3GPP TSG-RAN WG2 #111-e Draft R2-20xxxxx

Electronic Meeting, August 17 - 28, 2020

Agenda Item: x.x.x

Source: Swift Navigation

Title: [Post111-e][626][POS] Email Discussion on integrity use cases and specification impacts

Document for: Discussion, Decision

# 1 Introduction

This document addresses the agreements, open issues and draft TP for the following email discussion:

* [Post111-e][626][POS] Integrity use cases and specification impacts (Swift)

Scope: Capture any additional integrity use cases and open issues on integrity, and draft a TP incorporating the existing agreements and any further progress.

Intended outcome: Summary to next meeting

Deadline: Long

The agreements from RAN2#111-e are provided below [1]:

**Agreements:**

1. Agree to adopt the Target Integrity Risk (TIR), Alert Limit (AL) and Time-to-Alert TTA) as the Integrity KPIs.

2. Agree to the following definitions of the KPIs:

**Target Integrity Risk (TIR):** The probability that the positioning error exceeds the Alert Limit (AL) without warning the user within the required Time-to-Alert (TTA).

NOTE: The TIR is usually defined as a probability rate per some time unit (e.g. per hour, per second or per independent sample).

**Alert Limit (AL):** The maximum allowable positioning error such that the positioning system is available for the intended application. If the positioning error is beyond the AL, operations are hazardous and the positioning system should be declared unavailable for the intended application to prevent loss of integrity.

NOTE: When the AL bounds the positioning error in the horizontal plane or on the vertical axis then it is called Horizontal Alert Limit (HAL) or Vertical Alert Limit (VAL) respectively.

**Time-to-Alert (TTA):** The maximum allowable elapsed time from when the positioning error exceeds the Alert Limit (AL) until the function providing position integrity annunciates a corresponding alert.

3. Agree to include the PL integrity definition with the following baseline; FFS if updates are needed.

**Protection Level:** The PL is a statistical upper-bound of the positioning error 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.

NOTE: 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.

4. The additional definitions are FFS on a ‘need-to-define’ basis.

5. Agree to study the Automotive, IIoT and Rail use cases as illustrative examples.

6. Agree to the Skeleton for Section 9 of TR 38.857.

The agreements have been included in the draft text proposal in Section 3 below. The open issues are further discussed in Section 2 below, providing additional considerations for the draft TP.

# 2 Open Issues

The following open issues are presented for discussion and inclusion in the draft TP.

2.1 Use Cases

Three use cases were agreed as illustrative examples of integrity in the draft TP – Automotive, IIoT and Rail [1]. Companies are asked to comment and/or provide suggested text for the TP, with a view to describing the application of integrity to these use cases in accordance with the study objectives.

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| **Company** | **Please comment on the integrity use case descriptions (Automotive, IIoT, Rail)** |
| Swift Navigation | For the **Automotive** use case, we propose to adopt the Road-Level and Lane-Level Identification text provided in **Section 9.4.1** of [RP-2006541](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_111-e/Docs/R2-2006541.zip) [2], to illustrate the integrity KPIs and core integrity concepts in practice. |
| Huawei, HiSilicon | First, we propose to provide some description on why these use cases should be guaranteed with the integrity requirements, e.g.,  *“Integrity” should be specified for safety-critical or liability-critical applications, in terms of insurance of the quality of service.*  Second, for each use cases– Automotive, IIoT and Rail, we expect to study the corresponding integrity requirements and capture the corresponding KPIs (AL, TIR, TTA) by some exemplary values, which can be reflected in TR 22.872 Table 6.1-1. |
| vivo | According to RAN #89 e-meeting, RAT-dependent integrity was excluded from the study scope. So IIoT which is using indoor positioning should be removed as well. |
| ESA | For the **automotive** use case, we propose to complete the Road-Level and Lane-Level Identification text (section 9.4.1 of RP-2006541) with the summary of automotive use cases provided in section 4.1.3 of [R2-2007646](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_111-e/Docs/R2-2007646.zip).  With respect to the **rail** use case, we propose to illustrate the integrity KPIs with the text provided in section 4.2 of [R2-2007646](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_111-e/Docs/R2-2007646.zip). |
| Spreadtrum | RAT-dependent integrity is not in the scope based on RAN#89-E. So IIOT can be removed. For automotive, we think that the text provided in R2-2006541 can be a baseline. We propose to add a table to list KPIs clearer. For rail, the text in R2-2007646 can be a baseline. We think the text for both automotive and rail should have same style. |
| CATT | We propose to describe the use cases analysis following the structure of TR 22.872 (Study on positioning use cases (R16)).  x.1 Description  x.2 Pre-conditions  x.3 Service Flows  x.4 Post-conditions  x.5 Potential Requirements  Potential requirement of integrity KPIs will be specified in the TP, e.g. the level of integrity, integrity risk, and time to alarm. |
| Ericsson | We agree with the **Automotive** use-case text proposal suggested by Swift Navigation. For the **Industrial IoT** use-case, we have previously provided the TP in R2-2006954, which is in line with the automotive TP use-case, provides also Path and Zone Identification for AGV, and sheds some light on how integrity KPIs and concepts can benefit this use-case.  While the RAT-dependent positioning integrity is down prioritized by RAN, we still suggest to keep the same sectioning as per the agreements made in RAN2-111 to include IIOT as one of the use case, and with a sentence just indicating or a paragraph that this topic would not be studied within Rel.17 SI. |
| Apple | For the V2X and rail use cases, we agree to use related text in R2-2006541 and R2-2007646 as the baseline for the Text proposal. For IIOT case, I think we can postpone this use case to the next release as RAT-dependent positioning integrity is removed from the SID. |
| InterDigital | As in the suggested texts for Automotive use cases by Swift, we are fine to mention exemplary values for KPIs, i.e., TIR, AL and TTA. |
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2.2 Protocol Impacts

There was general consensus in the email discussions to review the protocol impacts to the RAN positioning specifications in the SI, in order to inform potential changes as part of the subsequent WI. The following table is therefore proposed for inclusion in Section 9.5 of the draft TP below. Protocol impacts to other specification groups (e.g. SA, CT, OMA) can be considered if a need is identified through the SI findings.

-------------------------------------------------Start of text proposal------------------------------------------------

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| **Impacted TS/TR** | | | |
| TS/TR | Vers | Title | Remarks |
| TS 38.305 |  | Stage 2 functional specification of User Equipment (UE) positioning in NG-RAN |  |
| TS 38.331 |  | NR; Radio Resource Control (RRC); Protocol specification |  |
| TS 37.355 |  | LTE Positioning Protocol (LPP) |  |
| TS 38.455 |  | NR Positioning Protocol A (NRPPa) |  |

Table 9.5 – Impacted RAN specifications.

--------------------------------------------------End of text proposal------------------------------------------------

Companies are asked to comment if they agree with the table of specifications.

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| **Company** | **Do you agree with the specification list for the SI phase?** |
| Swift Navigation | Yes. |
| Huawei, HiSilicon | Generally agree.  1) We also think the specific impacts on the listed specs should be provided.  38.305, 37.355 and 38.455 impacts:   * + Capture the integrity definitions and relevant KPIs.   + Capture the integrity assistance data that required to be transferred to/from UE or LMF.   + Capture measurements for integrity.   + Capture general procedure for supporting integrity.   2) Some other specs should also be listed.   * SA specs impacts:   + SA1 needs to capture the integrity definitions, KPIs and use cases.   + SA2 needs to specify the system level procedure for integrity. * CT specs impacts: * CT4 needs to define the QoS in the LCS request. * CT4 needs to define the alert from LMF to LCS client. * OMA impacts: * OMA needs to define the QoS for integrity and alert, similar to the CT impacts. |
| vivo | Yes |
| ESA | Yes |
| Spreadtrum | Yes. Only a few impacts to 38.331 because RAT-dependent integrity is not in the scope based on RAN#89-E. |
| CATT | Yes, agree.  Furthermore, the service levels in SA and Qos and alarm in CT specs will be impacted, because of service level from AMF and alarm to AMF:  SA: TS 22.261, TS 23.273  CT: TS 29.572 |
| Ericsson | Unicast integrity support:   * LPP + Stage 2   Broadcast integrity support   * LPP, NRPPa, Stage 2, RRC   We need to still study if various QoS levels/integrity levels are required or not. If there is no such classification then there are no impacts for SA or CT groups. |
| Apple | Instead of list what specification needs change, I think RAN2 need first illustrate the exact architecture and protocols for this work(e.g., any new interface or any new protocol/signaling expected). Then, the impact to the spec can be determined. |
| InterDigital | Yes, from RAN2 perspective |
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2.3 Integrity Concepts

The Tdoc submissions and email discussions contained information and questions relating to the core integrity concepts and how these concepts will be interpreted and defined within the 3GPP system. The core integrity concepts are therefore important inputs for addressing the remaining objectives (e.g. to categorize the errors, to specify the integrity methodologies, to identify the protocol impacts and to support the definition of more ‘3GPP-friendly’ descriptions throughout the SI/WI). Companies are asked to comment on key topics to be addressed in the integrity concepts.

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| **Company** | **Please identify the integrity concepts to be considered in the study** |
| Swift Navigation | We believe the Integrity Concepts (Section 9.1.2 of the Skeleton TR) should cover the following topics:   1. **What is positioning integrity?** 2. **Interpretation and relationship between the Protection Level and KPIs.**    1. Including the Stanford Diagram conceptual framework.   We think (1) and (2) can be addressed in part by including the text and diagrams from **Section** **9.2.3** (Accuracy versus Integrity), **Section 9.3.1** (KPI Descriptions), and **Section** **9.3.2** (Stanford Diagram) in [RP-2006541](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_111-e/Docs/R2-2006541.zip) [2]. |
| Huawei, HiSilicon | We think several issues should be illustrated for the integrity concepts.  1) Definition or explanation of threat models and failure modes.  2) The general system framework for positioning integrity should be captured.  3) How to conduct integrity validation according to the obtained information or assistance data, e.g. error sources, measurement results, calculated PL? Related signalling flow should be identified. |
| vivo | We prefer define integrity assisted data in more details like which information should be included and how does these information impact on integrity |
| ESA | We agree with Swift’s proposal of using RP-2006541 sections 9.2.3, 9.3.1 and 9.3.2 as a baseline for explaining the integrity concepts. To improve that baseline few recommendations are listed below:   * Section 9.2.3, *“For example, a Target Integrity Risk (TIR) of 10-7/hr translates to a 99.99999% probability that no hazardously misleading outputs occurred in a given hour of operation, which is a common requirement in aviation and automotive use cases”*. Because there are a wide range of automotive use cases with different requirements and, even in the safety-critical applications, there is no “usual” integrity risk, we propose to remove *“and automotive use cases”* from text above. * We propose to include in the integrity concepts a general explicit description of what we understand by position integrity. Something like the following text (from ETSI TS 103 246-3 V1.2.1 (2017-03)):   “The integrity of an estimated position is understood as the measure of the trust in the accuracy of the location-related data provided by the location system and the ability to provide timely and valid warnings to users when the location system does not fulfil the condition for intended operation.”   * In the second paragraph of section 9.3.1: add a paragraph on fault feared events as means of contrast to the fault free feared events line.   “   * *Fault feared events include any intentional or unintentional event that causes the malfunction of the system such as interference in GNSS frequency bands and spoofing events.*   ” |
| Spreadtrum | We generally agree with Swift’s proposal of using RP-2006541 sections 9.2.3, 9.3.1 and 9.3.2 as a baseline for explaining the integrity concepts. It is good to add the improvements provided by ESA. |
| CATT | We propose to illustrate:  1. the framework including the networks who collect errors and 3GPP positioning network.  2. the concepts of errors before addressing the remaining objectives (e.g. to categorize the errors). |
| Ericsson | We agree with the suggested additions by Swift Navigation to the TR. |
| Apple | We agree with Swift’s proposal of using RP-2006541 sections 9.2.3, 9.3.1 and 9.3.2 as a baseline. We also agree the additional descriptions provided by ESA. |
| InterDigital | We agree with Swift that explanations of integrity and KPIs are needed. We also agree with Swift that 9.2.3 is a good TP as the starting point to illustrate how integrity can provide confidence for positioning accuracy, and explain that the percentile performance does not guarantee overall confidence level. The Stanford Diagram provides a sufficient method to capture relationship between Protection Level and KPIs. Exemplary system behaviors of “system unavailable” can be explained here. |
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# 3 Text Proposal

The following section incorporates the existing agreements as text proposals within the agreed Skeleton.

-------------------------------------------------Start of text proposal------------------------------------------------

9 Positioning integrity and reliability

*From objective 2: Includes solutions necessary to support integrity and reliability of assistance data and position information:*

9.1 Integrity Overview – Background Information

9.1.1 Integrity Definitions

**Target Integrity Risk (TIR):** The probability that the positioning error exceeds the Alert Limit (AL) without warning the user within the required Time-to-Alert (TTA).

NOTE: The TIR is usually defined as a probability rate per some time unit (e.g. per hour, per second or per independent sample).

**Alert Limit (AL):** The maximum allowable positioning error such that the positioning system is available for the intended application. If the positioning error is beyond the AL, operations are hazardous and the positioning system should be declared unavailable for the intended application to prevent loss of integrity.

NOTE: When the AL bounds the positioning error in the horizontal plane or on the vertical axis then it is called Horizontal Alert Limit (HAL) or Vertical Alert Limit (VAL) respectively.

**Time-to-Alert (TTA):** The maximum allowable elapsed time from when the positioning error exceeds the Alert Limit (AL) until the function providing position integrity annunciates a corresponding alert.

**Protection Level:** The PL is a statistical upper-bound of the positioning error 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.

NOTE: 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.

9.1.2 Integrity Concepts

[TBC in Section 2 - Open Issues]

9.2 Use Cases

9.2.1 Automotive

[TBC in Section 2 - Open Issues]

9.2.2 Industrial IoT

[TBC in Section 2 - Open Issues]

9.2.3 Rail

[TBC in Section 2 - Open Issues]

9.3 Positioning Integrity Error Categories

9.3.1 RAT-Independent

9.3.2 RAT-Dependent

9.4 Positioning Integrity Methods

9.4.1 RAT-Independent

9.4.2 RAT-Dependent

9.5 Procedure and protocol impact analysis

[TBC in Section 2 - Open Issues]

--------------------------------------------------End of text proposal------------------------------------------------

Please provide any additional comments on the text proposal:

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| **Company** | **Comment** |
| ESA | Section 9.1.1 should be removed and definitions should be added to the Section 3.1 of TR 38.857.  Sections 9.3.2 and 9.4.2 should be removed to keep the ToC aligned to the SID objectives (i.e., RAT-dependent is no longer applicable when it comes to studying integrity in the position domain)  In Section 9.3.1 should introduce a 9.3.1.1 GNSS (3GPP positioning protocols support other RAT-independent techniques besides GNSS). Still in Section 9.3.1, under the proposed 9.3.1.1. GNSS, add the 4 categories of GNSS faults that were agreed at the last meeting (see below). In addition, R2-2007647 analyses several other faults under External feared events and UE faults categories. These faults, very impactful on position integrity, were recommended for further study in email discussion on Integrity Error Sources – R2 – 2008263.  9.3 Positioning Integrity Error Categories  9.3.1 RAT-Independent  9.3.1.1 GNSS  9.3.1.1.1 Faults in the correction data e.g.  a. Incorrect computation by the provider  b. External feared event impacting the provider  9.3.1.1.2 Faults in transmitting the data to the UE, e.g  a. Data integrity faults  9.3.1.1.3 External feared events, e.g.  a. Satellite feared events  b. Atmospheric feared events  c. Multipath  d. Jamming (FFS)  e. Spoofing (FFS)  9.3.1.1.4 UE faults  a. GNSS receiver design faults (FFS)  b. GNSS receiver noise (FFS)  c. Incorrect reception and decoding of GNSS assistance data (FFS) |
| CATT | The clauses of RAT- Dependent (e.g. 9.3.2 and 9.4.2) can be deleted because RAT-Dependent of integrity was excluded in SID after RAN #89-e meeting. |
| Ericsson | We can still keep the use case for IIOT as it has been already agreed; we can add remark saying RAT dependent integrity is not in scope of Rel-17. |
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# 4 Conclusion

# 5 References

1. [R2-2008125](http://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_111-e/Docs/R2-2008125.zip), Report from session on positioning and sidelink relay, Session Chair (MediaTek).
2. [R2-2006541](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_111-e/Docs/R2-2006541.zip), TP for Study on Positioning Integrity and Reliability, Swift Navigation, Deutsche Telekom, u-blox, Ericsson, Mitsubishi Electric, Intel Corporation, CATT, UIC.