**3GPP TSG-RAN WG2 Meeting #116-bis-eR2-22xxxxx**

**Electronic meeting, January 17th – 25th, 2022**

**Agenda item:** 8.11.7

**Source:** CATT

**Title: Accuracy enhancement TP for 38.305**

**Document for:** Approval

# 1 Introduction

This document submited the Accuracy enhancmenet TP for TS38.305, after the following email discussion:

 **[AT116bis-e][612][POS] Positioning accuracy enhancements (Apple)**

      Scope: Discuss the contributions in AI 8.11.7 on accuracy enhancements (excluding PRU topics).  Determine agreeable RAN2 spec impact from RAN1 conclusions and identify any issues requiring further RAN2 discussion.

      Intended outcome: Report to Monday CB session

      Deadline:  Friday 2022-01-21 1600 UTC

The TP is for running 38.305 CR, based R2-2200297 and merging parts of R2-2200299 and R2-2200429 in accordance with the comments provided for Question 2.5-1 at the [612] discussion, and while taking into account proposals with unanimous support listed below:

**Proposal 2.1-1: enhance LPP assistance data signalling to allow UE to request and LMF to provide TRP beam/antenna information.**

**Proposal 2.1-2: enhance LPP assistance data signalling to allow LMF to provide the association information of DL PRS resources with TRP Tx TEG ID.**

**Proposal 2.1-6: enhance LPP assistance data signalling to allow UE to request and LMF to provide the expected angle value and uncertainty.**

**Proposal 2.2-1: introduce in LPP RequestLocationInformation: request for UE Rx TEG ID, maximum number of Rx TEGs for the same PRS resource, request for UE RxTx TEG ID, maximum number of Tx TEGs for the same PRS resource, request for UE RxTx TED ID.**

**Proposal 2.2-2: introduce in LPP ProvideLocationInformation: UE Rx TEG IDs, UE Tx TEG IDs, and UE RxTx TEG IDs.**

**Proposal 2.2-3: introduce in LPP ProvideLocationInformation: multiple UE Rx-Tx time difference measurements (for N different UE Rx TEGs), and multiple UE Rx-Tx time difference measurements (for N different UE RxTx TEGs with the same UE Tx TEG).**

**Proposal 2.2-5: introduce support for an LMF to request and UE to report first path PRS RSRP for DL-AoD.**

**Proposal 2.2-6: introduce support for extended additional paths beyond 2.**

Note: There is no stage-2 impact of Proposal 2.2-6.

**Proposal 2.2-7: introduce support a LoS/NLoS indication per RSTD, RSRP and UE RxTx measurements.**

FFS is added in the TP for the Proposal 2.2-4:

**Proposal 2.2-4: to discuss which RRC message (UEAssistanceInformation, new RRC message, RRCReconfigurationComplete, none (LPP is enough)) to use to convey the information about association of UL SRS resources with UE Tx TEGs ID.**

As for potentially agreeable proposals (for discussion), there is no stage-2 impact observed as below:

**Proposal 2.1-3: to include the association information of DL PRS resources with TRP Tx TEG ID in posSIB.**

**Proposal 2.1-4: include in the LPP assistance data the information about subset of PRS resources for the purpose of prioritization of DL-AOD reporting.**

**Proposal 2.1-5: include in the LPP assistance data the the boresight direction information.**

# Annex A Text Proposal for running CR 38.305

/\*\*\*Start of changes\*\*\*/

# 3 Definitions, symbols and abbreviations

## 3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [1].

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 LMF to be used in the computation of a position estimate is described as "UE-assisted" (and could also be called "LMF-based"), while one in which the UE computes its own position is described as "UE-based".

**Transmission Point (TP)**: A set of geographically co-located transmit antennas (e.g. antenna array (with one or more antenna elements)) for one cell, part of one cell or one DL-PRS-only TP. Transmission Points can include base station (ng-eNB or gNB) antennas, remote radio heads, a remote antenna of a base station, an antenna of a DL-PRS-only TP, etc. One cell can include one or multiple transmission points. For a homogeneous deployment, each transmission point may correspond to one cell.

**Reception Point (RP)**: A set of geographically co-located receive antennas (e.g. antenna array (with one or more antenna elements)) for one cell, part of one cell or one UL-SRS-only RP. Reception Points can include base station (ng-eNB or gNB) antennas, remote radio heads, a remote antenna of a base station, an antenna of a UL-SRS-only RP, etc. One cell can include one or multiple reception points. For a homogeneous deployment, each reception point may correspond to one cell.

**PRS-only TP**: A TP which only transmits PRS, DL-PRS signals and is not associated with a cell.

**SRS-only RP**: An RP which only receives UL-SRS signals and is not associated with a cell.

**Transmission-Reception Point (TRP)**: A set of geographically co-located antennas (e.g. antenna array (with one or more antenna elements)) supporting TP and/or RP functionality.

UE Timing Error Group(s) (TEG(s)):

*-* ueRxTEGis associated with one or more DL timing measurements, which have the Rx timing error difference within a certain margin.

*-* ueRxTxTEGis associated with one or more UE Rx-Tx time difference measurements, which have the ‘Rx timing errors+Tx timing errors’ difference within a certain margin.

- ueTxTEGis associated with the transmissions of one or more UL SRS resources for the positioning purpose, which have the Tx timing error difference within a certain margin.

TRP Timing Error Group(s) (TEG(s)):

*-* trpRxTEGis associated with one or more UL timing measurements, which have the Rx timing error difference within a certain margin.

*-* trpRxTxTEGis associated with one or more gNB Rx-Tx time difference measurements, which have the ‘Rx timing errors+Tx timing errors’ difference within a certain margin.

- trpTxTEGis associated with the transmissions of one or more DL PRS resources, which have the Tx timing error difference within a certain margin.

Editor Notes: There is no discussion and proposal on the Definitions which are copied from RAN1 protocol, so RAN2 will further discuss it.

## 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].

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WLAN Wireless Local Area Network

Z-AoA Zenith Angles of Arrival

TEG Timing Error Group

# 4 Main concepts and requirements

## 4.3 Standard UE Positioning Methods

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4.3.11 Multi-RTT positioning

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

The UE measures the UE Rx-Tx time difference measurements (and optionally DL-PRS-RSRP 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 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 UE and TRP may be requested to provide the Rx TEG, RxTx TEG and/or Tx TEG information for the purpose of mitigating UE/TRP Rx/Tx timing error.

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

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4.3.13 DL-TDOA positioning

The DL-TDOA positioning method makes use of the DL RSTD (and optionally DL-PRS-RSRP) of downlink signals received from multiple TPs, at the UE. The UE measures the DL RSTD (and optionally DL-PRS-RSRP) 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 UE may be requested to provide the Rx TEG information for the purpose of mitigating UE Rx timing error. The TRP may be requested to provide the Tx TEG information for the purpose of mitigating TRP Tx timing error. The UE may be provided with the TRP Tx TEG information for the purpose of mitigating TRP Tx timing error for UE based DL-TDOA.

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) at multiple RPs of uplink signals transmitted from UE. The RPs measure the UL-RTOA (and optionally UL-SRS-RSRP) 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 UE may be requested to provide the Tx TEG information for the purpose of mitigating UE Tx timing error. The TRP may be requested to provide the Rx TEG information for the purpose of mitigating TRP Rx timing error.

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

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## 6.2 UE-terminated protocols

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### 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) to support NG-RAN measurements for NR positioning FFS and report the UE TxTEG (Tx Timing Error Group) for UL-TDOA.

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## 7.4 General RRC procedures for UE Positioning

Editor’s notes: all the impacts of RRC below will be updated after online discussion.

### 7.4.1 NR RRC Procedures

NR RRC supports the following positioning related procedures:

- Location Measurement Indication.

- UEAssistance Inforamtion for UE TxTEG

#### 7.4.1.2 UEAssistance Inforamtion for UE TxTEG

RRC reconfiguration and RRC UEAssistancecInformation procedures are used to request UE and report Tx ‘timing error group’ (UE TxTEG) for UL-TDOA. A UE TxTEG is associated with the transmissions of one or more UL SRS resources for the positioning purpose, which has the Tx timing error difference within a certain margin.



Figure 7.4.1.2-1: UEAssistance Information procedure for UE TxTEG

**Precondition:** The serving gNB of a UE has received a NRPPa message from an LMF requesting the TxTEG of the UE for NR UL-TDOA positioning.

1. If the serving gNB receives a NRPPa message from an LMF requesting the TxTEG of a UE, subject to the UE’s capability, the serving gNB may send a RRC reconfiguration message to the UE, requesting the UE to provide the association information of UL SRS resources for positioning with Tx TEGs for UL-TDOA to the serving gNB if the UE supports multiple UE Tx TEGs for UL TDOA. Based on the request from the LMF, the RRC Reconfiguration message from the serving gNB to the UE indicates the UE should provide either a single report or a periodic report of UE TxTEG association for UL-TDOA to the serving gNB.
2. When the UE receives the request via RRCReconfiguration, UE will report the UE TxTEG information, including all the changes of the UE TxTEG during the report period if the UE is required to report UE Tx TEG periodically. UE will report all the UE TxTEG at the time when the RRC Reconfiguration is received immediately if the UE is only required to report the one-shot UE TxTEG information.

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## 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 and UL-SRS-RSRP) 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 be requested to report UE RxTx TEG IDs, UE Tx TEG IDs, and/or UE Rx TEG IDs with UE Rx-Tx measurements which are used by an LMF to mitigate UE Rx/Tx timing error.

### 8.10.2 Information to be transferred between NG-RAN/5GC Elements

This clause defines the information that may be transferred between LMF and UE/gNB.

#### 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 |

Table 8.10.2.1-2: Location information request that may be transferred from LMF to the UE

|  |
| --- |
| Information |
| Requesting the UE to provide UE TEG IDs information, including UE RxTxTEG IDs, UE RxTEG IDs, UE TxTEG IDs |
| Maximum number of Rx TEGs for the same PRS resource for UE Rx-Tx measurements |
| Maximum number of RxTx TEGs for the same PRS resource for UE Rx-Tx measurements |
| Request of the LOS/NLOS information for UE measurements |

#### 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 for UE Rx-Tx measurements |
| Multiple UE Rx-Tx time difference measurements (for N different UE Rx TEGs) |
| Multiple UE Rx-Tx time difference measurements (for N different UE RxTx TEGs with the same UE Tx TEG). |
| LOS/NLOS information for UE measurements |

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## 8.11 DL-AoD positioning

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#### 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 | 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 |
| PRS-only TP indication | Yes | Yes |
| TRP beam/antenna information(include azimuth angle, zenith angle and relative power between PRS resources per angle per TRP) | No | Yes |
| LOS/NLOS indicators | No | Yes |

Table 8.11.2.1-1: Location information that may be transferred from LMF to the UE

|  |  |  |
| --- | --- | --- |
| Information | UE-assisted | UE-based |
| request of the PRS RSRP of first arrival path | Yes | Yes |
| Request of the LOS/NLOS information for UE measurements | Yes | No |

#### 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: Information 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, and TRP 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 |
| The first path DL-PRS RSRP measurement result | Yes | Yes |
| LOS/NLOS information for UE measurements | Yes | No |

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

## 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) 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 UE may be requested to report UE RxTEG IDs with RSTD measurements (including additional DL RSTD measurements) to LMF.

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

### 8.12.2 Information to be transferred between NG-RAN/5GC Elements

This clause defines the information that may be transferred between LMF and UE/gNB.

#### 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 |

Table 8.12.2.1-2: Location information request that may be transferred from LMF to the UE

|  |  |  |
| --- | --- | --- |
| Information | UE‑assisted | UE‑based |
| Request to the UE to report UE RxTEG ID with RSTD measurements | Yes | No |
| Maximum number of Rx TEGs for the same PRS resource | Yes | No |
| Request of the LOS/NLOS information for UE measurements | Yes | No |

#### 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, FFS including DL RSTD measurement measured from different UE Rx TEGs | 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 |
| FFS UE Rx TEG IDs for DL RSTD measurements | Yes | No |
| LOS/NLOS information for UE measurements | Yes | No |

Editor Notes: The measurement report via LPP ProvideLocationInformation for DL-TDOA is missed in the discussion and proposal which will be further discussed.

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

### 8.12.3 DL-TDOA Positioning Procedures

The procedures described in this clause support UE-assisted and UE-based DL-TDOA.

#### 8.12.3.1 Procedures between LMF and UE

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

##### 8.12.3.1.3 Location Information Transfer Procedure

The purpose of this procedure is to enable the LMF to request location estimate from the UE, or to enable the UE to provide location measurements to the LMF for position calculation.

###### 8.12.3.1.3.1 LMF-initiated Location Information Transfer Procedure

Figure 8.12.3.1.3.1-1 shows the Location Information Transfer operations for the DL-TDOA positioning method when the procedure is initiated by the LMF.



Figure 8.12.3.1.3.1-1: LMF-initiated Location Information Transfer Procedure

(1) The LMF sends an LPP Request Location Information message to the UE. This request includes indication of DL-TDOA measurements requested, including any needed measurement configuration information, and required response time.

(2) The UE obtains DL-TDOA measurements as requested in step 1. The UE then sends an LPP Provide Location Information message to the LMF, before the Response Time provided in step (1) elapsed, and includes the obtained DL RSTD measurements and, optionally, the DL-PRS-RSRP measurements, and optionally UE RxTEG IDs for DL RSTD measurements. If the UE is unable to perform the requested measurements, or the Response Time elapsed before any of the requested measurements were 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.

###### 8.12.3.1.3.2 UE-initiated Location Information Delivery procedure

Figure 8.12.3.1.3.2-1 shows the Location Information Delivery procedure operations for the DL-TDOA positioning method when the procedure is initiated by the UE.



Figure 8.12.3.1.3.2-1: UE-initiated Location Information Delivery Procedure.

(1) The UE sends an LPP Provide Location Information message to the LMF. The Provide Location Information message may include any UE DL-TDOA measurements and, optionally, the DL-PRS-RSRP measurements already available at the UE and UE RxTEG IDs with DL RSTD measurement.

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

## 8.13 UL-TDOA positioning

Editor’s notes: all the impacts of UL-TDOA below will be updated after online discussion.

### 8.13.1 General

In the UL-TDOA positioning method, the UE position is estimated based on UL-RTOA (and optionally UL-SRS-RSRP) 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.

FFS: The UE may be requested by the serving gNB to report UE Tx TEG to the serving gNB, using the procedure described in clause 7.4.1.2.

### 8.13.2 Information to be transferred between NG-RAN/5GC Elements

This clause defines the information that may be transferred between LMF and gNB/TRPs.

#### 8.13.2.4 Information that may be transferred from the serving gNB to UE

The information that may be transferred from serving gNB to the UE includes request listed in Table 8.13.2.4-1.

Table 8.13.2.4-1: Measurement request that may be transferred from the serving gNB to UE

|  |
| --- |
| Measurement request |
| Report UE TxTEG, FFS details |

#### 8.13.2.5 Information that may be transferred from UE to the serving gNB

The information that may be transferred from UE to the serving gNB includes parts of measurement results listed in Table 8.13.2.2-1. The individual measurements are defined in TS 38.215 [37].

Table 8.13.2.5-1: Measurement results that may be transferred from UE to the serving gNB

|  |
| --- |
| Measurement results |
| UE Tx TEG association information (TxTEG IDs, UL-SRS positioning Resource ID) with time stamp |

Editor’s notes: the information between serving gNB and UE will be updated together with the agreement of RRC procedure.

### 8.13.3 UL-TDOA Positioning Procedures

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#### 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

Editor’s notes: the procedures in Figure 8.13.3.4-1 will be updated together with the agreement of RRC 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. FFS Serving gNB will send the RRCReconfiguration to UE to request the UE to provide UE TxTEG if the serving gNB receives the request from LMF in the clause 8.13.2.4. Accordingly, UE will report the UE TxTEG to gNB via RRC message which is associated with the transmissions of one or more UL positioning SRS resources to mitigate UE Tx timing errors in the clause 8.13.2.5.

Editor’s notes: the description will be updated together with the agreement of RRC procedure.

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.