAN positioning SI together with V2X, we can live with Opt 2. They are both crucial use case for safety. |
| Huawei, HiSilicon | Opt 5 | V2X and commercial cases.  Since V2X is included in each option, it should be commonly understandable to be priorized. Different companies probably have different views for other cases priority. To harmonize or compromise, we can also live with option 1 and with all other cases optinally up to companies. With this compromise, we aslo assume it should be the common understanding that there is a section in the TR to capture the simulation results for each cases respectively. |
| FirstNet | Opt 2 | V2X and public safety use-cases are prioritized |

# Operation scenarios involving SL positioning

On operation scenarios, the following have been mentioned in company contributions:

* Scenario 1: PC5-based positioning
* Scenario 2: Combination of Uu- and PC5-based positioning solutions
* Scenario 3: Combination of NR RAT-dependent and RAT-independent solutions.

While consideration of Scenario 1 (PC5 only) may be somewhat obvious, hybrid options like either of or both Scenarios 2 and 3 are proposed in several contributions (e.g., [6], [12], [22], [26], [28], [29]). For Ues in coverage, it can be seen rather beneficial to consider availability of positioning mechanisms including assistance information from the NR network in addition to positioning or ranging methods operating exclusively over SL.

## FL1 Proposal 4-1

* *Following three operation scenarios are considered for studies on SL positioning:*
  + *Scenario 1: PC5-based positioning*
  + *Scenario 2: Combination of Uu- and PC5-based positioning solutions*
  + *Scenario 3: Combination of NR RAT-dependent and RAT-independent solutions.*

*Please share your views on the above proposal.*

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| --- | --- |
| **Company** | **Comments** |
| ZTE | We suggest focusing on scenario 1 and 2 only as it is hard to evaluate the scenario 3 in RAN1. |
| CATT | We prefer to prioritize Scenario 1. |
| CMCC | Scenario 1 and scenario 2 should be included for studies, where scenario 1 is applicable for out-of-coverage scenarios, and scenario 2 is applicable for in-coverage scenarios. |
| Vivo | We prefer to prioritize Scenario 1. |
| Huawei, HiSilicon | From SID, we only see Scenario 1 and scenario 2 are in the scope. |
| Lenovo | We prefer to study on scenario 1 and scenario 2. Scenario 3 can be decided by other WGs, e.g., RAN2. |
| Spreadtrum | We prefer Scenario 1 and Scenario 2. |
| OPPO | We would like to suggest to study both Scenario 1 and Scenario 2 by considering different coverage scenarios, i.e. IC, OoC and partial coverage. |
| Interdigital | We prefer to study both scenario 1 and 2. We don’t think that RAN1 is a suitable WG to study scenario 3. |
| Qualcomm | We share the view to study Scenarios 1 and 2. |
| Futurewei | We prefer Scenario 1 and Scenario 2 |
| Samsung | In our understanding, Scenario 3 can be discussed as separate proposal. We are OK with Scenario 1&2. |
| NEC | Option 1 and 2 only. |
| Sony | Prioritize Scenario 1 and Scenario 2 |
| Xiaomi | We prefer to prioritize scenario 1. |
| LGE | We prefer to prioritize the scenario 1, i.e. PC-5 based positioning, although we agree that the three scenarios are in scope of the SI. |
| Nokia, NSB | Scenario 1 and Scenario 2. Not clear to us what exactly we would study in RAN1 for Scenario 3. |
| Locaila | We share similar view with amsung |
| NTT DOCOMO | 1 and 2. |
| Sharp | We prefer Scenario 1 and Scenario 2. Scenario 1 is of higher priority. |
| CEWiT | We support scenario 1 and 2. |
| Ericsson | We support scenario 1 and 2. RAN1 can only consider scenarios 1 and 2. Scenario 3 would be very complex and require coordination with RAN2/3 |
| Apple | Scenarios 1 and 2. |
| FirstNet | Scenario 1 with highest priority. |
| Moderator | Summary of received responses:   * Almost all companies indicate preference to focus on operation scenarios 1 and 2.   Accordingly, an updated proposal is suggested as in FL2 Proposal 4-1. |

## FL2 Proposal 4-1

* *Following two operation scenarios are considered for studies on SL positioning:*
  + *Scenario 1: PC5-based positioning*
  + *Scenario 2: Combination of Uu- and PC5-based positioning solutions*

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| **Company** | **Preferred option** | **Comments** |
| ZTE | OK |  |
| Futurewei | Support. | It would be clearer if Scenario 1 is: “PC5 only based positioning” |
| CATT | Support | We prefer to prioritize Scenario 1 in Rel-18. |
| Samsung | OK |  |
| AT&T | Support | We think this is consistent with the SID |
| LGE | Support | Though we prefer to prioritized PC5-only to combination, we can accept the proposal for progress. |
| NEC | Support |  |
| CMCC | Support |  |
| Philips | OK with comments | Agree with wording change proposed by Futurewei |
| DCM | OK |  |
| Huawei, HiSilicon | OK |  |
| Xiaomi | OK |  |
| Lenovo | Support |  |
| OPPO | Support |  |
| FirstNet | Support |  |
| InterDigital | Support |  |
| Toyota ITC | OK |  |
| Nokia, NSB | OK |  |
| Qualcomm | Support |  |
| Spreadtrum | Support |  |
| Moderator |  | Summary of received feedback:   * All companies can accept or support the FL proposal.   Based on received feedback, the proposal is updated as FL3 Proposal 4-1. Further, it is listed in Section 7 as candidate for email endorsement. |

## [CLOSED] FL3 Proposal 4-1

* *Following two operation scenarios are considered for studies on SL positioning:*
  + *Scenario 1: PC5-only-based positioning*
  + *Scenario 2: Combination of Uu- and PC5-based positioning solutions*

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| **Company** | **Preferred Alt.** | **Comments** |
| Moderator |  | The following was agreed over email.  **Agreement**  Following two operation scenarios are considered for studies on SL positioning:   * Scenario 1: PC5-only-based positioning * Scenario 2: Combination of Uu- and PC5-based positioning solutions |
|  |  |  |

# Requirements for SL positioning

Considering various use-cases, the requirements for SL positioning can be defined using one of:

* Ranging (defined by distance and/or direction accuracy)
* Relative positioning (defined by accuracy of horizontal and vertical positions determined, relative to a reference node’s position)
* Absolute positioning (defined by accuracy of absolute horizontal and vertical positions determined).

For out-of-coverage and partial coverage scenarios, ranging and relative positioning may be more practical than absolute positioning, that would require assumption on knowledge on coordinates of reference nodes. At the same time, if SL positioning solutions are devised and studied, e.g., based on basic positioning methods like RTT, TDOA, or AoD/AoA, it would be natural to also study them towards enabling absolute positioning in different scenarios, as applicable.

From the perspective of requirements, it is also necessary to consider absolute positioning requirements as already identified in the RAN TR and SA2 TSs for the target use-cases for SL positioning. For consideration on absolute positioning in out of coverage and partial coverage scenarios, presence of anchoring nodes with known coordinates may be assumed in RAN1 studies. These may be modeled via assumptions on dedicated RSUs (for V2X use-cases) for out of coverage cases, while knowledge and propagation of coordinate information from NR network nodes, e.g., gNBs, are considerable for partial coverage scenarios.

## FL1 Proposal 5-1

* *Positioning accuracy requirements for SL positioning to consider the following metrics:*
  + *Ranging, expressed as accuracy at a particular percentile in the CDF of the error in estimated distance and/or direction from a reference node*
  + *Relative positioning accuracy, expressed as accuracy at a particular percentile in the CDF of the error in estimated horizontal and vertical positions relative to a reference node*
  + *Absolute positioning accuracy, expressed as accuracy at a particular percentile in the CDF of the error in estimated absolute horizontal and vertical positions*
  + *Note: the exact applicability of particular requirements may vary across use-cases*

*Please share your views on the above proposal.*

|  |  |
| --- | --- |
| **Company** | **Comments** |
| ZTE | Agree |
| CATT | We prefer the following revision: Updated FL1 Proposal 5-1  * *Positioning accuracy requirements for SL positioning to consider the following metrics:*   + *Ranging, expressed as accuracy requirement for ~~at~~ a particular percentile of UEs ~~in the CDF of the error~~ in estimated distance and/or direction from a reference node*   + *Relative positioning accuracy, expressed as accuracy requirement for ~~at~~ a particular percentile of UEs ~~in the CDF of the error~~ in estimated horizontal and vertical positions relative to a reference node*   + *Absolute positioning accuracy, expressed as accuracy requirement for ~~at~~ a particular percentile of UEs ~~in the CDF of the error~~ in estimated absolute horizontal and vertical positions*   + *Note: the exact applicability of particular requirements may vary across use-cases* |
| CMCC | We are fine with the proposal in general with one clarification.  Regarding the terminology “reference node” in the first and second bullet, does it related to the reference device that we have investigated in Rel-17, of which the coordinate is known in priori? In our understanding, ranging is to acquire distance between two UEs and/or direction of a UE from another UE, in typical use cases of ranging, e.g., vehicle collision avoidance, what matters is a target UE knowing its distance and/or direction ranging from another UE, whose coordinate is not necessarily required. |
| Huawei, HiSilicon | As ranging and relative positioning inherently involves two UEs, we propose the following modification: Updated FL1 Proposal 5-1  * *Positioning accuracy requirements for SL positioning to consider the following metrics:*   + *Ranging, expressed as accuracy at a particular percentile in the CDF of the error in estimated distance between the target UE and the reference UE and/or direction of the target UE from the reference UE ~~from a reference node~~*   + *Relative positioning accuracy, expressed as accuracy at a particular percentile in the CDF of the error in estimated horizontal and vertical positions of the target UE in a reference coordinate system ~~relative to a reference node~~*   + *Absolute positioning accuracy, expressed as accuracy at a particular percentile in the CDF of the error in estimated absolute horizontal and vertical positions*   + *Note: the exact applicability of particular requirements may vary across use-cases* |
| Lenovo | Agree, on bullet one reference node terminology may cause some confusion with respect to positioning reference unit (with known location) discussed in Rel-17. Since ranging involves distance/direction determination between a pair of UEs, we would prefer more clear terminology, e.g., ranging between an initiator entity and responder entity. |
| Spreadtrum | Support. |
| OPPO | We are fine with the proposal generally. |
| Interdigital | We are ok with the proposal. |
| Qualcomm | We are generally fine with the proposal except the “reference” node part as pointed by others and propose to update as follows:   * *Positioning accuracy requirements for SL positioning to consider the following metrics:*   + *Ranging, expressed as accuracy at a particular percentile in the CDF of the error in estimated distance and/or direction from ~~a reference~~ another node.*   + *Relative positioning accuracy, expressed as accuracy at a particular percentile in the CDF of the error in estimated horizontal and vertical positions relative to ~~a reference~~ another node*   + *Absolute positioning accuracy, expressed as accuracy at a particular percentile in the CDF of the error in estimated absolute horizontal and vertical positions*   + *Note: the exact applicability of particular requirements may vary across use-cases* |
| Futurewei | We are OK in principle with these metrics, but their definitions require additional clarifications as other companies mentioned. |
| Samsung | For raging, there is no reference (in TR38.845 and TS22.261 and TS22.104) for requirements of ‘direction (i.e. angle)’. So, we suggest to consider distance only. |
| NEC | Generally OK but we prefer to use the definition from TS 22.261 as below   * + *Ranging, expressed as accuracy at a particular percentile in the CDF of the error in estimated distance between two UEs and/or direction ~~from a reference node~~* *of one UE from the other one via direct device connection*   + *Relative positioning accuracy, expressed as accuracy at a particular percentile in the CDF of the error in estimated horizontal and vertical positions relative to ~~a reference node~~* *other network elements or relative to other UEs* |
| Sony | We need to have a clear definition to distinguish ranging and relative positioning.  It says the ranging is the error in estimated distance and/or direction. If the distance is without direction, is this horizontal distance or vertical distance?  For relative positioning, we prefer to say “… in estimated horizontal distance and/or vertical distance relative to a reference node”  The same view as QC, no need to say “reference UE”. It could be another UE. |
| Xiaomi | We are fine with FL proposal. On Samsung’s comment, in TS 22.261 section 7.9 Table 7.9-1, both distance accuracy and direction accuracy requirements are given. |
| LGE | We agree to the proposed requirements in general with one comment.  For ranging and relative positioning, we need to consider a distance in defining a performance metric. For example, a very high accuracy is not needed in ranging or relative positioning between UEs, which are apart by a long distance. In most cases, such a high accuracy is needed e.g. in lane change or avoiding collision, which happens in a very short distance.  A metric similar to PRR used in V2X evaluation can be used for this purpose. For example, the positioning error of average or target percentile in CDF vs. distance between UEs can be used as a metric. If CDF needs to be analyzed, then the CDF per distance can also be considered as a metric. We’re open to the method to include a distance into a metric. The point is that this issue should be included in defining a metric.  We propose to add the following sub-bullet.  *Positioning accuracy metric is defined as a function of a distance between UEs in ranging and relative positioning* |
| Nokia, NSB | The first metric introduced should be called “Ranging accuracy” rather than just “Ranging” to avoid confusion:   * + *Ranging accuracy, expressed as accuracy at a particular percentile in the CDF of the error in estimated distance and/or direction from a reference node*   Agree with other companies that the term “reference node” is potentially confusing here. |
| Locaila | We support FL’s proposal. |
| NTT DOCOMO | OK |
| Sharp | We are OK with the proposal. |
| CEWiT | We are fine with proposal with small modification about reference node as suggested by QualComm |
| Ericsson | OK with Qualcomm’s rewording. |
| Apple | We are fine with the need to define these metrics. Agree with Nokia on the need to add the word “accuracy” to the ranging bullet to make it similar to the others. . Also update to the term “reference node” should be made. |
| FirstNet | OK with the proposal. BTW, accuracy is the distance between two UEs. |
| Moderator | Summary of received responses:   * In general, most companies seem fine with the proposal in principle. * Most companies requested clarification on use of “reference node” and relationship to consideration of “reference nodes” during Rel-17 discussions, and suggested rewordings. * One response proposes to define positioning accuracy as a function of the distance between UEs involved in ranging or relative positioning. * One response proposes to remove “directional accuracy” as part of ranging accuracy, but it was pointed out that such requirements are currently specified in TS 22.261.   Couple of clarifications:   * No intention to imply “reference node” = PRU/anchor node – the wording is updated in updated proposal based on received suggestions. * On defining positioning accuracy as a function of distance, this would be out-of-scope for the current proposal as it is not considering *how the accuracy requirement is defined, but just the framework.* This aspect may be better discussed in context of EVM as in the AI 9.5.1.2.   Based on the received feedback, the proposal is updated as in FL2 Proposal 5-1. |

## FL2 Proposal 5-1

* *Positioning accuracy requirements for SL positioning to consider the following metrics:*
  + *Ranging accuracy, expressed as accuracy requirement of a particular percentile of UEs in estimated distance and/or direction from another node*
  + *Relative positioning accuracy, expressed as accuracy requirement of a particular percentile of UEs in estimated horizontal and vertical positions relative to another node*
  + *Absolute positioning accuracy, expressed as accuracy requirement of a particular percentile of UEs in estimated absolute horizontal and vertical positions*
  + *Note: the exact applicability of particular requirements may vary across use-cases*

|  |  |  |
| --- | --- | --- |
| **Company** | **Preferred option** | **Comments** |
| ZTE | OK |  |
| Futurewei | Support |  |
| CATT | Support |  |
| vivo | okay |  |
| Samsung | OK |  |
| AT&T | Not support | We think that the revised wording as it now reads is no longer technically correct. Accuracy is not the estimated distance or direction from another node, as it reads now. Accuracy metrics are the *difference (or error)* between the calculated distance/direction and the actual distance/direction in relation to another node. This is no longer reflected in the proposal. We propose the following:   * *Positioning accuracy requirements for SL positioning to consider the following metrics:*   + *Ranging accuracy is expressed as the difference (error) between the calculated distance/direction and the actual distance/direction in relation to another node for a particular percentile of UEs*   + *Relative positioning accuracy is expressed as the difference (error) between the calculated horizontal/vertical position and the actual horizontal/vertical position relative to another node for a particular percentile of UEs*   + *Absolute positioning accuracy is expressed the difference (error) between the calculated horizontal/vertical position and the actual horizontal/vertical position* |
| LGE | Support |  |
| NEC | Support |  |
| CMCC | Support |  |
| Philips | See comments | Agree with AT&T |
| DCM | OK |  |
| Huawei, HiSilicon |  | We tend to agree with AT&T’s proposal. |
| Xiaomi |  | We prefer to AT&T wording. |
| Lenovo | Support |  |
| OPPO | Support |  |
| FirstNet | See comments | Prefer AT&T’s wording |
| InterDigital |  | We support the suggested change from AT&T. |
| Toyota ITC |  | We prefer to AT&T wording. |
| Nokia, NSB | Comment | AT&T’s correction is required |
| Qualcomm |  | We have a general question about the definition of horizontal and vertical in the case of relative positioning. Is the horizontal plane one that contains the other UE and anchors or is it parallel to the ground? |
| Spreadtrum | Support |  |
| Moderator |  | Summary of received responses:   * Companies are fine with the proposal in general. * Few responses (AT&T and others) suggest a re-wording that defines the metrics from basics. * One response (QC) raises the question on definition of horizontal and vertical planes in context of relative positioning.   @AT&T and others: The definitions in FL2 Proposal 5-1 are technically accurate. Please note that the definitions say “accuracy *requirements* for … in estimated distance/direction/etc. …”. The aim was to avoid defining the basic accuracy metrics again as they have been defined in previous releases.  Note that, per the main bullet, we are not defining the accuracy metrics themselves, but defining the requirements for SL positioning based on these accuracy metrics. Thus, if we go with AT&T’s version, we need some further minor adjustment as indicated in updated proposal below.  @QC: In the Moderator’s understanding, they are same as for absolute positioning, and thus, horizontal plane is parallel to the ground. Otherwise, there can be ambiguity in defining the horizontal plane, e.g., when only two nodes are involved for relative positioning. A new proposal is added to clarify this.  Based on the received feedback and explanation above, the proposal is updated as FL3 Proposal 5-1. |

## FL3 Proposal 5-1

* *Positioning accuracy requirements for SL positioning are expressed as accuracy requirements of particular percentiles of UEs for one or more of the following metrics:*
  + - *Ranging accuracy, expressed as the difference (error) between the calculated distance/direction and the actual distance/direction in relation to another node for a particular percentile of UEs*
    - *Relative positioning accuracy, expressed as the difference (error) between the calculated horizontal/vertical position and the actual horizontal/vertical position relative to another node for a particular percentile of UEs*
    - *Absolute positioning accuracy. expressed the difference (error) between the calculated horizontal/vertical position and the actual horizontal/vertical position*
  + *Note: the exact applicability of particular requirements may vary across use-cases*

*Please share your views on the above.*

|  |  |
| --- | --- |
| **Company** | **Comments** |
| CATT | Support |
| ZTE | Support |
| CEWiT | Support |
| Lenovo | Support. |
| NEC | Since ‘particular percentiles of UEs’ appears in the main bullet, it can be removed in the sub-bullets. |
| OPPO | Support |
| AT&T | Support and thanks for incorporating our suggestions. We also agree with the NEC comment that “*for a particular percentile of UEs*” is redundant in the 1st two sub-bullets. |
| Huawei, HiSilicon | OK |
| Futurewei | Support |
| Qualcomm | Support |
| Ericsson | Support |
| Nokia, NSB | OK |
| Locaila | Support |
| Spreadtrum | Support |
| LGE | Support |
| Xiaomi | OK |
| Toyota ITC | Support |
| Sharp | Support |
| Moderator | Summary of received responses:   * All responses indicate support/acceptance of the FL proposal, with some suggesting editorial updates.   The proposal is updated based on received feedback as in **FL4 Proposal 5-1**. |

## FL4 Proposal 5-1

* *Positioning accuracy requirements for SL positioning are expressed as accuracy requirements of particular percentiles of UEs for one or more of the following metrics:*
  + - *Ranging accuracy, expressed as the difference (error) between the calculated distance/direction and the actual distance/direction in relation to another node*
    - *Relative positioning accuracy, expressed as the difference (error) between the calculated horizontal/vertical position and the actual horizontal/vertical position relative to another node*
    - *Absolute positioning accuracy. expressed the difference (error) between the calculated horizontal/vertical position and the actual horizontal/vertical position*
  + *Note: the exact applicability of particular requirements may vary across use-cases*

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Moderator | This proposal is stable, thus, moved to Section 7.1 and recommended for email approval. |

## FL3 Proposal 5-2

* *For relative positioning, the horizontal plane is assumed parallel to the ground.*

*Please share your views on the above.*

|  |  |
| --- | --- |
| **Company** | **Comments** |
| CATT | Support |
| ZTE | Support |
| CEWiT | Support |
| Lenovo | Support. |
| NEC | Support |
| OPPO | Support |
| AT&T | Support |
| Huawei, HiSilicon | We do not support the proposal.  In Rel-16/Rel-17, the local coordinate system can be expressed rather randomly, resulting the z axis in the LCS not necessarily perpendicular to the ground.  Having this assumption is too restrictive from the application of relative positioning if the UE may rotate or when a vehicle is on a slope. |
| InterDigital | Support |
| Futurewei | OK |
| Qualcomm | We are generally ok with the proposal but would like to limit it for evaluation purposes at this stage. We can revisit specification aspects later.   * *For evaluations of relative positioning, the horizontal plane is assumed parallel to the ground.* |
| Ericsson | Not really clear why the proposal is necessary. It seems the existing coordinate system allows to evaluate relative positioning without this limitation. |
| Nokia, NSB | OK |
| Locaila | Support. |
| Spreadtrum | Support |
| LGE | Support |
| Xiaomi | OK |
| Sharp | Support |
| Moderator | Summary of received responses:   * Most responses indicate support/acceptance of the FL proposal * One response (QC) suggests to clarify that the assumption is limited to evaluations only. * Two responses (HW-HiSi, Ericsson) question the need for the proposal considering availability of LCS.   Based on received feedback, it is clarified that this assumption is only for evaluation purposes and is accordingly updated as in **FL4 Proposal 5-2**. |

## FL4 Proposal 5-2

* *For evaluations of relative positioning, the horizontal plane is assumed parallel to the ground.*

*Please share your feedback* ***if you have strong concerns*** *with the above proposal.*

|  |  |
| --- | --- |
| **Company** | **Comments** |
|  |  |

In addition, requirements on positioning latency are also available from the SA2 TSs and RAN TRs and have been proposed for consideration by multiple companies.

In the next sub-sections, the requirements identified for each of the potential target use-cases are discussed, including consideration of potential harmonization of requirements across use-cases to manage the evaluation efforts.

# Requirements for ranging requirements for SL positioning

Requirements on ranging and relative positioning are some of the most important considerations for SL positioning. Ranging in LOS conditions is one of the minimal functionalities expected for V2X use-cases to estimate distance between two vehicles or direction of one vehicle from another vehicle or RSU, etc.

The requirements on ranging are defined in TS 22.261 and TR 22.855, and are reproduced below in Table 1.

**Table 1: Requirements on ranging services from TS 22.261 (Table 7.9-1)**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Ranging scenario** | **Ranging Accuracy**  **(95 % confidence level)** | | **Availability** | **Latency**  10ms  50ms  50ms | **Effective ranging distance** | **Coverage** | **NLOS/LOS** | **Relative UE velocity** | **Ranging interval** | **Number of concurrent ranging operation for a UE** | **Number of concurrent ranging operation in an area** |
| **Distance Accuracy** | **Direction Accuracy** |
| Smart TV Remoter | 10cm up to 3 meter separation | ±2° horizontal direction accuracy at 0.1 to 3 meter separation and AoA coverage of (-60°) to (+60°);  ±2° Elevation direction accuracy at 0.1 to 3 meter separation and AoA coverage of (-45°) to (+45°) | 99 % | 50ms | 10m | IC/PC/OOC | LOS | Static/ Moving  (<1m/s) | 50ms | - | - |
| Picture and video sharing based on Ranging results | 10cm | 2° | 99 % | 50ms | 10m | IC/PC/OOC | LOS | Static/ Moving  (<1m/s) | 50ms | - | - |
| Distance based smart device control | 10cm | - | 99 % | 100ms | 20m | IC/PC/OOC | LOS | Static/ Moving  (<1m/s) | 50ms | 20 | - |
| Smart Vehicle Key | 10 cm | - | 99 % | 50ms | 30m | IC/PC/OOC | LOS | Static/ Moving  (<2m/s) | 25ms | - | 50UEs/  (104m2) |
| Touchless Self-checkout Machine Control | 10cm | - | 99% | 150ms | 1m | IC/PC/OOC | LOS | Static/ Moving  (<1m/s) | 100ms | - | = |
| Hands Free Access | 10cm | - | 99 % | 500ms | 10 m | IC/PC/OOC | LOS | Static/ Moving  (1 m/s) | 50ms | - | 20 Ues/3.14\*100m2 |
| Smart Transportation Metro/Bus Validation | 10cm | - | 99 % | - | 2m | IC/PC/OOC | LOS | Static/ Moving  (3km/h) | 50ms | 20 | 100 in the area of 8 m2 |
| Ranging of UE’s in front of vending machine | 20cm | 10° | - | 1s | 5m | IC/PC/OOC | LOS | Static/ Moving  (<1m/s) | 50ms | - | 10 |
| Finding Items in a supermarket | 50 cm | 5 degree | 95 % | - | 100m | IC/PC/OOC | LOS | Static/ Moving  (<1m/s) | 250ms | - | 100 Ues/  (3.14\*104m2) |
| distance based intelligent perception for public safety | 50cm | - | 99 % | - | 20m | IC/PC/OOC | LOS | Static/ Moving  (<20km/h) | - | 100 | - |
| Long Distance Search | 20m | 5° | 99 % | - | 100m-1km | IC/PC/OOC | LOS | Static/ Moving  (up to 10m/s) | 5s | - | - |
| Long range approximate location | [10m] | ±[12.5°] | 99 % | - | 500m | IC/PC/OOC | LOS | Static/ Moving  (<10m/s) | - | 1 | [50]Ues/  (104m2) |

Different views on defining requirements on ranging have been expressed in submitted contributions as summarized below:

* References [7] and [20] propose that ranging requirements are not separately considered and instead they are assumed to be fulfilled by the requirements on relative positioning.
* Reference [10] proposes the following for ranging:
  + *Distance accuracy (< 3 m) for 90% of Ues.*
* Reference [15] proposes:
  + “*The scenario of direct ranging between two Ues shall be prioritized compared with ranging with assistance of third UE.*”
* Reference [16] indicates that the same requirements should be considered for ranging, relative positioning, and absolute positioning.
* Reference [23] proposes:
  + “*RAN1 to select 1 or 2 representative commercial ranging use cases to derive commercial SL positioning requirements, preferably based on the KPIs, e.g., accuracy, latency aligned with that of V2X or Public Safety*”
* Reference [24] proposes:
  + “*For commercial with ranging scenario, the more concrete applications for the positioning should be firstly clarified.”*
* Reference [27] proposes:
  + “*The number of concurrent ranging operations in an area and the number of concurrent operations for a UE shall be added to the evaluation criteria.”*
* Reference [28] proposes the following requirements down selected from Table 1:
* **Table 2. Ranging use-cases and requirements proposed in [28]**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Ranging scenario** | **Ranging Accuracy**  **(95 % confidence level)** | | **Availability** | **Latency**  10ms  50ms  50ms | **Effective ranging distance** | **Coverage** | **NLOS/LOS** | **Relative UE velocity** | **Ranging interval** | **Number of concurrent ranging operation for a UE** | **Number of concurrent ranging operation in an area** |
| **Distance Accuracy** | **Direction Accuracy** |
| Hands Free Access | 10cm | - | 99 % | 500ms | 10 m | IC/PC/OOC | LOS | Static/ Moving  (1 m/s) | 50ms | - | 20 Ues/3.14\*100m2 |
| distance based intelligent perception for public safety | 50cm | - | 99 % | - | 20m | IC/PC/OOC | LOS | Static/ Moving  (<20km/h) | - | 100 | - |
| Long Distance Search | 20m | 5° | 99 % | - | 100m-1km | IC/PC/OOC | LOS | Static/ Moving  (up to 10m/s) | 5s | - | - |

As a first step, it would be necessary to align views on the handling of requirements on ranging. Towards this, the following question is raised.

## FL1 Question 5.1-1

* *Please share your views on the handling of ranging requirements for SL positioning:*
  + ***Option 1:*** *Based on requirements defined in Table 7.9-1 in TS 22.261.*
    - *Please also indicate preferred use-cases and requirements from this table.*
  + ***Option 2:*** *For ranging, the requirements on distance accuracy are same as those identified for relative and absolute positioning.*
  + ***Option 3:*** *For ranging, the requirements are a subset of selected requirements from those identified for relative and absolute positioning.* 
    - *Please indicate preferred requirements.*
  + ***Option 4:*** *For ranging, the requirement on distance accuracy is < 3m for 90% of the Ues.*
  + ***Option 5:*** *Ranging requirements are not separately considered but assumed to be covered by relative positioning requirements.*
  + ***Option 6:*** *Other option(s).*

|  |  |  |
| --- | --- | --- |
| **Company** | **Preferred option** | **Comments** |
| ZTE | Option 5 | We prefer to make things simpler, so the requirements of ranging can be considered with relative poisoning together. |
| CATT | Option 4 | In addition, for ranging, the direction accuracy also needs to be considered. |
| CMCC | Option 5 | Based on the definition in TS22.261, ranging is to acquire distance between two Ues and/or direction of one UE from another UE. In our views, the typical use cases should be first justified before we discussing specific direction accuracy. Regarding the distance accuracy, we prefer Option 5. |
| Vivo | Option 4 | Same view as CATT, the direction accuracy also needs to be considered. |
| Lenovo | Option 3 | We prefer to select 1 or 2 commercial ranging use cases to derive commercial SL positioning requirements. The accuracy and latency of the selected commercial ranging use case should align with that of V2X or Public Safety”. For example, Long Distance Search and Hands Free Access. |
| OPPO | Option 5 | Ranging requirements can be considered together with relative positioning requirements for simplicity. |
| Interdigital | Option 4 | We are generally ok with Option 4 with the distance accuracy of 3m for 90% of the UE. However, we also need to consider the direction accuracy in Option 4. |
| Qualcomm | Option 6 | Ranging accuracy requirements should be similar to those for relative positioning. We propose to use 0.5m accuracy since it covers requirements of various use cases. |
| Futurewei | Option 6 | We think that it depends on the resolution of Proposal 5-1. If the ranging is defined only for UE-to-UE case in V2X scenarios, the case for a separate requirement may be done, and Option 4 is preferred. If ranging scenario is between any two nodes Option 5 would be preferable. |
| Samsung | Option 2 |  |
| NEC | Option 5 | Ranging can be a subset of relative positioning. |
| Sony | Option 5 | We could also have direction accuracy as part of Option 5 |
| Xiaomi | Option 1 | Distance accuracy of 0.1m and direction accuracy of 5 degree can be assumed as the SL ranging requirement, which is the requirement of most ranging use cases in TS 22.261. |
| LGE | 5 | We support option 5. The ranging is a subset of the relative positioning either with a distance or an angle. We don’t see the reason to separately define a requirement for ranging apart from those for relative positioning in this SI. |
| Nokia, NSB | Option 5 |  |
| Locaila | Option 5 | We share similar view that ranging is a sub set of the relative positioning. |
| NTT DOCOMO | Option 5 |  |
| Sharp | Option 5 | We prefer to consider together with relative positioning. |
| CEWiT | Option 6 | Ranging accuracy can be similar to the relative positioning and relative positioning accuracy can be more stringent than absolute accuracy. |
| Ericsson | Option 1 | We support the 3 accuracy targets mentioned in our contributions (0.1, 0.5 and 20m, respectively). |
| Apple | Option 5 |  |
| FirstNet | Option 5 |  |
| Moderator |  | Summary of received responses:   * **Option 1:** Xiaomi (w/ 0.1m distance and 5 deg for direction accuracies), E// (0.1, 0.5, and 20 m distance accuracy) **(2)** * **Option 2:** Samsung, [QC, similar as relative positioning], [CEWiT, similar as relative positioning] **(1 + [2])** * **Option 3:** Lenovo **(1)** * **Option 4:** CATT, vivo, IDC **(3)** * **Option 5:** ZTE, CMCC, OPPO, NEC, SONY, LGE, Nokia, Locaila, DCM, Sharp, Apple, FirstNet **(12)** * **Option 6:** QC (similar as relative positioning), Futurewei (depending on resolution of Proposal 5-1), CEWiT (similar as relative positioning) **(3)**   Most responses indicate preference to not consider ranging accuracy requirements separately in addition to requirements on relative positioning.  Some responses indicate preference to define ranging accuracy targets and consider similar requirements as for relative positioning. If Option 2 is limited to relative positioning, then Options 2 and 5 could effectively be merged.  In terms of ranging accuracy targets, candidate values include: 0.1 m, 0.5 m, 3 m, and 20 m.  At least four responses suggest to also consider directional accuracy requirements for relative positioning, including one suggestion to select 5 deg for 90% Ues, based on requirements in TS 22.261.  Based on the received feedback, FL2 Proposal 5.1-1 is suggested below. |

## FL2 Question 5.1-1

* *Ranging requirements for SL positioning are defined as:*
  + *For a given use-case, the requirements on ranging distance accuracy are same as those identified for relative positioning.*
  + *The requirement on ranging direction accuracy is 5 degrees for 90% of Ues.*

|  |  |  |
| --- | --- | --- |
| **Company** | **Preferred option** | **Comments** |
| ZTE | OK |  |
| Futurewei | Support |  |
| CATT | Support |  |
| vivo | No | In the SID, it includes the study and evaluation of ranging   * Study and evaluate performance and feasibility of potential solutions for SL positioning, considering relative positioning, ranging and absolute positioning: [RAN1, RAN2]   In addition, we can understand ranging of distance and angle may equal to relative positioning, but ranging also includes ranging of distance only, can the supporters explain why ranging of distance only is the same as relative positioning.  Besides we prefer to put 5 degrees in the bracket or FFS since determining a target is too early for us. |
| Samsung | OK in general. |  |
| AT&T | Support bullet 1 only | We think the second bullet is not entirely accurate and does not reflect the requirements in TS 22.261, which states: “an accuracy better than 5 degree for the 3-Dimension direction of travel.” This is not specific to ranging for SL or requirement for 90% of Ues. At a minimum these values should be bracketed or FFS. |
| LGE | Support |  |
| NEC | Support in principle | OK for the first sub-bullet but second can be further discussed. |
| CMCC |  | We are supportive of the first bullet.  Regarding the 2nd bullet, it seems too early to adopt 5% for 90% UE in this stage. It is not clear yet what is the typical use case of directional ranging, without which the target requirement is meaningless. |
| Philips | OK |  |
| DCM | OK | Probably 5 deg should be with brackets in this stage. |
| Huawei, HiSilicon |  | We suggest to tie ranging requirement with commercial use case, define the target equirement there. |
| Xiaomi | OK |  |
| Lenovo | Support |  |
| OPPO | OK |  |
| InterDigital | Support in principle but with comments | We prefer to FFS the ranging direction accuracy. |
| Nokia, NSB | OK with comment | [5] degrees should be in brackets for now |
| Qualcomm | Needs clarification | We think the proposal needs to be updated to clarify what it means that the requirements are the same. In relative positioning, we have x, y components in the horizontal plane with associated accuracy requirement D. Does the text propose the ranging accuracy to be D or sqrt(2)D? We propose the update below to implement the former understanding.  Separately, we think the 5 degree direction accuracy needs further discussion given the limited number of antennas for certain device class in this study.   * *Ranging requirements for SL positioning are defined as:*   + *For a given use-case, the value of requirements on ranging distance accuracy ~~are~~ is the same as ~~those~~ the value identified for relative positioning.*   + *The requirement on ranging direction accuracy is ~~5~~Y degrees for 90% of Ues.*     - FFS Y |
| Spreadtrum | Support |  |
| Moderator |  | Summary of received responses:   * In general, most responses indicate they are fine with FL proposal, with a preference to keep the directional accuracy requirements as FFS voiced by multiple companies and a question/suggestion for clarification of the proposal suggested by one response (QC). * One response (vivo) disagrees due to potential misunderstanding of the proposal. Hopefully, the update suggested by QC can address their concern.   To the question/suggestion from QC, the intention was indeed the first interpreration in QC’s optionsConsidering that direction accuracy requirements may need some further considerations and discussions, it is now identified as FFS.  Based n the above, the proposal is updated as in FL3 Proposal 5.1-1. |

## FL3 Proposal 5.1-1

* *Ranging requirements for SL positioning are defined as:*
  + *For a given use-case, the value of the distance requirement for ranging distance accuracy is same as the value identified for relative positioning.*
  + *The requirement on ranging direction accuracy is [Y] degrees for 90% of Ues.*

*Please share your views on the above.*

|  |  |
| --- | --- |
| **Company** | **Comments** |
| CATT | We prefer to add one sub-bullet for the value of Y is FFS as follow, Updated FL3 Proposal 5.1-1  * *Ranging requirements for SL positioning are defined as:*   + *For a given use-case, the value of the distance requirement for ranging distance accuracy is same as the value identified for relative positioning.*   + *The requirement on ranging direction accuracy is [Y] degrees for 90% of Ues.*     - FFS: the value of Y |
| ZTE | Support. Also fine with CATT’s revision. |
| CEWiT | Support. To complete the proposal suggestion from CATT should be adopted. |
| Lenovo | Support. |
| NEC | Agree with CATT |
| OPPO | OK |
| AT&T | Ok, FFS is fine for [Y] or square brackets for [5] |
| Huawei, HiSilicon | We prefer to independently consider the distance requirement instead of borrowing the “horizontal positioning accuracy” requirement, if that is the intention. |
| InterDigital | Support. We are ok with the added FFS from CATT. |
| Futurewei | OK |
| Qualcomm | Support |
| Nokia, NSB | OK. We support CATT’s proposal to add FFS on value of Y. |
| Locaila | We are also agree with CATT |
| Spreadtrum | Support |
| LGE | Support |
| Xiaomi | OK |
| Sharp | OK |
| Moderator | Summary of received responses:   * All but one responses indicate support/acceptable of FL proposal, with some suggestion on directional accuracy requirement. * One response (HW-HiSi) prefers to have the distance requirement for ranging independent from horizontal positioning accuracy for relative positioning.   @HW-HiSi: Yes, the reusing the target horizontal positioning accuracy is suggested. Would it help if this is clarified as for evaluations only?  Considering the feedback received, the proposal is updated as in **FL4 Proposal 5.1-1**. |

## FL4 Proposal 5.1-1

* *For evaluations in Rel-18, ranging requirements for SL positioning are defined as:*
  + *For a given use-case, the value of the distance requirement for ranging distance accuracy is same as the value identified for horizontal positioning accuracy for relative positioning.*
  + *The requirement on ranging direction accuracy is Y degrees for 90% of UEs.*
    - *FFS: value of Y*

*Please share your feedback* ***if you have strong concerns*** *with the above proposal.*

|  |  |
| --- | --- |
| **Company** | **Comments** |
|  |  |

# Requirements for SL positioning for V2X use-cases

For V2X use-cases, TR 38.845 provides the following sets of use-cases based on the identified requirements from TS 22.261.

**Table 3. Requirements for SL positioning for V2X use-cases**

|  |  |
| --- | --- |
| **Set #** | **SL positioning accuracy requirements (for absolute and relative positioning)** |
| 1 | 10 – 50 m horizontal accuracy, 3 m vertical accuracy, with 68 – 95 % confidence level |
| 2 | 1 – 3 m horizontal accuracy, 2 – 3 m vertical accuracy, with 95 – 99 % confidence level |
| 3 | 0.1 – 0.5 m, 2 m absolute vertical accuracy (/0.2 m relative vertical accuracy) with 95 – 99 % confidence level |

Considering the large number of use-cases and requirements, multiple contributions indicated prferences to limit the requirements to focus on for V2X use-cases. While some contributions indicating picking the most demanding requirements to focus on, some others have opined that, in view of Rel-18 being the first release for SL positioning, some of the most challenging requirements (e.g., sub-1m horizontal accuracy) may be deferred to a future release. The views are summarized below for V2X use-cases:

* References [8], [9], and [11] propose selecting the requirements based on “Set 2” in Table 3:
  + *Horizontal accuracy of 1 – 3 m; Vertical accuracy of 2 – 3 m (absolute and relative)*
* References [13], [18], and [21] propose selecting the requirements based on “Set 3” in Table 3:
  + *Horizontal accuracy of 0.1 – 0.5 m; Vertical accuracy of 2 m (absolute)/ 0.2 m (relative)*
* References [23], [28], and [29] propose selecting the requirements based on the following:
  + *Horizontal accuracy of 1 m; Vertical accuracy of 1 ~ 2 m (absolute)/ 0.2 m (relative)*

For the last case, the proponents have argued their preference from the perspective of aligning the requirements between V2X and public safety use-cases.

## FL1 Question 5.2-1

* *Please share your views on the requirements for V2X use-cases for SL positioning:*
  + ***Option 1:*** *Based on “Set 2” in TR 38.845:*
    - *Horizontal accuracy of 1 – 3 m; Vertical accuracy of 2 – 3 m (absolute and relative)*
  + ***Option 2:*** *Based on “Set 3” in TR 38.845:*
    - *Horizontal accuracy of 0.1 – 0.5 m; Vertical accuracy of 2 m (absolute)/ 0.2 m (relative)*
  + ***Option 3:*** *As below:* 
    - *Horizontal accuracy of 1 m; Vertical accuracy of 1 ~ 2 m (absolute)/ 0.2 m (relative)*
  + ***Option 4:*** *Other option(s).*

|  |  |  |
| --- | --- | --- |
| **Company** | **Preferred option** | **Comments** |
| ZTE | Option 1 | We prefer set 2 for 95% UE or 90% UE |
| CATT | Option 1 | We prefer Option 1 with the revision as follows,   * + ***Option 1:*** *Based on “Set 2” in TR 38.845:*     - *Horizontal accuracy of 1 – 3 m; Vertical accuracy of 2 – 3 m (absolute and relative) for 90% of UEs* |
| CMCC | Option 1 | Considering the BW limitation in ITS band (up to 40MHz), Set 2 is a more reasonable choice in this release. We are fine with the horizontal and vertical accuracy, and additionally, we think that similar as Rel-16/17, the number of Ues for which the accuracy holds can also be considered, and we think @90% Ues can be the starting point. |
| Vivo | Option 1 | In addition, we prefer Option 1 with modification since 1-3 m is a range other than bound   * + ***Option 1:*** *Based on “Set 2” in TR 38.845:*     - *Horizontal accuracy of ~~1 –~~ 3 m; Vertical accuracy of ~~2 –~~ 3 m (absolute and relative) for 90% of Ues*   And suggest it can be the common requirement for all use-cases. Then, only select one or two use cases as a baseline for evaluation. |
| Huawei, HiSilicon | Option 1 | for option 1 the “(absolute and relative)” should be meant for both Horizontal and vertical requirement. As set 2 provides a range of values for the accuracies, we prefer to take 3 m only for both the horizontal and vertical accuracy, also given the limitation of 40MHz bandwidth. |
| Lenovo | Option 3 |  |
| Spreadtrum | Option 1 |  |
| Interdigital | Option 1 | Given the limited bandwidth, 40MHz, in our view, 3m accuracy for 90% of the Ues is a reasonable requirement. |
| OPPO | Option 2 | Set 3 is preferred for more demanding requirements. |
| Qualcomm | Option 2 | It is important to consider the requirements indicated by the automotive industry here. The LS from 5GAA indicated that sub-meter accuracy is required and only Set 3 satisfies that requirement.  Determining how much bandwidth is needed to meet those requirements is part of the SI and should be separately treated. |
| Futurewei | Option 1 | We think that Option 1 is more realistic given the available BW for ITS. We suggest changing the requirement instead of a range [1-3m] to an inequality [<3m], in this way the higher accuracy is not excluded. Therefore, we suggest,   * + ***Option 1:*** *Based on “Set 2” in TR 38.845:*     - *Horizontal accuracy of < 3 m; Vertical accuracy of <3 m (absolute and relative) for 90% of Ues* |
| Samsung | Comment | We think that multiple sets of the target performance requirements (e.g., Option 1 and Option 2) can be defined regardless of use cases. |
| NEC | Option 1 | For 90% UE |
| Sony | Option 2 | First, we need to clarify whether V2X Positioning requirement is only dealing with accuracy (or it may also require another requirement?) (e.g., latency)  For the accuracy requirements, our preference is Option 2 (the most challenging one). |
| Xiaomi | Option 2 | We share the view as QC. |
| LGE | 1 | We prefer option 1 because it’s the first phase of sidelink positioning development. Solutions to meet the higher accuracy requirement from Set 3 can be studied in a later release. |
| Nokia, NSB | Option 1, Option 2 | Set 3 originates from requirements provided by 5GAA, but may be difficult to achieve. Both sets can be considered. |
| Locaila | Option 1 | Considering the limitation of bandwidth Set 2 seems reasonable in this release. |
| NTT DOCOMO | Option 2 | Same view with QC. |
| Sharp | Option 1 |  |
| CEWiT | Option 1 & 2 | For evaluation both set should be considered and achievable accuracy should be studied. |
| Ericsson | Option 1 |  |
| Apple | Option 1 |  |
| Moderator |  | Summary of received responses:   * **Option 1:** ZTE, CATT, CMCC, vivo, HW-HiSi, SPRD, IDC, Futurewei, NEc, LGE, SS, Nokia, Locaila, Sharp, CEWiT, E//, Apple **(17)** * **Option 2:** OPPO, QC, SONY, Xiaomi, SS, Nokia, DCM, CEWiT **(8)** * **Option 3:** Lenovo **(1)** * **Option 4:** **(0)**   A significant majority of responses indicate preference to only consider Set 2 to define the requirements for SL positioning (relative/absolute) accuracy for V2X.  While there are some concerns expressed on feasibility to achieve targets in Set 3 with limited BW, it was also pointed out that requirements per Set 3 should be considered at least as part of evaluating BW requirements to satisfy SL positioning targets.  At least three companies indicated that both Sets 2 and 3 can be considered for V2X use-cases.  Based on the received feedback, FL2 Proposal 5.2-1 is provided below. |

## FL2 Question 5.2-1

* *For V2X use-cases for SL positioning, accuracy requirements are defined based on:*
  + *At least “Set 2” defined in TR 38.845:*
    - *Horizontal accuracy of ~~1 –~~ 3 m; Vertical accuracy of ~~2 –~~ 3 m (absolute and relative) for 90% of UEs*
  + ***Optional:*** *“Set 3” defined in TR 38.845:*
    - *Horizontal accuracy of 0.1 – 0.5 m; Vertical accuracy of 2 m (absolute)/ 0.2 m (relative) for 90% of UEs*

|  |  |  |
| --- | --- | --- |
| **Company** | **Preferred option** | **Comments** |
| ZTE | OK |  |
| Futurewei | Support | Is the accuracy for horizontal both absolute and relative? It is not clear, why for vertical both absolute and relative are mentioned and not for horizontal? |
| CATT | Support with revision | We share the same view with Futurewei on the absolute/relative issue for horizontal accuracy, then we prefer the revision as follows, Updated FL2 Question 5.2-1  * *For V2X use-cases for SL positioning, accuracy requirements are defined based on:*   + *At least “Set 2” defined in TR 38.845:*     - *Horizontal accuracy of ~~1 –~~ 3 m (absolute and relative); Vertical accuracy of ~~2 –~~ 3 m (absolute and relative) for 90% of UEs*   + ***Optional:*** *“Set 3” defined in TR 38.845:*     - *Horizontal accuracy of 0.1 – 0.5 m (absolute and relative); Vertical accuracy of 2 m (absolute)/ 0.2 m (relative) for 90% of UEs* |
| Vivo | OK | We prefer it can be seen as a start point for a common requirement for all use cases. |
| Samsung |  | We still think that regardless of use cases, multiple sets of the target performance requirements can be defined commonly for evaluation.  However, majority want to define the requirements for each use case, we can accept |
| AT&T | Support | We support this with the CATT revision. |
| LGE | Support |  |
| NEC | Support with revision | Regarding how to handle the optional requirement, is there a sub use case for such more stringent requirement? In my understanding, if it is not mandatory requirement, then it should be on the best effort basis. Therefore, we suggest removing second sub-bullet. |
| CMCC | Support |  |
| DCM | OK |  |
| Huawei, HiSilicon |  | What does defining an optional requirement in the study mean? Should it be interpreted that this optional requirement does not have to be met, but rather a best effort requirement? |
| Xiaomi | OK |  |
| Lenovo | Support |  |
| OPPO |  | If only set 3 can satisfy the requirements provided by automotive industry, putting set 3 as optional may not lead to a clear result for V2X use case which is the most important one. |
| FirstNet | Support | Support as suggested by CATT’s revision |
| InterDigital | Support |  |
| Toyota ITC | Not support | For “Set 2”, 3-m horizontal accuracy is not acceptable for us. Typical basic V2X safety use cases (the main target of “Set 2”) require 1.5-m horizontal accuracy and 3-m vertical accuracy (cf. SAE J2945/1, RP-210040). So, if we select a single number in the range of 1~3 m, the horizontal accuracy should be 1.5 m (or 1 m) rather than 3 m. |
| Nokia, NSB | OK | support CATT’s revision proposal |
| Qualcomm | Disagree | We do not think the chosen value for baseline V2X evaluations is suitable. 3m is the width of a lane in many places. With these requirements, the vehicle would not be able to decide in which lane it is or whether the other vehicle it is positioning relative to is in the next lane, the one over, or the same lane.   * + *Optional: ~~At least~~ “Set 2” defined in TR 38.845:*     - *Horizontal accuracy of 1 – 3 m; Vertical accuracy of 2 – 3 m (absolute and relative) for 90% of UEs*   + ***~~Optional:~~*** *“Set 3” defined in TR 38.845:*   *Horizontal accuracy of ~~0.1 –~~ 0.5 m; Vertical accuracy of 2 m (absolute)/ 0.2 m (relative) for 90% of UEs* |
| Moderator |  | Summary of received responses:   * Most companies are fine with the FL proposal at least in principle. * Two responses (NEC and HW-HiSi) asked to clarify interpretation for “optional” for requirement. * Two responses (Toyota and QC) point out that 3m accuracy may not work for V2X use-cases considering lane-width considerations requiring 1~1.5 m horizontal accuracy. * One response (QC) proposes to make “Set 3” as the primary target requirement.   The intention of “optional” in context of requirement is for consideration of the requirement on a best-effort basis, although SL positioning solutions may be evaluated against the more demanding requirement itself and particular solutions/enhancements may be considered further based on such analyses/evaluations.  Considering the point from Toyota and QC, the proposal is updated to consider 1.5 m for “Set 2” which originally listed 1 – 3 m to address the practical requirement.  The proposal is updated as FL3 Proposal 5.2-1. |

## FL3 HP Proposal 5.2-1

* *For V2X use-cases for SL positioning, accuracy requirements are defined based on:*
  + *At least “Set 2” defined in TR 38.845:*
    - *Horizontal accuracy of 1.5 m (absolute and relative); Vertical accuracy of ~~2 –~~ 3 m (absolute and relative) for 90% of UEs*
  + ***Optional:*** *“Set 3” defined in TR 38.845:*
    - *Horizontal accuracy of 0.1 – 0.5 m (absolute and relative); Vertical accuracy of 2 m (absolute)/ 0.2 m (relative) for 90% of UEs*

*Please share your views on the above.*

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| --- | --- | --- |
| **Company** | **Preferred option** | **Comments** |
| CATT | Support | “Set 2” is fine for us. |
| ZTE | Support | “Set 2” is fine for us. |
| CEWiT | Support |  |
| Samsung | OK |  |
| Lenovo | Support. |  |
| NEC | OK | “Set 2” is sufficient. Suggest to add brackets as [1.5] m. |
| OPPO | OK |  |
| AT&T | Support |  |
| Huawei, HiSilicon | Set 2 | We prefer to have 3m for both horizontal and vertical. |
| InterDigital | Support |  |
| Futurewei | Support |  |
| Bosch | Support set 3 | We are not fine having set 3 as an option as it one of the identified sets in TR38.845. In our understanding the sets in TR38.845 are not associated with any prioritization. According to the input from 5GAA in TR38.845 requirements for the following use cases could not be met without set 3 being considered:  - High Definition Sensor Sharing  -     Vulnerable Road User - Awareness near potentially dangerous situations Urban  -     Vulnerable Road User - Collision risk warning  -     Real-Time Situational Awareness & High-Definition Maps  -     Group Start  -     Tele-Operated Driving (TOD)  -     TOD support  -     TOD for Automated Parking  -     Cooperative Manoeuvres of Autonomous Vehicles for Emergency Situations  -     High definition map collecting & sharing  -     Automated Intersection crossing  -     Infrastructure Assisted Environment Perception - Data Distribution about Objects on the Road  -     Infrastructure Assisted Environment Perception - Individual Data Transmission in Form of Trajectories or Actuation Commands)  -     Infrastructure based Tele-Operated Driving  -     Automated Valet Parking – Joint Authentication and Proof of Localisation  -     Coordinated, Cooperative Driving Manoeuvre - Pedestrian Crossing  -     Cooperative Traffic gap  -     Cooperative Lateral Parking  -     Cooperative Curbside Management  Considering only Set 2 would stop the realization of most autonomous driving related use cases, as 0.1-0.5 m is required to define, e.g., if a vehicle is within a lane, or in which lane a car is at all. From an automotive market point of view, once Rel. 18 is ready for deployment all of the above automotive use case need to be covered.  Therefore, we highly encourage to revisit the formulation of the proposal and check if we still can remove “optional” from set 3. |
| Qualcomm | Set 3 | We thank the feature lead for the updated proposal. However, 1.5 still rules out many important uses for SL positioning in V2X and we propose to take Set 3 as the baseline. |
| Ericsson | Support |  |
| Nokia, NSB | OK |  |
| Locaila | Support |  |
| Spreadtrum | Support |  |
| LGE | Set 2 | As companies’ views are divergent on the specific requirement values, we prefer to keep the original requirement text from RAN positioning SI report. The original requirements did not intend that all the solutions meet a specific value, but some for lower limit and others for higher limit within the range of requirement values. |
| CMCC | Set 2 |  |
| Xiaomi | OK |  |
| Toyota ITC | Support for Set 2, Comment for Set 3 | For Set 2, we support the updated proposal by the moderator. For Set 3, it would be better if “Optional” could be removed. |
| Sharp | Support |  |
| SONY | Set 3 | If set 3 not included, many critical / important use-cases are not covered |
| Moderator |  | Summary of received responses:   * Majority (19) responses are supportive or can accept the FL proposal. * Four companies (Bosch, QC, Toyota, SONY) proposes to consider Set 3 instead of or in addition to (i.e., Set 3 is not optional) Set 2. * One response (NEC) suggests to keep 1.5 m for Set 2 in brackets. * One response (HW-HiSi) suggests to consider 3 m for both horizontal and vertical. * One response (LGE) suggests to define Set 2 as a a range of positioning accuracy requirements from 1 – 3 m (horizontal) and 2 – 3 m (vertical).     **@ Bosch and other proponents of Set 3:** As discussed in previous rounds, the requirements corresponding to Set 2 may be a reasonable target considering this is the first release for SL positioning, and more advanced use-cases may be targeted as part of future enhancements once the basic capabilities with reasonable positioning accuracy are in place.  **@ HW-HiSi:** As pointed out in previous rounds, the 3 m accuracy requirement may not satisfy some of the basic automotive use-cases in detecting location w.r.t. lanes.  Nevertheless, the suggestion from NEC to keep exact value for horizotal accuracy requirements for Set 2 in brackets may be reasonable for this week, and the same proposal with addition of brackets is suggested in updated **FL4 HP Proposal 5.2-1**. |

## FL4 HP Proposal 5.2-1 (/5.2-1A)

* *For V2X use-cases for SL positioning, accuracy requirements are defined based on:*
  + *At least “Set 2” defined in TR 38.845:*
    - *Horizontal accuracy of [1.5] m (absolute and relative); Vertical accuracy of 3 m (absolute and relative) for 90% of UEs*
  + ***Optional:*** *“Set 3” defined in TR 38.845:*
    - *Horizontal accuracy of 0.1 – 0.5 m (absolute and relative); Vertical accuracy of 2 m (absolute)/ 0.2 m (relative) for 90% of UEs*

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| **Company** | **Comments** |
| Moderator | Considering the discussions during Tuesday (May 17th) GTW and the suggestions from Mr. Chairman, the Moderator would like to request all to kindly consider an updated version of the above where the two sets of requirements are merged towards a possible compromise.  Please provide your views to **FL4 HP Proposal 5.2-1A** below. FL4 HP Proposal 5.2-1A  * *For V2X use-cases for SL positioning, accuracy requirements are defined based on:*   + *Horizontal accuracy of 1 m (absolute and relative); Vertical accuracy of 2 m (absolute)/ 0.2 m (relative) for 90% of UEs* |
| CATT | We prefer to keep 2m for both absolute and relative SL positioning for vertical accuracy. And we failed to see the V2X application scenarios of “0.2m” relative positioning for vertical accuracy.  In fact, for both absolute and relative SL positioning, limited by SL-PRS bandwidth, it is difficult to reach the sub-meter level positioning accuracy. |
| OPPO | we are generally OK with the updated proposal.  We would like to ask a question for clarification on the horizontal accuracy value. Why 1m or previous 1.5m is selected rather than the original range of 1-3m or 0.1-0.5m? We understand that 3 meters might be too wide by considering about the lane width. How the single value is selected to take place the value range in set 2/3? |
| Samsung | Thanks for the updated proposal. In our understanding, this is not a good compromise since majority was OK for Set2 but some want Set3 become baseline. Having two different sets would be benefitial considering different V2X enviroments. So,we prefer the original version; Set2 and Set3 (optional). For the requirements, we are OK with fixed or range. |
| vivo | We share the same understanding of CATT, In addition, “0.2m” is too stringent, and wonder why the high accuracy vertical accuracy is needed.  In addition, 1m may be too challenging for horizontal accuracy for sidelink positioning and cannot be achieved for relative positioning even by 100M bandwidth based on QC simulation    Figure 1 CDF of range estimation error in a highway V2X scenario. |
| xiaomi | We are OK with FL proposal. |
| LGE | The updated proposal seems the middle of Set 2 and Set 3. For example, the horizontal accuracy requirement comes from Set 2 while the vertical from Set 3. We don’t think that such a mixture is meaningful for the use cases relevant to either Set 2 or Set 3 requirement.  Considering the discussions so far, it’s very clear that every company is ok with Set 2 requirements, while companies are split into for and against Set 3 requirements in this release. From the commericial deployment perspective, it is more probable that the use cases requiring Set 2 may come earlier than those requiring Set 3. We don’t understand why the first release of SL positioning satisfies all the strigent requirements from the beginning. All the technologies evolves with phase in accordance with the technical advance and the commercial needs. Any update relevant to Set 3 requirements can be added in a later release depending on the needs commented above.  Based on the observations above, it’s quite natural consequence that at least Set 2 requirement is used for V2X use case. This is also aligned with the previous agreement that FR1 up to 100MHz is baseline and FR2 up to 400MHz is optional. We’re skeptical that Set 3 requirement can be met with FR1.  Regarding the value of requirement, we’re ok to use a single value for evaluation purpose only. But the original requirements from RAN positioning SI should be kept as is because the range of requirements were made based on quite various scenarios of V2X. We suggest the following proposal.   * *For V2X use-cases for SL positioning, accuracy requirements are defined based on:*   + *At least “Set 2” defined in TR 38.845:*     - *For evaluation purpose, Horizontal accuracy of X m (absolute and relative); Vertical accuracy of Y m (absolute and relative) for 90% of UEs*       * *FFS X and Y value*   + ***~~Optional:~~*** *~~“Set 3” defined in TR 38.845:~~*   *~~Horizontal accuracy of 0.1 – 0.5 m (absolute and relative); Vertical accuracy of 2 m (absolute)/ 0.2 m (relative) for 90% of UEs~~* |
| Huawei, HiSilicon | We still prefer to have 1-3m, which directly maps to TR 38.845. It somehow can make sense if we say 1m@67% and 3m@90%. In addition, based on the input from 5GAA in TR 38.845, almost half of the 5GAA use case have a requirement in set 2 and considering that 20% of the use cases have a less stringent requirement from set 1, then set 2 can cover the requirements of the majority of 5GAA use cases.  As commented in the GTW, this SI aims to evaluate the solution based on NR SL only, without considering another location sources, e.g. IMU/VDR, etc. which are widely available in vehicles. In real practice, those motion sensors can be fused with NR SL positioning to reach higher accuracy. Note that the realization of autonomous driving is not only pending on whether SL positioning on its own is able to meet the positioning requirements.  If a single value is preferred, we can compromised to have 2m@90%. |

In terms of associated latency requirements, as can be noted from the related set of requirements defined in TS 22.261 for high-accuracy positioning (Table 7.3.2.2-1), different use-cases require a range of positioning latency requirements, ranging from 10ms to 1s. For V2X use-cases, some sources (e.g., [13], [18], [21]) indicated targeting a common set of values for end-to-end and PHY latency.

## FL1 Question 5.2-2

* *Please share your views on the requirements on positioning latency for V2X use-cases for SL positioning:*
  + ***Option 1:*** *End-to-end latency of 10 ms to 1s, depending on use-cases selected as in* *Table 7.3.2.2-1.*
  + ***Option 2:*** *End-to-end latency < 100 ms and PHY latency < 10 ~ 15 ms.*
  + ***Option 3:*** *Other option(s).*

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| --- | --- | --- |
| **Company** | **Preferred option** | **Comments** |
| ZTE | Option 3 | We prefer only focusing accuracy requirement in this release. |
| CATT | Option 3 | The latency requirements should be de-prioritize in Rel-18. |
| CMCC | Option 1 | We share similar views with ZTE and CATT that, as this is the first release to enable sidelink positioning function, we prefer to focus on the evaluation and discussion on accuracy. But back in Rel-16, though only accuracy was evaluated, end-to-end latency/TTFF was also defined in the target requirement. In this sense, we are basically fine with the direction of Option 1, and we are also open for the exact values of end-to-end latency. |
| Vivo | Option 3 | Same view as ZTE and CATT |
| Huawei, HiSilicon | Option3 | Share the view that only accuracy should be focused on in this release. If we don’t plan or don’t have efforts to evaluate the latency then it is better to not set the latency target for now because otherwise it may cause confusion as no evaluation may mean no efforts to do it or that the latency can be met so no need to evaluate |
| Lenovo | Option 1 | V2X positioning requirements lack any latency requirements for absolute and relative positioning, So we can set a broad target requirement of positioning latency for V2X use cases in this first release. |
| Spreadtrum | Option3 |  |
| OPPO | Option 3 or Option 1 | We share the similar view with ZTE/CATT that this first release of SL positioning can be focused on accuracy. If latency requirement is also needed to be defined, option 1 is fine. |
| Interdigital | Option 1 | In our view, latency is a critical parameter to evaluate. The positioning of a UE should be obtained within a bounded time. Otherwise, the positioning information can be out-of-date and may not be useful. Latency requirements also determine which use-cases to consider for the study.  We are open to further discuss which target latency is reasonable. |
| Qualcomm |  | We are ok to focus only on accuracy at this stage. |
| Futurewei | Option 3 | End to end latency is hard to control from PHY layer, it may be dependent on the architecture. In addition, the PHY latency will depend on the UEs density and traffic in the area. |
| Samsung |  | We also prefer only focusing accuracy requirement in this release. |
| NEC | Option 2 | Latency as essential requirement for V2X should also be considered. |
| Sony | Option 1 | For V2X positioning, both accuracy and latency are relevant. |
| Xiaomi |  | We share the view that we shall focus on accuracy requirement in this release. |
| LGE | 3 | With the same reason explained in Q5.2-1 (the first phase of sidelink positioning), R16 NR positioning can be a reference for requirements. We prefer end-to-end latency < 1 sec. PHY latency can be set as < 20ms. |
| Nokia, NSB | Option 3 | Prefer to focus on accuracy requirements for now; in addition, the meaning of end-to-end latency at least in out of coverage scenarios may require some discussion. |
| Locaila | Option 3 | We are fine to focus on accuracy in this release |
| NTT DOCOMO |  | We also are OK not to consider latency perspective. |
| Sharp | Option 3 | We prefer to focus on accuracy requirement in this study. |
| Ericsson |  | We can focus on accuracy. |
| Apple | Option 3 | Focus on accuracy |
| Moderator |  | Summary of received responses:   * **Option 1 :** CMCC, Lenovo, IDC, SONY **(4)** * **Option 2:** NEC **(1)** * **Option 3 (focus on accuracy in Rel-18)**: ZTE, CATT, [CMCC], vivo, HW-HiSi, SPRD, QC, Futurewei, SS, Xiaomi, LGE, Nokia, Locaila, DCM, Sharp, E//, Apple **(16 + [1])**   There is a clear preference amongst companies to focus on positioning/ranging accuracy in this release.  Accordingly, FL2 Proposal 5.2-2 is suggested. |

## FL2 Proposal 5.2-2

* *For Rel-18 studies on SL positioning, focus on positioning/ranging accuracy and requirements on positioning latency are de-prioritized.*

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| --- | --- | --- |
| **Company** | **Preferred option** | **Comments** |
| ZTE | OK | If no much interest on latency requirement, we prefer moving it out from the proposal considering really high workload. |
| Futurewei | Support | Either have a comma before “and” or better replace “and” with “. The” The text as written can be interpreted that both position accuracy and latency are de-prioritized. |
| CATT | Support with revision | We prefer to remove the ranging in the proposal, since positioning include absolute positioning, relative positioning and ranging.  Our preferred revision as follows, Updated FL2 Proposal 5.2-2  * *For Rel-18 studies on SL positioning, focus on positioning~~/ranging~~ accuracy requirements*   + *Note: ~~and~~ Requirements on positioning latency are de-prioritized.* |
| Vivo | Ok |  |
| Samsung | OK |  |
| AT&T |  | Ok to focus on accuracy at this stage, but per the SI requirements from e.g., TS 22.261, etc., we should evaluate latency requirements at some point. |
| LGE | Not support | Please correct our position in option 3 in the Moderator’s summary. We think the latency issue is very critical at least in V2X and public safety use case, which is directly related to the human safety. Considering this crucial use case, we’re reluctant to ignore the latency requirement only because it’s the first phase of SL positioning. We may consider to reduce the work load in evaluation purpose, but we have a strong concern on ignoring the latency requirement itself. |
| NEC | Support |  |
| CMCC | Support |  |
| DCM | OK |  |
| Huawei, HiSilicon | OK |  |
| Xiaomi | OK |  |
| Lenovo | Support | Ok to support, but we think that adding a broad latency requirement (e.g., < 1s) may still be added as part of the requirements without a dedicated evaluation, as was done in Rel-16. |
| OPPO | OK |  |
| FirstNet | Support | Focus on accuracy is fine at this stage |
| InterDigital | Not support | We agree with the argument from LGE that latency is an important metric and should be considered for some scenairos such as public safety use cases. However, if the majority prefers to prioritize accuracy evaluation, we can accept the FL’s proposal. |
| Toyota ITC | Not support | The latency requirement is critical for V2X use cases. So, latency should be considered in addition to accuracy. SL positioning with high latency is not so useful for latency critical V2X use cases. |
| Nokia, NSB | OK |  |
| Qualcomm | OK |  |
| Spreadtrum | Support |  |
| Moderator |  | Summary of received responses:   * In general, most responses are fine with FL proposal. * At least three responses indicate clear concerns on removal of latency requirements altogether, especially considering V2X use-cases. * Some responses suggest consideration of at least a generic equirement on positioning latency, e.g., < 1 s.   Based on the received feedback, the proposal is updated as in FL3 Proposal 5.2-2. |

## FL3 Proposal 5.2-2

* *For Rel-18 studies on SL positioning, focus on positioning accuracy*
  + *Note: End-to-end positioning latency is expected to satisfy a latency budget of [1 second].*

*Please share your views on the above.*

|  |  |  |
| --- | --- | --- |
| **Company** | **Preferred option** | **Comments** |
| CATT | Support with revision | We prefer to replace the note and latency budget with FFS as follows, Updated FL3 Proposal 5.2-2  * *For Rel-18 studies on SL positioning, focus on positioning accuracy*   + *FFS~~Note~~: End-to-end positioning latency is expected to satisfy a latency budget of [X~~1~~ second].*     - FFS: the value of X |
| ZTE | Support |  |
| Vivo |  | We acknowledge the latency requirement is needed, but we hope it can be discussed in the future release. In addition, we also have some concerns about the note, especially considering the limited/dynamic scheduling resource for SL. So, can we remove the note at this stage? |
| Lenovo | Support. | The note for End-to-End latency is fine to us. |
| NEC | Support | Support the original version by FL. With CATT’s modification, it seems latency will also be investigated. |
| OPPO | Support | We support FL’s update. |
| AT&T | Support | Support. We agree that the initial focus and priority is positioning accuracy (inclusive of confidence/uncertainty). However, other KPIs, including, but not limited to, e.g., latency, update rate, power consumption, should also be considered. Note that for some use cases, a latency of < 1 s. may be required. |
| Huawei, HiSilicon |  | OK. |
| InterDigital |  | We are fine with the note proposed by the FL. The precise value for the latency requirement can be discussed. |
| Futurewei | Support |  |
| Qualcomm | Support |  |
| Ericsson | Support |  |
| Nokia, NSB | OK |  |
| Locaila | Support |  |
| Spreadtrum | Support |  |
| LGE |  | As we commented in the previous round, the latency is crucial for V2X use cases. It should not be note. We’re fine with the bracket for the latency requirement value. We suggest the following modification.   * For Rel-18 studies on SL positioning, focus on positioning accuracy   + Note: End-to-end positioning latency needs is expected to satisfy a latency budget of [1 second]. |
| Xiaomi | support |  |
| Toyota ITC | OK | We are OK with the proposal by the moderator. The value of the latency requirement should be further discussed because different use cases may require different latency requirements. |
| Sharp | Support |  |
| Moderator |  | Summary of received responses:   * All responses indicate support/acceptance of the FL proposal, with some suggestions for improved phrasing and some further suggestions on whether the sub-bullet should be a Note or FFS.   As discussed in previous round, at this stage, a Note seems more appropriate than an FFS as also pointed out by NEC.  The wording of the proposal is updated based on received feedback as in **FL4 Proposal 5.2-2.** |

## FL4 Proposal 5.2-2

* *For Rel-18 studies on SL positioning, focus on positioning accuracy*
  + *Note: End-to-end positioning latency is expected to satisfy a latency budget of X second(s).*
    - *FFS: value of X*

*Please share your feedback* ***if you have strong concerns*** *with the above proposal.*

|  |  |
| --- | --- |
| **Company** | **Comments** |
| LGE | We still prefer to remove Note from the sub-bullet. For X value, it should be less than or equal to 1 sec, which was the latency requirement in the first phase of16 NR positioning in Rel.16.   * + *~~Note:~~ End-to-end positioning latency is expected to satisfy a latency budget of X second(s).* |

Based on information in TR 38.845, relative speeds of up to 250 kmph have been proposed for consideration for V2X use-cases. In addition, reference [5] proposes consideration of **“***three category of velocity levels: low velocity (less than 20km/h), medium velocity (20-100km/h) and high velocity (100-250km/h)*”**.**

## FL1 Proposal 5.2-3

* *SL positioning solutions for V2X should target use-cases involving relative speeds up to 250 km/hr.*
  + *Note: Not all solutions need to satisfy the highest relative speeds.*

*Please share your views on the above.*

|  |  |
| --- | --- |
| **Company** | **Comments** |
| ZTE | The discussion may not be needed if we focusing on accuracy requirement only. Then, UE speed may only impact simulation in which we can follow TR 37.885. |
| CATT | Support |
| vivo | For us, it is more like a conclusion, may not need to stress it here. |
| Huawei, HiSilicon | ok |
| Lenovo | Mobility parameters include absolute velocity and relative velocity. We prefer to have a common design for them. i.e., we can determine whether a high relative velocity is required based on workload for special design. |
| OPPO | We are OK with this proposal. |
| Interdigital | We support the proposal |
| Qualcomm | We are ok with the proposal |
| Futurewei | We are fine with the proposal. |
| Samsung | OK |
| NEC | Support to explicitly mention UE speed since it might have impacts for positioning performance. In TR 38.845, it says ‘The UE velocity up to 250 km/h needs to be supported for outdoor and tunnel areas.’ So it seems not relative speed but absolute speed. |
| Sony | Support the proposal |
| Xiaomi | Agree. |
| LGE | Support. We think the relative speed of up to 250 km/h is enough. No further categories are needed. |
| Nokia, NSB | OK |
| Locaila | We agree with FL’s proposal |
| NTT DOCOMO | OK |
| Sharp | OK |
| CEWiT | Okay With proposal |
| Ericsson | Not sure if this proposal is required for accuracy simulations. What is the use case for relative speed between UEs of 250kph? |
| Apple | Ok |
| Moderator | While many responses indicate they are fine with the proposal, it has been corrected that the requirement on 250 kmph is for absolute speed. Thus, this discussion can be closed for now and the assumptions corresponding to TR 37.885 can be followed for evaluations. |
|  |  |

# Requirements for SL positioning for public safety use-cases

The requirements for SL positioning for public safety use-cases can be obtained based on those in TR 38.845:

* 1 m horizontal accuracy for 90% of Ues
* 2 m (absolute) or 0.3 m (relative) vertical accuracy
* 95 – 98 % positioning service availability
* Latency < 5s
* Relative speed: up to 30 km/hr.

As such, the above is well-aligned with views expressed in most contributions.

## FL1 Proposal 5.3-1

* *SL positioning solutions for public safety use-cases should target the following requirements:*
  + *1 m horizontal accuracy and 2 m (absolute) or 0.3 m (relative) vertical accuracy for 90% of Ues*
  + *95 – 98 % positioning service availability*
  + *Latency < 5s*
  + *Relative speed: up to 30 km/hr.*

*Please share your views on the above.*

|  |  |
| --- | --- |
| **Company** | **Comments** |
| ZTE | We prefer focusing on V2X and IIOT use cases only. Also, considering the workload, we prefer not to define latency requirement in this release. |
| CATT | Low priority.  Studies on V2X and IioT use-cases are prioritized during the SI. |
| Vivo | Low priority, and suggest no common requirement needs to be defined for public safety use-cases only. We can define a common requirement first in the release and only select one or two use cases as a baseline to evaluate, |
| Huawei, HiSilicon | We prefer to focus only on evaluations for V2X and as second priority commercial use cases and consider only the accuracy requirements. The evaluations for V2X and commercial use cases can also serve as a baseline for how accuracy can be achieved for public safety. |
| Lenovo | Agree with FL’s proposal. |
| OPPO | We are fine with this proposal in general. |
| Interdigital | We propose to down-prioritize this use case. We prefer to focus on V2X and IIOT use cases only. |
| Qualcomm | We are generally ok with the proposal. We’d like to have the entire service availability bullet in brackets until it is clearer how this aspect is evaluated for SL positioning. We’d like to remove the latency part until 5.2-2 is finalized and then follow a unified approach for the use-cases.   * + [*95 – 98 % positioning service availability]*   + *~~Latency < 5s~~* |
| Futurewei | We prefer to express accuracy as inequalities respectively ( <2m) and (<0.3m) for 90% of the user. Regarding latency, its definition is not clear. Is the E2E or PHY definition? Should be removed. We should consider this case a lower priority. |
| Samsung | We think that multiple sets of the target performance requirements (e.g., Option 1 and Option 2 in Question 5.2-1) can be defined regardless of use cases. |
| NEC | Low priority |
| Sony | Support, we should re-use the outcome of the previous study item. |
| Xiaomi | Agree with the FL proposal. |
| LGE | We are ok with the proposal in general. It does not mean that all the solutions should meet the proposed requirements. |
| Nokia, NSB | The availability requirement needs some discussion – how is this evaluated, what is its meaning out of coverage etc? Prefer to remove it for now. |
| Locaila | We are OK with FL’s proposal. |
| NTT DOCOMO | OK and latency requirement can be removed as discussed for V2X. |
| Sharp | We would like to down-prioritize public safety use case. |
| CEWiT | In general fine with proposal. If we decide to evaluate this, it should be highly limited for certain scenarios like FR1 only to manage simulation load. |
| Ericsson | OK, but we should focus on accuracy requirements. |
| Apple | Fine with proposal but think that public safety should be de-prioritized for evaluation. |
| FirstNet | We are OK with all proposed requirements. |
| Moderator | Summary of received responses:   * While multiple responses indicate they can accept the proposal in general, there are also views to deprioritize the public safety use-case for SL positioning.   The use-case-related discussion is part of Proposal 3-1, and accordingly the proposal is updated as in FL2 Proposal 5.3-1. |

## FL2 Proposal 5.3-1

* *SL positioning solutions for public safety use-cases should target the following requirements:*
  + *1 m horizontal accuracy and 2 m (absolute) or 0.3 m (relative) vertical accuracy for 90% of Ues*
  + *FFS: 95 – 98 % positioning service availability*
  + *~~Latency < 5s~~*
  + *Relative speed: up to 30 km/hr.*
  + *Note: This does not intend to impact any potential de-prioritization of SL positioning for public safety use-cases for evaluations in Rel-18.*

*Please share your views on the above.*

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Futurewei | Support. Same comment as in 5.2-1. The horizontal accuracy should be clearly specified as relative, absolute or both. |
| Samsung | We still think that regardless of use cases, multiple sets of the target performance requirements can be defined commonly for evaluation.  However, majority want to define the requirements for each use case, we can accept.  We think that note is not necessary. |
| LGE | Not support. V2X and public safety use cases were the main topics in RAN positioning SI. With the same reason commented in Proposal 5-2-2, we have a strong concern on ignoring the latency requirement that is directly related to the human safety. We may compromise for evaluation purpose, but we cannot agree to remove the latency requirement itself. |
| NEC | Support. |
| Philips | OK in general. Agree with Samsung that NOTE is not necessary. This use case is important and should not be deprioritized. |
| DCM | OK |
| Huawei, HiSilicon | OK |
| Xiaomi | OK |
| Lenovo | Ok to Support, but similar to P 5.2-2, we think that adding a broad latency requirement (e.g., < 1s) may still be added as part of the requirements without a dedicated evaluation, as was done in Rel-16. |
| OPPO | We are OK with it, and we also think the note is not necessary. |
| FirstNet | Support all these requirements |
| InterDigital | We also share the similar concern as LGE, i.e., latency should be considered for public safety use cases. However if the majority prefers to prioritize accuracy evaluation, we can accept the majority view. We agree with other company that the Note is not necessary and should be removed. |
| Nokia, NSB | OK |
| Qaulcomm | Support in general but the note should be removed. |
| Spreadtrum | Support |
| Moderator | Summary of received responses:   * Most responses are supportive or can accept the FL2 Proposal 5.3-1, with particular suggestions on clarifying requirements for horizontal accuracy and removal of the note. * Some responses (LGE, IDC) indicate concerns for removal of latency requirrements for public safety.   Note that, now FL3 Proposal 5.2-2, a generic expectation on latency is suggested, and thus, it may be fine to not list latency requirements separately for each use-case.  Accordingly, the proposal is updated as in FL3 Proposal 5.3-1. |

## FL3 HP Proposal 5.3-1

* *SL positioning solutions for public safety use-cases should target the following requirements:*
  + *1 m (absolute or relative) horizontal accuracy and 2 m (absolute) or 0.3 m (relative) vertical accuracy for 90% of Ues*
  + *FFS: 95 – 98 % positioning service availability*
  + *Relative speed: up to 30 km/hr.*

*Please share your views on the above.*

|  |  |
| --- | --- |
| **Company** | **Comments** |
| ZTE | OK |
| CEWiT | FFS part is unclear. As frame work of service availability calculation is not fixed mentioning 95-98 % availability is unclear to us. Are we going to discuss the frame work for availability in separate proposal? |
| Samsung | OK |
| vivo | We wonder the Rel-18 public safety use case can define any relative requirement higher than the v2x requirements since the channel environment may more complex than v2x scenario (specially compared with highway). |
| Lenovo | Support. |
| FirstNet | Support. Vertical accuracy 2 m (absolute) or 0.3 m (relative) resolution is required for public safety to locate a fallen first responder to a floor level. |
| NEC | OK. |
| OPPO | OK with the updated proposal by FL. |
| AT&T | Support |
| Huawei, HiSilicon | We believe the requirement is too restrigent to be met with available bandwidth for PS. We suggest to either set to 3m or put the number in […]. |
| InterDigital | OK |
| Futurewei | Support |
| Qualcomm | Support |
| Ericsson | Support |
| Nokia, NSB | OK |
| Locaila | Support |
| Spreadtrum | Support |
| LGE | We’re fine with no text for the requirement as long as it’s kept in Proposal 5.2-2. It’s not clear why note is removed because it doesn’t say anything decisively. Every decision on the use case may have impact on the evaluation agenda as a natural consequence. We prefer to keep the note not only for this use case but also for other use cases. |
| Xiaomi | OK |
| Sharp | Support |
| SONY | Support |
| Moderator | Summary of received responses:   * Majority (19) responses indicate support/acceptance of the FL proposal. * One response (CEWiT) raises concerns regarding the FFS bullet on service availability. * Two responses (vivo, HW-HiSi) express concerns on feasibility of achieving the targets and HW-HiSi suggests placing the numbers in brackets. * One response (LGE) proposes to add back the note that this proposal is not intended to influence the decision on prioritization of use-cases.   @ vivo, HW-HiSi: On feasibility concerns, this is indeed one of the tasks for RAN1 according to the SID. In this regard, the natural approach would be to consider requirements coming from use-cases and then evaluating their feasibility and requirements from RAN solutions to achieve such targets. Nevertheless, the values are now placed in brackets for further confirmation.  @LGE: given that we now have a separate Proposal (FL4 HP Proposal 3-4) on prioritization of use-cases for evaluations, hopefully, we do not need to bring back the note.  Based on the above, the proposal is updated, including removal of the FFS bullet on service availability (can be revisted later) as in **FL4 HP Proposal 5.3-1**. |

## FL4 HP Proposal 5.3-1 (/5.3-1A)

* *SL positioning solutions for public safety use-cases should target the following requirements:*
  + *[1] m (absolute or relative) horizontal accuracy and [2] m (absolute) or [0.3] m (relative) vertical accuracy for 90% of UEs*
  + *Relative speed: up to 30 km/hr.*

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Moderator | Considering the suggestion from Mr. Chairman to avoid having brackets for the target values, the Moderator would like to request all and **@HW-HiSi and @Vivo** in particular, to kindly re-consider the above proposal without the brackets around the values. Hopefully, **@LGE** could also kindly accept the proposal without the earlier note.  Please provide your views to **FL4 HP Proposal 5.3-1A** below. FL4 HP Proposal 5.3-1A  * *SL positioning solutions for public safety use-cases should target the following requirements:*   + *1 m (absolute or relative) horizontal accuracy and 2 m (absolute) or 0.3 m (relative) vertical accuracy for 90% of UEs*   + *Relative speed: up to 30 km/hr.* |
| CATT | In order to reduce the work load, we prefer to focus on V2X and IIoT use cases during the SI. |
| OPPO | It seems like this proposal is related to the selection on use cases in proposal 3-4. We would like to ask about it for clarification: if public safety is deprioritized, is the requirements defined above still needed? If not, we would like to suggest to add wording “if it is prioritized”: FL4 HP Proposal 5.3-1A  * *SL positioning solutions for public safety use-cases (if it is prioritized) should target the following requirements:*   + *[1] m (absolute or relative) horizontal accuracy and [2] m (absolute) or [0.3] m (relative) vertical accuracy for 90% of UEs*   + *Relative speed: up to 30 km/hr.* |
| Samsung | OK |
| vivo | Firstly, we are okay with OPPO suggestion for adding the wording “if it is prioritized”  In addition, at least, 0.3m (relative) vertical accuracy cannot be accepted for us. And 1m as horizontal accuracy requirement is too challenging considering the complex channel condition and in public safety scenario.  Lastly, even in Rel-17, the vertical accuracy target is 3m to distinguish on which floor, why do we define it as 2m here? |
| Sharp | OK |
| xiaomi | OK |
| Huawei, HiSilicon | We prefer to have 3m@90% for horizontal accuracy especially considering the only available bandwith defined in RAN4 is 10MHz. |
| FirstNet | We support all requirements specified here with the square brackets removed for all numerical values. Public safety use cases are considered with highest priority. |

# Requirements for SL positioning for commercial use-cases

Requirements for SL positioning for commercial use-cases can be determined again based on the requirements in Table 7.3.2.2-1 in TS 22.261 (same as Table 1 in this document).

Most contributions expressing views on this issue indicate a choice that aims to align with the positioning accuracy requirements for public safety, that is:

* 1 m horizontal accuracy and [2 – 3] m (absolute) or 0.3 m (relative) vertical accuracy for 90% of UEs.
* End-to-end latency for position estimation < 100 ms
* Physical layer latency for position estimation < 10 ms

Aligning the requirements on positioning accuracy for these cases can help manage the amount of evaluation efforts more efficiently while not losing any insights.

Accordingly, the following is proposed.

## FL1 Proposal 5.4-1

* *SL positioning solutions for commercial use-cases should target the following requirements:*
  + *1 m horizontal accuracy and [2 – 3] m (absolute) or 0.3 m (relative) vertical accuracy for 90% of Ues*
  + *95 – 98 % positioning service availability*
  + *Latency: End-to-end latency < 100 ms; PHY latency < 10 s*
  + *Relative speed: up to 30 km/hr.*

*Please share your views on the above.*

|  |  |
| --- | --- |
| **Company** | **Comments** |
| CATT | Low priority.  Studies on V2X and IioT use-cases are prioritized during the SI. |
| Vivo | Low priority, and suggest no common requirement needs to be defined for commercial use-cases only. We can define a common requirement first in the release and only select one or two use cases as a baseline to evaluate, |
| Lenovo | Agree with FL’s proposal.  There seems to be a typo for PHY latency, it should read < 10 ms. We are also fine to use an end-to-end target latency of < 1 s. |
| Interdigital | We propose to down-prioritize this use case. We prefer to focus on V2X and IIOT use cases only. |
| Qualcomm | We are generally ok with the proposal. We’d like to have the entire service availability bullet in brackets until it is clearer how this aspect is evaluated for SL positioning. We’d like to remove the latency part until 5.2-2 is finalized and then follow a unified approach for the use-cases.   * + *[95 – 98 % positioning service availability]*   + *~~Latency: End-to-end latency < 100 ms; PHY latency < 10 s~~* |
| Futurewei | See our comments for 5.3-1 |
| Samsung | We think that multiple sets of the target performance requirements (e.g., Option 1 and Option 2 in Question 5.2-1) can be defined regardless of use cases. |
| NEC | Low priority |
| Sony | Low priority |
| xiaomi | We are fine with the proposal. |
| LGE | We are ok with the proposal in general. It does not mean that all the solutions should meet the proposed requirements. A typo needs to be corrected: *PHY latency < 10 ms.* |
| Nokia, NSB | Prefer to focus on accuracy for now. |
| Locaila | Low priority |
| NTT DOCOMO | OK and latency requirement can be removed as discussed for V2X. |
| Sharp | We would like to down-prioritize commercial use case. |
| CEWiT | Lower priority. We do not see need to evaluate it. It will be covered by other use cases’ requirements discussed before. |
| Ericsson | We would be OK to consider the commercial use case together with public safety. It seems that if PS accuracy targets are met, so will the commercial use case target. |
| Apple | Fine with the proposal. Note that from our contribution, we do say that commercial use case requirements are a superset of the public service requirements and as such evaluation/design for the commercial use case should automatically cover the public service use case. |
| Moderator | Summary of received responses:   * The situation is somewhat similar to that for public safety use-case. * Some responses indicate preference to de-prioritize commercial use-case * Some responses indicate preference to harmonize the requirements for commercial and public safety use-cases.   Considering the feedback, an updated version of the proposal is provided as in FL2 Proposal 5.4-1. |

## FL2 Proposal 5.4-1

* *SL positioning solutions for commercial use-cases should target the following requirements:*
  + *1 m horizontal accuracy and ~~[~~2 ~~– 3]~~ m (absolute) or 0.3 m (relative) vertical accuracy for 90% of Ues*
  + *FFS: 95 – 98 % positioning service availability*
  + *~~Latency: End-to-end latency < 100 ms; PHY latency < 10 s~~*
  + *Relative speed: up to 30 km/hr.*
  + *Note: This does not intend to impact any potential de-prioritization of SL positioning for commercial use-cases for evaluations in Rel-18.*

*Please share your views on the above.*

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Futurewei | Support. Same comment as in 5.3.1, for an outside reader it is not clear if the horizontal accuracy is absolute or relative. Also, a comma before “and” would improve clarity. |
| Samsung | We still think that regardless of use cases, multiple sets of the target performance requirements can be defined commonly for evaluation.  However, majority want to define the requirements for each use case, we can accept.  We think that note is not necessary. |
| LGE | Support in general. |
| NEC | Support. |
| Philips | Support. Agree with Samsung that Note is not necessary. |
| DCM | OK |
| Xiaomi | Since in Q 5.1-1 it is proposed that ranging distance accuracy requirement is the same as that for relative positioning, we shall define the requirement based on the ranging distance requirement listed in TS 22.261. Most of the commercial ranging use cases in TS 22.261 have distance accuracy requirement of 10cm or 20cm. |
| Lenovo | Ok to support, but we think that adding a broad latency requirement (e.g., < 1s) may still be added as part of the requirements without a dedicated evaluation as was done in Rel-16. |
| InterDigital | We also agree with other company that the Note is not necessary and should be removed. We would like to have the latency requirement. However, if the majority prefers to remove the latency requirement for commercial use cases, we can accept the majority view. We agree with Samsung and Philips that note is not needed. |
| Nokia, NSB | OK |
| Qualcomm | Support in general, but the note should be removed. |
| Moderator | Summary of received responses:   * Most responses can accept the FL proposal, with particular suggestions on removing the note. * Some responses (Lenovo, IDC) express concerns on removal of latency requirement. * One response (Xiaomi) proposes to consider tighter requirements on horizontal accuracy since some of the ranging requirements have 20 cm ~ 50 cm ranging distance accuracy.   As a generic requirement on latency is proposed, hopefully this addresses the concerns from Lenovo and InterDigital for the current proposal.  To the point raised by Xiaomi, in this case, one of the motivations is also to align the accuracy requirements between commercial and public safety use-cases, a common requirement of 1 m may not be too unreasonable for commercial use-cases in the first release of SL positioning, considering the overall workload.  Thus, the proposal is updated as in FL3 Proposal 5.4-1. |

## FL3 HP Proposal 5.4-1

* *SL positioning solutions for commercial use-cases should target the following requirements:*
  + *1 m (absolute or relative) horizontal accuracy and 2m (absolute) or 0.3 m (relative) vertical accuracy for 90% of Ues*
  + *FFS: 95 – 98 % positioning service availability*
  + *Relative speed: up to 30 km/hr.*

*Please share your views on the above.*

|  |  |
| --- | --- |
| **Company** | **Comments** |
| ZTE | OK |
| Samsung | OK |
| vivo | We wonder the Rel-18 commercial use case can define any relative requirement higher than the v2x requirements since the channel environment may more complex than v2x scenario (specially compared with highway). |
| Lenovo | Support. |
| NEC | OK |
| OPPO | OK |
| AT&T | Support |
| InterDigital | OK |
| Futurewei | OK |
| Bosch | ok |
| Qualcomm | Support |
| Ericsson | Support |
| Nokia, NSB | OK |
| LGE | We prefer to keep the note. As commented earlier, any decision (e.g. prioritization on some use cases) on this agenda may impact the evaluation agenda as a natural consequence. |
| Xiaomi | We still have concern on setting lower requiremnts than that defined in TS 22.261. If so, NR ranging technique may not as competitive as other RAT.  However, considering the majority view and to not delay the progress, we can compromise to accept the proposal. |
| Sharp | Support |
| SONY | OK |
| Moderator | Summary of received responses:   * Majority (16) responses indicate support/acceptance of the FL proposal. * One response (vivo) expresses concerns on feasibility of achieving the targets. * One response (LGE) proposes to add back the note that this proposal is not intended to influence the decision on prioritization of use-cases.   With similar reasoning as for Proposal 5.3-1, the current proposal is updated as in FL4 HP Proposal 5.4-1, including addition of brackets to the particular values. |

## FL4 HP Proposal 5.4-1 (/5.4-1A)

* *SL positioning solutions for commercial use-cases should target the following requirements:*
  + *[1] m (absolute or relative) horizontal accuracy and [2] m (absolute) or [0.3] m (relative) vertical accuracy for 90% of UEs*
  + *Relative speed: up to 30 km/hr.*

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Moderator | Considering the suggestion from Mr. Chairman to avoid having brackets for the target values, the Moderator would like to request all and **@Vivo** in particular, to kindly re-consider the above proposal without the brackets around the values. Hopefully, **@LGE** could also kindly accept the proposal without the earlier note.  Please provide your views to **FL4 HP Proposal 5.4-1a** below. FL4 HP Proposal 5.4-1A  * *SL positioning solutions for commercial use-cases should target the following requirements:*   + *1 m (absolute or relative) horizontal accuracy and 2 m (absolute) or 0.3 m (relative) vertical accuracy for 90% of UEs*   + *Relative speed: up to 30 km/hr.* |
| CATT | In order to reduce the work load, we prefer to focus on V2X and IIoT use cases during the SI. |
| OPPO | Similar comment with proposal 5.3-1 that commercial use cases may be de-prioritized since majority companies prefer to evaluate V2X, and potentially IIoT and/or public safety. Therefore, the similar update can be considered: FL4 HP Proposal 5.4-1A  * *SL positioning solutions for commercial use-cases (if it is prioritized) should target the following requirements:*   + *1 m (absolute or relative) horizontal accuracy and 2 m (absolute) or 0.3 m (relative) vertical accuracy for 90% of UEs*   + *Relative speed: up to 30 km/hr.* |
| Samsung | OK |
| vivo | Similar comment with proposal 5.3-1 |
| Sharp | OK |
| Xiaomi | We can accept the proposal. |

# Requirements for SL positioning for IIoT use-cases

Requirements for SL positioning for IioT use-cases can be determined based on information in TS 22.104, and reproduced in Table 4 below.

**Table 4. Requirements for SL positioning for IioT use-cases from TS 22.104**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Scenario | Horizontal accuracy | **Vertical accuracy** | Availability | Heading | Latency for position estimation of UE | UE speed | Corresponding Positioning Service Level in TS 22.261 |
| Mobile control panels with safety functions (non-danger zones) | < 5 m | < 3 m | 90 % | n/a | < 5 s | n/a | Service Level 2 |
| Process automation – plant asset management | < 1 m | < 3 m | 90 % | n/a | < 2 s | < 30 km/h | Service Level 3 |
| Flexible, modular assembly area in smart factories (for tracking of tools at the work-place location) | < 1 m (relative positioning) | n/a | 99 % | n/a | 1 s | < 30 km/h | Service Level 3 |
| Augmented reality in smart factories | < 1 m | < 3 m | 99 % | < 0.17 rad | < 15 ms | < 10 km/h | Service Level 4 |
| Mobile control panels with safety functions in smart factories (within factory danger zones) | < 1 m | < 3 m | 99.9 % | < 0.54 rad | < 1 s | n/a | Service Level 4 |
| Flexible, modular assembly area in smart factories (for autonomous vehicles, only for monitoring purposes) | < 50 cm | < 3 m | 99 % | n/a | 1 s | < 30 km/h | Service Level 5 |
| Inbound logistics for manufacturing (for driving trajectories (if supported by further sensors like camera, GNSS, IMU) of indoor autonomous driving systems)) | < 30 cm (if supported by further sensors like camera, GNSS, IMU) | < 3 m | 99.9 % | n/a | 10 ms | < 30 km/h | Service Level 6 |
| Inbound logistics for manufacturing (for storage of goods) | < 20 cm | < 20 cm | 99 % | n/a | < 1 s | < 30 km/h | Service Level 7 |

As can be seen from the above, for positioning service levels 2 through 4, the (absolute and relative) horizontal positioning accuracy requirements are at 1 m, while for service levels 5, 6, 7, the horizontal positioning accuracy may be as low as 0.2 m.

While references [17], [21], [25], and [29] propose consideration of the most strict (absolute and relative) horizontal positioning accuracy requirements of ~0.2 m for IioT use-cases, references [9] and [28] propose to consider up to service levels 3 or 4 to determine horizontal positioning accuracy of 1 m.

Further, references [9], [17], and [21] propose (absolute and relative) vertical positioning accuracy requirement of 1 m, while reference [29] proposes (absolute and relative) vertical positioning accuracy of 0.2 m.

While Table 4 indicates varied latency requirements, considering many of the use-cases demand very low latency, for simplicity, it is recommended to align the latency requirements to that for commercial use-cases.

## FL1 Proposal 5.5-1

* *SL positioning solutions for IioT use-cases should target the following requirements:*
  + *For horizontal accuracy, down select between:*
    - *1 m (absolute or relative) for 90% of Ues*
    - *0.2 m (absolute or relative) for 90% of Ues*
  + *For vertical accuracy, down select between:*
    - *1 m (absolute or relative) for 90% of Ues*
    - *0.2 m (absolute or relative) for 90% of Ues*
  + *90 – 99 % positioning service availability*
  + *Latency: End-to-end latency < 100 ms; PHY latency < 10 s*
  + *Relative speed: up to 30 km/hr.*

*Please share your views on the above.*

|  |  |
| --- | --- |
| **Company** | **Comments** |
| ZTE | Here is our suggestion to mitigate the workload.   * *SL positioning solutions for IioT use-cases should target the following requirements:*   + *For horizontal accuracy, down select between:*     - *1 m (absolute or relative) for 90% of Ues*     - *~~0.2 m (absolute or relative) for 90% of Ues~~*   + *For vertical accuracy, down select between:*     - *1 m (absolute or relative) for 90% of Ues*     - *~~0.2 m (absolute or relative) for 90% of Ues~~*   + *~~90 – 99 % positioning service availability~~*   + *~~Latency: End-to-end latency < 100 ms; PHY latency < 10 s~~*   + *~~Relative speed: up to 30 km/hr.~~* |
| CATT | We prefer the proposal with the revision as follows, Updated FL1 Proposal 5.5-1  * *SL positioning solutions for IioT use-cases should target the following requirements:*   + *For horizontal accuracy~~, down select between~~:*     - *1 m (absolute or relative) for 90% of Ues*     - *~~0.2 m (absolute or relative) for 90% of Ues~~*   + *For vertical accuracy~~, down select between~~:*     - *1 m (absolute or relative) for 90% of Ues*     - *~~0.2 m (absolute or relative) for 90% of Ues~~*   + *~~90 – 99 % positioning service availability~~*   + *~~Latency: End-to-end latency < 100 ms; PHY latency < 10 s~~*   + *Relative speed: up to 30 km/hr.* |
| CMCC | We prefer both 1m for the horizontal and vertical accuracy. Though sub-meter requirement (<0.2m or <0.5m) was defined in Rel-17 for IioT use cases, based on the evaluation back then, we should remember that the requirement can only be met in the ideal InF-SH scenario. However, considering the practical NLOS dominant indoor factory scenario, a more reasonable choice is to set meter-level requirement at the first place. |
| Vivo | Low priority, and suggest no common requirement needs to be defined for IioT use-cases only. We can define a common requirement first in the release and only select one or two use cases as a baseline to evaluate, |
| Huawei, HiSilicon | Rel-17 already supports 0.2/0.5 meter for IioT use case. We do not see any reason to do it again with SL positioning only to have a less-demanding requirement. |
| Lenovo | We prefer an accuracy of “*1 m (absolute or relative) for 90% of Ues”*. Similar to P5.4-1, there seems to be a typo for PHY latency, it should read < 10 ms. However, we also prefer to consider a relaxed end-to-end latency requirement of < 1s as indicated in TS 22.104 |
| OPPO | We are generally fine with the FL’s proposal. For the requirement of accuracy, 1m is preferred rather than 0.2m. The last 3 components can be removed for simplicity study. |
| Interdigital | Given the limited bandwidth for sidelink communication, in our view, we may not obtain sub-meter positioning accuracy. Therefore, for sidelink positioning only in IioT, we prefer the target accuracy of “*1m (absolute or relative) for 90% of Ues*” and latency of “*End-to-end latency < 100 ms; PHY latency < 10ms*”*.* |
| Qualcomm | We are ok generally with the proposal and propose to select the 0.2m requirements which is needed to enable IioT use cases. Like other proposals, we’d like to have the entire service availability bullet in brackets until it is clearer how this aspect is evaluated for SL positioning. We’d like to remove the latency part until 5.2-2 is finalized and then follow a unified approach for the use-cases.   * *SL positioning solutions for IioT use-cases should target the following requirements:*   + *For horizontal accuracy, down select between:*     - *1 m (absolute or relative) for 90% of Ues*     - *0.2 m (absolute or relative) for 90% of Ues*   + *For vertical accuracy, down select between:*     - *1 m (absolute or relative) for 90% of Ues*     - *0.2 m (absolute or relative) for 90% of Ues*   + *~~90 – 99 % positioning service availability~~*   + *~~Latency: End-to-end latency < 100 ms; PHY latency < 10 s~~*   + *Relative speed: up to 30 km/hr.* |
| Futurewei | We prefer to keep same requirements as in Rel 17 for IioT scenarios. |
| Samsung | We think that multiple sets of the target performance requirements (e.g., Option 1 and Option 2 in Question 5.2-1) can be defined regardless of use cases. |
| NEC | Low priority |
| Sony | Low priority |
| Xiaomi | We are fine with the proposal. |
| LGE | For horizontal accuracy, we prefer 1 m (absolute or relative) for 90% of Ues as defined in most use cases in Table 4. For vertical accuracy, we prefer 3 m (absolute or relative) for 90% of Ues because only one use case targets <20cm in Table 4. We’re ok with the latency requirement except the typo: *PHY latency < 10 ms.* |
| Nokia, NSB | Prefer to focus on accuracy for now. |
| Locaila | Low priority |
| NTT DOCOMO | OK and latency requirement can be removed as discussed for V2X. |
| Sharp | We are OK with the FL proposal. Latency requirement can be removed. |
| CEWiT | Okay with proposal |
| Ericsson | Same view as Huawei that rel17 can deliver the absolute positioning accuracy requirement. We can focus on ranging use cases for IIOT. |
| Apple | Use Rel-17 requirements for absolute positioning similar to Huawei and Ericsson’s views. |
| Moderator | Summary of received responses:   * Several responses indicate a preference to de-prioritize IioT use-cases. * Some responses propose to select the less demanding requirements, i.e., 1 m horizontal and vertical accuracy. * Multiple responses propose to align absolute positioning requirements to Rel-17 values or the more stringent target, i.e., 0.2 m horizontal accuracy, 1 m vertical accuracy. * Couple of responses suggest to only consider relative positioning and ranging for IioT use-cases under assumption that absolute positioning can be provided based on Uu, especially if SL positioning is to target relaxed accuracy requirements.   Considering the received feedback, the proposal is updated as in FL2 Proposal 5.5-1. |

## FL2 Proposal 5.5-1

* *SL positioning solutions for IioT use-cases should target the following requirements:*
  + *For horizontal accuracy, ~~down select between:~~*
    - *~~1 m (absolute or relative) for 90% of Ues~~*
    - *0.2 m (absolute or relative) for 90% of Ues*
  + *For vertical accuracy, ~~down select between:~~*
    - *1 m (absolute or relative) for 90% of Ues*
    - *~~0.2 m (absolute or relative) for 90% of Ues~~*
  + *FFS: 90 – 99 % positioning service availability*
  + *~~Latency: End-to-end latency < 100 ms; PHY latency < 10 s~~*
  + *Relative speed: up to 30 km/hr.*
  + *Note: This does not intend to impact any potential de-prioritization of SL positioning for commercial use-cases for evaluations in Rel-18.*

*Please share your views on the above.*

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| **Company** | **Comments** |
| Futurewei | Support. The note is not necessary. The proposal does not mention any prioritization, and therefore, it does not imply that the SL Pos for commercial cases is de-prioritized. |
| CATT | Regarding horizontal accuracy for IioT use cases, we still prefer to use 1m as the target performance requirement, since 0.2 m may not be reached for NLOS case, such InF-DH scenario. What about the following evision: Updated FL2 Proposal 5.5-1  * *SL positioning solutions for IioT use-cases should target the following requirements:*   + *For horizontal accuracy, ~~down select between:~~*     - *Baseline: 1 m (absolute or relative) for 90% of Ues*     - *Optional: 0.2 m (absolute or relative) for 90% of Ues*   + *For vertical accuracy, ~~down select between:~~*     - *1 m (absolute or relative) for 90% of Ues*     - *~~0.2 m (absolute or relative) for 90% of Ues~~*   + *FFS: 90 – 99 % positioning service availability*   + *~~Latency: End-to-end latency < 100 ms; PHY latency < 10 s~~*   + *Relative speed: up to 30 km/hr.*   + *Note: This does not intend to impact any potential de-prioritization of SL positioning for commercial use-cases for evaluations in Rel-18.* |
| Samsung | We still think that regardless of use cases, multiple sets of the target performance requirements can be defined commonly for evaluation.  However, majority want to define the requirements for each use case, we can accept.  We think that note is not necessary. |
| LGE | We prefer 1m accuracy for the horizontal accuracy. This is the first phase of SL positioning and 0.2m is too stringent target. Such a high accuracy can be developed in a later release. |
| NEC | Share the same view as CATT that 0.2 m accuracy requirement might be too aggressive and 1 m is a more reasonable target. |
| CMCC | Share similar views with LGE, and we still prefer 1m accuracy for horizontal and 3m for vertical. But if majority views are fine with it, we can accept it for making progress. |
| Philips | Support. Agree with Futurewei and Samsung that the note is not necessary. |
| DCM | OK |
| Huawei, HiSilicon | We noticed that the Note reads “commercial use cases”.  For IioT, the Uu-positioning already claimed 0.2m accuracy. Why do we need to study relaxed IioT requirements? |
| Lenovo | Ok to support, as in previous responses, adding a broad latency requirement (e.g., < 1s) may still be added as part of the requirements without a dedicated evaluation as was done in Rel-16. |
| InterDigital | Not support. We prefer 1m for horizontal (absolute or relative) accuracy. It may be better to start from a relaxed requirement given the constraints such as limited resources in SL positioning.  We also prefer to have latency to be considered (e.g., 100ms for end-to-end and 10ms for PHY) but if the majority prefers to remove the latency requirement, we can accept the proposal (e.g., removal of the latency requirement).  We agree with other companies that note is not needed. |
| Nokia, NSB | Agree with others that note is not needed and that requirement can be relaxed to 1 m for now |
| Qualcomm | We share the view that the note should be removed. We support using 0.2m for all requirements not only horizontal. |
| Moderator | Summary of received responses:   * While multiple responses can accept FL2 Proposal 5.5-1, many still indicate preference to target a relaxed requirement of 1m for the first release of SL positioning, especially considering InH-DH scenarios for factory environments. * One response (QC) proposes to consider 0.2 m (absolute or relative) accuracy for vertical accuracy, in addition to horizontal accuracy of 0.2 m (absolute or relative). * One response (HW-HiSi) questions the relevance of studying IioT for SL positioning considering Uu positioning can achieve 0.2m accuracy for IioT use-cases.   To the comment from HW-HiSi, the Moderator would like to note that the consideration of SL positioning for IioT follows from the approved SID and it is not necessary that SL positioning solutions be considered only to improve the accuracy that may be possible with Uu positioning. SL positioning solutions can be considerable for IioT use-cases to complement Uu positioning, especially in view of eventual support of positioning for IioT use-cases in OOC scenarios, which is listed as a requirement in TS 22.104:  “*The 5G system shall provide positioning information for a UE that is out of coverage of the network, with accuracy of < [1 m] relative to other Ues that are in proximity and in coverage of the network.*”  Considering the current status, the proposal is updated as in FL3 Proposal 5.5-1, where it is proposed to consider the relaxed requirement as first release for SL positioning. This is further motivated by the earlier observations from Round #1 that the Rel-17 studies indicated that sub-meter-level accuracy may only be achievable in very limited cases, under specific assumptions, e.g., InH-SH environments. |

## FL3 HP Proposal 5.5-1

* *SL positioning solutions for IioT use-cases should target the following requirements:*
  + *For horizontal accuracy,* 
    - *1 m (absolute or relative) for 90% of Ues*
  + *For vertical accuracy,* 
    - *1 m (absolute or relative) for 90% of Ues*
  + *FFS: 90 – 99 % positioning service availability*
  + *Relative speed: up to 30 km/hr.*

*Please share your views on the above.*

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| **Company** | **Comments** |
| CATT | Support |
| ZTE | Support |
| CEWiT | It is bit unclear to fix horizontal accuracy 1m in light of proposal 3.3 where we consider in coverage scenario is priority for IioT. In Rel 17, we already have 0.2 m horizontal requirement. It is not making sense for us to go for higher than this in SL positioning with incoverage scenario. So we suggest to keep it 0.2 m. |
| Samsung | OK |
| vivo | We also wonder why absolute also needs to be evaluated and defined since Rel-17 has satisfied the requirement in IioT. |
| Lenovo | Support. |
| NEC | OK |
| OPPO | OK |
| AT&T | Our view is that Rel-17 addresses absolute positioning for IioT, and the focus for this study should be relative/ranging with more stringent requirements, and perhaps add a note. Proposed update:   * *SL positioning solutions for IioT use-cases should target the following requirements:*   + *For horizontal accuracy,*      - *0.2 m (relative) for 90% of Ues*   + *For vertical accuracy,*      - *0.2 m (relative) for 90% of Ues*   + *FFS: 90 – 99 % positioning service availability*   + *Relative speed: up to 30 km/hr.*   + *Note: additional accuracy requirements are not precluded* |
| Huawei, HiSilicon | OK. |
| InterDigital | Support |
| Futurewei | OK |
| Bosch | We understand Rel.-17 considers already 0.2m accuracy. We support using 0.2m for all requirements not only horizontal. We also support the formulation by AT&T to consider it for horizontal and vertical. |
| Qualcomm | Not support. We share the same view as AT&T and CEWiT to use 0.2m. |
| Ericsson | OK |
| Nokia, NSB | OK |
| LGE | We prefer to keep the note. As commented earlier, any decision (e.g. prioritization on some use cases) on this agenda may impact the evaluation agenda as a natural consequence. |
| CMCC | We are generally support.  One more thing for clarification, what is the meaning of the FFS on 90%-99% positioning service availability, and how could we evaluate on it (or does it impact any evaluations on the positioning accuracy performance)? |
| Xiaomi | support |
| Sharp | Support |
| SONY | OK |
| Moderator | Summary of received responses:   * Majority (16) responses indicate support/acceptance of the FL proposal. * Two responses (CEWiT, QC) propose to consider the more stringent requirement of 0.2 m for both horizontal and vertical (absolute and relative). * Three responses (vivo, ATT, Bosch) propose to focus on relative positioning only – and ATT and Bosch further propose to consider the more stringent accuracy requirement of 0.2 m for both horizontal and vertical (relative only). * One response (LGE) proposes to add back the note that this proposal is not intended to influence the decision on prioritization of use-cases. * One response (CMCC) wonders on possible evaluations for E-to-E latency.   Considering the received feedback, an updated version of the proposal attempting at a potential compromise (and removal of the FFS bullet on latency) is suggested in **FL4 HP Proposal 5.5.-1**. |

## FL4 HP Proposal 5.5-1

* *SL positioning solutions for IioT use-cases should target the following requirements:*
  + *For horizontal accuracy,* 
    - *1 m (absolute) for 90% of Ues*
    - *0.2 m (relative) for 90% of Ues*
  + *For vertical accuracy,* 
    - *1 m (absolute) for 90% of Ues*
    - *0.2 m (relative) for 90% of Ues*
  + *Relative speed: up to 30 km/hr.*

*Please share your views on the above compromise proposal.*

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| **Company** | **Comments** |
| CATT | We prefer to keep 1m for both absolute and relative SL positioning.  For both absolute and relative SL positioning, limited by SL-PRS bandwidth, it is difficult to reach the sub-meter level positioning accuracy, especially for InF-DH scenario. Regarding the positioning service availability, we are fine to remove this bullet since it is not clear how to evaluate this metrics.  Our preferred revision as follows, Updated FL4 HP Proposal 5.5-1  * *SL positioning solutions for IioT use-cases should target the following requirements:*   + *For horizontal accuracy,*      - *1 m (absolute or relative) for 90% of Ues*   + *For vertical accuracy,*      - *1 m (absolute or relative) for 90% of Ues*   + *Relative speed: up to 30 km/hr.* |
| Samsung | OK |
| vivo | We don’t think 0.2 m or 1m can be achieved only by the measurement between a peer UE.  In Rel-17, 0.2 m can be achieved is because of the further convergence of the multi-base station location solution process. But only considering UE-2-UE measurement, based on Cramer-Rao Lower Bound (CRLB), more than 100M bandwidth is needed for 0.2 m or 1m accuracy. |
| Sharp | OK |
| Xiaomi | We share CATT view that 1m horizontal accuracy requirement is preferred. |
| Huawei, HiSilicon | Although we do not prefer to define a relaxed requirement for IIoT than Rel-17, the suggestion from CATT works for us as a compromise. |

# Other issues

In addition to the requirements discussed above, in contributions, some further requirements and metrics have been proposed. Some of these include:

* Direction/orientation accuracy
* Concurrent UEs performing relative location estimation
* Coverage range for V2X use-case > 300 m
* UE power consumption for SL positioning

## FL1 Proposal 6-1

* *Please share any other issues related to scenarios and requirements for SL positioning studies, including consideration of any further requirements or assumptions, in Rel-18 that should be addressed in this agenda.*

|  |  |
| --- | --- |
| **Company** | **Comments** |
| vivo | The angle accuracy requirement needs to be defined for ranging. |
| InterDigital | We are supportive of studying direction/orientation accuracy. Changes in orientation may impact relative/absolute positioning accuracy and awareness of orientation/direction of the UE will assist positioning. |
| NEC | UE power consumption should also be considered |
| Sony | Direction / orientation accuracy shall be considered as well. |
| Xiaomi | The direction accuracy requirement for ranging needs to be defined. |
| Moderator | Direction accuracy requirements have now been considered as part of ranging accuracy. UE power consumption aspects may be more suitable at a later phase when the basics of SL positioning are clear. |

# Proposals for email endorsement or GTW

# Proposals for email endorsement

The following proposal is recommended for email approval.

## FL4 Proposal 5-1

* *Positioning accuracy requirements for SL positioning are expressed as accuracy requirements of particular percentiles of UEs for one or more of the following metrics:*
  + - *Ranging accuracy, expressed as the difference (error) between the calculated distance/direction and the actual distance/direction in relation to another node*
    - *Relative positioning accuracy, expressed as the difference (error) between the calculated horizontal/vertical position and the actual horizontal/vertical position relative to another node*
    - *Absolute positioning accuracy. expressed the difference (error) between the calculated horizontal/vertical position and the actual horizontal/vertical position*
  + *Note: the exact applicability of particular requirements may vary across use-cases*

# Proposals for GTW

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# Outcome from RAN1 #109-e

**Status as of May 17th, 2022:**

**Agreement**

Following two operation scenarios are considered for studies on SL positioning:

* Scenario 1: PC5-only-based positioning
* Scenario 2: Combination of Uu- and PC5-based positioning solutions

**Agreement**

For evaluations for SL positioning:

* For V2X and public safety use-cases, at least in-coverage and out-of-coverage scenarios are considered.
* For IIoT and commercial use-cases, at least in-coverage scenarios are considered.

**Agreement**

For the purpose of evaluations, in-coverage and out-of-coverage scenarios are prioritized during the SI.

* Note: This prioritization is not intended to down-scope support of SL positioning for partial coverage scenarios.

**Agreement**

For evaluations for SL positioning:

* Operation in FR1 with channel bandwidths of up to 100 MHz are considered.
* Optional: Operation in FR2 with channel bandwidths of up to 400 MHz are considered.

# References

1. RP-213588, Revised SID on Study on expanded and improved NR positioning, Intel (Email discussion moderator), RAN #94-e.
2. 3GPP TR 38.845, Study on scenarios and requirements of in-coverage, partial coverage, and out-of-coverage NR positioning use cases.
3. 3GPP TS 22.261, Service requirements for the 5G system.
4. 3GPP TS 22.104, Service requirements for cyber-physical control applications in vertical domains.
5. R1-2203057, Considerations on scenarios and target requirements for sidelink positioning, FUTUREWEI
6. R1-2203127, SL positioning scenarios and requirements, Nokia, Nokia Shanghai Bell
7. R1-2203162, Discussion on scenarios and requirements, Huawei, HiSilicon
8. R1-2203334, Consideration on SL positioning scenarios and requirements, Spreadtrum Communications
9. R1-2203465, Discussion on SL positioning scenarios and requirements, CATT, GOHIGH
10. R1-2203564, Discussion on SL positioning scenarios and requirements, vivo
11. R1-2203622, Discussion on scenarios and requirements for SL positioning, ZTE
12. R1-2203718, Discussion on SL positioning scenarios and requirements, LG Electronics
13. R1-2203737, Considerations on SL positioning scenarios and requirements, Sony
14. R1-2203751, Scenarios and requirements for sidelink positioning, MediaTek Inc.
15. R1-2203821, Discussion on sidelink positioning scenarios and requirement, xiaomi
16. R1-2203909, On SL Positioning Scenarios and Requirements, Samsung
17. R1-2203941, SL positioning scenarios and requirements, NEC
18. R1-2203978, Discussion on SL positioning scenarios and requirements, OPPO
19. R1-2204094, Discussion on V2X use cases, scenarios, and requirements for sidelink positioning, TOYOTA Info Technology Center
20. R1-2204130, Potential scenarios and requirements for SL positioning, InterDigital, Inc.
21. R1-2204251, Discussion on SL positioning scenarios and requirements, Apple
22. R1-2204309, Discussion on SL positioning scenarios and requirements, CMCC
23. R1-2204557, Potential SL Positioning Scenarios and Requirements, Lenovo
24. R1-2204666, Views on SL positioning scenarios and requirements, Sharp
25. R1-2204753, Discussion on sidelink based positioning requirements & scenarios, CEWiT
26. R1-2204806, On SL positioning scenarios and requirements, Intel Corporation
27. R1-2204833, SL positioning scenarios and requirements, Fraunhofer IIS, Fraunhofer HHI
28. R1-2204948, SL positioning scenarios and requirements, Ericsson
29. R1-2205036, Sidelink Positioning Scenarios and Requirements, Qualcomm Incorporated