3GPP TSG-RAN WG2 Meeting #113-e***R2-21xxxxx***

Electronic, Jan 25 – Feb 05, 2021

**Agenda item:** 8.11.3.1

**Source:** Swift Navigation

**Title:** Moderator Summary - [AT113-e][601][POS] Integrity text proposal

**Document for:**  Discussion, Agreement

# 1. Introduction

This document provides the moderator summary and remaining open questions for the following email discussion:

 **[AT113-e][601][POS] Integrity text proposal (Swift)**

Scope: Continue discussion of the remaining open issues on integrity, taking into account contributions to agenda items 8.11.3.1 and 8.11.3.2, and develop an agreeable text proposal

Intended outcome: Updated TP

Deadline:  Tuesday 2021-02-02 1200 UTC

The **Moderator Summary** and *Suggested Resolution* for each question in the first round have been added to Section 3 below. The updated TP resulting from these discussions is provided in [16] and should be reviewed alongside this Moderator Summary. The remaining open questions are provided in Section 2 below.

The final deadline for email comments is **Monday 01-Feb-2021 1000 UTC**.

# 2. Open Questions

## 2.1 Recommendations for the TR

As per the running TP for draft TR 38.857, led by RAN1, Section 10 provides the template for reporting the recommendations for the normative work in response to the overall FS\_NR\_Pos\_Enh study objectives. The remaining open question from the Moderator Summary below is to capture the final text for the integrity study recommendations.

The Moderator’s view is that this section should attempt to capture those items indicated as FFS in the current baseline TP (which are further noted in the Moderator Summary), as well as the outstanding proposals summarized in Table 2 that are yet to be decided, but have been flagged to be addressed in the normative work. In the updated text below, the changes from the Suggested Resolution in Question 4 of the Moderator Summary are included:

*Start of Text Proposal*

## 10.10 Enhancements of signalling and procedures for positioning integrity

The following enhancements of signalling and procedures to support positioning integrity determination are recommended, including the following aspects:

* + Define the specific list of A-GNSS positioning integrity feared events to be addressed in the 3GPP specifications.
	+ Signalling and procedures to support positioning integrity determination:
		- The assistance information IEs that will be used to mitigate the feared events;
		- The details of the LPP signalling to transport the positioning integrity assistance information.
		- The details of the LPP signalling to transport the positioning integrity KPIs and integrity results.
	+ Support of integrity for UE-Based and UE-Assisted A-GNSS positioning.

*End oft Text Proposal*

**Question A: Do you agree with the text proposed for Section 10.10? If not, please propose specific changes to the text. General comments without an accompanying specific text proposal will not be considered at this stage.**

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| Company | Yes/No | Comments |
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## 2.2 Editorial

The Moderator has proposed several minor editorial corrections throughout the TP below for ‘clean-up’.

**Please review the track changes and recommend any additional editorial enhancements inline, as required.**

# 3. Moderator Summary - Discussion [AT113-e][601][POS]

The **Moderator Summary** and *Suggested Resolution* for each question have been included below.

The text and proposals submitted to agenda items 8.11.3.1 and 8.11.3.2 will be handled under three categories:

1. **Already identified for consideration in the baseline TP**
2. **Proposed text changes to the TP**
3. **May require further discussion**

## 3.1 Already identified for consideration in the baseline TP

In the Methodologies summary prepared by ESA [15] the conclusions were divided into ‘*proposals that may be agreeable’* and ‘*proposals that may require further discussion’*. To further streamline this email discussion, many of the proposals in both categories have already been identified for consideration as part of the normative work. A consolidated list of proposals is therefore provided in Table 2.

**Table 2: Moderator summary of proposals from [15] which have already been identified for consideration in the baseline TP [1].**

*NOTE: the numbering of proposals and references are from [15].*

Proposal 2: RAN2 supports detection and reporting of positioning related errors at UE and LMF

Proposal 3: For UE-based integrity method, the assistance data from LMF to UE should include the faults of correction data, feared events in transmitting the data to the UE and external feared events.

Proposal 4: For UE-assisted integrity method, UE needs to send UE feared events to LMF.

Proposal 5: Study the assistance information required for gNB or UE for integrity measurement reporting.

Proposal 9: RAN2 study UE-based solution for integrity, which includes procedures of:

1) LMF sending KPI to UE (for MT-LR),

2) LMF sending assistance information to UE, and

3) UE report integrity result to LMF (for MT-LR).

Proposal 10: RAN2 study UE-assisted solution for integrity, which includes procedures of:

1) UE sending KPI to LMF (for MO-LR),

2) UE sending assistance information to LMF, and

3) LMF report integrity result to UE (for MO-LR).

Proposal 11: UE will calculate the PL for UE-based positioning, while LMF will calculate the PL for LMF-based positioning.

Proposal 13: Integrity capability should be studied in WI.

Proposal 14: To study whether integrity information can be transmitted by existed signal modification without architecture change and new interface introduced.

Proposal 16: RAN2 supports mechanisms for recovering from positioning failure conditions/errors detected at UE and LMF

Proposal 17: For A-GNSS positioning method, Rel-16 Capability Transfer procedure in LPP shall be reused to indicate the UE´s positioning integrity capabilities.

Proposal 18: Integrity KPIs are provided to the UE by the LMF using Assistance Data transfer procedure.

Proposal 19: For UE-based positioning integrity, the Rel-16 assistance data transfer procedure can be reused for the integrity assistance data transfer, for UE-assisted positing integrity, how to transfer integrity assistance data to LMF need to be further studied.

Proposal 20: The Rel-16 LPP location information transfer procedure can be reused for integrity KPIs [3][6][8], integrity results [3][6] and integrity measurements delivering [6].

Proposal 21: Support signalling procedures for UE-assisted integrity (i.e. LMF-based) and network-assisted integrity (i.e. UE-based) as a baseline. Details are FFS.

Proposal 24: Study the enhancement for the quality of service (QoS) metrics for integrity as proposed in [12].

Proposal 25: Study the system framework for positioning integrity and adopt the baseline provided in [12].

**Question 1: Do you agree that the proposals listed in Table 2 should be resolved as part of the normative work?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Swift Navigation | Yes | The majority of topics in these proposals have already been identified as FFS in the baseline TP, or are topics relating to specific normative decisions. Therefore, we believe that each of these proposals can be resolved as part of the normative work. We do not see a need to restate or further address these proposals as part of the current study.  |
| Intel | Yes | The details of how to support integrity, e.g. procedures, signalling, necessary information, etc can be resolved during WI phase.  |
| Fraunhofer  | Yes | We could resolve them during the WI phase |
| ESA |  | We don´t understand the implications of answering with YES or NO. What would be the intention for the normative work – to have each proposal transformed into objectives? Table 2 is frontloaded and we think is best to draft candidate objective(s) for the normative work based on Table 2 proposals which we can then debate on. |
| vivo | Yes | The details can be discussed in WI phase. And for SI we should identify them. |
| Nokia | Yes |  |
| Xiaomi | Yes | The details of positioning integrity could be discussed during WI phase. |
| Huawei, HiSilicon | Yes, Partly  | We agree with part of the topics, but not all of them. The proposals in Table 2 are a little disorganized, such as P3, 4, 9, 10, 11, 18, 19 ,20, where some proposals are co-related and actually have the same intention. We think the proposal should be better organized, e.g., put all the proposals for UE-based integrity under the bullets of UE-based and those for LMF-based integrity under LMF-based. Also, for MO-LR and MT-LR.I should also be differentiated what are recommended for normative work and what are recommended for further study.We agree with ESA that we’d better to first select candidate objectives or provide a summary for the normative work based on Table 2 proposals. |
| CATT | Partly | Proposal 10: RAN2 study UE-assisted solution for integrity, which includes procedures of:1. UE sending KPI to LMF (for MO-LR),

Comments on P10: Item 1) should follow LCS framework. The KPI comes from LCS client to AMF not KPI directly from UE to LMF.Proposal 18 needs more discussion, because the accuracy of QoS is provided from AMF to LMF in LCS framework. Similarly, Integrity KPIs are provided to the UE by the AMF to LMF and LMF to UE using provide location info, instead of Assistance Data transfer procedure. |
| Convida | Yes | The details can be discussed in the WI phase and some of the proposals can be captured to reflect this in the summary/conclusions of the TR |
| InterDigital | Yes, Partly | We agree that most of the proposals in Table 2, related to the signaling and associated information carried in the signaling can be discussed during WI phase. However, we think certain aspects which have been marked as proposal that may require further discussions in the summary contribution from ESA (i.e. Proposals 12-14, 16, 18, 19, 24, 25) can be discussed during SI phase.  |

**Moderator Summary**

Yes: 7 (Swift, Intel, Fraunhofer, Vivo, Nokia, Xiaomi, Convida)

Partly: 3 (Huawei, CATT, InterDigital)

No Decision: 1 (ESA)

A majority of companies agreed that the proposals identified in Table 2 should be resolved as part of the normative work. Swift suggested that the proposals are sufficiently represented in the baseline TP and do not need to be restated. ESA, Huawei and Convida suggested that the proposals from Table 2 can be used to discuss and report the candidate objectives for the WI. Huawei added that the topics need to be grouped under headings and further differentiated for further study or normative work. CATT raised two procedural questions regarding Proposals 10 and 18. InterDigital agreed most proposals can be addressed in the WI but suggest some may require further discussion in the SI.

*Suggested Resolution*

* There is a consensus that these proposals should be resolved as part of the normative work.
* There were mixed views however on whether the proposals need to be grouped and restated as objectives for the WI, or whether the proposals are sufficiently represented in the baseline TP already.
* It is suggested to resolve this decision in **Question A** above.

## 3.2 Proposed text changes to the TP

### 3.2.1 Submissions to AI 8.11.3.1

This section individually addresses the Tdoc submissions to AI 8.11.3.1.

* **R2-2100596 [Post112-e][618][POS] – Integrity Text Proposal, Swift Navigation [1]**
* This is the baseline TP adopted in this email discussion which was described in Section 2.3 above.
* **R2-2100719 Text Proposals of Definitions Relating to Positioning Integrity Modes, Nokia, Nokia Shanghai Bell [2]**

The following proposals were made:

* **Proposal 1: In this SI, RAN2 should only consider the GNSS positioning cases wherein both positioning integrity result and positioning estimation are derived in either UE or network.**
* **Proposal 2: Endorse the text proposal for TR 38.857 in the appendix.**

*First Text Proposal*

**Integrity Computing Entity:** The logical entity responsible in computing the positioning integrity results based on assistance information and integrity KPIs provided by the LCS client. Such entity can reside in either UE or LMF.

**Network-Based Integrity:** The positioning integrity mode where the integrity computing entity resides in the network side (e.g. LMF) to derive integrity results.

**UE-Based Integrity:** The positioning integrity mode where the integrity computing entity resides in the UE to derive integrity results

*Next Text Proposal*

**Table 9.4.1.1.1: Summary of UE-Based and LMF-Based positioning integrity mode considerations for supporting MO-LR and MT-LR in 3GPP.**

NOTE: The table provides a summary of considerations and the final details and specification impacts are FFS in the WI.

\*NOTE: Examples of KPIs are the TIR, AL, TTA. Examples of Integrity results are the PL, Integrity Availability and KPIs.

\*\*NOTE: From LMF to UE does not mean the integrity assistance information is generated by the LMF.

\*\*\*NOTE: Both positioning integrity derivation and positioning estimation are conducted at either UE or LMF.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Positioning Integrity Mode\*\*\*** | **Location service type** | **Source of KPIs\***  | **Source of Integrity results\*** |  **Positioning Integrity assistance information\*\***  | **Specification impact**  |
|  UE-based integrity | MO-LR | UE internal implementation | UE internal implementation  | From LMF to UE: - Feared events in the GNSS Assistance Data- Feared events in transmitting the data to the UE- GNSS feared events | Procedure to transfer Integrity assistance information from LMF to UE |
| MT-LR | From LMF  | From UE | From LMF to UE: - Feared events in the GNSS Assistance Data- Feared events in transmitting the data to the UE- GNSS feared events | Procedure to transfer Integrity assistance information and KPIs from LMF to UEProcedure to transfer Integrity results from UE to LMF  |
| Network-based integrity | MO-LR | From UE | From LMF | From GNSS corrections provider (external source) to LMF: - Feared events in the GNSS Assistance Data- Feared events in transmitting the data to the UE- GNSS feared eventsFrom UE to LMF:- UE feared events | Procedure to transfer Integrity assistance information and KPIs from UE to LMFProcedure to transfer Integrity results from LMF to UE  |
| MT-LR | LMF implementation | LMF internal implementation | From GNSS corrections provider (external source) to LMF: - Feared events in the GNSS Assistance Data- Feared events in transmitting the data to the UE- GNSS feared eventsFrom UE to LMF:- UE feared events | Procedure to transfer Integrity assistance information from UE to LMF  |

*End of Text Proposal*

**Question 2: Do you agree to add the text proposals in R2-2100719?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Swift Navigation | No | We think the **Integrity Computing Entity** definition could be useful. For the other definitions however (i.e., **UE-Based Integrity and Network-Based Integrity**), we think extensive discussion and consensus has already taken place to align the existing terminology with the study objectives, i.e., **‘network-assisted (UE-Based)’** and **‘UE-assisted (LMF-Based)’**. We are concerned that altering these definitions at this late stage of the study may lead to confusion and inconsistencies with the objectives and remaining text. We think these terms can be further discussed and resolved as part of the normative work when defining and agreeing to the actual signaling procedures and IEs. |
| Intel | No | There is no big difference between **‘network-assisted (UE-Based)’** and **‘UE-assisted (LMF-Based)’** and “**UE-Based Integrity and Network-Based Integrity**”. Considering we already have extensive discussion on the terminologies, and then could prefer to keep existing terms.  |
| Fraunhofer  | Partly | The assistance data regarding GNSS feared events (Jamming/interference/spoofing) also needs to be sent to the network by capable UEs. We are fine with the text as long as ‘GNSS feared events’ is added to assistance data from UE to LMF. This applies both for UE-based and for NW-based. |
| ESA | Partly | We agree in principle with the cleaning of the table. Regarding definitions, we are ok with keeping as is.A first point that needs to be clarified: what is the reason for which we discuss MO-LR and MT-LR when objective c. clearly states “Study methodology for network-assisted and UE-assisted integrity”? Did the study revealed any impact on MO-LR and MT-LR?A second point that needs clarifications is represented by the various “NOTE” instances present in the baseline TP. |
| vivo | Yes | It is clear to explain UE-based and network-based integrity. |
| Nokia | Yes but alternatively … | Even if companies are reluctant to introduce new terminologies, we think at least some clear definitions of **network-assisted (UE-Based)’** and **‘UE-assisted (LMF-Based)’** integrity areneeded. Currently they are not explicitly defined in the TR except for some description in Table 9.4.1.1.1 that look very messy.We prefer to have some clear definitions, and thereby keeping Table 9.4.1.1.1 clean. |
| Xiaomi |  | No strong view from our side. |
| Huawei, HiSilicon | No | We are only fine with the definition of Integrity Computing Entity, and don’t agree with the rest changes.1) For the terms (‘network-assisted (UE-Based)’ and ‘UE-assisted (LMF-Based)’), we don’t see any benefit for changing them into ‘UE-Based Integrity’ and ‘Network-Based’ since the current ones are already widely used in the specs and can be easily understood.2) We think the TP for Table 9.4.1.1.1 is not necessary, especially for the NOTE, which is quite clear without having it. In particular, the “integrity estimation” and “integrity derivation” in the note are not defined.  |
| CATT | Partly | We are fine to clean Table 9.4.1.1.1 clean. But the existing terms should be used. Integrity and Accuracy are both the KPIs of a navigation system. So we can reuse the existing terms to describe the calculation on integrity or accuracy. |
| Convida | Partly | Agree with the intention and the heading change. Further clarification is helpful in the table, but we propose that we leverage existing, well-understood terminology that is used in 38.305 and 37.355 as follows for the 1st column:UE-based (LMF-assisted) Integrity: Positioning integrity result is derived by the UEUE-assisted (LMF-based) Integrity: Positioning integrity result is derived by the LMFPrefer to keep this clear as far as what entities are deriving the integrity result consistent. Referencing the “network” seems to create some ambiguity regarding where the integrity result will be derived, even if external entities (out of 3GPP scope) to the LMF are leveraged in some way. |
| InterDigital | No | We share similar views with Swift and Intel. The existing terminologies/definitions provide sufficient clarity and we do not see the need for simplifying the terminologies further as proposed in R2-2100719 gives additional clarification or resolves any confusion. Having said that, we do think the definition for Integrity Computing Entity can be beneficial.  |

**Moderator Summary**

Yes: 2 (Vivo, Nokia)

Partly: 4 (Fraunhofer, ESA, CATT, Convida)

No: 4 (Swift, Intel, Huawei, InterDigital)

No strong view: 1 (Xiaomi)

There was a strong preference in the comments to retain the current terms (‘network-assisted (UE-Based)’ and ‘UE-Assisted (LMF-Based)’). Nokia proposed that even if we retain the current terms we should include definitions of these terms for clarity. Convida proposed to leverage existing, well-understood definitions of these terms from other specifications. ESA, Nokia and CATT recommended some editorial clean-up of the table. Fraunhofer proposed to include ‘GNSS feared events’ as assistance data from the UE to the LMF. ESA sought clarity on whether MO-LR and MT-LR is in scope of the study objectives. Swift, Huawei and InterDigital were open to including the Integrity Computing Entity definition.

*Suggested Resolution*

* The current terminology ‘**network-assisted (UE-Based)**’ and ‘**UE-assisted (LMF-Based)**’ is retained in the draft TP.Minor editorial clean-up was also included for the table name and column 1 heading.
* Regarding the ‘GNSS feared events’ from the UE to the LMF, it should be noted that the GNSS feared events category is generically defined in Table 9.4.1.1, not tied to the network. The ‘Specification Impact’ column in Table 9.4.1.1.1 also investigates the ‘Procedure to transfer Integrity assistance information and KPIs from UE to LMF’, which is FFS as part of the normative work. This also helps to answer the proposals and comments in response to Question 9 below.
* Regarding the scope for considering the location service type (MO-LR, MT-LR), this topic has been discussed in the prior email discussion ([17], Question 2) with the consensus that Table 9.4.1.1 (latest numbering in the baseline TP) sufficiently captures the signaling topics to be considered as part of the normative work, notwithstanding the that the relationship to the MO-LR, MT-LR protocols remains FFS. The MO-LR, MT-LR topics can be further discussed online as needed.
* **R2-2101390 On RAT-dependent integrity use cases and error categories, Ericsson [3]**

The following proposals were made:

* **Proposal 1: RAN2 to agree to the TP in A.1.**
* **Proposal 2: RAN2 to agree to consider adding RAT-dependent error categories on a high level**

## A1. Use cases TP for the TR 38.357

*First Text Proposal*

### 9.2.3 Industrial IoT

In contrast to consumer-oriented Internet of Things (IoT), Industrial IoT (IIoT) use cases predominantly focus on operational, safety, and financially beneficial applications of the IoT ecosystem for businesses, infrastructure, and various industries. IIoT positioning integrity/reliability requirements are essential given various safety, payment, and regulatory critical applications. There are many outdoor IIoT devices/UEs employing GNSS-based positioning in various industries that include, but not limited to: Construction, Agriculture/forestry/fishing (smart farming), Oil/Gas industries, and Smart cities (traffic, electric and water systems, waste management, public safety, schools) derived from [1][20]. The ACIA white paper [22] provides some use cases and requirements on 5G positioning in general. An illustrative example relating to Automated Guided Vehicles (AGV) is provided below.

*Next Text Proposal*

## A2. Error categories TP for the TR 38.357

*Start of Text Proposal*

### 9.3.2 RAT-Dependent

#### 9.3.2.1 Generic aspects

This section describes generic feared events for RAT-dependent positioning.

* Feared events in the RAT-dependent Assistance Data
	+ Configured AD such as TRP location information, beam information, relative time difference information, etc is incorrect
* Feared events during positioning data transmission
	+ This is partly the same as for GNSS positioning, even more similar if the AD is seen as originating from an entity separate from LMF, such as OAM or 5G-RAN via NRPPa.
* RAT-dependent feared events
	+ RAN TRP feared events such as antennas being reoriented, relative time differences drifting
	+ Local environment feared events such as multipath, interference, jamming, spoofing
* UE feared events
	+ DL-PRS measurement errors
	+ Hardware faults -same/similar to GNSS
	+ Software faults – same/similar to GNSS
* LMF feared events
	+ Hardware faults -same/similar to GNSS
	+ Software faults – same/similar to GNSS

##### 9.3.2.1.1 Feared events in the RAT-dependent Assistance Data

###### a) Incorrect RAT-dependent Assistance Data

Several RAT-dependent positioning methods rely on provided assistance data. If the assistance data contain incorrect data, this can lead to incorrect computation of the PL and a potential integrity event.

##### 9.3.2.1.2 Feared events during positioning data transmission

###### a) Data integrity faults

Data tampering e.g., spoofing can also affect the quality and integrity of the positioning services provided by 5GS. For instance, the interface between 5G-RAN and 5GS may be vulnerable to malicious attacks.

##### 9.3.2.1.3 RAT-dependent feared events

Editor’s Note:GNSS feared events are those which occur external to the UE and potentially impact the quality and availability of the GNSS signals.

* + RAN TRP feared events such as antennas being reoriented, relative time differences drifting
	+ Local environment feared events such as multipath, interference, jamming, spoofing

**a) RAN**

###### a) RAN TRP feared events

RAN TRPs can suffer physical abuse causing the TRP location to change, the TRP beams becoming reoriented, relative time difference estimates impacts etc

###### c) Local Environment feared events

Multipath

Multipath is one of the most significant errors incurred in the RAT-dependent receiver measurement process. The magnitude of multipath errors varies rapidly and significantly depending on the environment the receiver is located, cellular network deployment, receiver signal processing, antenna gain pattern, and signal characteristics.

Interference

The interference can be separated into two categories

* Unintentional interference from nearby radio base stations and devices operational in the same or adjacent frequency carriers.
* Intentional RFI is the deliberate action of causing interference to degrade or block reception of RAT-dependent positioning signals.

##### 9.3.2.1.4 UE feared events

UE specific errors are not possible to mitigate with assistance data from the network, the UE is responsible for mitigating these feared events locally, based on implementation.

###### a) DL-PRS receiver measurement error

Measurement errors are also induced by the receiver tracking loops, so this is an inherent noise within the receiver which causes jitter in the signal.

###### b) Hardware faults

Editor’s Note: FFS

###### c) Software faults

Editor’s Note: FFS

##### 9.3.1.1.5 LMF Feared Events

Editor’s Note: FFS

###### a) Hardware Faults

###### b) Software Faults

*End of Text Proposal*

**Question 3: Do you agree to include the text proposal from R2-2101390?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Swift Navigation | No | We strongly encourage that future studies be undertaken to extend positioning integrity work to RAT-Dependent. We acknowledge however that the scope of the study was updated as follows at RAN#89-e:NOTE 4: Objective 2 is applicable to GNSS positioning methods.Therefore, while we think the contents of R2-2101390 is useful and pertinent to future discussions on RAT-Dependent, we feel the current TP should only focus on addressing what is in scope of the SI objectives and, therefore, what can realistically be achieved within scope of the normative work. A potential alternative to this proposal is to add back the original headings for RAT-Dependent Error Sources (i.e., 9.3.2) and Methodologies (i.e., 9.4.2) and include an editor’s note as the only text for each section, e.g.,:Editor’s Note: RAT-Dependent positioning integrity is not addressed within the scope of this study but should be considered in future releases by extending the concepts and signaling introduced in this study. We are supportive of the updated text for the IIoT Use Case in Section 9.2.3. |
| Intel | No | RAT dependent integrity has been ruled out from the SI scope, and therefore we should not spend efforts on this.  |
| Fraunhofer | No | Since RAT dependent integrity has been taken out of the SI scope, we suggest not to put this text. |
| ESA | Partly | IIOT Section 9.2.3 is ok. On RAT-dependent we agree with Ericsson´s findings and find the analysis very complete and good starting point. However, we suggest to respect the agreement made at RAN level where RAT-dependent has been de-scoped from this release. Precisely because we like to respect the SID objective and clarifications on objective as guiding principle is difficult for us to endorse this TP. |
| vivo | No | Agree with Intel |
| Nokia | Partly | Agree with ESA  |
| Xiaomi | No | Based on the SID, Rel-17 only study the integrity for GNSS positioning. |
| Huawei, HiSilicon | No  | We don’t agree with the changes for 9.3.2 since RAT dependent integrity has already been exclude from the SI scope.Besides, we are generally ok with the modifications about the IIoT section. |
| CATT | No | Agree with Intel |
| Convida | No | While we understand that integrity for additional positioning methods is important, this is not in scope of the existing SID. These sections should not be included. We are ok with an editor’s note somewhere in the TR that mentions this, but I would slightly rephrase the Swift suggestion:Editor’s Note: Only GNSS positioning integrity is addressed within the scope of this study. However, positioning integrity for additional positioning methods may be considered in future releases by extending the concepts and signalling introduced in this study.  |
| InterDigital | No | We share similar view with Swift for including the editor note  |

**Moderator Summary**

Yes: 0

Partly: 2 (ESA, Nokia)

No: 9 (Swift, Intel, Fraunhofer, Vivo, Xiaomi, Huawei, CATT, Convida, InterDigital)

There was unilateral consensus not to include the RAT-Dependent text. There was general support from Swift, ESA, Nokia and Huawei to include the minor editorial changes to the IIoT use case description (Section 9.2.3). Convida, Swift and InterDigital suggested an Editor’s Note could be included to advocate extending positioning integrity to other positioning methods in future releases.

*Suggested Resolution*

* The RAT-Dependent text is out of scope.
* The minor editorial changes to Section 9.2.3 were adopted.
* The Editor’s Note was not included.
* **R2-2101504 Recommendations for the Integrity Text Proposal , Swift Navigation, Intel Corporation [4]**

The following proposals were made:

* **Proposal 1: Agree to the proposed recommendations for positioning integrity.**
* **Proposal 2: Agree to the text proposal for inclusion in the TR.**

*Start of Text Proposal*

## 10.10 Enhancements of ignalling & procedures for positioning integrity

The following enhancements of ignalling & procedures to support positioning integrity determination are recommended, including the following aspects:

* + Define the specific list of RAT-Independent positioning integrity feared events to be addressed in the 3GPP specifications.
	+ Signaling & procedures to support positioning integrity determination:
		- The assistance information Ies that will be used to mitigate the feared events;
		- The details of the LPP ignalling to transport the positioning integrity assistance information.
	+ Support of integrity for UE-Based and UE-Assisted RAT-Independent positioning.

*End of Text Proposal*

**Question 4: Do you agree to include the text proposal submitted in R2-2101504?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Swift Navigation | Yes | We believe these recommendations sufficiently capture the topics which need to be resolved as part of the normative work, including the topics discussed in Question 1 above.  |
| Intel | Yes |  |
| Fraunhofer | Yes |  |
| ESA | Not upfront | We do not understand the reason for this new section in the TP. A revised version could be proposed as potential objective for Work Item description but it would require discussions at Working group level. * A specific list of RAT-independent positioning integrity feared events has been already identified and if something else is missing it should be addressed in the study.
* What does “integrity for UE-based and UE-assisted RAT-independent positioning” mean? As far as we are aware, current SI resumed to investigating error source and assistance information to mitigate the error sources, without an integrity concept being actually described.
 |
| Vivo | Yes |  |
| Nokia | Yes but | We think the following sentence can be modified as:* + The details of the LPP signaling to transport the positioning integrity assistance information and integrity result reporting.
 |
| Xiaomi | Yes |  |
| Huawei, HiSilicon | Yes  | We think this TP should avoid repeating the content that has already been existent in the other sections in the TP. Other than that, we are fine with the TP.  |
| CATT | Yes, but with some modifications | We agree to include the text proposal submitted in R2-2101504 with the following modification:10.10 Enhancements of signaling & procedures for positioning integrity positioning integrity determination are recommended, including the following aspects:* + Define the specific list of A-GNSS positioning integrity feared events to be addressed in the 3GPP specifications.
	+ Signaling & procedures to support positioning integrity determination:
		- The assistance information IEs that will be used to mitigate the feared events;
		- The details of the LPP signaling to transport the positioning integrity assistance information.
		- The details of the LPP signaling to transport requirement/QoS/result/ of integrity, and the warning on integrity

Support of integrity for UE-Based and UE-Assisted A-GNSS positioning. |
| Convida | Yes with some edits | Agree with some clerical edits as shown below, e.g., UK spelling of signalling, IEs, etc.10.10 Enhancements of signalling and procedures for positioning integrity The following enhancements of signalling and procedures to support positioning integrity determination are recommended, including the following aspects:* + Define the specific list of GNSS positioning integrity feared events to be addressed in the 3GPP specifications.
	+ Signalling and procedures to support positioning integrity determination:
		- The assistance information IEs that will be used to mitigate the feared events;
		- The details of the LPP signalling to transport the positioning integrity assistance information.
		- The details of the LPP signalling to transport the positioning integrity results.
	+ Support of integrity for UE-Based and UE-Assisted GNSS positioning.
 |
| InterDigital | Yes |  |

**Moderator Summary**

Yes: 10 (Swift, Intel, Fraunhofer, Vivo, Xiaomi, Huawei, Nokia/CATT/Convida (comments), InterDigital)

Not upfront: 1 (ESA)

There was strong consensus to adopt the proposed text in Section 10 of draft TR 38.857. ESA requested further discussion before deciding on the text and sought clarity on how it relates to the current scope of the study. Three variants of text were proposed by Nokia, ESA and Convida and all three suggested to include an additional objective to define the signaling to transport integrity results. CATT and Convida also proposed to replace the term ‘RAT-Independent’ with ‘A-GNSS’ for consistency with the baseline TP. CATT also proposed additional text for signaling the ‘requirement/QoS … and warning on integrity’.

*Suggested Resolution*

* A moderated version of the text proposals is provided for further discussion in **Question A** above as part of the follow-on email. This has been based on the three text suggestions, with moderated wording, i.e. **‘the details of the LPP signalling to transport the positioning integrity KPIs and integrity results.’**
* This approach is consistent with the signaling considerations identified in Section 9.4.1.1.1 of the baseline TP and is intended to address the additional suggestions from CATT (noting the requirements/QoS/warning parameters proposed by CATT could all be addressed in the WI as a subset of the proposed recommendations).
* It should also be noted that Section 10 the TR 38.857 (‘Identified NR impacts in Rel-17’) summarizes the recommendations for all topics studied in the Positioning Enhancements SI/WI, which is the basis for preparing the text proposal above. The TR can then be approved via standard RAN processes.
* The question therefore remains as to whether these recommendations sufficiently capture the list of proposals (Table 2) that were addressed in Question 1. We think this topic requires further discussion in **Question A** above.

### 3.2.2 Submissions to Agenda Item 8.11.3.2

This section addresses the specific proposals from the Methodologies summary [15] which requested text changes.

* **Proposal 1: Include a new section in clause 9.4 of the TR to capture the uncertainty of the GNSS ranging measurements (Annex A5).**

*Start of Text Proposal*

##### 9.4.1.1.2 Uncertainty of the ranging measurement

The uncertainty of all the ranging measurements, together with system data, is an input required by every integrity algorithms and is needed to compute integrity results i.e., PLs.

The following formula can be used to statistically describe the overall error contribution for each GNSS measurement. In other words, the **total uncertainty for measurements** performed by the UE to each visible ith satellite can be expressed as:

Where

|  |  |  |
| --- | --- | --- |
| **Quality indicator** | **Meaning** | **Observation** |
|  | Total uncertainty for measurements obtained from satellite i represented as UERE. |  |
|  | Uncertainty of the combined orbit, clock, and bias corrections. Could also be expressed as  | These terms are derived in real time based on measurements collected at stations part of GNSS CORS reference network. |
|  | Uncertainty of the ionosphere model |
|  | Uncertainty of the troposphere model |
|  | Uncertainty of the measurements in the given environment and receiver noise. Multipath is the dominant term here. | It is computed by the UE. Is perhaps the most difficult to determine as the value is dependent on UE environment, multipath, possible spoofing and jamming, and measurement quality. |

* Uncertainty of the ranging measurements in UE-based

GNSS receiver, present in the UE, aided by the information provided by the network, performs ranging on GNSS signals, compute its position, and estimates the trustworthiness of the location estimate (integrity). For this purpose, the LMF provides to the UE quality indicators using LPP Periodic Assistance Data Transfer procedure.

|  |  |  |
| --- | --- | --- |
| ***LMF sends to UE*** | ***UE computes*** | ***Observation*** |
| , ,  |  Total uncertainty for satellite i Uncertainty of the measurements in the given environment and due to receiver characteristics (function of multipath, thermal noise, etc.) | Of course, these quality indicators/variance needs to be provided together with the associated SSR IEs (see specification impact item further below) |

Specification impacts resume to a possible extension of GNSS-SSR IE by additional fields, representative to the quality of each GNSS error here modelled as SSR: GNSS-SSR-OrbitCorrections, GNSS-SSR-ClockCorrections, GNSS-SSR-CodeBias, GNSS-SSR-PhaseBias, etc. Alternatively, a new IE collecting quality indicators flags for all GNSS SSR IEs could be defined.

* Uncertainty of the ranging measurements in UE-assisted

GNSS receiver, present in the UE, performs ranging on GNSS signals, and sends the measurements to the LMF for location and position integrity estimation. For this purpose, the UE can use LPP Location Information Transfer (*A-GNSS-RequestLocationInformation* and *A-GNSS-ProvideLocationInformation*).

|  |  |  |
| --- | --- | --- |
| ***UE sends to LMF*** | ***LMF knows*** | ***LMF computes*** |
| Option 1: (if estimated by UE)Option 2: or information that may help the LMF estimate (e.g. *GNSS-MeasurementList* IE and in particular *mpathDet* field) | , ,  |  Total uncertainty for satellite i[and] |

A first specification impact could be the possible extension of *GNSS-MeasuremntList* IE by additional quality flags, if any. In this scenario, the UE can send to LMF information about the quality of the measurements using *GNSS-MeasurementList* IE. With this additional information, the LMF can estimate the total uncertainty of the ranging measurements.

The 37.355 includes period reporting of Assistance Data with direction from LMF to UE. Periodic reporting of measurements from UE to LMF may also need to be supported.

*End of Text Proposal*

**Question 5: Do you agree to include the text proposal describing the ‘Uncertainty of the ranging measurement’?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Swift Navigation | No | We think it is more suitable to bring forward this submission as part of the normative work, given it is attempting to define specific parameters for inclusion as part of the specifications. It is not yet clear how to correctly interpret these parameters in the integrity context. Therefore, resolving this discussion will also require further details on the broader signaling framework and IE definitions, which are reserved for the normative work.  |
| Intel | No | Agree with Swift. Such details should be discussed in WI phase.  |
| Fraunhofer | No | Agree with Swift and Intel. |
| ESA | Yes | According to 3GPP a Study Item is meant to conduct feasibility on multiple technology options in relation to a number of objectives and is contribution-driven. We should keep this in mind.Swift and Intel statements are misleading and do not reflect the reality: there is no proposal to “define specific parameters for inclusion as part of the specifications”. Our contribution is presenting a concept for dealing with uncertainty of the GNSS measurement which is the first step in any integrity positioning algorithm (see picture bellow); it goes on and discusses LPP specifications impact to enable this concept; and it establish a clear connection with an existing group of IEs already present in TS 37.355 (A-GNSS SSR and the GNSS Measurement List IE). Besides these strong points, a discussion for UE-assisted and UE-based is also provided as a link to specific objective .c (integrity UE-based and UE-assisted).**In conclusion, this TP is strictly applicable to the Technical Report and has nothing to do with the normative work.** We encourage companies to evaluate the merits and limitations of the concept considering these additional clarifications**.** |
| vivo | No | Agree with Swift. |
| Nokia |  | We somehow think this is implementation issue, so even in WI we probably don’t need to discuss unless we see some spec. impact. However, we do see these text valuable and it is up to companies to decide if we want to capture it in the TR.  |
| Xiaomi | No | Agree with Swift. |
| Huawei, HiSilicon | No  | We generally think it’s too specific to be discussed in SI phase.Besides, the details of the TP need more discussion, which should be left to WI phase. |
| CATT | Yes | Usually the context will not be captured in the TS in WI. However the text raised by ESA is valuable for readers to understand one of the algorithms in TR. So we are fine to capture it in the TR. |
| Convida | No, but | These are some good discussion points, but this can be left to the normative work item phase to determine the specific IEs.  |
| InterDigital | No | We share similar view with Swift that the details on the parameters can be discussed during WI phase |

**Moderator Summary**

Yes: 2 (ESA, CATT)

No: 8 (Swift, Intel, Fraunhofer, Vivo, Xiaomi, Huawei, Convida, InterDigital)

No Decision: 1 (Nokia (will take the consensus view))

There was strong consensus not to include the text proposal. ESA advocated that the contribution is conceptual only and therefore has nothing to do with the normative work. CATT suggested the text is informative as an example of one type of algorithm for integrity. Nokia suggested the text may be useful information but were happy to accept the consensus view.

*Suggested Resolution*

* Given the consensus view, the text has not been included in the draft TR. The comments suggest that this proposal would be useful to bring forward as part of the normative work instead.
* **Proposal 6: Include the TP from Annex A4 in clause 9 of TR 38.857**

*Start of Text Proposal*

|  |  |  |
| --- | --- | --- |
| **Feared Event Category**  | **Feared Event**  | **Examples of positioning integrity assistance information (FFS)**  |
| 1. Feared events in the GNSS Assistance Data  | Incorrect computation of the GNSS Assistance Data, e.g. software bug, corrupt or lost data | Validity or quality flags for existing assistance information |
| External feared event impacting the GNSS Assistance Data, e.g. satellite, atmospheric or local environment feared events (Category 3) impacting the GNSS reference stations in the GNSS correction provider’s network. |
| 2. Feared events during positioning data transmission  | Data integrity faults | Data corruption check, e.g. CRC |
| Data Authentication / Signature |
| 3. GNSS feared events | Satellite feared eventse.g. bad signal-in-space or bad broadcast navigation data | Satellite health or quality flags |
| Atmospheric feared events | Ionospheric indicator |
| Tropospheric indicator |
| Local Environment feared events, e.g. Multipath, Spoofing, Interference | ~~FFS~~Cross-check GNSS position with RAT-depedent positonAssistance information: Trustable time reference, Data Authentication / Signature |
| 4. UE feared events | GNSS receiver measurement error | FFS |
| Hardware faults | \* |
| Software faults | \* |
| 5. LMF feared events | Hardware faults | \* |
| Software faults | \* |

*End of Text Proposal*

**Question 6: Do you agree to include the text proposal from ESA to update the example of the Local Environment GNSS feared event?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Swift Navigation | Partly | We think the text ‘**Assistance information: Trustable time reference, Data Authentication / Signature**’ is fine as a potential example. But we suggest to remove the text ‘**Cross-check GNSS position with RAT-dependent position**’ as this seems to be an implementation/algorithm consideration rather than an example of assistance information. |
| Intel | Partly | Agree with Swift. ‘**Cross-check GNSS position with RAT-dependent position**’ is solution instead of assistance data, and therefore should be removed.  |
| Fraunhofer  | Yes | Agree with the assistance information suggested by ESA. The method could be captured elsewhere or left implementation specific.  |
| ESA | YES | Thank you for raising the objections, it will help clarify another confusing point. We agree that “cross-check GNSS position with RAT-dependent position” is not an example of assistance information. However, we brought up in Phase I of the preparatory email discussion on Error Sources for this RAN2 meeting our concerns regarding column 3 of this table:“We just want to point out that ***solutions other than provision of assistance data may be considered in some situations*** and therefore column 3 should ***not constrain discussions to solutions based on dissemination of AD only.’’***As far as we know, we have never agreed to limit this study to assistance data only. On the contrary, we should document all possible ways to deal with the feared events captured until now. Lastly, RAT-dependent positioning is already supported in LPP and could be leveraged on if desired. Having the means to cross-check GNSS position with an independent alternative positioning method is one way e.g., spoofing events can be detected.In line with our previous feedback and additional clarifications, we think title of column 3 needs to be made more inclusive and avoid forcing the discussion to assistance information only. |
| vivo | Partly | Agree with Swift. |
| Nokia |  | No strong view from our side |
| Xiaomi | Partly | Agree with Swift. |
| Huawei, HiSilicon | Partly  | We agree with Swift that ‘Cross-check GNSS position with RAT-dependent position’ should be left to implementation instead of assistance information.A question for clarification, for the RAT-dependent position, is it transferred from the LMF to the UE or the UE derives its own position with UE-based positioning?Then, for UE feared events, the current status for GNSS receiver measurement error is still FFS. We think this error should be a superset for GNSS local environmental feared events.  |
| CATT | Partly | Agree with the assistance information suggested by ESA. And we also agree with ESA that not only assistance data is for integrity, but also the positioning procedures are considered how to support integrity at system level. |
| Convida |  | Agree with Swift that “Cross-check GNSS position with RAT-dependent position” is not part of integrity assistance info. |
| InterDigital | Partly | We are ok with including “Assistance information: Trustable time reference, Data Authentication / Signature” as an example |

**Moderator Summary**

Yes: 2 (Faunhofer (yes to the assistance info), ESA)

Partly: 8 (Swift, Intel, Vivo, Xiaomi, Huawei, CATT, Convida, InterDigital)

No Decision: 1 (Nokia)

The majority view was to retain the text ‘**Assistance information: Trustable time reference, Data Authentication / Signature**’ and remove the text ‘**Cross-check GNSS position with RAT-dependent position**’ which is considered a solution/implementation topic. ESA and CATT suggested that column 3 should not be limited to assistance information considerations as the only option for mitigating feared events, given RAT-Dependent is already supported in LPP, although no text was proposed.

*Suggested Resolution*

* The consensus view is taken to only retain the text: ‘**Assistance information: Trustable time reference, Data Authentication / Signature’**. Consistent with the comments from ESA, this does not prohibit applying a method of ‘cross-checking with RAT-Dependent positions’ to mitigate the feared events in the implementation given RAT-Dependent is already supported in LPP.
* Regarding the heading for column 3, the comments from ESA and CATT noted the need for flexibility to support multiple solutions for mitigating the feared events. Given no text change was proposed and noting that the details and specifications impacts for Table 9.4.1.1 remain FFS in the WI, the column headings have been retained for now but can be further discussed online as needed.
* Regarding Huawei’s comments, refer to Question 7 on the GNSS receiver measurement error topic.
* **Proposal 8: RAN2 to agree to the TP in A2 (A1 in [9])**

*Start of Text Proposal*

|  |  |  |
| --- | --- | --- |
| **Feared Event Category**  | **Feared Event**  | **Examples of positioning integrity assistance information (FFS)**  |
| 1. Feared events in the GNSS Assistance Data  | Incorrect computation of the GNSS Assistance Data, e.g. software bug, corrupt or lost data | Validity or quality flags for existing assistance information |
| External feared event impacting the GNSS Assistance Data, e.g. satellite, atmospheric or local environment feared events (Category 3) impacting the GNSS reference stations in the GNSS correction provider’s network. |
| 2. Feared events during positioning data transmission  | Data integrity faults | Data corruption check, e.g. CRC |
| Data Authentication / Signature |
| 3. GNSS feared events | Satellite feared eventse.g. bad signal-in-space or bad broadcast navigation data | Satellite health or quality flags |
| Atmospheric feared events | Ionospheric indicator |
| Tropospheric indicator |
| Local Environment feared events, e.g. Multipath, Spoofing, Interference | Regionalized indicator of multipath, interference, jamming, spoofing, etc |
| 4. UE feared events | GNSS receiver measurement error | Similar to GNSS local environment feared events |
| Hardware faults | \* |
| Software faults | \* |
| 5. LMF feared events | Hardware faults | \* |
| Software faults | \* |

*End of Text Proposal*

**Question 7: Do you agree to include the text proposal from Ericsson to update the example of Local Environment GNSS feared events and GNSS receiver measurement error?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Swift Navigation | Partly | We think the Local environment feared event text (‘**Regionalized indicator of multipath, interference, jamming, spoofing, etc’**) could be combined with the ESA examples in Question 5 above. We disagree with including the text ‘**Similar to GNSS local environment feared events’** given UE feared events are not correlated between devices so a regional indicator would not be applicable. |
| Intel |  | Ok to add (‘**Regionalized indicator of multipath, interference, jamming, spoofing, etc’**). |
| Fraunhofer | Yes | Agree with the Swift and Intel.  |
| ESA | Partly | Local Environment – We propose to enlarge the pie and capture all non-overlapping suggestions from Ericsson and ESA:Cross-check GNSS position with RAT-dependent positon. Assistance information: Trustable time reference, Data Authentication / Signature, **Regionalized indicator of multipath, interference, jamming, spoofing, etc’**GNSS receiver measurement error: we agree with Ericsson´s thought but we think the answer to this is represented by fields captured in the *GNSS Measurement List* IE. Additional fields and better resolution to existing fields can be considered in normative work. Hence, we propose to replace FFS with *GNSS Measurement List* IE. Note, in our understanding of LPP, this IE applies to UE-assisted mode. For UE-based we think that GNSS receiver measurement error is something to be left to implementation. |
| Vivo | Partly | Agree with Swift. |
| Nokia | Partly | Agree with Swift |
| Xiaomi | Partly | Agree with Swift |
| Huawei, HiSilicon | Partly  | We think the assistance information (Trustable time reference, Data Authentication/ Signature) mentioned in Q6 is a typical example of the Regionalized indicator of jamming/spoofing in Q7. WE think that proposed assistance information in Q6/7 should be merged and propose a more general one.For UE feared events, please see the comments for Q6. |
| CATT | Partly | Agree with Swift |
| Convida | Yes but | Remove or clarify: “Similar to GNSS local environment feared events”. Since a GNSS receiver measurement error is specific to a particular UE, it is unclear why this requires regional assistance.  |
| InterDigital | Partly | Agree with Swift |

**Moderator Summary**

Yes: 2 (Faunhofer, Convida (with comments))

Partly: 9 (Swift, Intel, ESA, Vivo, Nokia, Xiaomi, Huawei, CATT, InterDigital)

The consensus view is to adopt the proposal by Swift to combine the ‘**Regionalized indicator of multipath, interference, jamming, spoofing, etc**’ with the Assistance Information example proposed by ESA.

*Suggested Resolution*

* The following text has been added as the example of Local environment feared events:
	+ **‘Assistance information: Trustable time reference, Data Authentication / Signature, Regionalized indicator of multipath, interference, jamming, spoofing, etc’**.
* In view of the ESA comments and feedback from Huawei in Question 6, the suggestion to include the ‘*GNSS-MeasurementList*’ as an example IE for the GNSS receiver measurement error is adopted.
* **Proposal 23: Use UE measurements to enable integrity methods for local RAT-dependent and UE feared events and agree to the TP in Annex A3 (A.2 of [9]).**

*Start of Text Proposal*

9.4.2 RAT-Dependent

This section addresses some generic RAT-dependent integrity methods

*9.4.2.1 Generic RAT-Dependent Integrity Methods*

The 3GPP specifications can be extended to support the determination of positioning integrity, by defining information elements and signaling procedures to transport assistance information to mitigate feared events. A summary of the RAT-dependent feared events studied in Section 9.3.2 is provided in Table 9.4.2.1 below, including examples of the types of assistance information to be considered for inclusion in LPP

Editor’s Note: The LPP IEs and procedures for positioning integrity will be defined in the WI.

**Table 9.4.2.1: Summary of generic RAT-dependent feared events and integrity assistance information considerations (FFS).**

NOTE: The positioning integrity assistance information IEs are FFS as part of the WI.

**\***NOTE: The UE or LMF are responsible for mitigating these feared events locally, outside the scope of the specifications.

|  |  |  |
| --- | --- | --- |
| **Feared Event Category**  | **Feared Event**  | **Examples of positioning integrity assistance information (FFS)**  |
| 1. Feared events in the RAT-dependent Assistance Data  | Incorrect information about RAN positioning configurations | Validity or quality flags for existing assistance information |
| 2. Feared events during positioning data transmission  | Data integrity faults | Data corruption check, e.g. CRC |
| Data Authentication / Signature |
| 3. RAT-dependent feared events | RAN TRP feared eventse.g. reoriented TRP antennas, relative time difference errors  | RAN TRP configuration quality flags |
| Local Environment feared events, e.g. Multipath, Spoofing, Interference | Regionalized indicator of multipath, interference, jamming, spoofing, etc |
| 4. UE feared events | DL-PRS receiver measurement error | Similar to RAT-dependent feared events |
| Hardware faults | \* |
| Software faults | \* |
| 5. LMF feared events | Hardware faults | \* |
| Software faults | \* |

9.4.1.1.1 Signaling considerations

The following LPP signaling was identified in the study, for consideration in the WI:

1. Signaling to determine the positioning integrity capability
2. Signaling to deliver the KPIs and integrity results
3. Signaling to deliver the integrity assistance information to the UE
4. Signaling to deliver the integrity information related to the positioning measurements from the UE to the LMF

Table 9.4.1.1.1 summarizes the UE-based and UE-assisted considerations for supporting positioning integrity in the 3GPP specifications, with respect to the feared events identified in Table 9.4.1.1 and the signaling considerations above.

**Table 9.4.2.1.1: Summary of network-assisted (UE-Based) and UE-assisted (LMF-Based) considerations for supporting positioning integrity in 3GPP.**

NOTE: The table provides a summary of considerations and the final details and specification impacts are FFS in the WI.

\*NOTE: Examples of KPIs are the TIR, AL, TTA. Examples of Integrity results are the PL, Integrity Availability and KPIs.

\*\*NOTE: From LMF to UE does not mean the integrity assistance information is generated by the LMF.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Positioning Mode** | **Location service type** | **Source of KPIs\***  | **Source of Integrity results\*** |  **Positioning Integrity assistance information\*\***  | **Specification impact**  |
| Network assisted (UE-based): Positioning integrity result is derived by the UE | MO-LR | UE internal implementation | UE internal implementation  | From LMF to UE: - Feared events in the RAT-dependent Assistance Data- Feared events in transmitting the data to the UE- RAT-dependent feared events | Procedure to transfer Integrity assistance information from LMF to UE |
| MT-LR | From LMF  | From UE | From LMF to UE: - Feared events in the RAT-dependent Assistance Data- Feared events in transmitting the data to the UE- RAT-dependent feared events | Procedure to transfer Integrity assistance information and KPIs from LMF to UEProcedure to transfer Integrity results from UE to LMF  |
| UE assisted (LMF-based): Positioning integrity result is derived by the LMF | MO-LR | From UE | From LMF | From NG-RAN or OAM to LMF: - Feared events in the RAT-dependent Assistance Data- Feared events in transmitting the data to the UE- RAT-dependent feared eventsFrom UE to LMF:- UE feared events | Procedure to transfer Integrity assistance information and KPIs from UE to LMFProcedure to transfer Integrity results from LMF to UE  |
| MT-LR | LMF implementation | LMF internal implementation | From NG-RAN or OAM to LMF: - Feared events in the RAT-dependent Assistance Data- Feared events in transmitting the data to the UE- RAT-dependent feared eventsFrom UE to LMF:- UE feared events | Procedure to transfer Integrity assistance information from UE to LMF  |

9.4.2.1.2 Summary of RAT-dependent Positioning Integrity Methods

The detection of feared events is necessary to support the implementation of positioning integrity. Assistance information and associated IEs can be optionally sent between the LMF and the UE to mitigate the feared events. LPP signaling considerations for UE-based and UE-assisted positioning integrity have been examined in this section to support the use cases in Section 9.2. To ensure that the system meets the integrity goals and requirements, it must be systematically validated, possibly including compliance to relevant industry functional safety specifications such as ISO-26262. Integrity validation is considered outside the scope of the 3GPP specification as it concerns a specific integrity system implementation.

*End of Text Proposal*

**Question 8: Do you agree to include the RAT-Dependent text proposed in R2-2101391?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Swift Navigation | No | Refer to our comments and suggestions in response to Question 3. |
| Intel | No | RAT dependent integrity has been ruled out.  |
| Fraunhofer  | No  | RAT-dependent integrity was not the scope of this study item, so should not be captured.  |
| ESA | No | It´s against SID objective and we would like to use the SID objectives as guiding principles  |
| vivo | No | RAT-dependent integrity is out of scope. |
| Nokia | No | As mentioned above, it is not desirable to still consider RAT-D in this late stage. |
| Xiaomi | No | It is out of the SID scope. |
| Huawei, HiSilicon | No  | RAT dependent integrity has already been exclude from the SI scope. |
| CATT | No | Out of SID scope. |
| Convida | No | Out of scope for this release and can be considered for future releases. |
| InterDigital | No |  |

**Moderator Summary**

Yes: 0

Partly: All 11 (Swift, Intel, Fraunhofer, ESA, Vivo, Nokia, Xiaomi, Huawei, CATT, Convida, InterDigital)

There was unilateral consensus not to include the text.

*Suggested Resolution*

* RAT-Dependent methods text is out of scope.

## 3.3 May require further discussion

The remaining proposals from the Methodologies summary [15] are addressed below.

* **Proposal 7: RAN2 shall enable the capability of employing local environment feared events detected by the UE to assist other UEs in the same region. The signaling mechanism to enable the UE to report the detected local environment feared events and the assistance data to other UEs from LMF shall be specified. How the UE detects the threat and how the LMF processes the received information shall be left implementation specific.**

**Question 9: Do you agree to further address Proposal 7 as part of the study?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Swift Navigation | No | We think this topic is captured by including the suggested text changes as part of our responses to Questions 6 and 7.  |
| Intel | No | We only need to specify what should be reported for local Environment feared events. But how to use it by LMF should be network implementation.  |
| Fraunhofer | Yes | We strongly support that the UE should be able to report the detected local environment feared events. How it does it and how the NW uses it could be left implementation dependent. The text changes suggested in response to Question 6 and 7 do not make it sufficiently clear that the capable UEs monitor local environment and report feared events (like spoofing/jamming/interference from other legitimate systems). The proposal also makes it clear what is the logic behind collecting these data.  |
| ESA |  | We think this point needs discussion. Multipath is experienced differently by each device even when in close proximity – we think proposal is not applicable to multipath. Regarding integrity and spoofing, we are open for discussion and would like to better understand the concept from the proponent. |
| vivo | No | This proposal belongs to implementation and should be discussed in WI phase. |
| Nokia | No | Too much implementation details |
| Xiaomi | No | We only need to discuss local environment feared events, and others are implementation. |
| Huawei, HiSilicon | No  | We think it has already been included in Q7 (Local Environment feared events, e.g. Multipath, Spoofing, Interference). We suggest to first identify what kind of local environment feared events should be detected by the target UE to assist other UEs, because not all of the feared event are able or suitable to be detected by nearby UEs.We then think the other UE’s feared event should be sent to the UE by LMF, since the feared events of the UE are different for different UEs and it should be under the control of the LMF.  |
| CATT | No | We can discuss it in WI. |
| Convida | No | This is left to LMF implementation albeit a use case that can be supported with suggested signalling already discussed above. |
| InterDigital | No | The information reported on the detected local environment can be discussed during WI phase |

**Moderator Summary**

Yes: 1 (Faunhofer)

No: 9 (Swift, Intel, Vivo, Nokia, Xiaomi, Huawei, CATT, Convida, InterDigital)

No Decision: 1 (ESA)

There was strong consensus that this topic does not require further investigation as part of the SI phase given the signaling and implementation aspects can be discussed as part of the WI phase. Fraunhofer advocated that the proposal clarifies that the UE should be capable of reporting the detected Local environment feared events. ESA suggested that Fraunhofer’s comments are not relevant to Multipath but may be relevant to spoofing and (data?) integrity.

*Suggested Resolution*

* No further action is needed given the topic remains FFS as part of the normative work.
* **Proposal 12: LMF decides whether to choose network-assisted or UE-assisted integrity.**

**Question 10: Do you agree with addressing Proposal 12 as part of the study?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Swift Navigation | No | The UE should be capable of initiating the transaction. The signaling procedures will be resolved as part of the normative work. |
| Intel |  | It is related to UE capability, e.g. whether the UE can support all of them or not. Can be decided in WI phase.  |
| Fraunhofer | No | This does not have to be resolved now – can be left for normative work. |
| ESA |  | Agreeing or disagreeing in the SID has no relevance. Specifications are changed only in normative work. |
| vivo | Yes | LMF decision depends on UE capability report through LPP and LMF own capability. |
| Nokia | No | Too much details for SI phase. |
| Xiaomi | No | It can be studied during the WI phase. |
| Huawei, HiSilicon |  | We think this issue should be left to WI phase. |
| CATT | No | We can discuss the detail with UE capabilities in WI. |
| Convida | No | This can be decided in the normative phase. |
| InterDigital | No | Leave for WI phase |

**Moderator Summary**

Yes: 1 (Vivo)

No: 10 (Swift, Fraunhofer, Nokia, Xiaomi, CATT, Convida, InterDgitial, Intel/ESA/Huawei (can be left to normative work).

There was strong consensus that the UE and general signaling capabilities will be addressed as part of the WI, which was further supported by comments from Intel, ESA and Huawei.

*Suggested Resolution*

* No further action is needed given the topic remains FFS as part of the normative work.
* **Proposal 15: Two possible integrity result reporting modes (PL Reporting and Integrity Event Flagging) could be captured in the TR with some descriptions.**

**Question 11: Do you agree with addressing Proposal 15 as part of the study?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Swift Navigation | Partly | We think these modes and descriptions are quite helpful, but the PL Reporting description may need clarification. In essence, the TIR only applies to HMI, so depending on the system implementation, the correct interpretation of the PL without a defined AL may not be well defined. This means that at least for some implementations it is not useful to just output the PL alone without also specifying the corresponding AL. This comes from the fact that the AL is not simply a threshold but is typically used as a design assumption/parameter in the implementation of the integrity algorithm. If there is a general consensus to include these proposals we can update the text to reflect the point above. Equally, these modes could also be brought forward for discussion as part of the normative work where this general topic needs to be addressed anyway. |
| Intel | Yes | Seems the proposal is to capture these two possible integrity result reporting modes in the TR. That is fine to us. But the details can be discussed in the WI phase.  |
| vivo | Yes | Agree with intel. |
| Nokia | Yes | Agree with Intel |
| Xiaomi | Yes | Agree with Intel |
| Huawei, HiSilicon | Yes  | We think these two reporting modes may be helpful in different scenarios, and the descriptions need further discussion, which may include the potential scenarios, the applicable positioning methods, the benefits, etc. |
| CATT | Partly | Agree with Swift. Suggest to update the context “possible integrity result reporting modes (PL Reporting and/or Integrity Event Flagging/ or warning)” |
| Convida | Yes | We think that integrity result reporting can be captured in the TR with details to be determined in the normative phase. |
| InterDigital | Yes | We share similar understanding with Convida |

**Moderator Summary**

Yes: 8 (Intel, Vivo, Nokia, Xiaomi, Huawei, CATT, Convida, InterDigital)

Partly: 2 (Swift, CATT)

There was strong consensus to include these descriptions in the TR, noting the details can be discussed in the WI phase. Swift and CATT noted that the descriptions may need some refinement.

*Suggested Resolutions*

* The descriptions were added to Section 9.4.1.1.1, noting the details are FFS in the WI.
* **Proposal 22: RAN2 supports simultaneous use of alternative positioning methods (RAT-dependent and hybrid of RAT-dependent and RAT-independent) at UE and RAN for improving positioning accuracy and integrity.**

**Question 12: Do you agree with addressing Proposal 22 as part of the study?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Swift Navigation | No | Refer to our comments and suggestions in response to Question 3. |
| Intel | No | RAT dependent has been ruled out.  |
| Fraunhofer | No | As far as we understand, the LMF could have two or more positioning methods running in parallel. Then the simultaneous use of two methods could be an implementation issue. |
| ESA | Already available by LPP design (no action is required) | LPP supports various RAT-dependent methods and hybrid of RAT-dependent and RAT-independent so there is nothing we need to do. What exactly is used at UE and LMF is up to implementation. It would be enough to capture in table of feared events – see our answer to Question 6. |
| vivo | No | RAT dependent is out of scope. |
| Nokia | No | Out of scope |
| Xiaomi | No | RAT dependent is out of scope. |
| Huawei, HiSilicon | No  | We agree with ESA that the simultaneous use of alternative positioning methods has already been supported in current specs. And whether to use the measurements or positioning results to assist improving positioning accuracy and integrity is an implementation issue. |
| CATT | No | Agree with ESA. |
| Convida | No | Out of scope for this release. |

**Moderator Summary**

Yes: 0

No: 10 (Swift, Intel, Fraunhofer, ESA, Vivo, Nokia, Xiaomi, Huawei, CATT, Convida)

There was unilateral consensus not to address this proposal in the study given RAT-Dependent is out of scope. Fraunhofer, Huawei and CATT agreed with ESA that LPP already supports RAT-Dependent and that these methods can be handled on implementation.

*Suggested Resolutions*

* No action taken.

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