**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:

|  |  |  |
| --- | --- | --- |
| **Company** | **Point of contact** | **Email address** |
| CATT | Jianxiang Li | lijianxiang@catt.cn |
| u-blox | David Bartlett | david.bartlett@u-blox.com |
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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.**

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| **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

The following show the changes made to the running CRs based on the discussion in Round 1 and latest agreements made during RAN2#117bis-e meeting (provided in Annex C)

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| **Issue**  **No** | **Section in TS 38.305/36.305** | **Editor's note or open issue (Pre-RAN2#117-e)** | **Status before and during RAN2#117-e** | **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" | No changes. Definition in current version of running CRs is retained |
| 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. | Following agreements were made during RAN2#117e:  **Proposal 6 and Proposal 7** | No parameters are added due to RAN2 agreement  Editor's note is removed |
| 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 | Following agreements were made during RAN2#117e:  **Proposal 1.** Covariance parameters for Orbital errors are not included in Rel17. These terms, together with the full cross-covariance matrix, can be revisted in future releases and possibly coordinated with RTCM.  **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. | No changes are made to description due to RAN2 agreement  Editor's note is removed |
| 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 | No changes. Descriptions from current version of running CRs are retained |
| 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. | Following agreements were made during RAN2#117e: **Proposal 1, Proposal 2, Proposal 3, Proposal 6 and Proposal 7** | Added information parameters on Integrity Alerts (Real-time Integrity) and Integrity Bounds (Orbit and Clock) to Table 8.1.2.1b-1    Editor's note is removed |
| Whether to remove SSR Gridded Corrections in the row corresponding to Ionosphere. Rapporteur thinks there may have been a typo in previous version of running CR | Following agreement was made during RAN2#117e:  **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. | Removed SSR Gridded Corrections in Table 8.1.2.1b-1 corresponding to Ionosphere |
| 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."  Following agreements were made during RAN2#117e:  **Proposal 1, Proposal 2, and Proposal 3** | The change from "Alert IEs" to "Integrity Service Alert IE and Real Time Integrity IEs" in Section 8.1.1a is made |
| 7 | Whether to include description on implicit integrity monitoring whenever any bound is issued for a parameter relating to a certain satellite and signal. | Following agreements were made during RAN2#117e: **Proposal 1, Proposal 2, and Proposal 3** | Not changed since corresponding description is captured under Section 8.1.2.1.8 |
| 8 | Whether to include description on validity period | Following agreement was made during RAN2#117e:  **Proposal 2.** The validity time of the integrity bounds is set as equal to the validity time of the SSR data. No additional validity time parameter is defined in Rel17. | Added description on validity time in Section 8.1.1a based on RAN2 agreement |
| 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. | Following agreements were made during RAN2#117e: **Proposal 1, Proposal 2, and Proposal 3** | Section 8.1.2.1.8 is updated to include description on signaling on bad satellites to UE (and GNSS constellations) and clarification on what condition can be interpreted as DNU = FALSE. |
| 10 | 8.1.2.1.21 (SSR Orbit Corrections) | Whether to include description related to mean and covariance that bounds the residual Orbit Error | Following agreement was made during RAN2#117e:  **Proposal 1.** Covariance parameters for Orbital errors are not included in Rel17. These terms, together with the full cross-covariance matrix, can be revisted in future releases and possibly coordinated with RTCM. | No change was made due to RAN2 agreement on covariance parameters for orbital errors |
| 11 | 8.1.2.1.31 (Integrity Residual Risk Parameters), 8.1.2.1.21 (SSR Orbit Corrections) | Whether to move description from 8.1.2.1.31 to 8.1.2.1.21 and delete clause 8.1.2.1.31 | Following agreement was made during RAN2#117e:  **Proposal 7.** If possible, reuse existing IEs the following Integrity Residual Risk parameters: Probability of Onset of Constellation Fault, Mean Constellation Fault Duration, Proability of Onset of Satellite Fault, and Mean Satellite Fault Duration. | Description on Integrity Residual Risk Parameters is moved from 8.1.2.1.31 to 8.1.2.1.21 (SSR Orbit Corrections).  Section 8.1.2.1.31 is removed |
| 12 | 8.1.2.1.32 (Integrity Orbit Clock Error Bounds), 8.1.2.1.21 (SSR Orbit Corrections) and 8.1.2.1.22 (SSR Clock Corrections) | Whether to move description from 8.1.2.1.32 to 8.1.2.1.21 and 8.1.2.1.22, and delete clause 8.1.2.1.32 | Following agreement was made during RAN2#117e:  **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. | Descriptions on Integrity Orbit Clock error bounds is moved from 8.1.2.1.32 to 8.1.2.1.21 and 8.1.2.1.22.  Section 8.1.2.1.32 is removed |

Companies are invited to provide comments/changes on the updated version of the running CRs, which include the changes indicated above, by responding to the following question:

**Q1: Please provide your comments on the updated versions of running CRs, as well as your suggested changes and corresponding clause/section where the comments/changes may apply (Please provide comments/suggested changes related to TP on issue 8 (validity time) as indicated above)**

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| --- | --- | --- | --- |
| **Company** | **Comments** | **Suggested Changes** | **Clause/Section** |
| Swift Navigation | The validity time description needs updating to align with Stage 3. | The validity time of the integrity bounds is set as equal to the validity time of the corresponding SSR Assistance Data, as defined by the SSR Update Interval for the given SSR Assistance Data message, i.e. the time period between the SSR Epoch Time and the SSR Epoch Time plus the SSR Update Interval in the GPS time scale. | 8.1.1a |
| u-blox | Shouldn’t the validity time be longer than the Update Interval to allow for transmission latency? | i.e. the time period between the SSR Epoch Time and the SSR Epoch Time plus twice the SSR Update Interval in the GPS time scale. | 8.1.1a |
| Swift Navigation | Agree with u-blox that 2x Update Interval would be preferable, but we should also make the first part consistent. Also we suggest dropping the concept of SSR Validity Time as its not defined elsewhere and not necessary to introduce | The validity time of the integrity bounds is set as equal to twice the SSR Update Interval for the given SSR Assistance Data message, i.e. the time period between the SSR Epoch Time and the SSR Epoch Time plus twice the SSR Update Interval in the GPS time scale. |  |
| Swift Navigation | The equation and accompanying text from Section 8.1.2.1.21 needs to be updated and shifted under the **Residual Risk** in Section 8.1.1a (because the equation also applies to the residual risk parameters in other messages, i.e. SSR Orbit, SSR STEC and SSR Gridded IEs). | The following text highlighted in track changes should be shifted from 8.1.2.1.21 and placed added under Section 8.1.1a instead. The equation number has also been updated:  In Section 8.1.1a:  **Residual Risk:** The residual risk is the component of the integrity risk provided in the assistance data as per Table 8.1.2.1b-1. This may correspond to the fault case risk but the implementation is permitted to allocate this component in any way that satisfies Equation 8.1.1a-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 8.1.1a-3)** | 8.1.1a  8.1.2.1.21 |
| Swift Navigation | The SSR Orbit Corrections integrity description needs updating to be consistent with the other SSR messages, and the corresponding equations for the *stdDevorbit* and *meanorbit* have been added and updated (i.e. to only send the diagonal variance vector). | For integrity purposes, SSR Orbit Corrections also provides the correlation time for orbit error and orbit error rate, and the mean and standard deviation that bounds the residual Orbit Error and its associated error rate. The SSR Orbit Corrections also includes the satellite and constellation residual risks. These residual risks are the aggregate residual risk for the satellite or constellation Signal in Space including Orbit, Clock, Bias and all other satellite or constellation feared events, but excluding atmospheric effects.  When applying the integrity bounds as per 8.1.1a, the mean and stdDev must be calculated by projecting the Orbit error mean and variance along the line-of-sight vector between the satellite and the user, according to the following formula:  *stdDevorbit =* **(Equation 8.1.2.1.21-1)**  *meanorbit =*  where: *I*: 3-D line of sight vector from the user to the satellite in the WGS-84 ECEF coordinate frame.  R: the rotation matrix from satellite along-track, cross-track and radial coordinates into the WGS-84 ECEF coordinate frame.  *σ*: the 3-D Orbit error variance vector expressed in satellite along-track, cross-track and radial coordinates.  *μ*: the Mean Orbit Error vector expressed in satellite along-track, cross-track and radial coordinates.  The vector *σ* is expressed in the SSR Orbit Corrections as the three elements in the Variance Orbit Residual Error Vector. | 8.1.2.1.21 |
| u-blox | σ is usually the symbol for standard deviation, variance is usually written as σ2 although this is also not typical nomenclature for matrix notation. | The equation for stdDev should reflect this:  *stdDevorbit =* **(Equation 8.1.2.1.21-1)**  *σ2*: the 3-D Orbit error variance vector expressed in satellite along-track, cross-track and radial coordinates.  The vector *σ2* is expressed in the SSR Orbit Corrections as the three elements in the Variance Orbit Residual Error Vector. | 8.1.2.1.21 |
| Swift Navigation | u-blox raises a good point that σ would usually denote the standard deviation and we would prefer to avoid σ2 for a vector – simply suggest using v instead. | The equation for stdDev should reflect this:  *stdDevorbit =* **(Equation 8.1.2.1.21-1)**  *v*: the 3-D Orbit error variance vector expressed in satellite along-track, cross-track and radial coordinates.  The vector v is expressed in the SSR Orbit Corrections as the three elements in the Variance Orbit Residual Error Vector. | 8.1.2.1.21 |
| Swift Navigation | The SSR Orbit Corrections integrity description needs updating to be consistent with the other SSR messages. | For integrity purposes, SSR Clock Corrections also provides the correlation time for clock error and clock error rate, and the mean and standard deviation that bounds the residual Clock Error and its associated error rate. | 8.1.2.1.22 |
| Swift Navigation | The Integrity Alerts description was made more explicit. | Integrity Service Alerts provide information on whether the service can be used for integrity. A Do Not Use (DNU) flag indicates that the corresponding assistance data is not suitable for the purpose of computing integrity. If an Integrity Service Alert is issued and the DNU flag is false, then the corresponding assistance data may be used for the purpose of computing integrity. The DNU flags are defined to be applicable to the specified epoch time only. | 8.1.2.1.30 |
| Swift Navigation | The equation numbering in Table 8.1.2.1b-1 needs updating for the Orbit Mean and StdDev Bounds. | Calculated according to Equation 8.1.1a-3 | Table 8.1.2.1b-1 |
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# 3 Summary

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

The moderator thanks companies for providing comments and suggested changes. The following are the sections in TS 38.305 and TS 36.305 where changes are made based on companies’ inputs in Round 1 and Round 2:

1. 8.1.1a (Integrity Principle of Operation)

* Add validity time description (Swift, u-blox)
* Add Residual Risk description (Swift)

1. 8.1.2.1.8 (Real-Time Integrity)

* Add integrity signalling description (Swift, CATT)

1. 8.1.2.1.21 (SSR Orbit Corrections)

* Modify SSR Orbit Corrections integrity description (Swift, u-blox, CATT)
* There seems to be a typo in the TP corresponding to the variance in Equation 8.1.2.1.21-1. We made a small correction (Rapporteur)

1. 8.1.2.1.22 (SSR Clock Corrections)

* Modify SSR Clock Corrections integrity description (Swift, CATT)

1. 8.1.2.1.30 (Integrity Service Alerts)

* Modify Integrity Alerts description (Swift)

1. 8.1.2.1.31 (Integrity Residual Risk Parameters)

* Remove section after moving description (CATT)

1. 8.1.2.1.32 (Integrity Orbit Clock Error Bounds)

* Remove Section after moving description (CATT)

1. Table 8.1.2.1b-1

* Modify equation numbering (Swift)

The rapporteur included all changes indicated above in the latest versions of the running CRs for TS 38.305 and TS 36.305.

# 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 |

## Annex C: Agreements made during RAN2#117-e on GNSS Integrity

Agreements:

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 clarly 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:

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 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:

Proposal 7. If possible, reuse existing IEs the following Integrity Residual Risk parameters: Probability of Onset of Constellation Fault, Mean Constellation Fault Duration, Proability 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 dealth 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 #5:

Proposal 10. Agree to enable periodic transmission of assistance data for GNSS integrity.

Proposal 11. Add gnss-Integrity-PeriodicServiceAlert-r17 to the list of periodic GNSS assistance data. FFS if other IEs need to be added (input from Stage 3 rapporteur).

Open Issue #6:

Proposal 13: Adopt the mapping of GNSS Integrity IEs to posSIB as propoed in the table from below:

GNSS Common Assistance Data (clause 6.5.2.2)

posSibType assistanceDataElement

posSibType1-9 GNSS-Integrity-ServiceParameters

posSibType1-10 GNSS-Integrity-ServiceAlert

Open Issue #7, #8 (R2-D1):

Proposal 14. Add TIR and AL to the IntegrityInformationRequest-r17 IE. TTA is FFS. Their value ranges shall be based on table 9.2.4 in TR 38.857.

Open Issue #9 (R2-D2):

Proposal 17. Add HPL and VPL to the IntegrityInfo IE. The value range of these two parameters covers 0 – 500m interval. Resolution is 1cm.

Note: HPL representation e.g., 2D ellipse or Alon-Cross track pair is based on input from Stage 3 rapporteur.

Open Issue #10 (R2-D4):

Proposal 21. Adopt the proposed encoding for GNSS-Integrity-ServiceParameter in Stage 3.

Proposal 22. Adopt the following description for the GNSS-Integrity-ServiceAlert in Stage 3. Service DNU is FFS.

GNSS-Integrity-ServiceAlert field descriptions

ionosphereDoNotUse

This field indicates whether the ionospheric corrections in IEs GNSS-SSR-STEC-Correction IE can be used for integrity related applications (FALSE) or not (TRUE).

troposphereDoNotUse

This field indicates whether the tropospheric corrections in IEs GNSS-SSR-GriddedCorrection IE can be used for integrity related applications (FALSE) or not (TRUE).

Open Issue #11 (R2-D5):

Proposal 23. Adopt the proposed encoding of the SSR-IntegrityCodeBiasBounds.

Open Issue #12 (R2-D6):

Proposal 24. Adopt the proposed encoding of the SSR-IntegrityPhaseBiasBounds.

Open Issue #13 (R2-D7):

Proposal 25. Adopt the proposed encoding for the STEC-IntegrityParameters-r17 and STEC-IntegrityErrorBounds-r17.

Open Issue #14 (R2-D8):

Proposal 26. Adopt the proposed encoding for the SSR-GriddedCorrectionIntegrityParameters-r17 and TropoDelayIntegrityErrorBounds-r17.

Agreement:

Proposal 1. Covariance parameters for Orbital errors are not included in Rel17. These terms, together with the full cross-covariance matrix, can be revisted in future releases and possibly coordinated with RTCM.

Agreement:

Proposal 2. The validity time of the integrity bounds is set as equal to the validity time of the SSR data. No additional validity time parameter is defined in Rel17.

Agreements:

Proposal 3. Release 17 supports only Reporting Mode 1 (PL reporting). Reporting Mode 2 can be revisited in future releases.

Proposal 4. For reporting Mode 1, TTA is not needed.

Proposal 5 (modified). Provide achievable TIR as optional parameter in the Integrity Information Result

# 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