**3GPP TSG-RAN2 Meeting #118-e *Draft R2-2206244***

**Online, 9- 20 May, 2022**

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| *CR-Form-v12.2* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
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|  | **38.305** | **CR** | **CRNum** | **rev** | **-** | **Current version:** | **17.0.0** |  |
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| *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:*** | 38.305 CR for Positioning WI | | | | | | | | | |
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| ***Source to WG:*** | Intel Corporation | | | | | | | | | |
| ***Source to TSG:*** | R2 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_pos\_enh-Core | | | | |  | ***Date:*** | | | 2022-04-25 |
|  |  | | | |  | |  | | |  |
| ***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 can be 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:*** | | To capture corrections into TS38.305 (R2-2204931, R2-2204995,). | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | **Proposal from R2-2204931**  **Proposal 1:** In 5.4.5 Positioning Reference Unit (PRU), remove the EN, keep rest part on PRU as it is; No additional work on this;  **Proposal 2:** Add abbreviation on TTA, DNU in section 3.2 as  TTA Time To Alert  DNU Do Not Use  TxTEG Tx Timing Error Group  **Proposal 3:** Combine the description on SRS in 6.2.2 Radio Resource Control (RRC) for NR as  The RRC protocol for NR is also used to configure UEs with a sounding reference signal (SRS) for SRS transmission in RRC\_CONNECTED and RRC\_INACTIVE to support NG-RAN measurements for NR positioning, provide pre-configured measurement gap configuration(s) and pre-configured PRS processing window for DL-PRS measurement and report the UE TxTEG (Tx Timing Error Group) for UL-TDOA.  ~~The RRC protocol for NR is also used to configure UEs with a sounding reference signal (SRS) for SRS transmission in RRC\_INACTIVE to support NG-RAN measurements for NR positioning.~~  **Proposal 4:** Clarify in 7.6.2 On-Demand PRS transmission procedures on “The On-Demand PRS request can be ~~the~~ a request for a pre-defined PRS configuration indicated withpre-defined PRS configuration ID ”  **Proposal5:** Clarify in 7.7.2 Pre-configured Measurement Gap procedures on “The UE sends RRC Reconfiguration complete message to the gNB to confirm the reception of pre-configured measurement gap configuration (s).”  **Proposal6:** Clarify in 7.7.2 Pre-configured Measurement Gap procedures on “the gNB may send DL MAC CE Positioning Measurement Gap Activation/Deactivation containing an ID to activate/deactivate the associated measurement gap.”  **Proposal7:** Clarify in 7.8.2 Pre-configured PRS processing window procedures on “The UE sends RRC Reconfiguration complete message to the gNB to confirm the reception of pre-configured PRS processing window configuration (s).”  **Proposal8:** Clarify in 7.8.2 Pre-configured PRS processing window procedures on “the gNB sends DL MAC CE PPW Activation/Deactivation Command containing an ID to activate/deactivate the associated PRS processing window.”  **Proposal9:** Clarify in 7.9 Positioning in RRC\_INACTIVE state on “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.”  **Proposal10 (modified based on At118-622):** In section 8.13.3.4 Sequence of Procedure for UL-TDOA positioning, remove step 3b and corresponding descriptions  **R2-2204995**  1. Added RSRPP measurement to the general description of the corresponding NR positioning methods.  2. Editorial correction to include the triggering condition in the “if” clause for the purpose of sending UL MAC CE for requesting the measurement gap activation.  3. Updated/changed RSRPP description in the information between UE/gNB and LMF.  4. Added association between SRS and UE Tx TEG ID in the information between UE and LMF for Multi-RTT.  5. Voided the row of the duplicated “spatial direction information” in the DL-AoD assistance data.  6. Added UL Angle of Arrival in the information between gNB and LMF for UL-TDOA.  **R2-2205655**  2) Added several additional editorial corrections  **R2-2204690**  Correct the publishing date of BDS system B3I signal ICD in references clause.  **R2-2205810**  Correct the typo in 7.3.4.  Added the UE request of new pre-configured gap. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | Error remains in TS38.305. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 2, 3.2, 4.3.11, 4.3.12, 4.3.13, 4.3.14, 4.3.15, 5.4.5, 6.2.2, 7.3.4, 7.7.2, 7.8.2, 7.9, 8.10.1, 8.10.2.2, 8.10.2.3, 8.10.3.1.2.1, 8.11.1, 8.11.2.1, 8.11.2.2, 8.12.1, 8.12.2.2, 8.12.3.1.2, 8.13.1, 8.13.2.1, 8.13.2.2, 8.13.3.4, 8.14.1, 8.14.2.2 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **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:*** | |  | | | | | | | | |

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non‑specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 23.501 "System Architecture for the 5G System; Stage 2".

[3] 3GPP TS 22.071: "Location Services (LCS); Service description, Stage 1".

[4] 3GPP TS 23.032: "Universal Geographical Area Description (GAD)".

[5] IS-GPS-200, Revision D, Navstar GPS Space Segment/Navigation User Interfaces, March 7th, 2006.

[6] IS-GPS-705, Navstar GPS Space Segment/User Segment L5 Interfaces, September 22, 2005.

[7] IS-GPS-800, Navstar GPS Space Segment/User Segment L1C Interfaces, September 4, 2008.

[8] Galileo OS Signal in Space ICD (OS SIS ICD), Draft 0, Galileo Joint Undertaking, May 23rd, 2006.

[9] Global Navigation Satellite System GLONASS Interface Control Document, Version 5, 2002.

[10] IS-QZSS, Quasi Zenith Satellite System Navigation Service Interface Specifications for QZSS, Ver.1.0, June 17, 2008.

[11] Specification for the Wide Area Augmentation System (WAAS), US Department of Transportation, Federal Aviation Administration, DTFA01-96-C-00025, 2001.

[12] RTCM 10402.3, RTCM Recommended Standards for Differential GNSS Service (v.2.3), August 20, 2001.

[13] 3GPP TS 36.331: "Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification".

[14] 3GPP TS 38.331: "NR Radio Resource Control (RRC) protocol specification".

[15] OMA-AD-SUPL-V2\_0: "Secure User Plane Location Architecture Approved Version 2.0".

[16] OMA-TS-ULP-V2\_0\_6: "UserPlane Location Protocol Approved Version 2.0.6".

[17] 3GPP TS 36.214: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer – Measurements".

[18] 3GPP TS 36.302: "Evolved Universal Terrestrial Radio Access (E-UTRA); Services provided by the physical layer".

[19] 3GPP TS 36.355: "Evolved Universal Terrestrial Radio Access (E-UTRA); LTE Positioning Protocol (LPP)".

[20] BDS-SIS-ICD-B1I-3.0: "BeiDou Navigation Satellite System Signal In Space Interface Control Document Open Service Signal B1I (Version 3.0)", February, 2019.

[21] IEEE 802.11: "Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications"

[22] Bluetooth Special Interest Group: "Bluetooth Core Specification v4.2", December 2014.

[23] ATIS-0500027: "Recommendations for Establishing Wide Scale Indoor Location Performance", May 2015.

[24] 3GPP TS 36.211: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical channels and modulation".

[25] 3GPP TS 36.305: "Stage 2 functional specification of User Equipment (UE) positioning in E‑UTRA".

[26] 3GPP TS 23.502: "Procedures for the 5G System; Stage 2".

[27] 3GPP TS 38.455: "NG-RAN; NR Positioning Protocol A (NRPPa)".

[28] 3GPP TS 29.518: "5G System; Access and Mobility Management Services; Stage 3".

[29] 3GPP TS 24.501: "Non-Access-Stratum (NAS) protocol for 5G System (5GS); Stage 3".

[30] 3GPP TS 38.413: "NG-RAN; NG Application Protocol (NGAP)".

[31] RTCM 10403.3, "RTCM Recommended Standards for Differential GNSS Services (v.3.3)", October 7, 2016.

[32] 3GPP TS 38.133: "NR; Requirements for support of radio resource management".

[33] 3GPP TS 29.572: "Location Management Services; Stage 3".

[34] BDS-SIS-ICD-B1C-1.0: "BeiDou Navigation Satellite System Signal In Space Interface Control Document Open Service Signal B1C (Version 1.0)", December, 2017

[35] 3GPP TS 23.273: "5G System (5GS) Location Services (LCS); Stage 2".

[36] IS-QZSS-L6-001, Quasi-Zenith Satellite System Interface Specification – Centimetre Level Augmentation Service, Cabinet Office, November 5, 2018.

[37] 3GPP TS 38.215: "NR; Physical layer – Measurements".

[38] 3GPP TS 38.401: "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; NG-RAN; Architecture description".

[39] 3GPP TS 38.321: "NR; Medium Access Control (MAC) protocol specification".

[40] 3GPP TS 38.212: "NR; Multiplexing and channel coding".

[41] 3GPP TS 24.571: "Control plane Location Services (LCS) procedures".

[42] 3GPP TS 37.355: "Technical Specification Group Radio Access Network; LTE Positioning Protocol (LPP)".

[43] IRNSS Signal-In-Space (SPS) Interface Control Document (ICD) for standard positioning service version 1.1, August 2017.

[44] BDS-SIS-ICD-B2a-1.0: "BeiDou Navigation Satellite System Signal In Space Interface Control Document Open Service Signal B2a (Version 1.0)", December, 2017.

[45] BDS-SIS-ICD-B3I-1.0: "BeiDou Navigation Satellite System Signal In Space Interface Control Document Open Service Signal B3I (Version 1.0)", February, 2018.

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

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

SET SUPL Enabled Terminal

SIB System Information Block

SLP SUPL Location Platform

SP Semi-Persistent

SRS Sounding Reference Signal

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\*\*/

### 4.3.11 Multi-RTT positioning

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

### 4.3.15 UL-AoA

The UL-AoA positioning method makes use of the measured azimuth angle of arrival (A-AoA) and zenith angle of arrival (Z-AoA) at multiple RPs of uplink signals transmitted from the UE. The RPs measure A-AoA and Z-AoA (and optionally 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-AoA positioning method is described in clause 8.14.

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5.4.5 Positioning Reference Unit (PRU)

A Positioning Reference Unit (PRU) at a known location can perform positioning measurements (e.g., RSTD, RSRP, UE Rx-Tx Time Difference measurements, etc.) and report these measurements to a location server. In addition, the PRU can transmit SRS to enable TRPs to measure and report UL positioning measurements (e.g., RTOA, UL-AoA, gNB Rx-Tx Time Difference, etc.) from PRU at a known location. The PRU measurements can be compared by a location server with the measurements expected at the known PRU location to determine correction terms for other nearby target devices. The DL- and/or UL location measurements for other target devices can then be corrected based on the previously determined correction terms.

From a location server perspective, the PRU functionality is realized by a UE with known location.

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

6.2.2 Radio Resource Control (RRC) for NR

The RRC protocol for NR is terminated between the gNB and the UE. It provides transport for LPP messages over the NR-Uu interface.

In addition to providing transport for LPP messages over the NR-Uu interface, it supports transfer of measurements that may be used for positioning purposes through the existing measurement systems specified in TS 38.331 [14].

The RRC protocol for NR also supports broadcasting of assistance data via positioning System Information messages.

The RRC protocol for NR is also used to configure UEs with a sounding reference signal (SRS) for SRS transmission in RRC\_CONNECTED and RRC\_INACTIVE to support NG-RAN measurements for NR positioning, provide pre-configured measurement gap configuration(s) and pre-configured PRS processing window for DL-PRS measurement and report the UE TxTEG (Tx Timing Error Group) for UL-TDOA.

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

### 7.3.4 Deferred MT-LR Event Reporting Support

Figure 7.3.4-1 shows the sequence of operations for a Deferred MT-LR Event Reporting starting at the point where the UE reports an event to the LMF.

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7.6 Procedures for On-Demand PRS transmission

7.6.1 General

On-Demand PRS transmission procedure allows the LMF to control and decide whether PRS is transmitted or not and to change the characteristics of an ongoing PRS transmission. The on-demand PRS transmission procedure can be initiated either by the UE or LMF. The actual PRS changes are requested by the LMF irrespective of whether the procedure is UE- or LMF-initiated.

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 PRS transmission update in the NRPPa PRS CONFIGURATION RESPONSE message accordingly.

6. LMF may provide the updated 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.

7.7 Procedures for Pre-configured Measurement Gap

7.7.1 General

The pre-configured measurement gap procedure is used by the network to provide measurement gap for NR DL-PRS measurements. The gNB may activate/deactivate the pre-configurated measurement gap upon receiving the request from a UE or LMF.

7.7.2 Pre-configured Measurement Gap procedures

Figure 7.7.2-1 shows the general positioning procedure for Pre-configured Measurement Gap.

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**Figure 7.7.2-1: Pre-configured measurement gap configuration procedure**

0. LMF obtains the TRP information required for positioning services from the gNBs.

1. The LMF provides the PRS information of the neighbour TRPs to the serving gNB and requests the serving gNBs to pre-configure measurement gap via NRPPa MEASUREMENT PRECONFIGURATION REQUIRED message.

2. Based on the assistance information from the LMF and the UE capability, the serving gNB provides pre-configured measurement gap configuration(s) with associated ID(s) to the UE by sending RRC Reconfiguration message specified in TS 38.331 [14].

3. The UE sends RRC Reconfiguration complete message to the gNB to confirm the reception of pre-configured measurement gap configuration(s).

4. The gNB sends the confirmation message to the LMF to indicate the success of the pre-configuration via NRPPa MEASUREMENT PRECONFIGURATION CONFIRM message.

5a. If the UE requires measurement gaps for performing the requested location measurements, and the triggering condition for UL MAC CE as specified in TS 38.331 [14] is met, the UE sends UL MAC CE Positioning Measurement Gap Activation/Deactivation Request to the gNB and indicates the requested measurement gap configuration based on the ID configured in step 1.

5b. LMF may send the NRPPa MEASUREMENT ACTIVATION message to request for measurement gap activation.

6. Based on the request from the UE in step 5a or the request from the LMF in step 5b, the gNB may send DL MAC CE Positioning Measurement Gap Activation/Deactivation containing an ID to activate/deactivate the associated measurement gap.

7.8 Procedures for Pre-configured PRS processing window

7.8.1 General

The pre-configured PRS processing window procedure is used by the network to provide PRS processing window for NR DL-PRS measurements to the UE without measurement gap. The gNB may activate the pre-configurated PRS processing window upon receiving the request from LMF.

7.8.2 Pre-configured PRS processing window procedures

Figure 7.8.2-1 shows the general positioning procedure for Pre-configured PRS processing window.

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**Figure 7.8.2-1: Pre-configured PRS processing window configuration procedure**

0. LMF obtains the TRP information required for positioning services from the gNBs.

1. The LMF provides the PRS information of the neighbour TRPs to the serving gNB and requests the serving gNBs to pre-configure PRS processing window configuration(s) via NRPPa MEASUREMENT PRECONFIGURATION REQUIRED message.

2. Based on the assistance information from the LMF and the UE capability, the serving gNB provides pre-configured PRS processing window configuration(s) with associated ID(s) to the UE by sending RRC Reconfiguration message specified in TS 38.331 [14].

3. The UE sends RRC Reconfiguration complete message to the gNB to confirm the reception of pre-configured PRS processing window configuration(s).

4. The gNB sends the confirmation message to the LMF to indicate the success of the pre-configuration via NRPPa MEASUREMENT PRECONFIGURATION CONFIRM message.

5. The LMF sends the NRPPa MEASUREMENT ACTIVATION message to request the gNB to (de)activate the preconfigured PRS processing window.

6. Based on the request from the LMF in step 5, the gNB sends DL MAC CE PPW Activation/Deactivation Command containing an ID to activate/deactivate the associated PRS processing window.

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 and RRC message (e.g. to configure SRS for UL positioning, if it is supported) to the UE without the need of state transition.

==================================NEXT CHANGE==================================

## 8.10 Multi-RTT positioning

### 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 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.

==================================NEXT CHANGE==================================

8.10.2.2 Information that may be transferred from the UE to LMF

The information that may be signalled from UE to the LMF is listed in Table 8.10.2.2-1. The individual UE measurements are defined in TS 38.215 [37].

**Table 8.10.2.2-1: Measurement results that may be transferred from UE to the LMF**

|  |
| --- |
| **Information** |
| PCI, GCI, and PRS ID, ARFCN, PRS resource ID, PRS resource set ID for each measurement |
| DL-PRS-RSRP measurement |
| UE Rx-Tx time difference measurement |
| Time stamp of the measurement |
| Quality for each measurement |
| TA offset used by UE |
| UE Rx TEG IDs, UE Tx TEG IDs, and UE RxTx TEG IDs associated with UE Rx-Tx time difference measurements |
| LOS/NLOS information for UE measurements |
| DL-PRS-RSRPP measurement |
| The association of UE Tx TEG ID and SRS |

==================================NEXT CHANGE==================================

8.10.2.3 Information that may be transferred from the gNB to LMF

==================================UNCHANGED PARTS==================================

The measurement results that may be signalled from gNBs to the LMF is listed in Table 8.10.2.3-3.

**Table 8.10.2.3-3 : Measurement results that may be transferred from gNBs to the LMF**

|  |
| --- |
| **Measurement results** |
| NCGI and TRP ID of the measurement |
| gNB Rx-Tx time difference measurement |
| UL-SRS-RSRP |
| UL Angle of Arrival (azimuth and elevation) |
| Time stamp of the measurement |
| Quality for each measurement |
| Beam Information of the measurement |
| UL-SRS-RSRPP |

==================================NEXT CHANGE==================================

###### 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 preconfigured 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. Preconfigured 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 area IDs a UE can support.

NEXT CHANGE

## 8.11 DL-AoD positioning

### 8.11.1 General

In the DL-AoD positioning method, the UE position is estimated based on DL-PRS-RSRP 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.

==================================NEXT CHANGE==================================

#### 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 |

==================================NEXT CHANGE==================================

#### 8.11.2.2 Information that may be transferred from the UE to LMF

The information that may be signalled from UE to the LMF is listed in Table 8.11.2.2-1. The individual UE measurements are defined in TS 38.215 [37].

Table 8.11.2.2-1: Measurement results that may be transferred from UE to the LMF

|  |  |  |
| --- | --- | --- |
| Information | UE‑assisted | UE‑based |
| Latitude/Longitude/Altitude, together with uncertainty shape | No | Yes |
| PCI, GCI, ARFCN, PRS resource ID, PRS resource set ID and PRS ID for each measurement | Yes | No |
| DL-PRS-RSRP measurement | Yes | No |
| Time stamp of the measurements | Yes | No |
| Time stamp of location estimate | No | Yes |
| DL-PRS receive beam index | Yes | No |
| DL-PRS-RSRPP measurements | Yes | No |
| LOS/NLOS information for UE measurements | Yes | No |

==================================NEXT CHANGE==================================

## 8.12 DL-TDOA positioning

### 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 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.

==================================NEXT CHANGE==================================

#### 8.12.2.2 Information that may be transferred from the UE to LMF

The information that may be signalled from UE to the LMF is listed in Table 8.12.2.2-1. The individual UE measurements are defined in TS 38.215 [37].

Table 8.12.2.2-1: Measurement results that may be transferred from UE to the LMF

|  |  |  |
| --- | --- | --- |
| Information | UE‑assisted | UE‑based |
| Latitude/Longitude/Altitude, together with uncertainty shape | No | Yes |
| PCI, GCI, ARFCN, PRS resource ID, PRS resource set ID and PRS ID for each measurement | Yes | No |
| DL RSTD measurement | Yes | No |
| DL-PRS-RSRP measurement | Yes | No |
| Time stamp of the measurements | Yes | No |
| Time stamp of location estimate | No | Yes |
| Quality for each measurement | Yes | No |
| UE Rx TEG IDs for DL RSTD measurements | Yes | No |
| DL-PRS-RSRPP measurement | Yes | No |
| LOS/NLOS information for UE measurements | Yes | No |

==================================NEXT CHANGE==================================

##### 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 preconfigured 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. Preconfigured 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 area IDs a UE can support.

NEXT CHANGE

## 8.13 UL-TDOA positioning

### 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 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.

==================================NEXT CHANGE==================================

#### 8.13.2.2 Location Information that may be transferred from the gNBs to LMF

The information that may be transferred from gNBs to the LMF include measurement results listed in Table 8.13.2.2-1. The individual measurements are defined in TS 38.215 [37].

Table 8.13.2.2-1: Measurement results that may be transferred from gNBs to the LMF

|  |
| --- |
| Measurement results |
| NCGI and TRP ID of the measurement |
| UL-RTOA |
| UL-SRS-RSRP |
| Time stamp of the measurement |
| Quality for each measurement |
| Beam Information for each measurement |
| UL Angle of Arrival (azimuth and elevation) |
| UL-SRS-RSRPP |

==================================NEXT CHANGE==================================

#### 8.13.2.1 Configuration Data that may be transferred from the gNB to the LMF

The configuration data for a target UE that may be transferred from the serving gNB to the LMF is listed in Table 8.13.2.1-1.

Table 8.13.2.1-1: UE configuration data that may be transferred from serving gNB to the LMF

|  |
| --- |
| UE configuration data |
| UE SRS configuration |
| Timing information of the TRP, which configured the UE SRS transmission |
| The association information of SRS resources with UE Tx TEG ID |

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

8.13.3.4 Sequence of Procedure for UL-TDOA positioning

Figure 8.13.3.4-1 shows the messaging between the LMF, the gNBs and the UE to perform UL-TDOA procedure.

****

**Figure 8.13.3.4-1: UL-TDOA positioning procedure**

0. The LMF may use the procedure in Figure 8.13.3.2.1-2 to obtain the TRP information required for UL-TDOA positioning.

1. The LMF may request the positioning capabilities of the target device using the LPP Capability Transfer procedure as described in clause 8.13.3.1.

2. The LMF sends a NRPPa POSITIONING INFORMATION REQUEST message to the serving gNB to request UL-SRS configuration information for the target device as described in Figure 8.13.3.2.1-1.

3. The serving gNB determines the resources available for UL-SRS and configures the target device with the UL-SRS resource sets at step 3a.

4. The serving gNB provides the UL information to the LMF in a NRPPa POSITIONING INFORMATION RESPONSE message.

5. In the case of semi-persistent or aperiodic SRS, the LMF may request activation of UE SRS transmission by sending the NRPPa Positioning Activation Request message to the serving gNB of the target device as described in clause 8.13.3.3a. The gNB then activates the UL-SRS transmission and sends the NRPPa Positioning Activation Response message. The target device begins the UL-SRS transmission according to the time domain behavior of UL-SRS resource configuration.

6. The LMF provides the UL-SRS configuration to the selected gNBs in a NRPPa MEASUREMENT REQUEST message as described in clause 8.13.3.3. The message includes all information required to enable the gNBs/TRPs to perform the UL measurements.

7. Each gNB configured at step 6 measures the UL-SRS transmissions from the target device.

8. Each gNB reports the UL-SRS measurements to the LMF in a NRPPa Measurement Response message as described in clause 8.13.3.3.

9. The LMF sends a NRPPa POSITIONING DEACTIVATION message to the serving gNB as described in clause 8.13.3.3a.

==================================NEXT CHANGE==================================

## 8.14 UL-AoA positioning

### 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 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.

==================================NEXT CHANGE==================================

#### 8.14.2.2 Location Information that may be transferred from the gNBs to LMF

The information that may be transferred from gNBs to the LMF include measurement results are listed in Table 8.14.2.2-1. The individual measurements are defined in TS 38.215 [37].

Table 8.14.2.2-1: Measurement results that may be transferred from gNBs to the LMF

|  |
| --- |
| Measurement results |
| NCGI and TRP ID of the measurement |
| UL Angle of Arrival (azimuth and elevation) |
| UL-SRS-RSRP |
| Time stamp of the measurement |
| Quality for each measurement |
| Beam information for each measurement |
| UL-SRS-RSRPP |

==================================END OF CHANGES==================================