**3GPP TSG-RAN WG2 Meeting #116bis-e R2-220xxxx**

**Electronic Meeting, February 21 – March 3, 2022**

**Agenda item:** 8.11.1

**Source:** InterDigital Inc.

**Title:** [AT117-e][603][POS] Integrity stage 2 CRs (InterDigital)

**Document for:**  Discussion

# 1. Introduction

This document summarizes the following email discussion:

* [AT117-e][603][POS] Integrity stage 2 CRs (InterDigital)

      Scope: Review and update the following CRs:

* R2-2202861 (integrity introduction to 36.305)
* R2-2202862 (integrity introduction to 38.305)

      Intended outcome: Endorsable CRs

      Deadline:  Friday 2022-02-25 1000 UTC

**Round 1: To collect comments on the current versions of draft running CRs. Deadline for Round 1:** Wednesday 2022-02-23 0200 UTC;

**Round 2: To review the updated version of the running CRs containing TP from latest agreements in RAN2#117-e. Deadline for Round 2:** Friday 2022-02-15 1000 UTC.

**The updated versions of the running CRs containing the updated TPs are to be discussed during Round 2 of this email discussion. Round 2 discussion will be triggered as soon as relevant agreements are made in the online session for GNSS integrity AI on Wednesday 2022-02-23.**

The draft running CRs are attached with this email discussion.

Please provide the contact information in the following Table:

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| --- | --- | --- |
| **Company** | **Point of contact** | **Email address** |
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# 2. Discussion

The scope of this email discussion is to discuss the Stage 2 description included in the versions of running CRs for TS 38.305 and TS 36.305 submitted to RAN2#117-e meeting in [1] and [2], respectively, as well as the updated versions of draft CRs containing the TPs from the agreements made during RAN2#117-e meeting.

## 2.1 Round 1 Discussion

The current text proposal provided in the running CRs are based on the agreements in previous RAN2 meetings, including RAN2#116bis-e meeting [3]. The changes and editor’s notes included in the draft CRs after post-meeting discussion [4] (post RAN2#116bis-e) are as follows:

**Table 1: Open Issues after RAN2#116bis-e**

|  |  |  |  |
| --- | --- | --- | --- |
| **Issue No** | **Clause/Section** | **Topic** | **Status after post-meeting discussion [4]** |
| **1** | 3.1 (Definitions) | Definition of Positioning integrity | Revised definition as per discussion in [4] |
| **2** | Table 8.1.2.1-1 | Whether to include Integrity Residual Risk parameters and Integrity Orbit Clock Error Bounds | Added the following editor’s note:  Editor's Note: Integrity Residual Risk Parameters and Integrity Orbit Clock Error Bounds may be added to Table 8.1.2.1-1 based on the outcome of RAN2 discussion on whether the parameters will be new assistance data or integrated into existing SSR assistance data. |
| **3** | 8.1.1a (Integrity Principle of Operation) | Whether to update text and equations if the combined orbit/clock covariance approach is adopted, to show how the bound can be computed using the covariance matrix. | Added the following editor’s note:  Editor's Note: The description and equation 8.1.1a-1 may be updated based on the outcome of RAN2 discussion on whether cross-covariance should be included for the Orbit and Clock integrity bounds and whether these bounds should be included as a new IE or within the existing SSR Orbit and Clock IEs |
| **4** | 8.1.2.1.25 (SSR STEC Corrections) and 8.1.2.1.26 (SSR Gridded Correction) | To include description related to Integrity Residual Risk and Integrity Correlation times | Revised descriptions as per discussion in [4] |
| **5** | Table 8.1.2.1b-1 | Whether to include Orbit/Clock Alerts and Bounds | Added the following editor’s note:  Editor's Note: Integrity Orbit Clock Error Bounds may be added based on the outcome of RAN2 discussion on whether the parameters will be new assistance data or integrated into existing SSR assistance data. |

During pre-meeting (pre-RAN2#117-e) [Pre117-e][610][POS] Open issues on GNSS positioning integrity (ESA) [5] discussion on open issues on GNSS Integrity, several proposals which may result in potential changes to Stage 2 description were formulated. The proposals are provided in Annex A on this email discussion. Additionally, further open issues on GNSS Integrity with potential changes to Stage 2 description are being discussed in [AT117-e][623][POS] Early discussion of integrity issues (ESA) [7].

Some of the proposals in [5] may address the editor’s notes indicated in Table 1 and other proposals in [5] may result in further changes to the descriptions in the running CRs. A summary of overall potential changes to the running CRs which may be handled during RAN2#117-e are provided in Annex B.

Based on the progress of discussion during RAN2#117-e, the running CRs are expected to be updated as indicated in Annex B. **The updated running CRs containing the updated TPs are to be discussed during Round 2 of this email discussion. Round 2 discussion will be triggered as soon as relevant agreements are made in the online session for GNSS integrity AI on Wednesday 2022-02-23.**

In Round 1, companies are invited to provide comments/changes on the current version of the running CRs [1] and [2] by responding to the following question:

**Q1: Please provide your comments on the CRs [1] and [2], as well as your suggested changes and corresponding clause/section where the comments/changes may apply.**

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **Comments** | **Suggested Changes** | **Clause/Section** |
| CATT | 1. Remove the Editor’s note below Table 8.1.2.1-1. 2. Remove the Editor’s note below Table 8.1.2.1b-1 |  | 8.1.2.1, 8.1.2.1b |
| 1. Update description of GNSS-RealTimeIntegrity IE in clause 8.1.2.1.8 |  | 8.1.2.1.8 |
| 1. Add the integrity description into SSR Orbit corrections and SSR Clock corrections. | 8.1.2.1.21 SSR Orbit Corrections SSR Orbit Corrections provides the GNSS receiver with parameters for orbit corrections in radial, along-track and cross-track components. These orbit corrections are used to compute a satellite position correction, to be combined with satellite position ­calculated from broadcast ephemeris (see clause 8.1.2.1.7). For integrity purposes, SSR Orbit Corrections also provides the orbit and orbit rate residual errors after application of the SSR corrections. The correlation times for the orbit range error and orbit range rate error are also provided. 8.1.2.1.22 SSR Clock Corrections SSR Clock Corrections provides the GNSS receiver with parameters to compute the GNSS satellite clock correction applied to the broadcast satellite clock (see clause 8.1.2.1.7). A polynomial of order 2 describes the clock differences for a certain time period: clock offset, drift, and drift rate. For integrity purposes, SSR Clock Corrections also provides the clock and clock rate residual errors after application of the SSR corrections. The correlation times for the clock range error and clock range rate error are also provided. | 8.1.2.1.21, 8.1.2.1.22 |
| 1. Move the description of Integrity Residual Risk Parameters into clause SSR STEC Corrections and SSR Gridded Correction. 2. Delete clauses 8.1.2.1.31 and 8.1.2.1.32 | 8.1.2.1.25 SSR STEC Corrections SSR STEC Corrections provides the GNSS receiver with the parameters to compute the ionosphere slant delay correction based on a variable order polynomial on a per satellite basis and applied to the code and phase measurements.  For integrity purposes, SSR STEC Corrections also provides the ionosphere residual risk parameters, correlation time for ionosposphere range error and range error rate, and the mean and standard deviation that bounds the residual Ionospheric Error and its associated error rate.  Integrity Residual Risk Parameters are used to provide the residual risk parameters related to the satellite, constellation, ionosphere and troposphere residual risk probabilities. These parameters include a Probability of Onset which is defined per unit of time and represents the probability that the feared event begins. The Mean Duration 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 8.1.2.1.25-1)** | 8.1.2.1.25, 8.1.2.1.26, 8.1.2.1.31, 8.1.2.1.32 |
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## 2.2 Round 1 Moderator’s Summary

The moderator thanks CATT for providing comments and suggested changes. All changes indicated by CATT to the draft CRs are relevant to the discussions that will take place during online session of RAN2#117-e. The moderator will revisit the changes indicated by CATT after progress is made during the online session on GNSS Integrity. The following are the responses to each comment:

1. Remove the Editor’s note below Table 8.1.2.1-1
   * Moderator: Agree to remove editor's note based on the outcome of RAN2 discussion on Proposals 6 and 7 in [5]
2. Remove the Editor’s note below Table 8.1.2.1b-1
   * Moderator: Agree to remove editor's note based on the outcome of RAN2 discussion on Proposals 1, 2, 3, 5, and 6 in [5]
3. Update description of GNSS-RealTimeIntegrity IE in clause 8.1.2.1.8
   * Moderator: Agree to update the description under clause 8.1.2.18 based on the outcome of RAN2 discussion on Proposals 1, 2, and 3 in [5]
4. Add the integrity description into SSR Orbit corrections and SSR Clock corrections.
   * Moderator: Agree to add integrity descriptions to 8.1.2.1.21 (SSR Orbit Corrections) and 8.1.2.1.22 (SSR Clock Corrections) based on the outcome of RAN2 discussion on Proposal 6 in [5]
5. Move the description of Integrity Residual Risk Parameters into clause SSR STEC Corrections and SSR Gridded Correction.
   * Moderator: Agree to move the description on Integrity Residual Risk Parameters from 8.1.2.1.31 to 8.1.2.1.21 (SSR Orbit Corrections) or 8.1.2.1.8 (Real-Time Integrity) based on the outcome of RAN2 discussion on Proposal 7 in [5]
6. Delete clauses 8.1.2.1.31 and 8.1.2.1.32
   * Moderator: Agree to delete clauses 8.1.2.1.31 and 8.1.2.1.32 based on the outcome of RAN2 discussion on Proposals 6 and 7 in [5]

The changes indicated above will be reflected in the updated draft CRs in round 2 discussion. The moderator will close the first-round discussion for now.

## 2.3 Round 2 Discussion

## 2.4 Round 2 Moderator’s Summary

# 3 Summary

The following is the summary containing the companies and rapporteur’s views derived from the discussion above:

# 4 Annex

## Annex A: Proposals in R2-2203525 with potential changes to Stage 2 description

The following lists the open issues and corresponding proposals which were discussed and formulated in R2-2203525 [5]. Depending on the progress of discussion during RAN2#117-e, any agreements made related to these proposals below may result in changes to description in the draft CRs.

**Open Issue 1: Update GNSS-RealTimeIntegrity or a new IE for DNU flag**

**Proposal 1. For the purpose of GNSS integrity feature added in Release17, use GNSS-RealTimeIntegrity IE to signal to UE bad satellites (and GNSS constellations).**

**Proposal 2. Update description of GNSS-RealTimeIntegrity IE and Stage 2 to clearly state what condition can be interpreted as DNU = FALSE.**

**Note: Annex A contain a modified version of the GNSS-RealTimeIntegrity IE which highlights the list of satellites monitored for integrity. This can be used as input for Stage 3 CR and subject to offline review.**

**Proposal 3. For the purpose of GNSS integrity feature added in Release17, an additional DNU flag per constellation is not needed.**

**Open Issue 2: Cross-covariance and inclusion of integrity bounds for Clock and Orbit in a new or existing IEs.**

**Proposal 4. For Release 17, the bounding of GNSS errors is based on paired overbounding principle characterized by mean and standard deviation. In future releases provision of full covariance matrix for the orbital covariance can be revisited.**

**Proposal 5. For Release 17, besides the 3 required variance parameters for Orbit, the covariance parameters, in along-track/cross-track/radial frame, can be provided optionally.**

**Proposal 6. Agree to include integrity bounds for Clock in the GNSS-SSR-ClockCorrections IE and bounds for Orbit in the existing** ***GNSS-SSR-OrbitCorrections* IEs rather than combining them in a new joint IE.**

**Open Issue 3: Residual Risk parameters**

**Proposal 7. If possible, reuse existing IEs the following Integrity Residual Risk parameters: Probability of Onset of Constellation Fault, Mean Constellation Fault Duration, Probability of Onset of Satellite Fault, and Mean Satellite Fault Duration.**

**Note: candidate IEs in order of preference: GNSS-SSR-OrbitCorrections, GNSS-RealTimeIntegrity IE. This can be dealt offline as part of update to stage 3 CR – input from Rapporteur.**

**Proposal 8. Probability of Onset of Ionosphere Fault and Mean Ionosphere Fault Duration parameters are included in the GNSS-SSR-STEC-Correction. Probability of Onset of Troposphere Fault and Mean Troposphere Fault Duration parameters are included in the GNSS-SSR-GriddedCorrection.**

**Open Issue 4: Validity period for each error bound and value ranges**

**Proposal 9. Agree not to include additional validity time parameters together with the bounds parameters.**

## Annex B: Overall potential changes to running CRs during RAN2#117-e

The following shows a summary of potential changes to the running CRs which may be handled during RAN2#117-e.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Issue**  **No** | **Section in TS 38.305/36.305** | **Editor's note or open issue (Pre-RAN2#117-e)** | **Status before RAN2#117-e (pre-meeting open issues discussion)** | **Potential changes during/post RAN2#117-e meeting** |
| 1 | 3.1 (Definition of "Positioning integrity") | Revision of definition | In pre-meeting version of running CRs (R2-2202861 and R2-2202862) captures the following revised definition: "Positioning integrity: A measure of the trust in the accuracy of the position-related data and the ability to provide associated alerts" |  |
| 2 | Table 8.1.2.1-1 (Integrity Residual Risk parameters and Integrity Orbit Clock Error Bounds) | Editor's Note: Integrity Residual Risk Parameters and Integrity Orbit Clock Error Bounds may be added to Table 8.1.2.1-1 based on the outcome of RAN2 discussion on whether the parameters will be new assistance data or integrated into existing SSR assistance data. | The following proposals discussed in R2-2203525 may be applicable for handling any change: Proposal 5, Proposal 6, and Proposal 7 [5] | Editor's note to be removed based on the outcome of discussion in RAN2#117e of the indicated proposals 5, 6, 7 in R2-2203525 |
| 3 | 8.1.1a (Integrity Principle of Operation) | Editor's Note: The description and equation 8.1.1a-1 may be updated based on the outcome of RAN2 discussion on whether cross-covariance should be included for the Orbit and Clock integrity bounds and whether these bounds should be included as a new IE or within the existing SSR Orbit and Clock IEs | The following proposals discussed in R2-2203525 may be applicable for handling any change: Proposal 5 and Proposal 6 [5] | Editor's note to be removed based on the outcome of discussion in RAN2#117e of the indicated proposals 5, 6 in R2-2203525 |
| 4 | 8.1.2.1.25 (SSR STEC Corrections) and 8.1.2.1.26 (SSR Gridded Correction) | To include description related to Integrity Residual Risk and Integrity Correlation times | In pre-meeting version of running CRs (R2-2202861 and R2-2202862) already captures the description related to Integrity residual risk and integrity correlation times |  |
| 5 | Table 8.1.2.1b-1 (Orbit/Clock Alerts and Bounds) | Editor's Note: Integrity Orbit Clock Error Bounds may be added based on the outcome of RAN2 discussion on whether the parameters will be new assistance data or integrated into existing SSR assistance data. | The following proposals discussed in R2-2203525 may be applicable for handling any change: Proposal 1, Proposal 2, Proposal 3, Proposal 5 and Proposal 6 [5] | Editor's note to be removed (after adding the parameters related to Integrity Alerts and Integrity Bounds to Table 8.1.2.1b-1) based on the outcome of discussion in RAN2#117e of the indicated proposals 1, 2, 3, 5, 6 in R2-2203525 |
| Other potential changes to description in draft CRs based on progress of discussion during RAN2#117-e on the proposals in R2-2203525 [5] | | | | |
| 6 | 8.1.1a (Integrity Principle of Operation) | Whether to change the description on Alerts to clarify the IEs associated with the Alerts | Existing text in draft CR is, "DNU flags are affirmative and non-presence of the Alert IEs should not be interpreted as a usable condition."  The following proposals discussed in R2-2203525 may be applicable for handling any change: Proposal 1, Proposal 2, Proposal 3 [5] | The corresponding change (from "Alert IEs" to "Integrity Service Alert IE and Real Time Integrity IEs" in Section 8.1.1a may be made based on outcome of discussion in RAN2#117-e of the indicated proposals 1 ,2, 3 in R2-2203525 |
| 7 | Whether to include description on implicit integrity monitoring whenever any bound is issued for a parameter relating to a certain satellite and signal. | The following proposals discussed in R2-2203525 may be applicable for handling any change: Proposal 1, Proposal 2, Proposal 3 [5] | The corresponding change in Section 8.1.1a may be made based on outcome of discussion in RAN2#117-e of the indicated proposals 1 ,2, 3 in R2-2203525 |
| 8 | Whether to include description on validity period | The following proposal discussed in R2-2203525 may be applicable for handling any change: Proposal 9 [5] | The corresponding change in Section 8.1.1a may be made based on outcome of discussion in RAN2#117-e of the indicated proposal 9 in R2-2203525 |
| 9 | 8.1.2.1.8 (Real-Time Integrity) | Whether to include description on signaling on bad satellites to UE (and GNSS constellations) and to clarify what condition can be interpreted as DNU = FALSE. | The following proposals discussed in R2-2203525 may be applicable for handling any change: Proposal 1, Proposal 2, Proposal 3 [5] | The corresponding change in Section 8.1.2.1.8 may be made based on outcome of discussion in RAN2#117-e of the indicated proposals 1, 2, 3 in R2-2203525 |
| 10 | 8.1.2.1.21 (SSR Orbit Corrections) | Whether to include description related to mean and covariance that bounds the residual Orbit Error | The following proposals discussed in R2-2203525 may be applicable for handling any change: Proposal 5 and Proposal 6 [5] | The corresponding change in Section 8.1.2.1.21 may be made based on outcome of discussion in RAN2#117-e of the indicated proposals 5, 6 in R2-2203525 |

# 4 Reference

1. R2-2202861, Running CR of 36.305 GNSS Positioning Integrity (InterDigital, Inc), Feb 2022
2. R2-2202862, Running CR of 38.305 GNSS Positioning Integrity (InterDigital, Inc), Feb 2022
3. RAN2 chairman notes RAN2#116bis-e, January 2022
4. R2-2201798, Email discussion report on [Post116bis-e][627][POS] 36.305/38.305 integrity running CRs (InterDigital), Jan 2022
5. R2-2203525, [Pre117-e][610][POS] Open issues on GNSS positioning integrity (ESA), Feb 2022
6. R2-22xxxxx, GNSS Integrity – Remaining TPs (Stages 2 and 3), Feb 2022
7. R2-22xxxxx, [AT117-e][623][POS] Early discussion of integrity issues (ESA), Feb 2022