**3GPP TSG-RAN WG2 Meeting #119bis-eR2-22xxxxx**

**Electronic meeting, Oct 10th – 19th, 2022**

**Agenda item:** 8.2.3

**Source:** CATT

**Title:** Rel-18 integrity text proposal

**Document for:** Discussion and Agreement

# 1 Introduction

This is to provide text proposal on Rel-18 RAT-Dependent integrity based on email discussion as below:

* [AT119bis-e][429][POS] Rel-18 integrity text proposal (CATT)

 Scope: Draft a text proposal on the RAN2 agreements on RAT-dependent integrity.

 Intended outcome: Endorsable TP in R2-2210918

 Deadline: Monday 2022-10-17 1700 UTC

Justification: The assistance data related with Equation 6.1.2.1-1 is replaced with error source in the updated TP since the assistance data is from UE’s perspective in GNSS-Integrity. Equation 6.1.2.1-1 works for both UE-Based and LMF-Based in RAT-Dependent Integrity.

# 2 Text Proposal

**/\*\*\*\*Start of the changes\*\*\*\*/**

## 6.1 Integrity for RAT-Dependent Positioning Techniques

### 6.1.1 Identification of error sources

### 6.1.2 Methodologies, procedures and signalling for determination of positioning integrity

#### 6.1.2.1 Integrity Principle of Operation

For integrity operation, the network will ensure that:

*P(Error > Bound for longer than TTA | NOT DNU) <= Residual Risk + IRallocation* (Equation 6.1.2.1-1)

for all values of IRallocation in the range irMinimum <= *IRallocation* <= irMaximum

for all the errors in Table 6.1.4-1, which are available and where the corresponding DNU flag(s) are set to false.

The integrity risk probability is decomposed into a constant Residual Risk component provided in the error source as well as a variable IRallocation component that corresponds to the contribution from the Bound according to the Bound formula in Equation 6.1.2.1-2. IRallocation may be chosen freely by the client based on the desired Bound, therefore the network should ensure that Equation 6.1.2.1-1 holds for all possible choices of IRallocation. The Residual Risk and IRallocation components may be mapped to fault and fault-free cases respectively, but the implementation is free to choose any other decomposition of the integrity risk probability into these two components.

Equation 6.1.2.1-1 holds for all error sources that have been issued that are still within its validity period. If this condition cannot be met then the corresponding DNU flag must be set.

Equation 6.1.2.1-1 holds at any epochs for which error source is provided. For any bound that is still valid (within its validity time), the network ensures that the Integrity Alert is also included in the provided error sources if needed to satisfy the condition in Equation 6.1.2.1-1. It is up to the implementation how to handle epochs for which integrity results are desired but there are no DNU flag(s) available, e.g. the Time To Alert (TTA) may be set such that there is a "grace period" to receive the next set of DNU flags.

**Editor note: the DNU flag and its related description will be removed or updated later, if RAN2 conclude there is no need to indicate the DNU presence in the integrity principle equation.**

Only UEs and TRPs for which the integrity error sources are provided are monitored by the network and can be used for integrity related applications.

Where:

**Error:** Error is the difference between the true value of a parameter (e.g. FFS etc.), and its value as estimated and provided in the corresponding error sources as per Table 6.1.4-1

**Editor note: the error sources depend on RAN1, and the FFS will be replaced with defined error sources later once RAN1 finalize the error sources.**

**Bound:** Integrity Bounds provide the statistical distribution of the errors. The bound is computed according to the Bound formula defined in Equation 6.1.2.1-2. The bound formula describes a bounding model including a mean and standard deviation (e.g. FFS). The bound may be scaled by multiplying the standard deviation by a K factor corresponding to an IRallocation, for any desired IRallocation within the permitted range.

Bound for a particular error is computed according to the following formula:

*FFS the equation of bound* (Equation 6.1.2.1-2)

 *FFS the distribution of K*

 *FFS the IRallocation*

**Editor note: the modelling of the error sources depend on RAN1, and the FFS will be updated later once RAN1 finalize the modelling of the error sources.**

**Time-to-Alert (TTA):** The maximum allowable elapsed time from when the Error exceeds the Bound until a DNU flag must be issued.

**DNU:** The DNU flag(s) corresponding to a particular error as per Table 6.1.4-1. Where multiple DNU flags are specified, the DNU condition in Equation 6.1.2.1-1 is present when any of the flags are true (logical OR of the flags).

**Editor note: the DNU flag and its related description will be removed or updated later, if RAN2 conclude there is no need to indicate the DNU presence in the integrity principle equation.**

**Residual Risk:** The residual risk is the component of the integrity risk provided in the error sources as per Table 6.1.4-1. This may correspond to the fault case risk but the implementation is permitted to allocate this component in any way that satisfies Equation 6.1.2.1-1.

The Residual Risk is the Probability of Onset which is defined per unit of time and represents the probability that the feared event begins. Each Residual Risk is accompanied by a Mean Duration which represents the expected mean duration of the corresponding feared event and is used to convert the Probability of Onset to a probability that the feared event is present at any given time, i.e.

*P(Feared Event is Present) = Mean Duration \* Probability of Onset of Feared Event* (Equation 6.1.2.1-3)

**irMinimum, irMaximum:** Minimum and maximum allowable values of IRallocation that may be chosen by the client. Provided as service parameters from the Network according to Integrity Service Parameters.

**Correlation Times:** The minimum time interval beyond which two sets of integrity error source parameters for a given error can be considered to be independent from one another.

**Editor note: the correlation time will be removed or updated later, if RAN1 conclude no support of correlation time later.**

#### 6.1.2.2 Procedures and signalling for determination of positioning integrity

Signalling and procedures to support RAT-dependent positioning integrity determination are recommended for normative work. The details of the solutions are left for further discussion in normative work, which may include the following aspects:

- Support of integrity for both UE-based and LMF-based integrity for RAT-dependent positioning.

- The error sources that will be used to support integrity determination;

- The information that will be used to provide the positioning integrity KPIs and integrity results.

- For UE-based integrity for RAT-dependent positioning, the R17 UE-based integrity mode signaling can be used as baseline with the following aspects:

* UE sends capability info to LMF on integrity for UE-based mode using LPP capability transfer procedure
* LMF sends the assistance data for integrity calculation to UE for integrity of UE-based mode
* LMF sends integrity requirement e.g., TIR to UE in LPP request location information message for integrity of UE-based mode
* UE sends integrity result to LMF using LPP location information Transfer message
* LMF provides, in assistance data, the information of error sources (e.g., originated from RAN node) to UE for integrity in UE-based mode.

### 6.1.3 Summary of Evaluation Results for Integrity for RAT-Dependent Positioning Techniques

### 6.1.4 Potential Specification Impact for Integrity for RAT-Dependent Positioning Techniques

The potential specification impact for the integrity of NR Positioning Technologies comprises the following.

- Specification of the LPP/NRPPa signalling and procedure to provide the error sources, positioning integrity capability, integrity KPI/ integrity results for UE-based and LMF-based integrity for NR RAT-dependent positioning technologies. (RAN2, RAN3);

- Specification of a new Alert Assistance Data element ("DNU") for each error source in Table 6.1.4-1 (RAN2);

- Specification of a new Integrity Service Assistance Data Element for UE-Based mode to provide the minimum and maximum allowable values of *IRallocation* that may be chosen by the client (RAN2);

- Specification of the integrity bounds (mean and standard deviation of errors and error rates) for each error source in Table 6.1.4-1;

- Specification of the residual risk component for each error source in Table 6.1.4-1;

- Specification of the minimum time interval beyond which two sets of NR error source parameters for a given error can be considered to be independent from one another (Integrity Correlation Times).

Table 6.1.4-1 shows the mapping between the integrity fields and the NR error sources.

 Table 6.1.4-1: Mapping of Integrity Parameters

|  |  |  |  |
| --- | --- | --- | --- |
| Positioning method | Error Sources originated from NG-RAN/UE | TRP /Measurement Error | Integrity Fields |
| Integrity Alerts | Integrity Bounds (Mean) | Integrity Bounds (StdDev) | Residual Risks | Integrity Correlation Times |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |

**Editor note1: the Mapping of Integrity Parameters will be updated later based on RAN1 input of the error sources.**

**Editor note2: The DNU related description will be removed later, if RAN2 conclude there is no need to indicate the DNU presence in the integrity principle equation.**

**Editor note3: The correlation time will be removed later, if RAN1 conclude no support of correlation time.**

**/\*\*\*\*End of the changes\*\*\*\*/**