**3GPP TSG-RAN WG2 Meeting #121bis electronic R2-230xxxx**

**e-Meeting, 17th – 26th Apr, 2023**

**Source: vivo**

**Title:** **Summary of AI 7.2.3 on RAT-dependent integrity**

**Agenda Item:** **7.2.3**

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

1. Introduction

At the RAN2#121bis-e meeting, the following contributions have been submitted:

1. R2-2302504 Discussion on RAT-Dependent integrity CATT
2. R2-2302581 Discussion on RAT-dependent Integrity Huawei, HiSilicon
3. R2-2302741 Further considerations on RAT dependent integrity Intel Corporation
4. R2-2302959 Discussion on RAT-dependent positioning integrity vivo
5. R2-2303184 Consideration on RAT-dependent positioning integrity OPPO
6. R2-2303230 Discussion on RAT-dependent integrity Lenovo
7. R2-2303433 Discussion on RAT-dependent positioning integrity Xiaomi
8. R2-2303495 Discussion on RAT-dependent methods positioning integrity ZTE Corporation
9. R2-2303540 Discussion on the integrity issues CMCC
10. R2-2303571 Discussion on solutions for integrity of RAT-dependent positioning techniques Spreadtrum Communications
11. R2-2303682 Integrity of NR Positioning Technologies Qualcomm Incorporated
12. R2-2303705 RAT Dependent positioning Integrity Ericsson
13. R2-2303994 Discussion on RAT dependent integrity InterDigital Communications
14. R2-2304058 Spec impact of RAT-dependent error sources for positioning integrity Nokia, Nokia Shanghai Bell

This document provides the summary of agenda item 7.2.3 “RAT-dependent positioning integrity” toward the work item objective:

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| Error modelling parameters, signalling, and procedures to support UE-based and LMF-based integrity of RAT-dependent positioning methods. |

1. Discussion

## 2.1 General Aspects of Integrity

In this section, we categorize several general aspects of RAT-dependent positioning methods.

### 2.1.1 clarification about error sources

Issues about error sources have been held for a long discussion since the SI phase. Table 6.1.1-1 of TR 38.859 presents the identified error sources from RAN1 regarding different positioning methods. For UE-based positioning integrity mode, whether the boresight direction of DL PRS (NR-DL-PRS-BeamInfo in TS 37.355 [16]) and/or beam information (NR-TRP-BeamAntennaInfo in TS 37.355 [16]) of DL PRS can be error sources was left to be considered further in the normative work phase.

Table 6.1.1-1: Error sources for LMF-based and UE-based positioning integrity modes

| Positioning Integrity Mode | DL TDOA | UL TDOA | Multi-RTT | UL AoA | DL AoD |
| --- | --- | --- | --- | --- | --- |
| LMF-based (as defined in Table 9.4.1.1.1 in TR 38.857) | - RSTD measurement  - TRP location  - Inter-TRP synchronization (can be caused in part by errors in SFN initialization time.) | - RTOA measurement  - TRP location  - Inter-TRP synchronization (can be caused in part by errors in SFN initialization time.) | - UE Rx-Tx time difference measurement  - gNB Rx-Tx time difference measurement  - TRP location | - Angle of arrival measurement  - TRP location  - ARP location (e.g., ***ARPLocationInformation*** in TS 38.455) | - TRP location  - DL-PRS RSRPP of the first path or RSRP |
| UE-based (as defined in Table 9.4.1.1.1 in TR 38.857) | - TRP location (e.g., ***NR-TRP-LocationInfo*** in TS 37.355 [16])  - Inter-TRP synchronization (e.g., ***NR-RTD-Info*** in TS 37.355) |  |  |  | - TRP location (e.g., ***NR-TRP-LocationInfo*** in TS 37.355) |

Further, the candidates for distributions to model the different error sources are present in Table 6.1.1-2. Note that the distribution of RSRPP for DL-AoD was not identified.

Table 6.1.1-2: Identified candidates for distributions to model the errors due to different error sources

| Error source | Candidate(s) for distribution for error source |
| --- | --- |
| Timing measurement errors (NOTE 1, 2, 3) | Gaussian distribution |
| Inter-TRP synchronization errors | - Uniform distribution (NOTE 4)  - Gaussian distribution |
| TRP location error (e.g., ***NR-TRP-LocationInfo*** in [16]) | - Uniform distribution (NOTE 5)  - Gaussian distribution |
| TRP location error (e.g., Geographical coordinates in [17]) | - Uniform distribution  - Gaussian distribution |
| ARP location error (e.g., ***ARPLocationInformation*** in [17]) | - Uniform distribution  - Gaussian distribution |
| NOTE 1: Timing measurement errors are applicable to RSTD, RTOA and UE/gNB Rx-Tx time difference measurements.  NOTE 2: It is assumed that the timing measurement error is associated with the first path.  NOTE 3: It is assumed that the timing measurement error contains TEG related TX/RX timing error if the TEG related information is provided  NOTE 4: This may already be consistent with the uncertainty related to ***NR-RTD-Info*** in [16].  NOTE 5: This may already be consistent with the uncertainty related to ***NR-TRP-LocationInfo*** in [16]. | |

At the RAN2 #121 meeting, the following agreements were made regarding the identified error sources:

Agreements:

RAN2 anticipate that the error sources are overbounded by a Gaussian distribution.

LS to RAN1 to check this view and ask about the parameters for the overbound distributions.

TRP related error source bounds can be provided to UE via dedicated LPP providing assistance message or posSIB.

Any interaction between the LMF and NG-RAN to support determination of error sources is in RAN3 scope. Other aspects of determining the TRP error sources are left to deployment and implementation.

As there are some remaining issues about the error source, the following proposals have been raised:

|  |  |
| --- | --- |
| **Contribution** | **Proposal** |
| R2-2302504 CATT | Proposal 1: It is left to LMF implementation to decide TRP-related error sources bound distribution. |
| R2-2302959 vivo | Observation: RAN1 did not model some error distributions of DL-AOD positioning methods during the SI phase:  1) DL-PRS RSRP or RSRPP for LMF-based integrity  2) FFS: Boresight direction and beam information of DL-PRS  Proposal 1: Discuss whether to support the integrity operation for DL-AOD. LS to RAN1 to confirm when RAN2 reaches the consensus. The following two options can be considered:  - Option 1: do not support integrity evaluation in DL-AOD positioning  - Option 2: handle undefined error sources based on implementation |
| R2-2303495 ZTE | Proposal 4: Support RAN2 to wait for RAN3’s conclusion on the TRP error bound provision to the LMF for the error sources of TRP location, ARP location and *inter-TRP synchronization*. |
| R2-2303682 Qualcomm | Proposal 1: The beam related information (Beam Bore-Sight Direction/Beam Antenna Information) are error sources for DL-AoD positioning.  Observation 1: To leverage the PL definition, the individual error source distributions are modelled as Gaussian distribution.  Observation 2: The process of replacing an actual distribution with a simplified, conservative error model is called overbounding.  Observation 3: To leverage the PL definition, the idealized overbound must be Gaussian.  Observation 4: Paired Overbounding uses a pair of bounds, rather than a single bound, to represent the actual error distribution.  Proposal 2: How an LMF obtains the integrity assistance data (e.g., using a reference receiver network/PRUs) should be left to implementation/deployment (similar to Rel-17 GNSS integrity). |
| R2-2303705 Ericsson | Proposal 4: Represent the TRP and ARP location errors by a Gaussian over-bounding or paired over-bounding.  Proposal 6: Represent the RTD errors by a Gaussian over-bounding or paired over-bounding.  Proposal 7: Add antenna/beam direction error sources to the set of considered error sources and define corresponding error bounds |

The above proposals concentrate on the following issues:

**Issue 1**: FFS on error sources of DL-AOD

* 3 companies [vivo, QC, E///] notice that beam information is left FFS as an error source in SI. Among them, 2 companies [Qualcomm, E///] propose the beam related information (Beam Bore-Sight Direction/Beam Antenna Information) are error sources for DL-AoD positioning. As RAN1 is responsible for identifying error sources during the SI phase, the rapporteur tends to LS to RAN1 to confirm if RAN2 agrees to support the integrity operation for DL-AOD.
* In addition, 1 company [vivo] notices that the distribution of DL-PRS RSRP or RSRPP was not identified and would like to discuss whether to support the integrity operation for DL-AOD. As the proposals from [Qualcomm, E///] imply the preference to support it, the rapporteur suggests RAN2 to discuss how to address the remaining FFS.

**Proposal 1: Address the remaining issues to support the integrity operation for DL-AOD:**

* **LS to RAN1 to confirm that the beam-related information (Beam Bore-Sight Direction and Beam Antenna Information) are error sources for DL-AoD positioning.**
* **LS to RAN1 to ask about the error distribution of DL-PRS RSRP, RSRPP and beam-related information.**

**Issue 2**: How LMF gets the TRP-related error sources bound distribution.

* 2 companies [CATT, QC] propose that it is left to LMF implementation to obtain the distribution
* 1 company [ZTE] supports RAN2 to wait for RAN3’s conclusion on the TRP error bound provision to the LMF for the error sources of TRP location, ARP location and inter-TRP synchronization.

Note that RAN2 already agreed that any interaction between the LMF and NG-RAN to support the determination of error sources is in RAN3 scope, and other aspects of determining the TRP error sources are left to deployment and implementation.

**Therefore, the rapporteur tends to wait for RAN3’s decision on the TRP-related error sources and no proposal is made for issue 2.**

**Issue 3**: Further clarification on the bounds of identified errors.

* 1 company [E///] proposes to represent the TRP, ARP location errors and RTD errors by a Gaussian over-bounding or paired over-bounding, which is aligned with the previous RAN2 agreement.

**Thus, no further proposal is made for issue 3.**

### 2.1.2 Support of DNU flag

DNU flag is reused from GNSS integrity as an indication of whether the corresponding assistance data can be used for integrity-related applications. At the RAN2#120 meeting, the following agreement was made regarding the DNU flag in assistance data:

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| --- |
| Use DNU flag for RAT-dependent integrity, with the meaning that the concerned assistance data cannot be used for integrity calculation but may be usable for positioning. |

Companies’ views about the DNU flag are listed below.

|  |  |
| --- | --- |
| **Contribution** | **Proposal** |
| R2-2302581 Huawei | Proposal 2: Introduce a DNU flag for the integrity assistance data for each error source per RAT-dependent positioning method.  Proposal 3: Send an LS to RAN1 asking whether the DNU flag for measurement is needed for LMF-based integrity. |
| R2-2303230 Lenovo | Proposal 4: Support to indicate the presence of DNU flag in the integrity principal equation, and the DNU flag is transmitted with both assistance data and measurement results to support integrity results calculation. |
| R2-2302959 vivo | Proposal 3a: For UE-based integrity, the spec impact of integrity related information includes:  - to introduce integrity service parameters and integrity service alerts (common DNU, e.g. a list of TRP) per positioning method  - to introduce integrity parameters and DNU flag for each error source in the form of assistance data  Proposal 3b: to introduce integrity parameters and DNU flag for each error source related to UE measurement information |
| R2-2303433 Xiaomi | Proposal 1: For UE based positioning integrity, LMF sends DNU flag by LPP provide assistance message and the DNU flag indicates the TRPs or PRS resources which are not usable for positioning integrity.  Proposal 2: It is not necessary to provide the DNU flag on positioning measurement to LMF for LMF based positioning integrity. |
| R2-2303495 ZTE | Proposal 6: Support to configure DNU flags per TRP in the DL assistance data. |
| R2-2303540 CMCC | Proposal 3: the DNU flag used in integrity principle of operation should be provided at least for each positioning method. And the DNU flags may be provided to the assistant data, such TPRs and/or PRS resources to indicate the health of assistant data. |
| R2-2303571 Spreadtrum | Proposal 1: RAN2 to configure DNU flags per TRP per positioning method in assistance data. |
| R2-2303682 Qualcomm | Proposal 3: The DNU flags are provided per TRP and per error contribution (e.g., TRP location, RTD, beam information, etc.). |
| R2-2303994 InterDigital | Proposal 1: Study which parameters in assistance data should be applied for DNU flags |

The discussion is mainly about the granularity of DNU flag in assistance data, and whether to introduce DNU flag in the measurement report.

**Issue 1**: the granularity of DNU flag in assistance data

* 2 companies [Huawei, vivo] propose that DNU flag in assistance data should be provided per error source for each method. Further, 2 companies [ZTE, Spreadtrum] think DNU flag in assistance data can be provided per TRP. 1 company [QC] thinks it is per TRP and per error contribution (e.g., TRP location, RTD, beam information, etc.). 2 companies [Xiaomi, CMCC] think it can be per TRP or PRS resources.

For the DNU flag in GNSS integrity, the network may provide three types of DNU flags:

* *GNSS-RealTimeIntegrity*: providing a bad GNSS signal list, which is per GNSS satellite and signal combination, and is mapped to multiple error sources (i.e., SSR Orbit, SSR Clock, SSR Code Bias, SSR Phase Bias)
* *ionosphereDoNotUse*: integrity service alerts of the ionosphere, which is mapped to one error source (i.e., Ionosphere)
* *TroposphereDoNotUse*: integrity service alerts of the troposphere-related information, which is mapped to two error sources (i.e., Troposphere Vertical Hydro Static Delay and TroposphereVertical WetDelay).

To reuse the idea in RAT-dependent integrity, there can also be a TRP list that transmits the PRS with bad quality. Besides, the DNU flag can be mapped to one or more error sources to indicate the related assistance data is not suitable for integrity evaluation.

As to the specific error source in assistance data, only TRP location and Inter-TRP synchronization have been identified. Whether beam-related information (PRS level) will be concluded as an error source depends on the conclusion of Proposal 1.

**Proposal 2: RAN2 to discuss the granularity of DNU flags in TRP-related assistance data (e.g., TRP location and Inter-TRP synchronization). The following two options can be considered:**

* **Option 1: The DNU flags are provided per error source**
* **Option 2: The DNU flags are provided per TRP in each error source**

**Issue 2**: Whether to introduce DNU flag in the measurement report

* 3 companies [Huawei, Lenovo, vivo] consider DNU flag can also be applied for measurement-related errors. Specifically, Huawei explains that the DNU flag can indicate whether the measurement results can be utilized for integrity calculation or how reliable the measurement results can be. Further, Huawei suggests to LS RAN1 about feasibility and necessity of DNU for measurement information. As the DNU flag in TRP measurement may have an impact on RAN3, the rapporteur thinks RAN3 should also be involved.
* On the contrary, 1 company [Xiaomi] assumes that UE/gNB can provide the updated positioning measurement to the LMF when the UE or gNB thinks the positioning measurement is not usable for LMF-based positioning integrity. Therefore, it is not necessary to provide the DNU flag on positioning measurement to LMF for LMF-based positioning integrity.

**Proposal 3: RAN2 to discuss whether to introduce DNU flag in measurement from UE/gNB for LMF-based integrity. If agreed from RAN2's perspective, LS to RAN1/RAN3 to confirm the feasibility and necessity.**

### 2.1.3 Additional integrity parameters

It is a consensus that the concepts developed for GNSS integrity can be reused in RAT-dependent integrity. The following integrity parameters are utilized in GNSS integrity:

* Integrity Alerts: Indicates whether the corresponding assistance data can be used for integrity-related applications.
* Integrity Bounds: Provide the statistical distribution of the residual errors associated with the GNSS positioning corrections (e.g. RTK, SSR etc), including a mean and standard deviation (e.g. paired over-bounding Gaussian)
* Residual Risks: 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.
* Integrity Correlation Times: The minimum time interval beyond which two sets of GNSS assistance data parameters for a given error can be considered to be independent from one another.

Up till now, only integrity alerts (DNU flag) and integrity bounds have been discussed.

The proposals on other integrity parameters are listed as follows.

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| --- | --- |
| **Contribution** | **Proposal** |
| R2-2302959 vivo | Proposal 4: RAN2 to discuss how to handle the integrity risk for RAT-dependent integrity:  - Option 1: to reuse the candidate value ranges of parameters in GNSS to calculate the Residual Risk for each error source and the IRallocation for each positioning method; LS to RAN1 about the feasibility  - Option 2: to not distinguish fault and fault-free cases with no import of the Residual Risk and the IRallocation |
| R2-2303230 Lenovo | Proposal 5: Integrity alert output is performed when some defined integrity information or events are detected for both UE-based and LMF-based integrity modes. |
| R2-2303682 Qualcomm | Proposal 4: The 'Integrity Correlation Times', defining the minimum time interval beyond which two sets of assistance data parameters for a given error can be considered to be independent from one another, should optionally be provided for the integrity assistance data for NR to allow the use of time-based estimation techniques (e.g. Kalman Filtering) in addition to snapshot-based techniques. |
| R2-2304058 Nokia | Proposal 1: RAN2 to discuss and identify the residual risks which are specific and applicable to RAT-dependent positioning integrity and evaluate their impacts.  Proposal 2: Reuse the integrity related IE and fields defined for GNSS integrity for RAT-dependent positioning integrity when possible e.g., mean and standard deviation as bounds for an error source. |

**Issue 1**: Whether to introduce Residual Risk

For integrity operation, the network will ensure that:

*P(Error > Bound for longer than TTA | NOT DNU) <= Residual Risk + IRallocation* (Equation 8.1.1a-1)

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

Based on the above equation,

* 2 companies [vivo, Nokia] suggest discussing and identifying the residual risks which are specific and applicable to RAT-dependent positioning integrity and evaluating their impacts. vivo provides two options and option 1 is similar to GNSS integrity. The rapporteur thinks option 1 can be the baseline for further discussion.

**Proposal 4: RAN2 to discuss whether to introduce Residual Risk and the IRallocation for RAT-dependent integrity.**

**Issue 2**: Whether to introduce Integrity Correlation Times

* 1 company [QC] proposes that the 'Integrity Correlation Times', defining the minimum time interval beyond which two sets of assistance data parameters for a given error can be considered to be independent from one another, should optionally be provided for the integrity assistance data for NR to allow the use of time-based estimation techniques (e.g. Kalman Filtering) in addition to snapshot-based techniques.

**Proposal 5: RAN2 to discuss whether to introduce the Integrity Correlation Times for RAT-dependent integrity.**

### 2.1.4 Others

The proposals on other aspects are listed as follows.

|  |  |
| --- | --- |
| **Contribution** | **Proposal** |
| R2-2302581 Huawei | Proposal 1: Discuss the feasibility for UE/gNB to calculate the PL for RAT-independent integrity, including the key factors (e.g. measurement error, GDOP) and any potential spec impacts. |
| R2-2303184 OPPO | Proposal 4: RAN2 to agree that the entity for integrity computation and the one for positioning computation should not be decoupled, from the perspective of saving unnecessary processing time for the time-sensitive positioning services. |
| R2-2303230 Lenovo | Proposal 6: RAN2 is suggested to consider the integrity assistance information when performing RAT-dependent positioning method determination to ensure the integrity performance. |
| R2-2303682 Qualcomm | Observation 5: The Protection Level is determined by the entity which hosts the position calculation engine; i.e., by the UE for UE-based mode or LMF for UE-assisted mode/network-based mode. The same integrity assistance data need to be available at the LMF for both position modes but need to be provided to the UE for UE-based mode. |

**Issue 1**: The relationship between integrity computation and positioning estimation

* 2 companies [OPPO, QC] put forward their considerations on this issue and both of them think the integrity calculation couples with the location estimation. That is, UE obtains PL in UE-based positioning methods and LMF obtains PL in LMF-based positioning methods.

During the SI phase, most of the companies shared the view but no agreement was made. To facilitate the discussion on signaling procedures, the rapporteur thinks it may be beneficial to reach a consensus on it.

**Proposal 6: The PL calculation is performed by the entity which also performs the position calculation for a location process.**

**Issue 2**: the feasibility for UE/gNB to calculate the PL for RAT-independent integrity

* 1 company [Huawei] thinks PL calculation is related to measurement errors and GDOP for RAT-dependent integrity and suggests discussing the feasibility for UE/gNB to calculate the PL for RAT-independent integrity, including the key factors (e.g. measurement error, GDOP) and any potential spec impacts.

The rapporteur thinks only UE-based and LMF-based integrity is considered in Rel-18. Therefore, no need to discuss the feasibility of gNB to calculate the PL. Besides, how to derive the PL is up to the implementation. **Therefore, the proposal can be treated with low priority.**

Note: The rapporteur suppose the intention of the proposal is for RAT-dependent integrity. Therefore, the original proposal is revised as:

**Proposal 7: RAN2 to discuss the feasibility for UE/gNB to calculate the PL for RAT-dependent integrity, including the key factors (e.g. measurement error, GDOP) and any potential spec impacts.**

**Issue 3**: integrity assistance information for positioning method determination

* 1 company [Lenovo] thinks integrity assistance information may also be beneficial for assisting the positioning method determination since the error source/fear events of different positioning methods may be different. For example, if the inter-TRP synchronization is identified as a type of integrity assistance information and transferred to LMF, then LMF may determine the positioning methods in which the potential error sources exclude the inter-TRP synchronization, e.g., DL-AoD, and multi-RTT, etc.

The rapporteur thinks the intention is OK. However, it is up to LMF implementation as LMF may request for TRP information before location method determination. That is, no spec impact is needed. **Therefore, the proposal can be treated with low priority.**

**Proposal 8: RAN2 to consider the integrity assistance information when performing RAT-dependent positioning method determination to ensure integrity performance.**

## 2.2 Signaling procedure of UE-based integrity

The general procedure of UE-based integrity is as follows:

- 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. LMF provides, in assistance data, the information of error sources (e.g., originated from RAN node) to UE for integrity in 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.

On top of the above, the following agreements were made at the RAN2 #121 meeting.

Agreements:

TRP related error source bounds can be provided to UE via dedicated LPP providing assistance message or posSIB.

For UE-based RAT-dependent integrity, the PL and/or its corresponding TIR are provided to LMF as legacy, using the existing common LPP signalling from Rel-17.

The proposals on further signaling design of UE-based integrity are listed as follows.

|  |  |
| --- | --- |
| **Contribution** | **Proposal** |
| R2-2302504 CATT | Proposal 3: For UE-based integrity, RAN2 to agree that the provision of TRP related error source bounds via dedicated LPP message is per positioning method.  Proposal 4: For UE-based integrity, RAN2 to agree to introduce new error cause dedicated for integrity calculation in the case that there is no integrity result provided to LMF.  Proposal 5: For UE-based and LMF-based integrity, UE need to provide the integrity capability to LMF per positioning method. |
| R2-2302581 Huawei | Proposal 4: For UE-based integrity, support the following enhancements:   * LPP signaling to deliver the error of related assistance data from LMF to UE, which at least includes: * TRP location error for DL-TDOA and DL-AoD * Inter-TRP synchronization error for DL-TDOA   Proposal 7: For the request of RAT-dependent integrity results, reuse the legacy signaling in *commonIEsRequestLocationInformation*. No spec change is needed. |
| R2-2302959 vivo | Proposal 3a: For UE-based integrity, the spec impact of integrity related information includes:   * to introduce integrity service parameters and integrity service alerts (common DNU, e.g. a list of TRP) per positioning method * to introduce integrity parameters and DNU flag for each error source in the form of assistance data * to introduce integrity bounds for each element within each assistance data |
| R2-2303495 ZTE | Proposal 1: Support to configure the error distribution parameters of TRP location in 37.355 per *TRP-LocationInfoElement* IE or per *NR-TRP-LocationInfoPerFreqLayer* IE in the *NR-TRP-LocationInfo*.  Proposal 2: Support to configure the error distribution parameters of *inter-TRP synchronization* in 37.355 per *ReferenceTRP-RTD-Info* IE or per *NR-RTD-Info* IE in the *NR-RTD-Info*. |
| R2-2303540 CMCC | Proposal 1: The error from assistant data, e.g. TRP location or inter-TRP synchronization could be specified for each positioning method like *NR-PositionCalculationAssistance-r16* for positioning calculation. |
| R2-2303184 OPPO | Proposal 2: RAN2 to discuss the granularity of the RAT-dependent positioning integrity capability flag to be included in at least the LPP Provide Capabilities msgs, which valids either for all RAT-dependent positioning methods or per RAT-dependent positioning method.  Proposal 3: RAN2 to agree to include the IEs related to request of results related to positioning integrity for integrity error sources, and optionally, the integrity KPI, in the LPP Request Location Infomration msg. |
| R2-2303230 Lenovo | Proposal 7: For RAT-dependent positioning, at least reporting Mode 1 of integrity results should be supported for both UE-based and LMF-based integrity. FFS on Mode 2 and whether the additional integrity results that are used in the integrity calculation shall also be reported in the integrity results.  Proposal 8: In the case of LMF-based positioning integrity, support mechanisms to request and report DL-based/UL-based measurement error information and assistance data error information, e.g., error bounds. In the case of UE-based positioning integrity, support mechanisms to request and report assistance data error information, e.g., error bounds. |
| R2-2303433 Xiaomi | Proposal : The signalling procedures for UE based positioning integrity are as follows:   * UE sends capability info to LMF on UE based positioning integrity using LPP provide capability message * UE sends integrity result to LMF using LPP provide location information message.   Proposal : Both Mode 1 and Mode 2 of Integrity Result Reporting should be specified for RAT-dependent positioning integrity. |
| R2-2303705 Ericsson | Observation 7: For key use cases of UE-based RAT dependent positioning the UE needs TIR, AL and TTA to make integrity calculations and be able to determine reliability and availability of the positioning estimates to UE higher layers  Observation 8: LMF can be configured with the integrity parameters TIR, AL and TTA.  Observation 9: UE can request the integrity parameters TIR, AL and TTA as part of assistance data in a similar way as it requests for positioning calculation assistance from LMF.  Proposal 8: Add TIR, AL and TTA to the integrity assistance data that the UE can request for on a need basis to support UE-based integrity calculations |

**Issue 1**: UE capability on UE-based RAT-dependent integrity

* 1 company [CATT] thinks UE needs to provide the integrity capability to LMF per positioning method.
* 1 company [OPPO] suggests discussing whether the capability is shared for all RAT-dependent positioning methods or indicated in each positioning method.
* 1 company [Xiaomi] indicates the capability is sent via LPP provide capability message.

For GNSS integrity, the capability is included in the *GNSS-CommonAssistanceDataSupport.* The rapporteur thinks it is straightforward that the RAT-dependent integrity capability is also per positioning method. However, capability-related issues are generally discussed after the solution has been finalized. **Therefore, the proposal can be treated with low priority.**

**Proposal 9: For UE-based and LMF-based integrity, UE provides the integrity capability to LMF per positioning method.**

**Issue 2**: Error source bounds for UE-based integrity

* 1 company [Huawei] confirms the assistance data for UE-based integrity includes TRP location and inter-TRP synchronization, which is aligned with the above table 6.1.1-1.
* 2 company [CATT, CMCC] thinks the provision of TRP-related error source bounds is per positioning method. Further, 2 company [vivo, ZTE] thinks the integrity parameters should be per TRP n each error source. Specifically, ZTE proposes to include the error distribution parameters of TRP location per *TRP-LocationInfoElement* IE or per *NR-TRP-LocationInfoPerFreqLayer* IE in the *NR-TRP-LocationInfo*, and to include the error distribution parameters of inter-TRP synchronization per *ReferenceTRP-RTD-Info* IE or per *NR-RTD-InfoElement* IE in the *NR-RTD-Info*.
* 1 company [Lenovo] suggests supporting mechanisms to request and report assistance data error information, e.g., error bounds.

For GNSS integrity, the UE may request the integrity parameters and LMF will provide them per satellite per GNSS. The signaling design can be reused for RAT-dependent integrity.

**Proposal 10a: For UE-based integrity, support mechanisms to request and report integrity parameters of TRP-related error sources per location method in assistance data.**

**Proposal 10b: The bound parameters of TRP-related error sources are provided per TRP in each error source for the concerned positioning method. To be specific:**

* **TRP location error can be provided for DL-TDOA and DL-AoD in *TRP-LocationInfoElement*.**
* **Inter-TRP synchronization error can be provided for DL-TDOA in *ReferenceTRP-RTD-Info* and *RTD-InfoElement*.**

**Issue 3**: provision of integrity KPI and result

* 2 companies [Huawei, OPPO] think the legacy signaling in commonIEsRequestLocationInformation can be reused to request the integrity result, and no spec change is needed. On the contrary, 1 company [E///] would add TIR, AL and TTA to the integrity assistance data that the UE can request on a need basis to support UE-based integrity calculations. The rapporteur thinks it is not aligned with the GNSS integrity. **Thus, the proposal to add the KPI in assistance data will be treated with low priority.**
* 2 companies [Lenovo, Xiaomi] would revisit the integrity reporting mode for RAT-dependent integrity. Lenovo thinks that at least reporting Mode 1 of integrity results should be supported, FFS on Mode 2. Xiaomi suggests both Mode 1 and Mode 2 of Integrity Result Reporting should be specified for RAT-dependent positioning integrity.
* 1 company [CATT] suggests introducing a new error cause dedicated for integrity calculation in the case that there is no integrity result provided to LMF. As we already agreed that the existing field *integrityInfo* is reused to provide integrity results, the error cause mechanism seems common for both RAT-dependent and RAT-independent integrity. However, the error cause for GNSS integrity was not introduced in Rel-17. **Therefore, the proposal can be treated with low priority.**

**Proposal 11: For UE-based integrity, reuse the *TargetIntegrityRisk* in *commonIEsRequestLocationInformation* to request RAT-dependent integrity results.**

**Proposal 12: For UE-based integrity, RAN2 to discuss whether to support Mode 2 of Integrity Result Reporting, i.e., UE compares the calculated PL with the given AL and indicates whether the positioning system is available or not.**

**Proposal 13: For UE-based integrity, RAN2 to discuss whether to introduce error cause dedicated for integrity calculation in the case that there is no integrity result provided to LMF.**

**Proposal 14: For UE-based integrity, RAN2 to discuss whether to add TIR, AL and TTA to the integrity assistance data that the UE can request.**

## 2.3 Signaling procedure of LMF-based integrity

The general procedures of LMF-based integrity were concluded in the SI phase as follows:

- UE sends capability info to LMF for LMF-based positioning integrity mode using LPP capability transfer procedure

- LMF sends the request of results related to integrity for integrity error sources to UE for integrity of LMF-based mode

- LMF sends the request of results related to integrity for integrity error sources to RAN for integrity of LMF-based mode

- RAN sends results related to integrity to LMF using NRPPa message.

NOTE 1: The signaling to transmit integrity KPI and integrity results can be discussed during normative work.

NOTE 2: Whether UE sends results related to integrity to LMF using LPP message or not can be discussed during normative work.

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| **Contribution** | **Proposal** |
| R2-2302504 CATT | Proposal 2: It is left to LMF implementation to decide the measurement error source bound distribution based on the measurement results from UE and/or NG-RAN. |
| R2-2302581 Huawei | Proposal 5: For LMF-based integrity, support the following enhancements:   * LPP signaling to deliver the error of related positioning measurements from UE to LMF, which at least includes: * RSTD measurement error for DL-TDOA * UE Rx-Tx time difference error for Multi-RTT * DL-PRS RSRPP error of the first path or RSRP   Proposal 6: For the request of RAT-dependent integrity measurement, support the request of integrity related positioning measurements per positioning method for LMF-based RAT-dependent integrity. |
| R2-2302741 Intel | Proposal 1: RAN2 agree following categories of error sources for LMF based integrity:   * Error sources for UE related measurements: “RSTD measurement”, “UE Rx-Tx time difference measurement” and “DL-PRS RSRPP of the first path or RSRP”; * Error sources for assistance information: “TRP location”, “Inter-TRP synchronization (can be caused in part by errors in SFN initialization time.)” and “ARP location (e.g., ARPLocationInformation in TS 38.455 [17])” * Error sources for gNB related measurements: “gNB Rx-Tx time difference measurement”, “Angle of arrival measurement”   Proposal 2: For LMF based integrity, Error sources related to the UE measurements should be provided by UE via LPP Provide Location Information message if requested by the LMF via LPP Request Location Information message;  Proposal 3: For LMF based integrity, Error sources related to the gNB should be provided by gNB via NRPPa message if requested by the LMF (details to be discussed in RAN3). |
| R2-2302959 vivo | Proposal 2: Discuss how to handle error sources from UE measurement information for LMF-based integrity. The following two options can be considered:  - Option 1: UE to report integrity information (DNU flag, error distribution parameters and Residual Risk parameters) together with measurement information to LMF directly  - Option 2: LMF to handle all the error sources based on implementation  Proposal 3b: For LMF-based integrity, the spec impact of integrity related information includes:   * to introduce integrity parameters and DNU flag for each error source related to UE measurement information * to introduce integrity bounds for each measurement element   Proposal 5: Any interaction between the LMF and NG-RAN to support integrity information related to TRP measurement information (i.e. which NRPPa message to carry and whether to carry) is in RAN3 scope.  Proposal 6: There is no integrity KPIs (i.e. TIR, AL, TTA and PL and/or its corresponding achievable TIR) transfer in LPP message.  Proposal 7: The signaling enhancement for LMF-based integrity includes Capability and Location information transfer:  - LMF requests UE’s integrity capabilities in a per-method manner via LPP Request Capabilities  - UE provides its capabilities of sending integrity information with measurement information in a per-method manner via LPP Provide Capabilities  - LMF requests integrity information with measurement information in a per-method manner via LPP Request Location Information  - UE provides the requested integrity information with measurement information in a per-method manner via LPP Provide Location Information |
| R2-2303184 OPPO | Proposal 1: RAN2 to agree to embed the UE-side integrity result related IE into the positioning method related Provide Location Information IEs such as *nr-DL-TDOA-ProvideLocationInformation, nr-DL-AoD-ProvideLocationInformation, nr-Multi-RTT-ProvideLocationInformation* in the LPP Provide Location Information msg. |
| R2-2303495 ZTE | Proposal 3: Support RAN2 to down select the following configuration level of UE measurement error distribution:   * + Error distribution parameter is associated with each TRP pair for DL-TDOA / each TRP for multi-RTT and DL-AOD   + Error distribution parameter is associated with each DL-TDOA measurement report / each multi-RTT measurement report / each DL-AoD measurement report   Proposal 5: For error source of RTOA measurement, gNB Rx-Tx time difference measurement and angle of arrival measurement, the error distribution parameters of the each error source should be associated with each MEASUREMENT RESPONSE message or MEASUREMENT REPORT message in 38.455. Details should be determined by RAN3. |
| R2-2303230 Lenovo | Proposal 1: RAN2 is suggested to discuss using 1) MO-LR request/response message 2) LPP message to transfer integrity KPIs/results for MO-LR service under LMF-based integrity mode and determine signalling design if LPP signalling is supported.  Proposal 2: RAN2 confirms it is left to network implementation to transmit integrity KPIs/results for MT-LR service under LMF-based integrity mode.  Proposal 3：RAN2 is suggested to confirm UE sends information/results related to integrity to LMF using LPP message with explicit request or unsolicited manner for LMF-based integrity.  Proposal 8: In the case of LMF-based positioning integrity, support mechanisms to request and report DL-based/UL-based measurement error information and assistance data error information, e.g., error bounds. In the case of UE-based positioning integrity, support mechanisms to request and report assistance data error information, e.g., error bounds. |
| R2-2303433 Xiaomi | Proposal : The signalling procedures for LMF based positioning integrity are as follows:   * UE sends the capability on reporting the results related to integrity for DL positioning method by LPP provide capability message, which includes RSTD, UE Rx-Tx time difference and DL-PRS RSRPP of the first path or RSRP. * The LPP provide location information message should be used for UE reporting results related to integrity to LMF for LMF based positioning integrity, which includes RSTD, UE Rx-Tx time difference and DL-PRS RSRPP of the first path or RSRP; * For results related to integrity originated from RAN, LMF sends the request of results related to integrity for integrity error sources to RAN and RAN sends results related to integrity to LMF and the NRPPa message is used, and the error sources include TRP location, Inter-TRP synchronization, ARP location, RTOA, gNB Rx-Tx time difference and Angle of arrival, which is up to RAN3. |
| R2-2303540 CMCC | Proposal 2: It is suggested that the UE could send the measurement error generated from UE, e.g. RSTD measurement, UE Rx-Tx time difference measurement, to LMF via LPP Provide Location Information message while NG-RAN could send the error in assistant data and measurement generated from NG-RAN node, e.g. TRP location, RTOA measurement, inter-TRP synchronization, gNB Rx-Tx time difference measurement to LMF via NRPPa messages. |
| R2-2303571 Spreadtrum | Proposal 2: For LMF-based positioning integrity mode, measurement error source related information such as mean and standard deviation should be provided to LMF via the LPP Provide Location Information message if required by LMF via LPP Request Location Information message.  Proposal 3: To support RAT-dependent positioning integrity, UE sends positioning integrity capabilities for each RAT-dependent positioning method to LMF, which includes error source receiving, error source reporting and positioning integrity result reporting. |
| R2-2303682 Qualcomm | Observation 7: For LMF-based PL calculation ("LMF based integrity" in the Work Item objective), there are two general options: Option 1: The UE/TRP determines the sample statistics/error bounds and reports them to the LMF, or  Option 2: the LMF determines the sample statistics/error bounds using (existing) periodic UE/TRP measurement reporting.  Proposal 5: For LMF-based PL calculation ("LMF based integrity" in the Work Item objective), the LMF requests periodic UE and TRP measurement reporting and the LMF determines any desired sample statistics/bounds from the measurements. |
| R2-2303705 Ericsson | Observation 1: Complete UE/TRP measurement error statistics cannot be derived only from measurements confined to a short time window.  Observation 2: UE/TRP needs to establish measurement error statistics and bounds from extensive measurements and calibration efforts  Proposal 1: It is up to implementation how the UE/TRP establishes measurement error statistics and bounds, where a UE/TRP can be expected to measure outside the response time window in order to establish sufficient statistics.  Observation 3: The RSTD timing quality for neighbor TRP combines a timing measurement error and a UE Rx TEG offset between RSTD reference TRP timing measurement and neighbor TRP timing measurements  Observation 4: The DL TDOA additional measurement timing quality combines a timing measurement error and a UE Rx TEG offset between RSTD PRS resource and additional PRS resource timing measurements  Proposal 2: DL TDOA timing quality and bounds refers to the combination of timing measurement error and any UE Rx TEG offset  Observation 5: The UE RxTx difference timing quality combines a timing measurement error and any UE Rx/Tx/RxTx TEG offsets  Observation 6: The UE RxTx difference additional measurement timing quality combines a timing measurement error and a UE Rx TEG offsets  Proposal 3: Multi RTT timing quality and bounds refers to the combination of timing measurement error and any UE Rx/Tx/RxTx TEG offsets  Proposal 5: The error bound of the relative timing difference between two DL PRS resources combines the relative time difference error and any TRP Tx TEG offsets  Proposal 10: For LMF-based integrity for RAT-dependent positioning, the R17 UE-assisted integrity mode signaling can be used as baseline with the following aspects and agree to the text proposal as in Annex:  • UE sends capability info to LMF on integrity for UE-Assisted mode using LPP capability transfer procedure  • LMF provides the Assistance Data for Positioning (same as legacy) and request for Integrity error sources  • UE performs positioning measurements and computes the error (same as legacy)  • UE generates error sources for the requested measurements using mean and standard deviation and provides to the LMF using LPP  • LMF computes the Integrity.  Proposal 11: For LMF-based positioning integrity mode, LMF requests UE to send error source statistics of error source in the Request Location Information for each RAT positioning method.  Proposal 12: For LMF-based positioning integrity mode, UE sends the error source statistics in the Signal Measurement Information message for the corresponding positioning method. |
| R2-2303994 InterDigital | Proposal 2: Study whether there’s a need for the UE to provide additional measurements (e.g., statistical information about measurements) to the LMF related to measurement error sources for LMF-based integrity of DL positioning  Proposal 3: Study whether there’s a need for the gNB to provide additional measurements (e.g., statistical information about measurements) to the LMF related to measurement error sources for LMF-based integrity of UL positioning |

**Issue 1**: The signaling to transmit integrity KPI and integrity results

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| NOTE 1: The signaling to transmit integrity KPI and integrity results can be discussed during normative work. |

* To address Note 1 in the SI phase,2 companies [vivo, Lenovo] provide their view on this.
* vivo thinks the KPI and results for LMF-based have no impact on LPP.
* Lenovo suggests discussing using 1) MO-LR request/response message 2) LPP message to transfer integrity KPIs/results for MO-LR service under LMF-based integrity mode and determine signaling design if LPP signaling is supported. Besides, Lenovo would confirm it is left to network implementation to transmit integrity KPIs/results for MT-LR service under LMF-based integrity mode. And UE sends information/results related to integrity to LMF using LPP message with explicit request or unsolicited manner for LMF-based integrity.

From Rapporteur’s understanding, for LMF-based integrity, no matter for MO-LR, MT-LR, or NI-LR positioning, it is the LCS message that conveys the KPI and integrity results, which has no impact on the LPP message.

**Proposal 15: For LMF-based integrity, no integrity KPI and integrity results transfer in LPP message.**

**Issue 2**: integrity information related to measurement

* 2 companies [CATT, QC] think the LMF is responsible to generate integrity information related to the measurement from UE and gNB. Among them, CATT and QC suppose how LMF derives the error distribution is up to implementation, e.g., the LMF can request periodic UE and TRP measurement reporting and the LMF determines any desired sample statistics/bounds from the measurements.
* 11 companies [Huawei, Intel, vivo, OPPO, ZTE, Lenovo, Xiaomi, CMCC, Spreadtrum, E///, IDC] would follow the procedure concluded in the SI phase. That is, error sources related to the UE/gNB measurements should be provided via LPP/NRPPa message. Specifically, E/// suppose it is up to the implementation how the UE/TRP establishes measurement error statistics and bounds, where a UE/TRP can be expected to measure outside the response time window to establish sufficient statistics.
* For the error source of UE measurement, 4 companies [Huawei, Intel, Xiaomi, CMCC] confirm that it includes RSTD measurement error for DL-TDOA, UE Rx-Tx time difference error for Multi-RTT and DL-PRS RSRPP error of the first path or RSRP. 1 company [vivo] thinks it should be per measurement element per method. 1 company [ZTE] would down-select between per measurement element (each TRP pair for DL-TDOA / each TRP for multi-RTT and DL-AOD) or per error source (each DL-TDOA measurement report / each multi-RTT measurement report / each DL-AoD measurement report).
* 1 company [E///] emphasizes that the error bound of the timing measurement error contains TEG-related TX/RX timing error, which is aligned with Note 3 in the above Table 6.1.1-2. **As the proposals seem to have no stage 3 impacts, the rapporteur thinks they can be treated with low priority**.

The rapporteur thinks any interaction between the LMF and NG-RAN to support integrity information with TRP measurement information is in RAN3's scope. Therefore, these proposals will be left to RAN3 to discuss.

**Proposal 16a: RAN2 to discuss how to handle error sources from UE/gNB measurement information for LMF-based integrity. The following two options can be considered:**

* **Option 1: UE/gNB to report integrity parameters together with measurement information to LMF directly. (11/13)**
* **Option 2: It is left to LMF implementation to decide the measurement error source bound distribution based on the measurement results from UE and/or NG-RAN. (2/13)**

**Note: Option 2 is not aligned with the procedure in the SI phase and has an impact on RAN3. If Option 2 is preferred from RAN2’s perspective, LS to RAN3 to confirm.**

**Proposal 16b: If Option 1 of P16a is agreed, RAN2 to discuss how to capture the error bounds of UE measurement for the concerned location method (RSTD measurement error for DL-TDOA, UE Rx-Tx time difference error for Multi-RTT and DL-PRS RSRPP error of the first path or RSRP). The following two options can be considered:**

* **Option 1: the error bounds of UE measurement are provided per measurement element**
* **Option 2: the error bounds of UE measurement are provided per error source**

**Proposal 17: RAN2 to confirm that the timing measurement error contains TEG-related TX/RX timing error if the TEG-related information is provided. Specifically,**

* **DL TDOA timing quality and bounds refer to the combination of timing measurement error and any UE Rx TEG offset**
* **Multi RTT timing quality and bounds refer to the combination of timing measurement error and any UE Rx/Tx/RxTx TEG offsets**
* **The error bound of the relative timing difference between two DL PRS resources combines the relative time difference error and any TRP Tx TEG offsets**

**Issue 3**: UE capability on LMF-based RAT-dependent integrity

* 4 companies [vivo, Xiaomi, spreadtrum, E///] would discuss the UE integrity capability for LMF-based integrity. The related proposals can be merged in Proposal 9 in section 2.2.

**Thus, no further proposal is made for issue 3.**

## 2.4 Text Proposal

### 2.4.1 Stage 2 TP

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| **Contribution** | **Proposal** |
| R2-2302504 CATT | Proposal 6: RAN2 to take the stage 2 TP in annex 1 as baseline. |
| R2-2302959 vivo | Proposal 8: Endorse the Skeleton of Text Proposal in Annex. |
| R2-2303682 Qualcomm | Proposal 6: Endorse the Text Proposal for TS 38.305 in the Annex of this contribution as baseline. |

Three companies provide text proposals on Stage 2 TS, with three different chapters to capture the RAT-dependent integrity:

* CATT would capture it in Chapter 5.3, which describes the NG-RAN NG-RAN Positioning Operations. Other clauses in this chapter are about the interaction between LMF and NG-RAN node.
* vivo would capture it in Chapter 7, which describes the NG-RAN UE positioning procedures. In Rel-17, some new features were captured in this chapter, e.g., on-demand PRS, pre-MG, and PPW.
* QC would capture it in Chapter 8, which describes the Positioning methods and Supporting Procedures. In Rel-17, GNSS integrity was also captured in this chapter.

**Proposal 18: RAN2 to discuss which chapter (5.3, 7, or 8) to capture the stage 2 impact in TS 38.305 for RAT-dependent integrity. Take the TP from R2-2302504 and R2-2303682 as the baseline.**

### 2.4.2 Stage 3 TP

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| **Contribution** | **Proposal** |
| R2-2302581 Huawei | Proposal 8: Consider the text proposal of LPP in the Annex as a baseline for the support of RAT-dependent positioning integrity. |
| R2-2303705 Ericsson | Proposal 9: Agree to the text proposal in Annex A.  Proposal 11: Agree to the LPP text proposal in Annex B.1  Proposal 13: Agree to the LPP text proposal in Annex B.2 |

Having summed up several unresolved issues regarding signaling procedures, Rapporteur suggests waiting until some agreements are achieved in this meeting and then scheduling the Stage 3 discussion.

**Proposal 19: RAN2 to discuss the stage 3 impact after the signaling procedures for RAT-dependent integrity are finalized. Take the TP from R2-2302581 and R2-2303705 as the baseline.**

# Conclusion

Since there are a great many proposals analyzed based on all the submitted tdocs, the rapporteur recommends discussing them with priority as follows:

**To discuss online**

* General aspects

**Proposal 1: Address the remaining issues to support the integrity operation for DL-AOD:**

* **LS to RAN1 to confirm that the beam-related information (Beam Bore-Sight Direction and Beam Antenna Information) are error sources for DL-AoD positioning.**
* **LS to RAN1 to ask about the error distribution of DL-PRS RSRP, RSRPP and beam-related information.**

**Proposal 3: RAN2 to discuss whether to introduce DNU flag in measurement from UE/gNB for LMF-based integrity. If agreed from RAN2's perspective, LS to RAN1/RAN3 to confirm the feasibility and necessity.**

**Proposal 4: RAN2 to discuss whether to introduce Residual Risk and the IRallocation for RAT-dependent integrity.**

**Proposal 5: RAN2 to discuss whether to introduce the Integrity Correlation Times for RAT-dependent integrity.**

**Proposal 6: The PL calculation is performed by the entity which also performs the position calculation for a location process.**

* Signaling procedure of UE-based integrity

**Proposal 10a: For UE-based integrity, support mechanisms to request and report integrity parameters of TRP-related error sources per location method in assistance data.**

**Proposal 10b: The bound parameters of TRP-related error sources are provided per TRP in each error source for the concerned positioning method. To be specific:**

* **TRP location error can be provided for DL-TDOA and DL-AoD in *TRP-LocationInfoElement*.**
* **Inter-TRP synchronization error can be provided for DL-TDOA in *ReferenceTRP-RTD-Info* and *RTD-InfoElement*.**

**Proposal 2: RAN2 to discuss the granularity of DNU flags in TRP-related assistance data (e.g., TRP location and Inter-TRP synchronization). The following two options can be considered:**

* **Option 1: The DNU flags are provided per error source**
* **Option 2: The DNU flags are provided per TRP in each error source**

**Proposal 11: For UE-based integrity, reuse the *TargetIntegrityRisk* in *commonIEsRequestLocationInformation* to request RAT-dependent integrity results.**

**Proposal 12: For UE-based integrity, RAN2 to discuss whether to support Mode 2 of Integrity Result Reporting, i.e., UE compares the calculated PL with the given AL and indicates whether the positioning system is available or not.**

* Signaling procedure of LMF-based integrity

**Proposal 15: For LMF-based integrity, no integrity KPI and integrity results transfer in LPP message.**

**Proposal 16a: RAN2 to discuss how to handle error sources from UE/gNB measurement information for LMF-based integrity. The following two options can be considered:**

* **Option 1: UE/gNB to report integrity parameters together with measurement information to LMF directly. (11/13)**
* **Option 2: It is left to LMF implementation to decide the measurement error source bound distribution based on the measurement results from UE and/or NG-RAN. (2/13)**

**Note: Option 2 is not aligned with the procedure in the SI phase and has an impact on RAN3. If Option 2 is preferred from RAN2’s perspective, LS to RAN3 to confirm.**

**Proposal 16b: If Option 1 of P16a is agreed, RAN2 to discuss how to capture the error bounds of UE measurement for the concerned location method (RSTD measurement error for DL-TDOA, UE Rx-Tx time difference error for Multi-RTT and DL-PRS RSRPP error of the first path or RSRP). The following two options can be considered:**

* **Option 1: the error bounds of UE measurement are provided per measurement element**
* **Option 2: the error bounds of UE measurement are provided per error source**
* Text proposal

**Proposal 18: RAN2 to discuss which chapter (5.3, 7, or 8) to capture the stage 2 impact in TS 38.305 for RAT-dependent integrity. Take the TP from R2-2302504 and R2-2303682 as the baseline.**

**To handle with low priority**

**Proposal 7: RAN2 to discuss the feasibility for UE/gNB to calculate the PL for RAT-independent integrity, including the key factors (e.g. measurement error, GDOP) and any potential spec impacts.**

**Proposal 8: RAN2 to consider the integrity assistance information when performing RAT-dependent positioning method determination to ensure integrity performance.**

**Proposal 9: For UE-based and LMF-based integrity, UE provides the integrity capability to LMF per positioning method.**

**Proposal 13: For UE-based integrity, RAN2 to discuss whether to introduce error cause dedicated for integrity calculation in the case that there is no integrity result provided to LMF.**

**Proposal 14: For UE-based integrity, RAN2 to discuss whether to add TIR, AL and TTA to the integrity assistance data that the UE can request.**

**Proposal 17: RAN2 to confirm that the timing measurement error contains TEG-related TX/RX timing error if the TEG-related information is provided. Specifically,**

* **DL TDOA timing quality and bounds refer to the combination of timing measurement error and any UE Rx TEG offset**
* **Multi RTT timing quality and bounds refer to the combination of timing measurement error and any UE Rx/Tx/RxTx TEG offsets**
* **The error bound of the relative timing difference between two DL PRS resources combines the relative time difference error and any TRP Tx TEG offsets**

**Proposal 19: RAN2 to discuss the stage 3 impact after the signaling procedures for RAT-dependent integrity are finalized. Take the TP from R2-2302581 and R2-2303705 as the baseline.**