**3GPP TSG- RAN2 Meeting #121 *Draft* R2-23xxxxx**

**Athens, GR, 27th Feb – 3rd Mar, 2023**

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| --- |
| *CR-Form-v12.2* |
| **CHANGE REQUEST** |
|  |
|  | **37.355** | **CR** | **0412** | **rev** | **1** | **Current version:** | **17.3.0** |  |
|  |
| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* |
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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***Proposed change affects:*** | UICC apps |  | ME | **X** | Radio Access Network |  | Core Network | **X** |

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| --- |
|  |
| ***Title:***  | Clarifying Galileo NAV message in the GNSS Navigation model to clarify SSR clock correction signal reference and clarification of GNSS Troposperic Delay Correction |
|  |  |
| ***Source to WG:*** | Ericsson |
| ***Source to TSG:*** | R2 |
|  |  |
| ***Work item code:*** | NR\_pos-Core |  | ***Date:*** | 2023-02-28 |
|  |  |  |  |  |
| ***Category:*** | A |  | ***Release:*** | Rel-17 |
|  | *Use one of the following categories:****F*** *(correction)****A*** *(mirror corresponding to a change in an earlier release)****B*** *(addition of feature),* ***C*** *(functional modification of feature)****D*** *(editorial modification)*Detailed explanations of the above categories canbe found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | *Use one of the following releases:Rel-8 (Release 8)Rel-9 (Release 9)Rel-10 (Release 10)Rel-11 (Release 11)…Rel-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)Rel-19 (Release 19)* |
|  |  |
| ***Reason for change:*** | The SSR orbit corrections are relative to broadcasted Ephemeris described by the IE *GNSS-NavigationModel.* To ensure that there is no ambiguity with the clock correction reference, since Galileo has both F/NAV and I/NAV messages, the IE *GNSS-NavigationModel iod* field needs to be clarified to refer to Galileo I/NAV. Furthermore, the Galileo clock model needs to define a default clock model ID if no clock model ID is provided or only one clock model is provided.For tropospheric corrections, there is a missing field description, and the specification should also specify that in case the tropo is provided only for one GNSS it is applicable for all GNSS. |
|  |  |
| ***Summary of change:*** | The IE *GNSS-NavigationModel* GNSS to iod Bit String(11) relation has been clarified for Galileo to refer to Galileo I/NAV. Also, the Galileo clock model is I/NAV unless both I/NAV and F/NAV clock models are included and corresponding clock model IDs are providedThe tropospheric changes are: * Clarifying text describing the applicability of the tropospheric delay corrections applicability to all in case it is provided for only one GNSS

**Impact Analysis, orbit corrections**Impacted 5G architecture options: NR SA, (NG)EN-DC, NE-DC,NR-DC Impacted functionality:GNSS SSR Clock Corrections via GNSS Navigation model changeInter-operability:If NW implements the CR and UE does not* UE may not be able to apply SSR clock corrections for GNSS Type Galileo, which may result in positioning error

If UE implements the CR and NW does not* UE may apply the clock corrections with reference to I/NAV, while the network may provide clock corrections with reference to F/NAV signal (not very likely).

**Impact Analysis, tropospheric correction**Impacted 5G architecture options: NR SA, (NG)EN-DC, NE-DC,NR-DC Impacted functionality:GNSS SSR Gridded CorrectionsInter-operability:If NW implements the CR and UE does not* UE interprets the AD as without the CR, i.e. AD applicable only to the associated constellation, which may result in positioning error

If UE implements the CR and NW does notUE interprets the AD correctly if tropospheric delay corrections is provided only for one constellation |
|  |  |
| ***Consequences if not approved:*** | Incomplete specification and missing behaviour. The standard may not fully support high accuracy GNSS Galileo. The standard is not fully supporting tropospheric delay corrections. |
|  |  |
| ***Clauses affected:*** | 6.5.2.2 |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **X** |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** |  | **X** |  Test specifications | TS/TR ... CR ...  |
| ***(show related CRs)*** |  | **X** |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

*Beginning of Changes*

#### 6.5.2.2 GNSS Assistance Data Elements

#### ***<Skip Unmodified Changes>***

#### – *GNSS-NavigationModel*

The IE *GNSS-NavigationModel* is used by the location server to provide precise navigation data to the GNSS capable target device. In response to a request from a target device for GNSS Assistance Data, the location server shall determine whether to send the navigation model for a particular satellite to a target device based upon factors like the T-Toe limit specified by the target device and any request from the target device for DGNSS (see also *GNSS-DifferentialCorrections*). GNSS Orbit Model can be given in Keplerian parameters or as state vector in Earth-Centered Earth-Fixed coordinates, dependent on the *GNSS-ID* and the target device capabilities. The meaning of these parameters is defined in relevant ICDs of the particular GNSS and GNSS specific interpretations apply. For example, GPS and QZSS use the same model parameters but some parameters have a different interpretation [7].

-- ASN1START

GNSS-NavigationModel ::= SEQUENCE {

 nonBroadcastIndFlag INTEGER (0..1),

 gnss-SatelliteList GNSS-NavModelSatelliteList,

 ...

}

GNSS-NavModelSatelliteList ::= SEQUENCE (SIZE(1..64)) OF GNSS-NavModelSatelliteElement

GNSS-NavModelSatelliteElement ::= SEQUENCE {

 svID SV-ID,

 svHealth BIT STRING (SIZE(8)),

 iod BIT STRING (SIZE(11)),

 gnss-ClockModel GNSS-ClockModel,

 gnss-OrbitModel GNSS-OrbitModel,

 ...,

 [[ svHealthExt-v1240 BIT STRING (SIZE(4)) OPTIONAL -- Need ON

 ]]

}

GNSS-ClockModel ::= CHOICE {

 standardClockModelList StandardClockModelList, -- Model-1

 nav-ClockModel NAV-ClockModel, -- Model-2

 cnav-ClockModel CNAV-ClockModel, -- Model-3

 glonass-ClockModel GLONASS-ClockModel, -- Model-4

 sbas-ClockModel SBAS-ClockModel, -- Model-5

 ...,

 bds-ClockModel-r12 BDS-ClockModel-r12, -- Model-6

 bds-ClockModel2-r16 BDS-ClockModel2-r16, -- Model-7

 navic-ClockModel-r16 NavIC-ClockModel-r16 -- Model-8

}

GNSS-OrbitModel ::= CHOICE {

 keplerianSet NavModelKeplerianSet, -- Model-1

 nav-KeplerianSet NavModelNAV-KeplerianSet, -- Model-2

 cnav-KeplerianSet NavModelCNAV-KeplerianSet, -- Model-3

 glonass-ECEF NavModel-GLONASS-ECEF, -- Model-4

 sbas-ECEF NavModel-SBAS-ECEF, -- Model-5

 ...,

 bds-KeplerianSet-r12 NavModel-BDS-KeplerianSet-r12, -- Model-6

 bds-KeplerianSet2-r16 NavModel-BDS-KeplerianSet2-r16, -- Model-7

 navic-KeplerianSet-r16 NavModel-NavIC-KeplerianSet-r16 -- Model-8

}

-- ASN1STOP

| *GNSS-NavigationModel* field descriptions |
| --- |
| ***nonBroadcastIndFlag***This field indicates if the *GNSS-NavigationModel* elements are not derived from satellite broadcast data or are given in a format not native to the GNSS. A value of 0 means the *GNSS-NavigationModel* data elements correspond to GNSS satellite broadcasted data; a value of 1 means the *GNSS-NavigationModel* data elements are not derived from satellite broadcast.  |
| ***gnss-SatelliteList***This list provides ephemeris and clock corrections for GNSS satellites indicated by *SV‑ID*. |
| ***svHealth***This field specifies the satellite's current health. The health values are GNSS system specific. The interpretation of *svHealth* depends on the *GNSS‑ID* and is as shown in table GNSS to svHealth Bit String(8) relation below. |
| ***iod***This field specifies the Issue of Data and contains the identity for GNSS Navigation Model.In the case of broadcasted GPS NAV ephemeris, the *iod* contains the IODC as described in [4].In the case of broadcasted Modernized GPS ephemeris, the *iod* contains the 11-bit parameter toe as defined in [4, Table 30-I] [6, Table 3.5-1].In the case of broadcasted SBAS ephemeris, the *iod* contains the 8 bits Issue of Data as defined in [10] Message Type 9.In the case of broadcasted QZSS QZS-L1 ephemeris, the *iod* contains the IODC as described in [7].In the case of broadcasted QZSS QZS-L1C/L2C/L5 ephemeris, the *iod* contains the 11-bit parameter toe as defined in [7].In the case of broadcasted GLONASS ephemeris, the *iod* contains the parameter tb as defined in [9].In the case of broadcasted Galileo ephemeris, the *iod* contains the IOD index as described in [8].In the case of broadcasted BDS B1I/B3I ephemeris, the *iod* contains 11 MSB bits of the toe as defined in [23], [50].In the case of broadcasted BDS B1C/B2a ephemeris, the *iod* contains the IODC as described in [39], [49].In the case of broadcasted NavIC ephemeris, the iod contains 11 MSB bits of the toe as defined in [38].The interpretation of *iod* depends on the *GNSS‑ID* and is as shown in table GNSS to iod Bit String(11) relation below. |
| ***svHealthExt***This field specifies the satellite's additional current health. The health values are GNSS system specific. The interpretation of *svHealthExt* depends on the *GNSS‑ID* and is as shown in table GNSS to svHealthExt Bit String(4) relation below. |

GNSS to svHealth Bit String(8) relation

|  |  |
| --- | --- |
| GNSS | *svHealth* Bit String(8) |
| Bit 1(MSB) | Bit 2 | Bit 3 | Bit 4 | Bit 5 | Bit 6  | Bit 7 | Bit 8 (LSB) |
| GPS L1/CA(1) | SV Health [4] | '0'(reserved) | '0'(reserved) |
| Modernized GPS(2) | L1C Health[6] | L1 Health [4,5] | L2 Health[4,5] | L5 Health [4,5] | '0'(reserved) | '0'(reserved) | '0'(reserved) | '0'(reserved) |
| SBAS(3) | RangingOn (0),Off(1) [10] | Corrections On(0),Off(1) [10] | IntegrityOn(0),Off(1)[10] | '0'(reserved) | '0'(reserved) | '0'(reserved) | '0'(reserved) | '0'(reserved) |
| QZSS(4)QZS-L1 | SV Health [7] | '0'(reserved) | '0'(reserved) |
| QZSS(5)QZS‑L1C/L2C/L5 | L1C Health[7] | L1 Health[7] | L2 Health[7] | L5 Health[7] | '0'(reserved) | '0'(reserved) | '0'(reserved) | '0'(reserved) |
| GLONASS | Bn (MSB)[9, page 30] | FT [9, Table 4.4] | '0'(reserved) | '0'(reserved) | '0'(reserved) |
| Galileo[8, clause 5.1.9.3] | E5a Data Validity Status | E5b Data Validity Status | E1-B Data Validity Status | E5a Signal Health Status | '0'(reserved) | '0'(reserved) | '0'(reserved) |
| BDS(6) B1I[23] | B1I Health (SatH1) [23], [50] | B3I Health (SatH1) [23], [50] | '0'(reserved) | '0'(reserved) | '0'(reserved) | '0'(reserved) | '0'(reserved) | '0'(reserved) |
| BDS(7) B1C[39]/B2a [49] | Sat Clock Health [39], [49] | B1C Health[39], [49] | B2a Health[39],[49] | '0'(reserved) | '0'(reserved) | '0'(reserved) | '0'(reserved) | '0'(reserved) |
| NavIC | L5 health | '0'(reserved) | '0'(reserved) | '0'(reserved) | '0'(reserved) | '0'(reserved) | '0'(reserved) | '0'(reserved) |
| Note 1: If *GNSS‑ID* indicates 'gps', and GNSS Orbit Model-2 is included, this interpretation of *svHealth* applies.Note 2: If *GNSS‑ID* indicates 'gps', and GNSS Orbit Model-3 is included, this interpretation of *svHealth* applies.If a certain signal is not supported on the satellite indicated by *SV‑ID*, the corresponding health bit shall be set to '1' (i.e., signal can not be used).Note 3: *svHealth,* in the case that *GNSS‑ID* indicates 'sbas', includes the 5 LSBs of the Health included in GEO Almanac Message Parameters (Type 17) [10].Note 4: If *GNSS‑ID* indicates 'qzss', and GNSS Orbit Model-2 is included, this interpretation of *svHealth* applies.Note 5: If *GNSS‑ID* indicates 'qzss', and GNSS Orbit Model-3 is included, this interpretation of *svHealth* applies.Note 6: If *GNSS‑ID* indicates 'bds', and GNSS Orbit Model-6 is included, this interpretation of *svHealth* applies.Note 7: If *GNSS‑ID* indicates 'bds', and GNSS Orbit Model-7 is included, this interpretation of *svHealth* applies. |

GNSS to iod Bit String(11) relation

|  |  |
| --- | --- |
| GNSS | *iod* Bit String(11) |
| Bit 1(MSB) | Bit 2 | Bit 3 | Bit 4 | Bit 5 | Bit 6 | Bit 7 | Bit 8 | Bit 9 | Bit 10 | Bit 11(LSB) |
| GPS L1/CA | '0' | Issue of Data, Clock [4] |
| Modernized GPS | toe (seconds, scale factor 300, range 0 – 604500) [4,5,6] |
| SBAS | '0' | '0' | '0' | Issue of Data ([10], Message Type 9) |
| QZSS QZS-L1 | '0' | Issue of Data, Clock [7] |
| QZSSQZS-L1C/L2C/L5 | toe (seconds, scale factor 300, range 0 – 604500) [7] |
| GLONASS | '0' | '0' | '0' | '0' | tb (minutes, scale factor 15) [9] |
| Galileo I/NAV | '0' | IODnav [8] |
| BDS B1I/B3I | 11 MSB bits of toe (seconds, scale factor 512, range 0 – 604672) [23], [50] |
| BDS B1C/B2a | '0' | Issue of Data, Clock [39], [49] |
| NavIC | 11 MSB bits of toe (seconds, scale factor 512) [38] |

GNSS to svHealthExt Bit String(4) relation

|  |  |
| --- | --- |
| GNSS | *svHealthExt* Bit String(4) |
| Bit 1(MSB) | Bit 2 | Bit 3 | Bit 4(LSB) |
| Galileo [8, clause 5.1.9.3] | E5b Signal Health Status | E1-B Signal Health Status |

– *StandardClockModelList*

-- ASN1START

StandardClockModelList ::= SEQUENCE (SIZE(1..2)) OF StandardClockModelElement

StandardClockModelElement ::= SEQUENCE {

 stanClockToc INTEGER (0..16383),

 stanClockAF2 INTEGER (-32..31),

 stanClockAF1 INTEGER (-1048576..1048575),

 stanClockAF0 INTEGER (-1073741824..1073741823),

 stanClockTgd INTEGER (-512..511) OPTIONAL, -- Need ON

 sisa INTEGER (0..255),

 stanModelID INTEGER (0..1) OPTIONAL, -- Need ON

 ...

}

-- ASN1STOP

| ***StandardClockModelList* field descriptions** |
| --- |
| ***standardClockModelList****gnss-ClockModel* Model-1 contains one or two clock model elements. If included, clock Model-1 shall be included once or twice depending on the target device capability.If the target device is supporting multiple Galileo signals, the location server shall include both F/Nav and I/Nav clock models in *gnss-ClockModel* if the location server assumes the target device to perform location information calculation using multiple signals. |
| ***stanClockToc***Parameter toc defined in [8].Scale factor 60 seconds. |
| ***stanClockAF2***Parameter af2 defined in [8].Scale factor 2-59 seconds/second2. |
| ***stanClockAF1***Parameter af1 defined in [8].Scale factor 2-46 seconds/second. |
| ***stanClockAF0***Parameter af0 defined in [8].Scale factor 2-34 seconds. |
| ***stanClockTgd***Parameter TGD, Broadcast Group Delay (BGD), defined in [8].Scale factor 2-32 seconds.This field is required if the target device supports only single frequency Galileo signal. |
| ***sisa***Signal-In-Space Accuracy (SISA), defined in [8] clause 5.1.11. |
| ***stanModelID***This field specifies the identity of the clock model according to the table Value of *stanModelID* to Identity relation below. This field is required if the location server includes both F/Nav and I/Nav Galileo clock models in *gnss-ClockModel.* If only one clock model is included by the location server, it is the I/NAV Galileo clock model. |

**Value of *stanModelID* to Identity relation**

|  |  |
| --- | --- |
| **Value of *stanModelID*** | **Identity** |
| 0 | I/Nav (E1,E5b) |
| 1 | F/Nav (E1,E5a) |

***<Skip Unmodified Changes>***

#### *– GNSS-SSR-OrbitCorrections*

The IE *GNSS-SSR-OrbitCorrections* is used by the location server to provide radial, along-track and cross-track orbit corrections together with integrity information. The target device may use the *SSR-OrbitCorrectionList* to compute a satellite position correction to be combined with the satellite position calculated from broadcast ephemeris.

The parameters provided in IE *GNSS-SSR-OrbitCorrections –* except for *ORBIT-IntegrityParameters* and *SSR-IntegrityOrbitBounds –* are used as specified for SSR Clock Messages (e.g., message type 1057 and 1063) in [30] and apply to all GNSSs.

-- ASN1START

GNSS-SSR-OrbitCorrections-r15 ::= SEQUENCE {

 epochTime-r15 GNSS-SystemTime,

 ssrUpdateInterval-r15 INTEGER (0..15),

 satelliteReferenceDatum-r15 ENUMERATED { itrf, regional, ... },

 iod-ssr-r15 INTEGER (0..15),

 ssr-OrbitCorrectionList-r15 SSR-OrbitCorrectionList-r15,

 ...,

 [[

 orbit-IntegrityParameters-r17 ORBIT-IntegrityParameters-r17 OPTIONAL -- Need OR

 ]]

}

SSR-OrbitCorrectionList-r15 ::= SEQUENCE (SIZE(1..64)) OF SSR-OrbitCorrectionSatelliteElement-r15

SSR-OrbitCorrectionSatelliteElement-r15 ::= SEQUENCE {

 svID-r15 SV-ID,

 iod-r15 BIT STRING (SIZE(11)),

 delta-radial-r15 INTEGER (-2097152..2097151),

 delta-AlongTrack-r15 INTEGER (-524288..524287),

 delta-CrossTrack-r15 INTEGER (-524288..524287),

 dot-delta-radial-r15 INTEGER (-1048576..1048575) OPTIONAL, -- Need ON

 dot-delta-AlongTrack-r15 INTEGER (-262144..262143) OPTIONAL, -- Need ON

 dot-delta-CrossTrack-r15 INTEGER (-262144..262143) OPTIONAL, -- Need ON

 ...,

 [[

 ssr-IntegrityOrbitBounds-r17 SSR-IntegrityOrbitBounds-r17 OPTIONAL -- Cond Integrity1

 ]]

}

ORBIT-IntegrityParameters-r17 ::= SEQUENCE {

 probOnsetConstFault-r17 INTEGER (0..255),

 meanConstFaultDuration-r17 INTEGER (1..3600),

 probOnsetSatFault-r17 INTEGER (0..255),

 meanSatFaultDuration-r17 INTEGER (1..3600),

 orbitRangeErrorCorrelationTime-r17 INTEGER (0..255) OPTIONAL, -- Need OR

 orbitRangeRateErrorCorrelationTime-r17 INTEGER (0..255) OPTIONAL, -- Cond Integrity2

 ...

}

SSR-IntegrityOrbitBounds-r17 ::= SEQUENCE {

 meanOrbitError-r17 RAC-OrbitalErrorComponents-r17,

 stdDevOrbitError-r17 RAC-OrbitalErrorComponents-r17,

 meanOrbitRateError-r17 RAC-OrbitalErrorComponents-r17,

 stdDevOrbitRateError-r17 RAC-OrbitalErrorComponents-r17,

 ...

}

RAC-OrbitalErrorComponents-r17 ::= SEQUENCE {

 radial-r17 INTEGER (0..255),

 alongTrack-r17 INTEGER (0..255),

 crossTrack-r17 INTEGER (0..255)

}

-- ASN1STOP

| Conditional presence | Explanation |
| --- | --- |
| *Integrity1* | The field is mandatory present if *ORBIT-IntegrityParameters* is present*;* otherwise it is not present. |
| *Integrity2* | The field is mandatory present if *orbitRangeErrorCorrelationTime* is present*;* otherwise it is not present. |

| *GNSS-SSR-OrbitCorrections* field descriptions |
| --- |
| ***epochTime***This field specifies the epoch time of the orbit corrections. The *gnss-TimeID* in *GNSS-SystemTime* shall be the same as the *GNSS-ID* in IE *GNSS-GenericAssistDataElement*.  |
| ***ssrUpdateInterval***This field specifies the SSR Update Interval. The SSR Update Intervals for all SSR parameters start at time 00:00:00 of the GPS time scale. A change of the SSR Update Interval during the transmission of SSR data should ensure consistent data for a target device. See table Value of *ssrUpdateInterval* to SSR Update Interval relation below. NOTE 1. |
| ***satelliteReferenceDatum***This field specifies the satellite refence datum for the orbit corrections. |
| ***iod-ssr***This field specifies the Issue of Data number for the SSR data. A change of *iod-ssr* is used to indicate a change in the SSR generating configuration.  |
| ***svID***This field specifies the satellite for which the orbit corrections are provided. |
| ***iod***This field specifies the IOD value of the broadcast ephemeris for which the orbit corrections are valid (see IE *GNSS‑NavigationModel*). NOTE 2. |
| ***delta-radial***This field specifies the radial orbit correction for broadcast ephemeris. NOTE 3.Scale factor 0.1 mm; range ±209.7151 m. |
| ***delta-AlongTrack***This field specifies the along-track orbit correction for broadcast ephemeris. NOTE 3.Scale factor 0.4 mm; range ±209.7148 m. |
| ***delta-CrossTrack***This field specifies the cross-track orbit correction for broadcast ephemeris. NOTE 3.Scale factor 0.4 mm; range ±209.7148 m. |
| ***dot-delta-radial***This field specifies the velocity of radial orbit correction for broadcast ephemeris. NOTE 3.Scale factor 0.001 mm/s; range ±1.048575 m/s. |
| ***dot-delta-AlongTrack***This field specifies the velocity of along-track orbit correction for broadcast ephemeris. NOTE 3.Scale factor 0.004 mm/s; range ±1.048572 m/s. |
| ***dot-delta-CrossTrack***This field specifies the velocity of cross-track orbit correction for broadcast ephemeris. NOTE 3.Scale factor 0.004 mm/s; range ±1.048572 m/s. |
| ***probOnsetConstFault***This field specifies the Probability of Onset of Constellation Fault per Time Unit where a constellation fault is at least two satellites being faulty simultaneously due to the same event.This field specifies the onset probability that the residual range or range rate error exceeds a bound created using the minimum allowed inflation factor *Kmin*, and bounding parameters as *mean* + *Kmin* \* *stdDev* where *Kmin* = *normInv*(*irMaximum* / 2), with *irMaximum* as provided in IE *GNSS-Integrity-ServiceParameters*.The probability is calculated by *P*=10-0.04*n* [hour-1] where *n* is the value of *probOnsetConstFault* and the range is 10-10.2 to 1 per hour. |
| ***meanConstFaultDuration***This field specifies the Mean Constellation Fault Duration which is the mean duration between when a constellation fault occurs, and the user is alerted by IE *GNSS-RealTimeIntegrity* (or the integrity violation is over).Scale factor 1 s; range 1-3600 s. |
| ***probOnsetSatFault***This field specifies the Probability of Onset of Satellite Fault per Time Unit which is the probability of occurrence of satellite error to exceed the residual error bound for more than the Time to Alert (TTA).This field specifies the onset probability that the residual range or range rate error exceeds a bound created using the minimum allowed inflation factor *Kmin*, and bounding parameters as *mean* + *Kmin* \* *stdDev* where *Kmin* = *normInv*(*irMaximum* / 2), with *irMaximum* as provided in IE *GNSS-Integrity-ServiceParameters*.The probability is calculated by *P*=10-0.04*n* [hour-1] where *n* is the value of *probOnsetSatFault* and the range is 10-10.2 to 1 per hour. |
| ***meanSatFaultDuration***This field specifies the Mean Satellite Fault Duration which is the mean duration between when a satellite fault occurs, and the user is alerted by IE *GNSS-RealTimeIntegrity* (or the integrity violation is over).Scale factor 1 s; range 1-3,600 s. |
| ***orbitRangeErrorCorrelationTime***This field specifies the Orbit Range Error Correlation Time which is the upper bound of the correlation time of the satellite residual range error due to orbit.The time is calculated using:$$t=\left\{\begin{array}{c}10i, \&i\leq 180\\1800+100(i-180), 180<\&i\leq 234 \\7200+1000\left(i-234\right), \&i>234\end{array} [s]\right.$$Range is 1-28,200 s. |
| ***orbitRangeRateErrorCorrelationTime***This field specifies the Orbit Range Rate Error Correlation Time which is the upper bound of the correlation time of the satellite residual range rate error due to orbit.The time is calculated using:$$t=\left\{\begin{array}{c}10i, \&i\leq 180\\1800+100(i-180), 180<\&i\leq 234 \\7200+1000\left(i-234\right), \&i>234\end{array} [s]\right.$$Range is 1-28,200 s. |
| ***meanOrbitError***This field specifies the Mean Orbit Error bound in satellite radial, along-track and cross-track coordinates, which are the mean values for a set of three overbounding models that bound the residual orbit error in satellite radial, along-track and cross-track directions.Each mean is calculated using:$$μ=\left\{\begin{array}{c}0.01i, \&i\leq 200\\2+0.1(i-200), 200<\&i\leq 230 \\5+0.5\left(i-230\right), \&i>230\end{array} [m]\right.$$Range is 0-17.5 m. |
| ***stdDevOrbitError***This field specifies the Standard Deviation Orbit Error bound in satellite radial, along-track and cross-track coordinates, which are the standard deviation values for a set of three overbounding models that bound the residual orbit error in satellite radial, along-track and cross-track directions.Each standard deviation is calculated using:$$σ=\left\{\begin{array}{c}0.01i, \&i\leq 200\\2+0.1(i-200), 200<\&i\leq 230 \\5+0.5\left(i-230\right), \&i>230\end{array} [m]\right.$$Range is 0-17.5 m. |
| ***meanOrbitRateError***This field specifies the Mean Orbit Rate Error in satellite radial, along-track and cross-track coordinates, which are the mean values for a set of three overbounding models that bound the residual satellite orbit rate error in satellite radial, along-track and cross-track directions.Scale factor 0.001 m/s; range 0-0.255 m/s. |
| ***stdDevOrbitRateError***This field specifies the Standard Deviation Orbit Rate Error in satellite radial, along-track and cross-track coordinates, which are the standard deviation values for a set of three overbounding models that bound the residual satellite orbit rate error in satellite radial, along-track and cross-track directions.Scale factor 0.001 m/s; range 0-0.255 m/s. |

NOTE 1: The update intervals are aligned to the GPS time scale for all GNSSs in order to allow synchronous operation for multiple GNSS services. This means that the update intervals may not be aligned to the beginning of the day for another GNSS. Due to the leap seconds, this is generally the case for GLONASS.

NOTE 2: In the cases that *gnss-ID* indicates 'gps', 'qzss' or ‘bds’, the *iod* refers to the NAV broadcast ephemeris (GPS L1 C/A, QZSS QZS-L1 or BDS B1C/B2a, respectively, in table GNSS to iod Bit String(11) relation in IE *GNSS‑NavigationModel).*

NOTE 3: The reference time *t0* is *epochTime* + ½ × *ssrUpdateInterval*. The reference time *t0* for *ssrUpdateInterval* '0' is *epochTime*.

Value of *ssrUpdateInterval* to SSR Update Interval relation

|  |  |
| --- | --- |
| Value of *ssrUpdateInterval* | SSR Update Interval |
| 0 | 1 second |
| 1 | 2 seconds |
| 2 | 5 seconds |
| 3 | 10 seconds |
| 4 | 15 seconds |
| 5 | 30 seconds |
| 6 | 60 seconds |
| 7 | 120 seconds |
| 8 | 240 seconds |
| 9 | 300 seconds |
| 10 | 600 seconds |
| 11 | 900 seconds |
| 12 | 1800 seconds |
| 13 | 3600 seconds |
| 14 | 7200 seconds |
| 15 | 10800 seconds |

***<Skip Unmodified Changes>***

*– GNSS-SSR-GriddedCorrection*

The IE *GNSS-SSR-GriddedCorrection* is used by the location server to provide troposphere delay correction, together with the residual part of the STEC corrections and integrity information.

The parameters provided in IE *GNSS-SSR-GriddedCorrection* *–* except for *SSR-GriddedCorrectionIntegrityParameters* and *TropoDelayIntegrityErrorBounds –* are used as specified for Compact SSR Gridded Correction Message (e.g., message type 4073,9) in [43] and apply to all GNSSs, where the troposphere delay correction may be provided for one GNSS and in that case valid for all other GNSSs.

-- ASN1START

GNSS-SSR-GriddedCorrection-r16 ::= SEQUENCE {

 epochTime-r16 GNSS-SystemTime,

 ssrUpdateInterval-r16 INTEGER (0..15),

 iod-ssr-r16 INTEGER (0..15),

 troposphericDelayQualityIndicator-r16 BIT STRING (SIZE(6)) OPTIONAL, -- Cond Tropo

 correctionPointSetID-r16 INTEGER (0..16383),

 gridList-r16 GridList-r16,

 ...,

 [[

 ssr-GriddedCorrectionIntegrityParameters-r17

 SSR-GriddedCorrectionIntegrityParameters-r17

 OPTIONAL -- Need OR

 ]]

}

GridList-r16 ::= SEQUENCE (SIZE(1..64)) OF GridElement-r16

GridElement-r16 ::= SEQUENCE {

 tropospericDelayCorrection-r16 TropospericDelayCorrection-r16 OPTIONAL, -- Need ON

 stec-ResidualSatList-r16 STEC-ResidualSatList-r16 OPTIONAL, -- Need ON

 ...

}

TropospericDelayCorrection-r16 ::= SEQUENCE {

 tropoHydroStaticVerticalDelay-r16 INTEGER (-256..255),

 tropoWetVerticalDelay-r16 INTEGER (-128..127),

 ...,

 [[

 tropoDelayIntegrityErrorBounds-r17 TropoDelayIntegrityErrorBounds-r17

 OPTIONAL -- Cond Integrity1

 ]]

}

STEC-ResidualSatList-r16 ::= SEQUENCE (SIZE(1..64)) OF STEC-ResidualSatElement-r16

STEC-ResidualSatElement-r16 ::= SEQUENCE {

 svID-r16 SV-ID,

 stecResidualCorrection-r16 CHOICE {

 b7-r16 INTEGER (-64..63),

 b16-r16 INTEGER (-32768..32767)

 },

 ...

}

SSR-GriddedCorrectionIntegrityParameters-r17 ::= SEQUENCE {

 probOnsetTroposphereFault-r17 INTEGER (0..255),

 meanTroposphereFaultDuration-r17 INTEGER (1..256),

 troposphereRangeErrorCorrelationTime-r17 INTEGER (1..255) OPTIONAL, -- Need OR

 troposphereRangeRateErrorCorrelationTime-r17 INTEGER (1..255) OPTIONAL, -- Cond Integrity2

 ...

}

TropoDelayIntegrityErrorBounds-r17 ::= SEQUENCE {

 meanTroposphereVerticalHydroStaticDelay-r17 INTEGER (0..255),

 stdDevTroposphereVerticalHydroStaticDelay-r17 INTEGER (0..255),

 meanTroposphereVerticalWetDelay-r17 INTEGER (0..255),

 stdDevTroposphereVerticalWetDelay-r17 INTEGER (0..255),

 meanTroposphereVerticalHydroStaticDelayRate-r17 INTEGER (0..255),

 stdDevTroposphereVerticalHydroStaticDelayRate-r17 INTEGER (0..255),

 meanTroposphereVerticalWetDelayRate-r17 INTEGER (0..255),

 stdDevTroposphereVerticalWetDelayRate-r17 INTEGER (0..255),

 ...

}

-- ASN1STOP

| **Conditional presence** | **Explanation** |
| --- | --- |
| *Tropo* | The field is mandatory present if *tropospericDelayCorrection* is included in *gridList*. Otherwise it is not present. |
| *Integrity1* | The field is mandatory present if *SSR-GriddedCorrectionIntegrityParameters* is present; otherwise it is not present. |
| *Integrity2* | The field is mandatory present if *troposphereRangeErrorCorrelationTime* is present; otherwise it is not present. |

| ***GNSS-SSR-GriddedCorrection* field descriptions** |
| --- |
| ***epochTime***This field specifies the epoch time of the gridded correction data. The *gnss-TimeID* in *GNSS-SystemTime* shall be the same as the *GNSS-ID* in IE *GNSS-GenericAssistDataElement*.  |
| ***ssrUpdateInterval***This field specifies the SSR Update Interval. The SSR Update Intervals for all SSR parameters start at time 00:00:00 of the GPS time scale. A change of the SSR Update Interval during the transmission of SSR data should ensure consistent data for a target device. See table Value of *ssrUpdateInterval* to SSR Update Interval relation in IE *GNSS‑SSR‑OrbitCorrections*. |
| ***iod-ssr***This field specifies the Issue of Data number for the SSR data. A change of *iod-ssr* is used to indicate a change in the SSR generating configuration.  |
| ***troposphericDelayQualityIndicator***This field specifies the quality indicator of the tropospheric delay. The troposphere quality indicator is represented by a combination of CLASS and VALUE. The 3 MSB define the CLASS with a range of 0-7 and the 3 LSB define the VALUE with a range of 0-7. The troposphere quality indicator is computed by:$$SSR Troposphere Quality [mm] \leq 3^{CLASS}\left(1+\frac{VALUE}{4}\right)-1 [mm]$$See Table 'Relationship between SSR troposphere quality and URA indicator and physical quantity' below. |
| ***correctionPointSetID***This field provides the ID of the *GNSS-SSR-CorrectionPoints* set. The *GNSS-SSR-GriddedCorrection* are valid for the correction points provided in IE *GNSS-SSR-CorrectionPoints* with the same *correctionPointSetID.* |
| ***gridList***This field provides the troposphere delay correction together with the residual part of the STEC corrections for up to 64 correction points defined in IE *GNSS-SSR-CorrectionPoints*.If the IE *GNSS-SSR-CorrectionPoints,* which belongs to the *correctionPointSetID*, includes the *listOfCorrectionPoints*, the *gridList* includes the same number of entries, and listed in the same order, as in the *listOfCorrectionPoints.*If the IE *GNSS-SSR-CorrectionPoints,* which belongs to this *correctionPointSetID*, includes the *arrayOfCorrectionPoints* the *gridList* includes the same number of entries, and listed in the same order, as defined by the enabled bits in the *bitmaskOfGrids*. |
| ***tropospericDelayCorrection***This field specifies information element with the troposphere vertical delay components. NOTE: This field may only be provided with one GNSS constellation, in which case it is valid for all GNSS constellations. If this field is provided with one GNSS constellation this field may not be provided with other GNSS constellations for the same epoch. |
| ***tropoHydroStaticVerticalDelay***This field specifies the variation in the hydro static troposphere vertical delay relative to nominal value. The target device should add the constant nominal value of 2.3 m to calculate the tropospheric hydro-static vertical delay.Scale factor 0.004 m; range ±1.02 m. |
| ***tropoWetVerticalDelay***This field specifies the variation in the wet troposphere vertical delay relative to nominal value. The target device should add the constant value of 0.252 m to calculate the tropospheric wet (non hydro-static) vertical delay.Scale factor 0.004 m; range ±0.508 m. |
| ***svID***This field specifies the GNSS satellite for which the STEC residual corrections are provided. |
| ***stecResidualCorrection***This field specifies the STEC residual correction.Scale factor 0.04 TECU; range ±2.52 TECU (b7) or ±1310.68 TECU (b16). |
| ***probOnsetTroposphereFault***This field specifies the Probability of Onset of Troposphere Fault per Time Unit which is the probability of occurrence of troposphere error to exceed the residual error bound for more than the Time to Alert (TTA) This field specifies the onset probability that the residual range or range rate error exceeds a bound created using the minimum allowed inflation factor *Kmin*, and bounding parameters as *mean* + *Kmin* \* *stdDev* where *Kmin* = normInv(*irMaximum* / 2) and *irMaximum* as provided in IE *GNSS-Integrity-ServiceParameters*.The probability is calculated by P=10-0.04n [hour-1] where *n* is the value of *probOnsetTroposphereFault* and the range is 10-10.2 to 1 per hour. |
| ***meanTroposphereFaultDuration***This field specifies the Mean Troposphere Fault Duration which is the mean duration between when a troposphere integrity violation occurs, and the user is alerted through *GNSS-Integrity-ServiceAlert* (or the integrity violation is over).Scale factor 1 s; range 1-256 s. |
| ***troposphereRangeErrorCorrelationTime***This field specifies the Troposphere Range Error Correlation Time which is the upper bound of the correlation time of the troposphere residual range error.The time is calculated using:$$t=\left\{\begin{array}{c}10i, \&i\leq 180\\1800+100(i-180), 180<\&i\leq 234 \\7200+1000\left(i-234\right), \&i>234\end{array} [s]\right.$$Range is 1-28,200 s. |
| ***troposphereRangeRateErrorCorrelationTime***This field specifies the Troposphere Range Rate Error Correlation Time which is the upper bound of the correlation time of the troposphere residual range rate error.The time is calculated using:$$t=\left\{\begin{array}{c}10i, \&i\leq 180\\1800+100(i-180), 180<\&i\leq 234 \\7200+1000\left(i-234\right), \&i>234\end{array} [s]\right.$$Range is 1-28,200 s. |
| ***meanTroposphereVerticalHydroStaticDelay***This field specifies the Mean Troposphere Vertical Hydro Static Delay Error bound which is the mean value for an overbounding model that bounds the residual troposphere error in the vertical hydro static delay component.The bound is *meanTroposphereVerticalHydroStaticDelay* + K \* *stdDevTroposphereVerticalHydroStaticDelay* and shall be so that the probability of it to be exceeded shall be lower than IRallocation for *irMinimum* < IRallocation < *irMaximum*, where K = normInv(IRallocation / 2) and *irMinimum*, *irMaximum* as provided in IE *GNSS-Integrity-ServiceParameters*.This IRallocation is a fraction of the Target Integrity Risk that represents the integrity risk budget available.Scale factor 0.005 m; range 0-1.275 m. |
| ***stdDevTroposphereVerticalHydroStaticDelay***This field specifies the Standard Deviation Troposphere Vertical Hydro Static Delay Error bound which is the standard deviation for an overbounding model that bounds the residual troposphere error in the vertical hydro static delay component.Scale factor 0.005 m; range 0-1.275 m. |
| ***meanTroposphereVerticalWetDelay***This field specifies the Mean Troposphere Vertical Wet Static Delay Error bound which is the mean value for an overbounding model that bounds the residual troposphere error in the vertical wet delay component.The bound is *meanTroposphereVerticalWetDelay* + K \* *stdDevTroposphereVerticalWetDelay* and shall be so that the probability of it to be exceeded shall be lower than IRallocation for *irMinimum* < IRallocation < *irMaximum*, where K = normInv(IRallocation / 2) and *irMinimum*, *irMaximum* as provided in IE *GNSS-Integrity-ServiceParameters*.This IRallocation is a fraction of the Target Integrity Risk that represents the integrity risk budget available.Scale factor 0.005 m; range 0-1.275 m. |
| ***stdDevTroposphereVerticalWetDelay***This field specifies the Standard Deviation Troposphere Vertical Wet Static Delay Error bound which is the standard deviation for an overbounding model that bounds the residual troposphere error in the vertical wet delay component.Scale factor 0.005 m; range 0-1.275 m. |
| ***meanTroposphereVerticalHydroStaticDelayRate***This field specifies the Mean Troposphere Vertical Hydro Static Delay Rate Error bound which is the mean value for an overbounding model that bounds the residual troposphere rate error in the vertical hydro static delay component.The bound is *meanTroposphereVerticalHydroStaticDelayRate* + K \* *stdDevTroposphereVerticalHydroStaticDelayRate* and shall be so that the probability of it to be exceeded shall be lower than IRallocation for *irMinimum* < IRallocation < *irMaximum*, where K = normInv(IRallocation / 2) and *irMinimum*, *irMaximum* as provided in IE *GNSS-Integrity-ServiceParameters*.This IRallocation is a fraction of the Target Integrity Risk that represents the integrity risk budget available.Scale factor 0.00005 m/s; range 0-0.01275 m/s. |
| ***stdDevTroposphereVerticalHydroStaticDelayRate***This field specifies the Standard Deviation Troposphere Vertical Hydro Static Delay Rate Error bound which is the standard deviation for an overbounding model that bounds the residual troposphere rate error in the vertical hydro static delay component.Scale factor 0.00005 m/s; range 0-0.01275 m/s. |
| ***meanTroposphereVerticalWetDelayRate***This field specifies the Mean Troposphere Vertical Wet Static Delay Rate Error bound which is the mean value for an overbounding model that bounds the residual troposphere rate error in the vertical wet delay component.The bound is *meanTroposphereVerticalWetDelayRate* + K \* *stdDevTroposphereVerticalWetDelayRate* and shall be so that the probability of it to be exceeded shall be lower than IRallocation for *irMinimum* < IRallocation < *irMaximum*, where K = normInv(IRallocation / 2) and *irMinimum*, *irMaximum* as provided in IE *GNSS-Integrity-ServiceParameters*.This IRallocation is a fraction of the Target Integrity Risk that represents the integrity risk budget available.Scale factor 0.00005 m/s; range 0-0.01275 m/s. |
| ***stdDevTroposphereVerticalWetDelayRate***This field specifies the Standard Deviation Troposphere Vertical Wet Static Delay Rate Error bound which is the standard deviation for an overbounding model that bounds the residual troposphere rate error in the vertical wet delay component.Scale factor 0.00005 m/s; range 0-0.01275 m/s. |

**Relationship between SSR troposphere quality and URA indicator and physical quantity**

|  |  |  |  |
| --- | --- | --- | --- |
| **CLASS** | **VALUE** | **Index** | **SSR troposphere quality indicator****and****SSR URA****Q [mm]** |
| 7 | 7 | 63 |  5466.50 < Q |
| 7 | 6 | 62 |  4919.75 < Q ≤ 5466.50 |
| 7 | 5 | 61 |  4373.75 < Q ≤ 4919.75 |
| 7 | 4 | 60 |  3826.25 < Q ≤ 4373.00 |
| 7 | 3 | 59 |  3279.50 < Q ≤ 3826.25 |
| 7 | 2 | 58 |  2732.75 < Q ≤ 3279.50 |
| 7 | 1 | 57 |  2186.00 < Q ≤ 2732.75 |
| 7 | 0 | 56 |  2003.75 < Q ≤ 2186.00 |
| 6 | 7 | 55 |  1821.50 < Q ≤ 2003.75 |
| 6 | 6 | 54 |  1639.25 < Q ≤ 1821.50 |
| 6 | 5 | 53 |  1457.00 < Q ≤ 1639.25 |
| 6 | 4 | 52 |  1274.75 < Q ≤ 1457.00 |
| 6 | 3 | 51 |  1092.50 < Q ≤ 1274.75 |
| 6 | 2 | 50 |  910.25 < Q ≤ 1092.50 |
| 6 | 1 | 49 |  728.00 < Q ≤ 910.25 |
| 6 | 0 | 48 |  667.25 < Q ≤ 728.00 |
| 5 | 7 | 47 |  606.50 < Q ≤ 667.25 |
| 5 | 6 | 46 |  545.75 < Q ≤ 606.50 |
| 5 | 5 | 45 |  485.00 < Q ≤ 545.75 |
| 5 | 4 | 44 |  424.25 < Q ≤ 485.00 |
| 5 | 3 | 43 |  363.50 < Q ≤ 425.25 |
| 5 | 2 | 42 |  302.75 < Q ≤ 363.50 |
| 5 | 1 | 41 |  242.00 < Q ≤ 302.75 |
| 5 | 0 | 40 |  221.75 < Q ≤ 242.00 |
| 4 | 7 | 39 |  201.50 < Q ≤ 221.75 |
| 4 | 6 | 38 |  181.25 < Q ≤ 201.50 |
| 4 | 5 | 37 |  161.00 < Q ≤ 181.25 |
| 4 | 4 | 36 |  140.75 < Q ≤ 161.00 |
| 4 | 3 | 35 |  120.50 < Q ≤ 140.75 |
| 4 | 2 | 34 |  100.25 < Q ≤ 120.50 |
| 4 | 1 | 33 |  80.00 < Q ≤ 100.25 |
| 4 | 0 | 32 |  73.25 < Q ≤ 80.00 |
| 3 | 7 | 31 |  66.50 < Q ≤ 73.25 |
| 3 | 6 | 30 |  59.75 < Q ≤ 66.50 |
| 3 | 5 | 29 |  53.00 < Q ≤ 59.75 |
| 3 | 4 | 28 |  46.25 < Q ≤ 53.00 |
| 3 | 3 | 27 |  39.50 < Q ≤ 46.25 |
| 3 | 2 | 26 |  32.75 < Q ≤ 39.50 |
| 3 | 1 | 25 |  26.00 < Q ≤ 32.75 |
| 3 | 0 | 24 |  23.75 < Q ≤ 26.00 |
| 2 | 7 | 23 |  21.50 < Q ≤ 23.75 |
| 2 | 6 | 22 |  19.25 < Q ≤ 21.50 |
| 2 | 5 | 21 |  17.00 < Q ≤ 19.25 |
| 2 | 4 | 20 |  14.75 < Q ≤ 17.00 |
| 2 | 3 | 19 |  12.50 < Q ≤ 14.75 |
| 2 | 2 | 18 |  10.25 < Q ≤ 12.50 |
| 2 | 1 | 17 |  8.00 < Q ≤ 10.25 |
| 2 | 0 | 16 |  7.25 < Q ≤ 8.00 |
| 1 | 7 | 15 |  6.50 < Q ≤ 7.25 |
| 1 | 6 | 14 |  5.75 < Q ≤ 6.50 |
| 1 | 5 | 13 |  5.00 < Q ≤ 5.75 |
| 1 | 4 | 12 |  4.25 < Q ≤ 5.00 |
| 1 | 3 | 11 |  3.50 < Q ≤ 4.25 |
| 1 | 2 | 10 |  2.75 < Q ≤ 3.50 |
| 1 | 1 | 9 |  2.00 < Q ≤ 2.75 |
| 1 | 0 | 8 |  1.75 < Q ≤ 2.00 |
| 0 | 7 | 7 |  1.50 < Q ≤ 1.75 |
| 0 | 6 | 6 |  1.25 < Q ≤ 1.50 |
| 0 | 5 | 5 |  1.00 < Q ≤ 1.25 |
| 0 | 4 | 4 |  0.75 < Q ≤ 1.00 |
| 0 | 3 | 3 |  0.50 < Q ≤ 0.75 |
| 0 | 2 | 2 |  0.25 < Q ≤ 0.50 |
| 0 | 1 | 1 |  Q ≤ 0.25 |
| 0 | 0 | 0 |  undefined/unknown |

*End of Changes*