**3GPP TSG-RAN2 Meeting #116-e *R2-211xxxx***

**Online, 01- 11-November 2021**

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| *CR-Form-v12.1* |
| **CHANGE REQUEST** |
|  |
|  | **36.305** | **CR** | **CRNum** | **rev** | **RevNum** | **Current version:** | **16.4.0** |  |
|  |
| *For* [***HELP***](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 | **X** | Core Network |  |

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|  |
| ***Title:***  | Running CR of 36.305 for Positioning WI on GNSS Positioning Integrity |
|  |  |
| ***Source to WG:*** | InterDigital Inc |
| ***Source to TSG:*** | R2 |
|  |  |
| ***Work item code:*** | NR\_pos\_enh-Core |  | ***Date:*** | 2021-10-21 |
|  |  |  |  |  |
| ***Category:*** | B |  | ***Release:*** | Rel-16 |
|  | *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-15 (Release 15)Rel-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)* |
|  |  |
| ***Reason for change:*** | To capture agreements on GNSS positioning integrity into TS 36.305. |
|  |  |
| ***Summary of change:*** | **RAN2#116**, to capture the following :* Definition of positioning integrity captured in Clause 3.1
* General description on GNSS positioning integrity captured in Clause 8.1.1
* Descriptions on GNSS Positioning Procedures (capability transfer, assistance data transfer and location information transfer) captured in Clauses 8.1.3.1, 8.1.3.2, 8.1.3.3
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| ***Consequences if not approved:*** | Rel-17 GNSS Positioning Integrity is not supported in 36.305. |
|  |  |
| ***Clauses affected:*** | 3.1, 8.1.1, 8.1.3.1, 8.1.3.2, 8.1.3.3  |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** | **X** |  |  Other core specifications  | TS/TR 38.331 CR TBDTS/TR 37.355 CR TBD |
| ***affected:*** |  | **X** |  Test specifications | TS/TR ... CR ...  |
| ***(show related CRs)*** |  | **X** |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

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## 3 Definitions and abbreviations

### 3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [1] apply.

As used in this document, the suffixes "-based" and "-assisted" refer respectively to the node that is responsible for making the positioning calculation (and which may also provide measurements) and a node that provides measurements (but which does not make the positioning calculation). Thus, an operation in which measurements are provided by the UE to the E-SMLC to be used in the computation of a position estimate is described as "UE-assisted" (and could also be called "E-SMLC-based"), while one in which the UE computes its own position is described as "UE-based".

Both standalone LMU and LMU integrated into an eNB are supported. As used in this document, LMU refers to both cases of a standalone LMU and an LMU integrated into an eNodeB unless explicitly mentioned otherwise.

**State Space Representation (SSR)**: The state space representation provides information on the status of individual GNSS error sources. State parameter values are transmitted to UE. The user corrects his own observations of a single GNSS receiver with SSR corrections computed from these state parameters for his individual position, and performs RTK positioning with corrected observations. This contrasts with Observation Space Representation (OSR) which uses a lump-sum of distance-dependent GNSS errors instead of individual GNSS error sources. For OSR the representation of RTK network corrections in the observation space always uses GNSS observation of an actual reference station, which are then applied by the user to the conventional RTK algorithm.

**Transmission Point (TP)**: A set of geographically co-located transmit antennas for one cell, part of one cell or one PRS-only TP. Transmission Points can include base station (eNode B) antennas, remote radio heads, a remote antenna of a base station, an antenna of a PRS-only TP, etc. One cell can be formed by one or multiple transmission points. For a homogeneous deployment, each transmission point may correspond to one cell.

**PRS-only TP**: A TP which only transmits PRS signals for PRS-based TBS positioning and is not associated with a cell.

**Positioning integrity:** A measure of the trust in the accuracy of the position-related data and the ability to provide timely warnings based on assistance data provided by the network

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## 8 Positioning methods and Supporting Procedures

### 8.1 GNSS positioning methods

#### 8.1.1 General

A navigation satellite system provides autonomous geo-spatial positioning with either global or regional coverage. Augmentation systems, such as SBAS, are navigation satellite systems that provide regional coverage to augment the navigation systems with global coverage.

By definition, GNSS refers to satellite constellations that achieve global coverage, however, in 3GPP specifications the term GNSS is used to encompass global, regional, and augmentation satellite systems. The following GNSSs are supported in this version of the specification:

- GPS and its modernization [6], [7], [8]; (global coverage)

- Galileo [9]; (global coverage)

- GLONASS [10]; (global coverage)

- Satellite Based Augmentation Systems (SBAS), including WAAS, EGNOS, MSAS, and GAGAN [12]; (regional coverage)

- Quasi-Zenith Satellite System (QZSS) [11]; (regional coverage)

- BeiDou Navigation Satellite System (BDS) [28], [34]; (global coverage)

- NAVigation with Indian Constellation (NavIC) [35]. (regional coverage)

Each global GNSS can be used individually or in combination with others, including regional navigation systems and augmentation systems. When used in combination, the effective number of navigation satellite signals would be increased:

- extra satellites can improve availability (of satellites at a particular location) and results in an improved ability to work in areas where satellite signals can be obscured, such as in urban canyons;

- extra satellites and signals can improve reliability, i.e., with extra measurements the data redundancy is increased, which helps identify any measurement outlier problems;

- extra satellites and signals can improve accuracy due to improved measurement geometry and improved ranging signals from modernized satellites.

When GNSS is designed to inter-work with the E-UTRAN, the network assists the UE GNSS receiver to improve the performance in several respects. These performance improvements will:

- reduce the UE GNSS start-up and acquisition times; the search window can be limited and the measurements speed up significantly;

- increase the UE GNSS sensitivity; positioning assistance messages are obtained via E-UTRAN so the UE GNSS receiver can operate also in low SNR situations when it is unable to demodulate GNSS satellite signals;

- allow the UE to consume less handset power than with stand-alone GNSS; this is due to rapid start-up times as the GNSS receiver can be in idle mode when it is not needed;

- allow the UE to compute its position with a better accuracy; RTK corrections (for N-RTK) and GNSS physical models (for SSR/PPP) are obtained via E-UTRAN so the UE can use these assistance data, together with its own measurements, i.e., code and carrier phase measurements, to enable computation of a position with a high accuracy.

- allow the UE to compute and report its positioning integrity results (i.e. metrics that characterize the trust in the accuracy of its position estimate); the UE can use the integrity requirements and assistance data obtained via E-UTRAN, together with its own measurements, to compute its positioning integrity results

The network-assisted GNSS methods rely on signalling between UE GNSS receivers (possibly with reduced complexity) and a continuously operating GNSS reference receiver network, which has clear sky visibility of the same GNSS constellation as the assisted UEs. Two assisted modes are supported:

*- UE-Assisted*: The UE performs GNSS measurements (pseudo-ranges, pseudo Doppler, carrier phase ranges, etc.) and sends these measurements to the E-SMLC where the position calculation takes place, possibly using additional measurements from other (non GNSS) sources;

*- UE-Based*: The UE performs GNSS measurements and calculates its own position location, possibly using additional measurements from other (non GNSS) sources and assistance data from the E-SMLC.

The assistance data content may vary depending on whether the UE operates in UE-Assisted or UE-Based mode.

The assistance data signalled to the UE can be broadly classified into:

- *data assisting the measurements*: e.g. reference time, visible satellite list, satellite signal Doppler, code phase, Doppler and code phase search windows;

- *data providing means for position calculation*: e.g. reference time, reference position, satellite ephemeris, code and carrier phase measurements from a GNSS reference receiver or network of receivers;

- *data increasing the position accuracy*: e.g. satellite code biases, satellite orbit corrections, satellite clock corrections, atmospheric models. RTK residuals, gradients.

*-    data providing means for positioning integrity results calculation*

A UE with GNSS measurement capability may also operate in an autonomous (standalone) mode. In autonomous mode the UE determines its position based on signals received from GNSS without assistance from the network.

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#### 8.1.3 Assisted-GNSS Positioning Procedures

##### 8.1.3.1 Capability Transfer Procedure

The Capability Transfer procedure for Assisted-GNSS positioning is described in clause 7.1.2.1.

The Capability Transfer procedure can be used to transfer capability information for positioning integrity.

###### 8.1.3.1.1 Void

##### 8.1.3.2 Assistance Data Transfer Procedure

The purpose of this procedure is to enable the E-SMLC to provide assistance data to the UE (e.g., as part of a positioning procedure) and the UE to request assistance data from the E-SMLC (e.g., as part of a positioning procedure or for autonomous self location (i.e., UE determines its own location)). In the case of high-accuracy GNSS positioning techniques (e.g., RTK), the E-SMLC can provide unsolicited periodic assistance data to the UE and the UE can request periodic assistance data from the E-SMLC.

The Assistance Data Transfer procedure can be used to transfer the assistance data for positioning integrity for UE-based mode.

###### 8.1.3.2.1 E-SMLC initiated Assistance Data Delivery

Figure 8.1.3.2.1-1 shows the Assistance Data Delivery operations for the network-assisted GNSS method when the procedure is initiated by the E-SMLC.



Figure 8.1.3.2.1-1: E‑SMLC-initiated Assistance Data Delivery Procedure

(1) The E-SMLC determines that assistance data needs to be provided to the UE (e.g., as part of a positioning procedure) and sends an LPP Provide Assistance Data message to the UE. This message may include any of the GNSS assistance data defined in clause 8.1.2.1.

###### 8.1.3.2.1a E-SMLC initiated Periodic Assistance Data Delivery

The Periodic Assistance Data Delivery procedure allows the server to provide unsolicited periodic assistance data to the target and is shown in Figure 8.1.3.2.1a-1.

NOTE: In this version of the specification, periodic assistance data delivery is supported for HA GNSS (e.g., RTK) positioning only.



Figure 8.1.3.2.1a-1: LPP Periodic Assistance data delivery procedure

(1) The E-SMLC determines that assistance data needs to be provided to the UE and sends an LPP Provide Assistance Data message to the UE. This message includes information to identify the type of periodic assistance data and a duration for ending the assistance data delivery.

(2) When the first periodic message is available, the E-SMLC sends an unsolicited LPP Provide Assistance Data message to the UE containing the periodic assistance data announced in step (1).

(3) The server may continue to send further LPP Provide Assistance Data messages to the target containing the periodic assistance data announced in step (1) when each additional periodicity condition occurs. When the duration for ending the periodic assistance data transfer occurs, the last LPP Provide Assistance Data message transferred indicates the end of transaction. Additionally, the session can be ended on request by the UE or by the E-SMLC with the help of an Abort message.

###### 8.1.3.2.2 UE initiated Assistance Data Transfer

Figure 8.1.3.2.2-1 shows the Assistance Data Transfer operations for the network-assisted GNSS method when the procedure is initiated by the UE.



Figure 8.1.3.2.2-1: UE-initiated Assistance Data Transfer Procedure

(1) The UE determines that certain A-GNSS assistance data are desired (e.g., in case the UE requires its own location with autonomous self location or as part of a positioning procedure when the E-SMLC provided assistance data are not sufficient for the UE to fulfill the request) and sends a LPP Request Assistance Data message to the E-SMLC. This request includes an indication of which specific A-GNSS assistance data are requested for each GNSS, possibly together with additional information (e.g., for which GNSS signal types, or satellites, or times the assistance is requested, etc.). Additional information concerning the UE's approximate location and serving and neighbour cells may also be provided in the Request Assistance Data message and/or in an accompanying Provide Location Information message to help the E-SMLC provide appropriate assistance data. This additional data may include the UE's last known location if available, the cell IDs of the UE serving eNodeB and possibly neighbour eNodeBs, as well as E-CID measurements.

(2) The E-SMLC provides the requested assistance data in a LPP Provide Assistance Data message, if available at the E-SMLC. The entire set of assistance data may be delivered in one or several LPP messages, e.g., one message per GNSS. In this case, this step may be repeated by the E-SMLC several times. If any of the UE requested assistance data in step (1) are not provided in step 2, the UE shall assume that the requested assistance data are not supported, or currently not available at the E-SMLC. If none of the UE requested assistance data in step (1) can be provided by the E-SMLC, return any information that can be provided in an LPP message of type Provide Assistance Data which includes a cause indication for the not provided assistance data.

###### 8.1.3.2.2a UE initiated Periodic Assistance Data Transfer

Figure 8.1.3.2.2a-1 shows the Periodic Assistance Data Transfer operations for the high-accuracy GNSS methods (e.g., RTK) when the procedure is initiated by the UE.

NOTE: In this version of the specification, periodic assistance data transfer is supported for HA GNSS (e.g., RTK) positioning only.



Figure 8.1.3.2.2a-1: UE-initiated Periodic Assistance Data Transfer Procedure

(1) The UE determines that certain periodic A-GNSS assistance data, specific to one or more RTK-service levels, are desired and sends a LPP Request Assistance Data message to the E-SMLC. This request includes an indication of which specific A-GNSS assistance data are requested for each GNSS. Additional information like desired periodicity for sending the assistance data and a duration for ending the periodic session shall also be provided in the LPP Request Assistance Data message.

(2) The E-SMLC responds with a LPP Provide Assistance Data message to the UE. If the UE request can be supported, the message contains information which may confirm or redefine the type of assistance data or periodicity parameters requested at step (1). This response indicates the end of the control transaction.

(3) When available, the E-SMLC provides unsolicited the requested assistance data in a LPP Provide Assistance Data message to the UE. If any of the requested assistance data in step (1) or redefined in step (2) are not provided in step (3), the UE shall assume that the requested assistance data are not supported, or currently not available at the E-SMLC.

(4) The E-SMLC may transmit one or more additional LPP Provide Assistance Data messages to the UE containing further periodic assistance data confirmed or redefined in step (2). When the duration for ending the periodic assistance data transfer occur, the last LPP Provide Assistance Data message transferred indicates the end of the transaction. Additionally, the session can be ended on request by the UE or by the E-SMLC with the help of an Abort message.

##### 8.1.3.3 Location Information Transfer Procedure

The purpose of this procedure is to enable the E-SMLC to request position measurements or location estimate from the UE, or to enable the UE to provide location measurements to the E-SMLC for position calculation (e.g., in case of basic self location where the UE requests its own location).

The Location Information Transfer procedure can be used to transfer integrity requirements and integrity results for positioning integrity for UE-based mode.

###### 8.1.3.3.1 E-SMLC initiated Location Information Transfer Procedure

Figure 8.1.3.3.1-1 shows the Location Information Transfer operations for the network-assisted GNSS method when the procedure is initiated by the E-SMLC.



Figure 8.1.3.3.1-1: E-SMLC-initiated Location Information Transfer Procedure

(1)The E-SMLC sends a LPP Request Location Information message to the UE for invocation of A-GNSS positioning. This request includes positioning instructions such as the GNSS mode (UE-assisted, UE-based, UE-based preferred but UE-assisted allowed, UE-assisted preferred, but UE-based allowed, standalone), positioning methods (GPS, Galileo, GLONASS, BDS, NavIC, etc. and possibly non-GNSS methods, such as downlink positioning or E-CID), specific UE measurements requested if any, such as fine time assistance measurements, velocity, carrier phase, multi-frequency measurements, and quality of service parameters (accuracy, response time).

(2) The UE performs the requested measurements and possibly calculates its own location. The UE sends an LPP Provide Location Information message to the E-SMLC before the Response Time provided in step (1) elapsed. If the UE is unable to perform the requested measurements, or if the Response Time provided in step 1 elapsed before any of the requested measurements have been obtained, the UE returns any information that can be provided in an LPP message of type Provide Location Information which includes a cause indication for the not provided location information.

###### 8.1.3.3.2 UE-initiated Location Information Delivery Procedure

Figure 8.1.3.3.2-1 shows the Location Information delivery operations for the UE-assisted GNSS method when the procedure is initiated by the UE.



Figure 8.1.3.3.2-1: UE-initiated Location Information Delivery Procedure

(1) The UE sends an LPP Provide Location Information message to the E-SMLC. The Provide Location Information message may include any UE measurements (GNSS pseudo-ranges, carrier phase-ranges, and other measurements) already available at the UE.

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# Annex-Agreements on GNSS Positioning Integrity

### 3GPP TSG-RAN WG2 Meeting #114-e R2-21xxxxx

Agreement:

Proposal 1 (modified): RAN2 confirms that LPP messages RequestCapabilities and ProvideCapabilities are used to transfer capability information of GNSS positioning integrity support. FFS the contents of capability information for GNSS positioning integrity support.

### 3GPP TSG-RAN WG2 Meeting #115-e R2-2108835

Agreements:

Proposal 1: Agree that the GNSS feared events will be addressed in the WI.

Proposal 2 (modified): Agree that all for A-GNSS positioning methods, positioning integrity determination is supported in LPP.

Proposal 3: Agree that additional IEs are needed in LPP to support A-GNSS positioning integrity determination.

Proposal 4: The specific algorithms used for positioning integrity shall be up to implementation.

Proposal 5: For interoperability, the use of “hard-coded” parameters should be minimized and instead the needed parameters should be sent explicitly in the assistance data.

Proposal 6: RAN2 agrees that the PL will be reported in the Integrity Results. It is FFS whether Mode 2 and the TIR, AL, TTA that were used in the integrity calculation will also be reported in the integrity results.

Proposal 8: Agree that the UE feared events will be handled in the implementation for UE-based (network-assisted) methods of positioning integrity determination.

Proposal 10: Agree that the LMF feared events can be handled via implementation for the UE-based (network-assisted) and UE-assisted (LMF-based) methods of positioning integrity determination.

Proposal 11: RAN2 agrees to use Common Positioning IEs to transfer the KPIs and Integrity Results.

Proposal 12: RAN2 agrees that the LPP procedures can be used to transfer the KPIs and Integrity Results. For UE-assisted, the LCS procedures remain FFS in the case of MO-LR.

Agreements:

In Rel-17, we do not address the data transmission feared event (i.e. we rely on the system’s existing methods for assuring data integrity).

Agreements:

Proposal 1: The support of GNSS integrity is enabled by using existing NG-RAN positioning architecture.

Proposal 2: Any additional functional elements, positioning/integrity modes, etc. should be introduced only when needed.

Agreements:

Proposal 3 (modified): Separate procedures for "A-GNSS Positioning Integrity" as proposed in R2-2107503 will not be defined; the existing A-GNSS (and general location) Procedures are applicable/sufficient.

Proposal 4 (modified): RAN2 confirms that LPP messages RequestLocationInformation and ProvideLocationInformation are used to transfer integrity KPIs/results, respectively, for GNSS positioning at least for UE-based mode.

Proposal 5 (modified): RAN2 confirms that LPP messages RequestAssistanceData and ProvideAssistanceData are used to transfer integrity assistance data for GNSS positioning at least for UE-based mode.