**3GPP TSG-RAN2 Meeting #119-e *R2-220xxxx***

**Online, 17- 29 Aug, 2022**

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| *CR-Form-v12.2* |
| **CHANGE REQUEST** |
|  |
|  | **38.305** | **CR** | **0105** | **rev** | **2** | **Current version:** | **17.1.0** |  |
|  |
| *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:***  | Mscellaneous corrections for TS38.305 |
|  |  |
| ***Source to WG:*** | Intel Corporation (running CR Rapporteur) |
| ***Source to TSG:*** | R2 |
|  |  |
| ***Work item code:*** | NR\_pos\_enh-Core |  | ***Date:*** | 2022-08-31 |
|  |  |  |  |  |
| ***Category:*** | F |  | ***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-15 (Release 15)Rel-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)Rel-19 (Release 19)* |
|  |  |
| ***Reason for change:*** | From R2-2207384: 1 Some abbreviations are missing, e.g. SDT, SSB2 in section 7.9, If the UE initiated data transmission using UL SDT, the network can send DL LCS, LPP and RRC message (e.g. to configure SRS for UL positioning, if it is supported) to the UE without the need of state transition. It led the potential misunderstanding that any RRC message can be sent, e.g. RRCReconfiguration to configure SRS; But only RRCRelease message can be used;3 Pre-configured assistance data, “-” is used. However “preconfigured” without “-” is used in 8.10.3.1.2.1, 8.11.3.1.2.1, 8.12.3.1.2, and one of “preconfigured “ is missing in 8.11.3.1.2.1.4 As agreed Stage 2 CR in R2-2206244 (To reomove the IDs since we do not support area ID in 8.10.3.1.2.1, 8.12.3.1.2). However the change is missing for DL-AoD in 8.11.3.1.2.1.From R2-2208491: The validity area of PRS-configuration was introduced in Rel-17 for pre-configuration. But the information was not captured in the assistance data that may be transferrred from LMF to the UE for the DL and DL+UL positioning methods.From R2-2208415:In Equation 8.1.2.1.21-1, the current formula uses the dot product of the meanorbit vector with the line-of-sight vector (I), but this is not the correct computation for bounding the line-of-sight error. The meanorbit vector represents the extents of a bounding box from - meanorbit to + meanorbit and therefore both the positive and negative extents of the box must be taken into consideration in the line-of-sight bound formula.From R2-2208494:1. In accordance to TS 37.355, the need for the field *nr-DL-PRS-RSRP-Result-r16/nr-UL-SRS-RSRP-Result-r16* in the NR Multi-RTT and DL/UL-TDOA Location Information Elements is OPTIONAL. As for the field *nr-DL-PRS-RSRPP-Result-r16/nr-UL-SRS-RSRPP-Result-r16* in the NR Multi-RTT, DL/UL-TDOA and DL-AOD Location Information Elements is OPTIONAL as well.2. In the following description, the DL-PRS-RSRPP shall be UL-SRS-RSRPP.TRPs measure the gNB Rx-Tx time difference measurements (and optionally UL-SRS-RSRP and/or DL-PRS-RSRPP of the received signals).In addition,1 the description on SPS/MAC CE is missing for RRC-INACTIVE, capture agreements:Proposal 4 (modified): Update the first change of R2-2208521 to “Periodic and Semi-persistent UL-SRS transmission for positioning can be supported in RRC\_INACTIVE” , and merge it into the stage 2 rapporteur CR.To address comments on the description of MAC CE is missing;2 The resolution and range for the meanOrbitError, varOrbitError, meanClock, stdDevClock parameters are inconsistent with the corresponding values for the meanIonosphere and stdDevIonosphere.  |
|  |  |
| ***Summary of change:*** | From R2-2207384: 1 add abbreviations for SDT and SSB in section 3.2;2 add RRC message name for positioning in RRC\_INACTIVE in section 7.93 change preconfigured to pre-configured in 8.10.3.1.2.1, 8.11.3.1.2.1, 8.12.3.1.2 and add pre-configured for 8.11.3.1.2.14 remove IDs from area IDs in 8.11.3.1.2.1From R2-2208491: Add the validity area in the assistance data that may be transferrred from LMF to the UE for Multi-RTT, DL-AoD and DL-TDOA positioning.From R2-2208415:Update the meanorbit formula as presented in this CR.From R2-2208494:Revise the description about DL-PRS-RSRP and DL-PRS-RSRPP measurement in Multi-RTT, DL-AoD and DL-TDOA positioning.Additional added:1 to “Periodic and Semi-persistent UL-SRS transmission for positioning can be supported in RRC\_INACTIVE”2 Clarify “If the UE initiated data transmission using UL SDT, the network can send DL LCS, LPP, RRC Release message (e.g. to configure SRS for UL positioning, if it is supported) and MAC CE to the UE without the need of state transition.”3The varOrbitError and varOrbitRateError fields are renamed and redefined as stdDevOrbitError and stdDevOrbitRateError, respectively.Inter-operability:There are no impacts on inter-operability. |
|  |  |
| ***Consequences if not approved:*** | Error remains and incomplete of assistance data in stage 2 spec.For the changes on integrity, the UE uses an incorrect formula to project the orbit error bound from the satellite frame to the UE line-of-sight vector, leading to an incorrect bound.This can cause the UE to underestimate the orbit error.For the changes on DL-PRS-RSRPP, DL-PRS-RSRP, risk of misunderstanding on the presence of DL-PRS-RSRP and DL-PRS-RSRPP in DL and DL+DL measurement results. |
|  |  |
| ***Clauses affected:*** | 3.2, 4.3.11, 4.3.12, 4.3.13, 4.3.14, 7.6.2, 7.9, 8.1.2.1b, 8.1.2.1.21, 8.10.1, 8.10.2.1, 8.10.3.1.2.1, 8.11.1, 8.11.2.1, 8.11.3.1.2.1, 8.12.1, 8.12.2.1, 8.12.3.1.2, 8.13.1, 8.14.1 |
|  |  |
|  | **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:*** | Capture changes from R2-2207384 (change 1-4, updated 2), R2-2208491 (updated), R2-2208415 and R2-2208494 |
|  |  |
| ***This CR's revision history:*** | Rev 1: to capture changes from R2-2208801 (change 1-4, updated 2), R2-2208491 (updated), R2-2208415, , R2-2208494, R2-2208395 (stage 3 change, but impact stage 2 name)). Rev 2; To capture new agreements:Proposal 4 (modified): Update the first change of R2-2208521 to “Periodic and Semi-persistent UL-SRS transmission for positioning can be supported in RRC\_INACTIVE” , and merge it into the stage 2 rapporteur CR.To address comments on the description of MAC CE is missing; |

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1].

5GC 5G Core Network

5GS 5G System

A-AoA Azimuth-Angle of Arrival

ADR Accumulated Delta Range

AoA Angle of Arrival

AP Access Point

ARP Antenna Reference Point

BDS BeiDou Navigation Satellite System

BSSID Basic Service Set Identifier

CID Cell-ID (positioning method)

CLAS Centimetre Level Augmentation Service

DL-AoD Downlink Angle-of-Departure

DL-PRS Downlink Positioning Reference Signal

DL-TDOA Downlink Time Difference Of Arrival

DNU Do Not Use

E-SMLC Enhanced Serving Mobile Location Centre

E-CID Enhanced Cell-ID (positioning method)

ECEF Earth-Centered, Earth-Fixed

ECI Earth-Centered-Inertial

EGNOS European Geostationary Navigation Overlay Service

E-UTRAN Evolved Universal Terrestrial Radio Access Network

FDMA Frequency Division Multiple Access

FKP Flächenkorrekturparameter (Engl: Area Correction Parameters)

GAGAN GPS Aided Geo Augmented Navigation

GLONASS GLObal'naya NAvigatsionnaya Sputnikovaya Sistema (Engl.: Global Navigation Satellite System)

GMLC Gateway Mobile Location Centre

GNSS Global Navigation Satellite System

GPS Global Positioning System

GRS80 Geodetic Reference System 1980

HESSID Homogeneous Extended Service Set Identifier

LCS LoCation Services

LMF Location Management Function

LPP LTE Positioning Protocol

MAC Master Auxiliary Concept

MBS Metropolitan Beacon System

MO-LR Mobile Originated Location Request

MT-LR Mobile Terminated Location Request

Multi-RTT Multi-Round Trip Time

NavIC NAVigation with Indian Constellation

NG-C NG Control plane

NG-AP NG Application Protocol

NI-LR Network Induced Location Request

N-RTK Network – Real-Time Kinematic

NRPPa NR Positioning Protocol A

OTDOA Observed Time Difference Of Arrival

PDU Protocol Data Unit

posSI Positioning System Information

posSIB Positioning SIB

PPP Precise Point Positioning

PPP-RTK Precise Point Positioning – Real-Time Kinematic

PRS Positioning Reference Signal (for E-UTRA)

PRU Positioning Reference Unit

QZSS Quasi-Zenith Satellite System

RP Reception Point

RRM Radio Resource Management

RSRP Reference Signal Received Power

RSRPP Reference Signal Received Path Power

RSRQ Reference Signal Received Quality

RSSI Received Signal Strength Indicator

RSTD Reference Signal Time Difference

RTK Real-Time Kinematic

SBAS Space Based Augmentation System

SDT Small Data Transmission

SET SUPL Enabled Terminal

SIB System Information Block

SLP SUPL Location Platform

SP Semi-Persistent

SRS Sounding Reference Signal

SSB Synchronization Signal Block

SSID Service Set Identifier

SSR State Space Representation

STEC Slant TEC

SUPL Secure User Plane Location

TADV Timing Advance

TBS Terrestrial Beacon System

TEC Total Electron Content

TEG Timing Error Group

TP Transmission Point

TRP Transmission-Reception Point

TTA Time To Alert

TxTEG Tx Timing Error Group

UE User Equipment

UL-AoA Uplink Angle of Arrival

UL-RTOA Uplink Relative Time of Arrival

UL-SRS Uplink Sounding Reference Signal

UL-TDOA Uplink Time Difference of Arrival

URA User Range Accuracy

WAAS Wide Area Augmentation System

WGS-84 World Geodetic System 1984

WLAN Wireless Local Area Network

Z-AoA Zenith Angles of Arrival

/\*\*Skip unrelated parts\*\*/

7.6.2 On-Demand PRS transmission procedures

Figure 7.6.2-1 shows the general positioning procedure for On-Demand PRS transmission.

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**Figure 7.6.2-1: Procedures for On-Demand PRS request.**

0. The LMF may receive information on the possible On-Demand PRS configurations that the gNB can support during the TRP Information Exchange procedure.

1. In case of UE-initiated On-Demand PRS, the LMF may configure the UE with pre-defined PRS configurations via LPP Provide Assistance Data message or via posSI.

2a. In case of UE-initiated On-Demand PRS, the UE sends an On-Demand PRS request to the LMF via LPP Request Assistance Data message. The On-Demand PRS request can be a request for a pre-defined PRS configuration indicated with pre-defined PRS configuration ID or explicit parameter for PRS configuration and may be a request for PRS transmission or change to the PRS transmission characteristics for positioning measurements.

NOTE 1: The LPP Request Assistance Data message for On-Demand PRS may also be sent in an MO-LR location service request message.

NOTE 2: If the NW has provided the pre-defined On-Demand PRS configurations to the UE, the UE is allowed to request On-Demand PRS parameters based on pre-defined PRS configuration ID (index-based request) or explicit parameter requests that is within the scope of the received pre-defined On-Demand PRS configurations. Otherwise, the UE may blindly request On-Demand PRS parameters via an explicit request within the scope of the allowed parameter list, as specified in TS37.355 [42].

2b. In case of LMF-initiated On-Demand PRS, the LMF and the UE may exchange LPP messages e.g., to obtain UE measurements or the DL-PRS positioning capabilities of the UE, etc.

3. The LMF determines the need for PRS transmission or change to the transmission characteristics of an ongoing PRS transmission.

4. The LMF requests the serving and non-serving gNBs/TRPs for new PRS transmission or PRS transmission with changes to the PRS configuration via NRPPa PRS CONFIGURATION REQUEST message.

5. The gNBs/TRPs provide the successfully configured or updated PRS transmission in the NRPPa PRS CONFIGURATION RESPONSE message accordingly.

6. LMF may provide the PRS configuration used for PRS transmission or error cause via LPP Provide Assistance Data message to the UE.

NOTE 3: If the LPP Request Assistance Data for On-Demand DL-PRS at Step 2a was sent in an MO-LR location service request message, the LMF provides a MO-LR response as described in clause 7.3.3.

NOTE 4: It is up to Network (LMF) implementation on the steps to follow (accept/reject/ignore) on receiving UE-initiated On-Demand PRS request.

NOTE 5: It is up to Network (TRP) implementation on the steps to follow (accept/reject/ignore) on receiving LMF-initiated On-Demand PRS requests.

/\*\*Skip unrelated parts\*\*/

7.9 Positioning in RRC\_INACTIVE state

Positioning may be performed when a UE is in RRC\_INACTIVE state. Any uplink LCS or LPP message can be transported in RRC\_INACTIVE state. If the UE initiated data transmission using UL SDT, the network can send DL LCS, LPP, RRC Release message (e.g. to configure SRS for UL positioning, if it is supported) and MAC CE to the UE without the need of state transition.

Periodic and Semi-persistent UL-SRS transmission for positioning can be supported in RRC\_INACTIVE.

/\*\*Skip unrelated parts\*\*/

4.3.11 Multi-RTT positioning

The Multi-RTT positioning method makes use of the UE Rx-Tx time difference measurements (and optionally DL-PRS-RSRP and/or DL-PRS-RSRPP) of downlink signals received from multiple TRPs, measured by the UE and the measured gNB Rx-Tx time difference measurements (and optionally UL-SRS-RSRP and/or UL-SRS-RSRPP) at multiple TRPs of uplink signals transmitted from UE.

The UE measures the UE Rx-Tx time difference measurements (and optionally DL-PRS-RSRP and/or DL-PRS-RSRPP of the received signals) using assistance data received from the positioning server, and the TRPs measure the gNB Rx-Tx time difference measurements (and optionally UL-SRS-RSRP and/or UL-SRS-RSRPP of the received signals) using assistance data received from the positioning server. The measurements are used to determine the RTT at the positioning server which are used to estimate the location of the UE.

The operation of the Multi-RTT positioning method is described in clause 8.10.

4.3.12 DL-AoD positioning

The DL-AoD positioning method makes use of the measured DL-PRS-RSRP (and optionally DL-PRS-RSRPP) of downlink signals received from multiple TPs, at the UE. The UE measures the DL-PRS-RSRP (and optionally DL-PRS-RSRPP) of the received signals using assistance data received from the positioning server, and the resulting measurements are used along with other configuration information to locate the UE in relation to the neighbouring TPs.

The operation of the DL-AoD positioning method is described in clause 8.11.

4.3.13 DL-TDOA positioning

The DL-TDOA positioning method makes use of the DL RSTD (and optionally DL-PRS-RSRP and/or DL-PRS-RSRPP) of downlink signals received from multiple TPs, at the UE. The UE measures the DL RSTD (and optionally DL-PRS-RSRP and/or DL-PRS-RSRPP) of the received signals using assistance data received from the positioning server, and the resulting measurements are used along with other configuration information to locate the UE in relation to the neighbouring TPs.

The operation of the DL-TDOA positioning method is described in clause 8.12.

4.3.14 UL-TDOA positioning

The UL-TDOA positioning method makes use of the UL-RTOA (and optionally UL-SRS-RSRP and/or UL-SRS-RSRPP) at multiple RPs of uplink signals transmitted from UE. The RPs measure the UL-RTOA (and optionally UL-SRS-RSRP and/or UL-SRS-RSRPP) of the received signals using assistance data received from the positioning server, and the resulting measurements are used along with other configuration information to estimate the location of the UE.

The operation of the UL-TDOA positioning method is described in clause 8.13.

/\*\*Skip unrelated parts\*\*/

8.1.2.1b Mapping of integrity parameters

Table 8.1.2.1b-1 shows the mapping between the integrity fields and the SSR assistance data according to the Integrity Principle of Operation (Clause 8.1.1a). The corresponding field descriptions for each of the field names listed in Table 8.1.2.1b-1 are specified under Clause 6.5.2.2 of TS 37.355 [42].

**Table 8.1.2.1b-1: Mapping of Integrity Parameters**

|  |  |  |
| --- | --- | --- |
| **Error** | **GNSS Assistance Data** | **Integrity Fields** |
| **Integrity Alerts** | **Integrity Bounds (Mean)** | **Integrity Bounds (StdDev)** | **Residual Risks** | **Integrity Correlation Times** |
| Orbit | SSR Orbit Corrections | Real-Time Integrity(see Clause 8.1.2.1.8) | Mean Orbit ErrorMean Orbit Rate Error(Calculated according to Equation 8.1.2.1.21-1) | Standard Deviation Orbit ErrorStandard Deviation Orbit Rate Error(Calculated according to Equation 8.1.2.1.21-1) | Probability of Onset of Constellation FaultProbability of Onset of Satellite FaultMean Constellation Fault DurationMean Satellite Fault Duration | Orbit Range Error Correlation TimeOrbit Range Rate Error Correlation Time |
| Clock | SSR Clock Corrections | Mean Clock ErrorMean Clock Rate Error | Standard Deviation Clock ErrorStandard Deviation Clock Rate Error | Clock Range Error Correlation TimeClock Range Rate Error Correlation Time |
| Code Bias | SSR Code Bias | Mean Code Bias ErrorMean Code Bias Rate Error | Standard Deviation Code Bias ErrorStandard Deviation Code Bias Rate Error |  |
| Phase Bias | SSR Phase Bias | Mean Phase Bias ErrorMean Phase Bias Rate Error | Standard Deviation Phase Bias ErrorStandard Deviation Phase Bias Rate Error |
| Ionosphere | SSR STEC Correction | Ionosphere DNU | Mean Ionospherre ErrorMean Ionospherre Rate Error | Standard Deviation Ionosphere ErrorStandard Deviation Ionosphere Rate Error | Probability of Onset of Ionosphere FaultMean Ionosphere Fault Duration | Ionosphere Range Error Correlation TimeIonosphere Range Rate Error Correlation Time |
| Troposphere Vertical Hydro Static Delay | SSR Gridded Corrections | Troposphere DNU | Mean Troposphere Vertical Hydro Static Delay ErrorMean Troposphere Vertical Hydro Static Delay Rate Error | Standard Deviation Troposphere Vertical Hydro Static Delay ErrorStandard Deviation Troposphere Vertical Hydro Static Delay Rate Error | Probability of Onset of Troposphere FaultMean Troposphere Fault Duration | Troposphere Range Error Correlation TimeTroposphere Range Rate Error Correlation Time |
| TroposphereVertical WetDelay | Mean Troposphere Vertical Wet Delay ErrorMean Troposphere Vertical Wet Delay Rate Error | Standard Deviation Troposphere Vertical Wet Delay ErrorStandard Deviation Troposphere Vertical Wet Delay Rate Error |

/\*\*Skip unrelated parts\*\*/

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 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 (AT), cross-track (CT) and radial (RA) coordinates into the WGS-84 ECEF coordinate frame. RT denotes the transposed matrix.

*v*: 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 v is expressed in the SSR Orbit Corrections as the three elements in the Variance Orbit Residual Error Vector.

/\*\*Skip unrelated parts\*\*/

8.10.1 General

In the Multi-RTT positioning method, the UE position is estimated based on measurements performed at both, UE and TRPs. The measurements performed at the UE and TRPs are UE/gNB Rx-Tx time difference measurements (and optionally DL-PRS-RSRP, DL-PRS-RSRPP, UL-SRS-RSRP, and/or UL-SRS-RSRPP) of DL-PRS and UL-SRS, which are used by an LMF to determine the RTTs.

The UE may require measurement gaps to perform the Multi-RTT measurements from NR TRPs. The UE may request measurement gaps from a gNB using the procedure described in clause 7.4.1.1. The UE may also request to activate pre-configured measurement gaps as described in clause 7.7.2.

/\*\*Skip unrelated parts\*\*/

8.10.2.1 Information that may be transferred from the LMF to UE

The information that may be transferred from the LMF to the UE are listed in Table 8.10.2.1-1.

**Table 8.10.2.1-1: Assistance data that may be transferred from LMF to the UE**

|  |
| --- |
| **Information**  |
| Physical cell IDs (PCIs), global cell IDs (GCIs), and PRS IDs, ARFCNs of candidate NR TRPs for measurement |
| Timing relative to the serving (reference) TRP of candidate NR TRPs |
| DL-PRS configuration of candidate NR TRPs |
| SSB information of the TRPs (the time/frequency occupancy of SSBs) |
| PRS-only TP indication |
| On-Demand DL-PRS-Configurations |
| Validity Area of the Assistance Data |

/\*\*Skip unrelated parts\*\*/

8.10.3.1.2.1 Assistance Data Transfer between LMF and UE

The purpose of this procedure is to enable the LMF to provide assistance data to the UE (e.g., as part of a positioning procedure) and the UE to request assistance data from the LMF (e.g., as part of a positioning procedure). The LMF may provide the pre-configured DL-PRS assistance data (with associated validity criteria) to the UE (before or during an ongoing LPP positioning session), to be utilized for potential positioning measurements at a future time. Pre-configured DL-PRS assistance data may consist of multiple instances, where each instance is applicable to a different area within the network. One or more assistance data instances may be provided in one or more LPP Assistance Data messages.

If a UE receives assistance data for a TRP for which it has already stored assistance data, it overwrites the stored assistance data, whereas if a UE receives assistance data for a TRP for which it has not stored assistance data, it maintains its stored assistance data for other TRPs. The TRPs are uniquely identified using a combination of PRS-ID and Cell-ID. The number TRPs for which the UE can store Assistance Data is a UE capability and is indicated by the number of areas a UE can support.

/\*\*Skip unrelated parts\*\*/

8.11.1 General

In the DL-AoD positioning method, the UE position is estimated based on DL-PRS-RSRP and/or DL-PRS-RSRPP measurements taken at the UE of downlink radio signals from multiple NR TRPs, along with knowledge of the spatial information of the downlink radio signals and geographical coordinates of the TRPs.

The UE while connected to a gNB may require measurement gaps to perform the DL-AoD measurements from NR TRPs. The UE may request measurement gaps from a gNB using the procedure described in clause 7.4.1.1. The UE may also request to activate pre-configured measurement gaps as described in clause 7.7.2.

The specific positioning techniques used to estimate the UE's location from this information are beyond the scope of this specification.

/\*\*Skip unrelated parts\*\*/

8.11.2.1 Information that may be transferred from the LMF to UE

The information that may be transferred from the LMF to the UE are listed in table 8.11.2.1-1.

**Table 8.11.2.1-1: Assistance data that may be transferred from LMF to the UE**

|  |  |  |
| --- | --- | --- |
| **Information**  | **UE-assisted** | **UE-based** |
| Physical cell IDs (PCIs), global cell IDs (GCIs), ARFCN, and PRS IDs of candidate NR TRPs for measurement | Yes | Yes |
| Timing relative to the serving (reference) TRP of candidate NR TRPs | Yes | Yes |
| DL-PRS configuration of candidate NR TRPs | Yes | Yes |
| SSB information of the TRPs (the time/frequency occupancy of SSBs) | Yes | Yes |
| Spatial direction information (e.g. azimuth, elevation etc.) of the DL-PRS Resources of the TRPs served by the gNB | Yes | Yes |
| Geographical coordinates of the TRPs served by the gNB (include a transmission reference location for each DL-PRS Resource ID, reference location for the transmitting antenna of the reference TRP, relative locations for transmitting antennas of other TRPs) | No | Yes |
| PRS-only TP indication | Yes | Yes |
| TRP beam/antenna information (including azimuth angle, zenith angle and relative power between PRS resources per angle per TRP) | No | Yes  |
| LOS/NLOS indicators | No | Yes |
| On-Demand DL-PRS-Configurations | Yes | Yes |
| Expected Angle Assistance information | Yes | Yes |
| PRS priority list  | Yes | Yes |
| Validity Area of the Assistance Data | Yes | Yes |

/\*\*Skip unrelated parts\*\*/

8.11.3.1.2 Assistance Data Transfer Procedure

The purpose of this procedure is to enable the LMF to provide assistance data to the UE (e.g., as part of a positioning procedure) and the UE to request assistance data from the LMF (e.g., as part of a positioning procedure). The LMF may provide the pre-configured DL-PRS assistance data (with associated validity criteria) to the UE (before or during an ongoing LPP positioning session), to be utilized for potential positioning measurements at a future time. Pre-configured DL-PRS assistance data may consist of multiple instances, where each instance is applicable to a different area within the network. One or more assistance data instances may be provided in one or more LPP Assistance Data messages.

If a UE receives assistance data for a TRP for which it has already stored assistance data, it overwrites the stored assistance data, whereas if a UE receives assistance data for a TRP for which it has not stored assistance data, it maintains its stored assistance data for other TRPs. The TRPs are uniquely identified using a combination of PRS-ID and Cell-ID. The number TRPs for which the UE can store Assistance Data is a UE capability and is indicated by the number of areas a UE can support.

/\*\*Skip unrelated parts\*\*/

8.12.1 General

In the DL-TDOA positioning method, the UE position is estimated based on DL RSTD (and optionally DL-PRS-RSRP and/or DL-PRS-RSRPP) measurements taken at the UE of downlink radio signals from multiple NR TRPs, along with knowledge of the geographical coordinates of the TRPs and their relative downlink timing.

The UE while connected to a gNB may require measurement gaps to perform the DL-TDOA measurements from NR TRPs. The UE may request measurement gaps from a gNB using the procedure described in clause 7.4.1.1.

The specific positioning techniques used to estimate the UE's location from this information are beyond the scope of this specification.

/\*\*Skip unrelated parts\*\*/

8.12.2.1 Information that may be transferred from the LMF to UE

The information that may be transferred from the LMF to the UE are listed in table 8.12.2.1-1.

**Table 8.12.2.1-1: Assistance data that may be transferred from LMF to the UE**

|  |  |  |
| --- | --- | --- |
| **Information**  | **UE‑assisted**  | **UE‑based**  |
| Physical cell IDs (PCIs), global cell IDs (GCIs), ARFCN, and PRS IDs of candidate NR TRPs for measurement | Yes | Yes |
| Timing relative to the serving (reference) TRP of candidate NR TRPs | Yes | Yes |
| DL-PRS configuration of candidate NR TRPs | Yes | Yes |
| SSB information of the TRPs (the time/frequency occupancy of SSBs) | Yes | Yes |
| Spatial direction information (e.g. azimuth, elevation etc.) of the DL-PRS Resources of the TRPs served by the gNB | No | Yes |
| Geographical coordinates of the TRPs served by the gNB (include a transmission reference location for each DL-PRS Resource ID, reference location for the transmitting antenna of the reference TRP, relative locations for transmitting antennas of other TRPs) | No | Yes |
| Fine Timing relative to the serving (reference) TRP of candidate NR TRPs | No | Yes |
| PRS-only TP indication | Yes | Yes |
| The association information of DL-PRS resources with TRP Tx TEG ID | No | Yes |
| LOS/NLOS indicators | No | Yes |
| On-Demand DL-PRS-Configurations | Yes | Yes |
| Validity Area of the Assistance Data | Yes | Yes |

/\*\*Skip unrelated parts\*\*/

8.12.3.1.2 Assistance Data Transfer Procedure

The purpose of this procedure is to enable the LMF to provide assistance data to the UE (e.g., as part of a positioning procedure) and the UE to request assistance data from the LMF (e.g., as part of a positioning procedure). The LMF may provide the pre-configured DL-PRS assistance data (with associated validity criteria) to the UE (before or during an ongoing LPP positioning session), to be utilized for potential positioning measurements at a future time. Pre-configured DL-PRS assistance data may consist of multiple instances, where each instance is applicable to a different area within the network. One or more assistance data instances may be provided in one or more LPP Assistance Data messages.

If a UE receives assistance data for a TRP for which it has already stored assistance data, it overwrites the stored assistance data, whereas if a UE receives assistance data for a TRP for which it has not stored assistance data, it maintains its stored assistance data for other TRPs. The TRPs are uniquely identified using a combination of PRS-ID and Cell-ID. The number TRPs for which the UE can store Assistance Data is a UE capability and is indicated by the number of areas a UE can support.

/\*\*Skip unrelated parts\*\*/

8.13.1 General

In the UL-TDOA positioning method, the UE position is estimated based on UL-RTOA (and optionally UL-SRS-RSRP and/or UL-SRS-RSRPP) measurements taken at different TRPs of uplink radio signals from UE, along with other configuration information.

The specifics of any UL-TDOA positioning methods or techniques used to estimate the UE's location from these measurements are beyond the scope of this specification.

In order to obtain uplink measurements, the TRPs need to know the characteristics of the SRS signal transmitted by the UE for the time period required to perform uplink measurement. These characteristics should be static over the periodic transmission of SRS during the uplink measurements. Hence, the LMF will indicate to the serving gNB the need to direct the UE to transmit SRS signals for uplink positioning. It is up to the serving gNB to make the final decision on resources to be assigned and to communicate this SRS configuration information back to the LMF so that LMF can forward the SRS configuration to the TRPs. The gNB may decide (e.g., in case no resources are available) to configure no resources for the UE and report the empty resource configuration to the LMF.

/\*\*Skip unrelated parts\*\*/

8.14.1 General

In the UL-AoA positioning method, the UE position is estimated based on UL-AoA (and optionally UL-SRS-RSRP and/or UL-SRS-RSRPP) of uplink radio signals taken at different TRPs, along with other configuration information.

The specific of any UL-AoA positioning methods or techniques used to estimate the UE's location from these measurements are beyond the scope of this specification.

In order to obtain uplink measurements, the TRPs need to know the characteristics of the SRS signal transmitted by the UE for the time period required to calculate uplink measurement. These characteristics should be static over the periodic transmission of SRS during the uplink measurements. Hence, the LMF will indicate to the serving gNB the need to direct the UE to transmit SRS signals for uplink positioning. It is up to the gNB to make the final decision on resources to be assigned and to communicate this configuration information back to the LMF so that LMF can configure the TRPs. The gNB may decide (e.g., in case no resources are available) to configure no resources for the UE and fail the corresponding NRPPa procedure.