3GPP TSG-RAN WG2 #119-e R2-22xxxxx

Online Meeting, Aug 17th – 29th, 2022

Agenda Item: 6.11.2.4

Source: Ericsson

Title: [AT119-e][425][POS] UE-based integrity assessment (Ericsson)

Document for: Discussion, Decision

# Introduction

This document is to gather input for below email discussion.

* [AT119-e][425][POS] UE-based integrity assessment (Ericsson)

Scope: Evaluate the proposal in R2-2208075 from the standpoint of determining if it is an essential correction. New functionality will not be introduced and the discussion should determine if there is support for this change as a correction in Rel-17.

Intended outcome: Report to CB session

Deadline: Tuesday 2022-08-23 1200 UTC

The email discussion is related to the contribution

1. R2-2208075 Provisioning of missing integrity requirements , Ericsson

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# Discussion

## Background

The WID on NR positioning enhancements [3] includes the following objective

* Specify the signalling, and procedures to support GNSS positioning integrity determination, including [RAN2, RAN3]:
  + The assistance information that will be used to support integrity determination
  + The information that will be used to provide the positioning integrity KPIs and integrity results
  + Support of integrity for UE-based and UE-assisted A-GNSS positioning.

Note: This objective is applicable to NR and E-UTRA.

Most of this objective has been completed already in Rel 17, but as raised in [1], the support of integrity for UE-based A-GNSS positioning still has some remaining parts.

To put integrity in UE-assisted and UE-based positioning context, the following was provided in [1]

* **UE-assisted integrity** **assessment**, where LMF configures the device with TIR to enable the device to determine PL, report PL to LMF, which LMF compares to AL, possibly in consideration of TTA to make integrity assessments.
* **UE-based integrity assessment**, where LMF configures the device with TIR, AL and TTA to enable the device to determine PL, compare to AL, possibly in consideration of TTA to make integrity assessments. A typical beneficiary of the integrity assessments is higher layers in the device, which becomes aware of whether reliable positioning estimates are available or not.

In comparison, we already have UE-assisted and UE-based positioning for several positioning methods including A-GNSS

* **UE-assisted positioning**, where LMF configures the device with assistance data to enable the device to determine positioning measurements, report positioning measurements to LMF, which LMF uses together with additional information such as TRP or SV locations to estimate the device position.
* **UE-based positioning**, where LMF configures the device with assistance data to enable the device to determine positioning measurements, using additional information such as TRP or SV locations from the assistance data to estimate the device position. A typical beneficiary of the position estimates is higher layers in the device, which becomes aware of the device position.

Since online time is limited, we will in this email discussion pick up the issues and concerns brought up during the brief online discussion. These comments relate to UE-assisted and UE-based integrity assessments, and therefore, the email discussion will be separated accordingly.

## UE-assisted integrity assessments

With the RAN2#118-e agreement “Keep the definition of PL, and clarify in a NOTE that the PL inequality is valid for all values of the AL.”, the definition of PL in 36.305/38.305 now reads

**Protection Level (PL):** A statistical upper-bound of the Positioning Error (PE) that ensures that, the probability per unit of time of the true error being greater than the AL and the PL being less than or equal to the AL, for longer than the TTA, is less than the required TIR, i.e., the PL satisfies the following inequality:   
 *Prob per unit of time* [((*PE>AL*) & (*PL<=AL*)) *for longer than TTA*] *< required TIR*  
When the PL bounds the positioning error in the horizontal plane or on the vertical axis then it is called Horizontal Protection Level (HPL) or Vertical Protection Level (VPL) respectively.  
A specific equation for the PL is not specified as this is implementation-defined. For the PL to be considered valid, it must simply satisfy the inequality above.

NOTE: the PL inequality is valid for all values of the AL.

This definition is intended to both define the protection level as a concept as well as a measurement that the UE can be requested to report to the location server as part of UE-assisted integrity assessments.

Since several companies raise the issue about whether AL is needed to compute PL, it could be relevant to define how the PL *that is reported* to the location server shall be determined and that definition does not include AL, or at least marginalize AL.

Question UEA-1: Companies are requested to provide their view about whether a specific PL definition shall be agreed, specifically for the PL value to be reported by the device to the location server upon request. Suggestions of such a specific PL definition for PL reporting are encouraged.

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| Company | Specific PL definition for PL reporting Yes/No | Comments, suggested specific PL definition |
| CATT | No | The inequality below is used for assessments but not for the operation of calculating PL.  the PL satisfies the following inequality:   *Prob per unit of time* [((*PE>AL*) & (*PL<=AL*)) *for longer than TTA*] *< required TIR* So an example of how to calculate PL will be helpful to understand the PL. |
| InterDigital | No (with comments) | The definition of PL currently captured in TS 37.355 is reasonable, generic and is based on the definition that was discussed during Rel-17 SI. We do not see the need for modifying the definition at this late stage. Perhaps any clarification to the definition can be discussed during Rel-18. |
| Xiaomi | No | In the TS 38.305, it said that *A specific equation for the PL is not specified as this is implementation-defined. For the PL to be considered valid, it must simply satisfy the inequality above*. But Ok to provide an example for PL definition. |
| Qualcomm | No | Not clear how this question relates to the scope of the email discussion.  3GPP specifications support a generic representation of the integrity parameter and assistance data that do not require e.g., hard-coding of parameters and specific user algorithms. |
| vivo | No | In our understanding, PL is calculated based on the inequality and the distribution of PE. As the distribution of PE is implementation-defined based on the feared events, the PL is up to implementation correspondingly.  Therefore, it is rational to keep the current definition of PL. |
| Ericsson | No | The definition is implicit, while it could have been explicit (e.g. via some arg max formulation), |
| Swift Navigation | No | The PL inequality is generic and applicable to all modes of positioning (e.g. UE-based and UE-assisted). |
| Intel | See comments | Agree with others, current PL definition is defined in the general way. However it looks like the assessment instead of calculation since the UE should calculate PL without the comparison with AL? It would be good to clarify this. |
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The discussion about KPI and integrity result report was held several meetings ago, concerning mode 1 (only PL reporting) and mode 2 (integrity event flagging), and only mode 1 was agreed. Just to straight out confusion, it can be good to confirm what the mode 1 agreement means.

Question UEA-2: Do you agree that the mode 1 agreement concerns device reporting of integrity results upon request from the location server – i.e. part of UE-assisted integrity assessment?

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| Company | Yes/No | Comments |
| CATT | Yes | The calculated/estimated PL is part of integrity assessment. |
| InterDigital | With comments | The description of “UE-assisted integrity assessment” provided in the background is somewhat confusing. Does it refer to LPP Location Information procedure with LPP request and provide messages? From our understanding Mode 1 reporting specified during Rel-17 applies for UE-based positioning integrity mode for services such as MT-LR. |
| Xiaomi | Yes |  |
| Qualcomm | No | Not clear how this question relates to the scope of the email discussion.  There exists no agreed concept of "UE-assisted integrity assessment".  "Mode 1" and "Mode 2" reporting provide the same functionality, but with different signalling requirements (and UE impacts). |
| vivo | The question is confusing | To my understanding, both the UE-assisted and UE-based integrity assessment introduced by moderator are UE-based integrity as the UE is the one who calculate the PL.  As to the question, according to the description in Background, the integrity assessment is mainly classified by whether UE is exposed to KPIs other than TIR via an LPP message. Mode 1 reporting equals to the so-called UE-assisted integrity assessment under GNSS integrity, not part of. |
| Ericsson | Yes | Mode 1 (agreed) and mode 2 (not agreed) both represented reported integrity results from device to location server, where the location server may use the reported protection level to make a UE-assisted integrity assessment  Only calculating PL is not integrity, it needs to be compared to an alert limit, in consideration of the TTA. In UE-assisted integer assessment, this comparison is on the location server side, while in UE-based integer assessment, this comparison is on the device side, and the device needs AL and TTA for that purpose.  The WID supports both UE-based and UE-assisted integrity for GNSS |
| Swift Navigation | No, with comments | Mode 1 is only about reporting the PL. Any ‘assessment’ of the PL result (e.g. availability assessment etc) is explicitly out of scope of Mode 1, i.e. the rest is up to implementation, see actual definition below from TR 38.857:   * **Mode 1 of Integrity Result Reporting : PL Reporting**   The integrity computing entity calculates the PL, based on the measurement, assistance information and TIR. Then, the calculated PL is directly reported to where the LCS client resides (Network or UE). Hence, the integrity computing entity does not judge whether the positioning system is still available, it simply provides whatever PL value it has obtained. It is left to the LCS client itself to determine if the positioning system is still available based on the reported PL.  The concept of ‘integrity assessment’ seems to need further discussion and definition given the current terminology is confusing with respect to the traditional interpretation of UE-B and UE-A functionality. We can continue discussing as part of R18 given it may be relevant to both RAT-I and RAT-D integrity. |
| Intel | With comments | Agree with others, “assessment” is the new concept that we did not discuss before. Mode 1 is the UE to report PL (calculated by the UE). Assessment itself seems out of 3GPP scope? |
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## UE-based integrity assessment

UE-based integrity assessment means that the device compares PL to AL in consideration of TTA to determine availability of the location estimate within the device itself. The AL and TTA can be provided to the device in many different ways such as provided by the location server, provided by some application on the device side or pre-configured in the device.

If the AL and TTA, together with TIR would be provided by the location server as part of the assistance data to support UE-based integrity, one question raised was if the device is required to use it.

As comparison, we have UE-based positioning where the device is provided with assistance data from the location server to support UE-based positioning. It is up to device implementation if and how the device is using different parts of the assistance data for UE-based positioning.

Question UEB-1: Do companies agree that if AL and TTA, together with TIR is provided as part of assistance data from the location server to enable UE-based integrity assessment, it is up to device implementation if and how the information is used for integrity assessment, if information from higher layers in the device is used etc ?

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| Company | Yes/No | Comments |
| CATT | Yes | If location can be estimated by device, the integrity alert of estimated location from UE is acceptable. But it seems that UE-based integrity assessment is a new feature introduced to device, not a correction on Rel-17. |
| InterDigital | Yes (with comments) | From previous discussions during WI stage the UE could calculate PL when provided with TIR in the assistance data. Given this late stage into the discussion and that no foreseeable issue with support for GNSS integrity, we think any discussion related to providing AL and TTA in assistance data should not be handled as correction. However, the topic could be considered in Rel-18. |
| Xiaomi | See comments | If AL and TTA from LMF is needed for the UE-assisted integrity assessment , we think the the AL and TTA from LMF are also needed even for the UE-assisted integrity assessment in some cases. |
| Qualcomm |  | Not clear how this question relates to the scope of the email discussion.  AL, TTA, TIR seems not required assistance data.  The PL is a measure of the integrity that allows the receiver to operate without knowing the AL. |
| vivo | Depends on whether mode 2 reporting shall be supported in rel-17. | To support UE-based integrity assessment, KPIs such as TIR, AL and TTA should all be provided to UE. In our understanding, the UE-based integrity assessment equals mode 2 reporting. However, we have concluded not supporting mode 2 reporting in Rel-17. |
| Ericsson | Yes | Comments:  To CATT, InterDigital: UE-based integrity is part of the Rel 17 WID, just not completed yet  To Xiami: As concluded at the last meeting, only TIR is needed by the device som compute PL and report to LMF as part of UE-assisted integrity so this is different from what is needed for UE-based integrity  To QC: PL is an integrity result, but AL and TTA is needed for assessing integrity, either on the device side (UE-based) or location server side (UE-assisted)  To vivo: Mode 2 was a report option discussed, so part of UE-assisted integrity, while here we discuss UE-based integrity with no reporting to location server needed.  Important that we separate the different way of operation here, where UE-based integrity needs to related PL to AL in consideration of TTA on the device side, and somehow, the device needs these parameters. They can be preconfigured of course, but 3GPP LPP should be complete when it comes to integrity, and UE-based integrity is a WID objective. |
| Swift Navigation | Yes, with comments | We aren’t opposed to having the option of sending all three KPIs (TIR, AL, TTA), e.g. to enable configuration of these parameters at the UE or to compare with the KPIs which are already pre-configured at the UE. However, we think further discussion and description is needed in Stage 2 first to understand the expected behaviour such as:   * Is the UE required to use these parameters under certain circumstances or would they always be optional and up to the UE? * In the latter case, if the UE does not choose to use them, will this lead to a situation where the UE has a different configuration than the LMF expected?   We can keep discussing as part of R18. |
| Intel | Yes with comments | We share the same view with Swift, it would be good to understand the assessment, and expected UE behavior first. |
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The contribution [1] provides a text proposal with the few changes needed to enable the support of integrity for UE-based and A-GNSS positioning which is the remaining part of the WID objective [3].

Question UEB-2: Do companies agree to the text proposal in [1] with the few changes needed to enable the support of integrity for UE-based and A-GNSS positioning which is the remaining part of the WID objective ?

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| Company | Yes/No | Comments |
| CATT | Yes, but | There will be an extra requirement to device if the support of integrity for UE-based and A-GNSS positioning is enabled. We’d like to follow the views of devices.  It’s good to have it if there is no big concern from device vendors. |
| InterDigital | No | Similar to our comments to question UEB-1, providing integrity requirements (i.e. AL and TTA) in assistance data should not be handled as correction. |
| Xiaomi | See comments | We think the key issue is that whether the positioning integrity can be implemented well without LMF providing AL and TTA for the UE-assisted integrity assessment. If Yes, the proposed change is needed, otherwise, we don’t think it is feasible to introduce UE-based integrity assessment at this later stage. |
| Qualcomm | No | Not clear how this question relates to the scope of the email discussion.  The WID has been closed at RAN#95e with all objectives of the WID completed. |
| vivo |  | Even if we would support mode 2 reporting, the integrity requirements should all be provided to LMF in the first hand. Then the LMF will determine the integrity reporting mode. In this way, Instead of UE request for the integrity requirements, it is up to LMF to decide what kind of KPIs are provided to UE. |
| Ericsson | Yes | It is important to stress that UE-based integrity is a WID objective and we need to make LPP complete when it comes to integrity to also support UE-based integrity.  Without this, AL and TTA will need to be provided as preconfigured or some way outside LPP, while it should be in everyone’s interest here to ensure that the integrity support is complete according to the WID, including also UE-based integrity. |
| Swift Navigation | No | We see the changes as additional functionality which could be useful and should be further discussed in R18, however we do not see them as essential corrections to enable the WID. |
| Intel |  | Tend to agree with other companies that it is function change. |
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Question UEB-3: Any other question or comment concerning UE-based integrity assessment?

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| Company | Comments |
| Qualcomm | There is no difference between UE-based and UE-assisted in terms of "integrity assessment". The integrity may be assessed at the consumer or requestor of the location information, but this does not need to be standardized. |
| vivo | One separate question during the study of moderator’s contribution.  In the current integrity report, there is an *achievableTargetIntegrityRisk*. In our understanding, the UE can derive the PL with TIR, and can derive the achievable TIR with AL.  We are wondering how can UE calculate the *achievableTargetIntegrityRisk* without knowing the AL. |
| Ericsson | Of course there is a difference between UE-assisted and UE-based integrity assessment. How can a network application configure integrity in a use case where the device evaluates integrity over time and report to its higher layer otherwise?  To vivo: The achievable TIR is matching the reported HPL and VPL. |
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# Conclusion

TBD

# References

[1] R2-2208075 Provisioning of missing integrity requirements, Ericsson

[2] AI 6.11.2.4

[3] RP-210903, WID on NR Positioning Enhancements