**OPTION D**

*Beginning of Changes*

### 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 and/or DL-RSCP) 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 and/or UL-RSCP) 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 and/or DL-RSCP 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 and/or UL-RSCP of the received signals) using assistance data received from the positioning server. The UE and TRPs may optionally use bandwidth aggregation of downlink signals and bandwidth aggregation of uplink signals respectively, in order to perform measurements on a wider effective signal bandwidth. Depending on UE capabilities, the UE may perform measurements using receive frequency hopping based on the request 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.

For network verification of UE location in NTN, 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 a single TRP at different time instances, measured by the UE and the measured gNB Rx-Tx time difference measurements (and optionally UL-SRS-RSRP and/or UL-SRS-RSRPP) at a single TRP at different time instances of uplink signals transmitted from UE. Together with each UE Rx-Tx time difference measurement, the UE also reports the UE Rx – Tx time difference subframe offset measurement in unit of subframe and the DL timing drift due to Doppler on service link between UE and satellite as defined in TS 38.215 [37].

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 UE may optionally use bandwidth aggregation of received downlink signals in order to perform measurements on a wider effective signal bandwidth. Depending on UE capabilities, the UE may perform measurements using receive frequency hopping based on the request from the positioning server.

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 and/or DL-RSCPD) 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 and/or DL-RSCPD) 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 optionally use bandwidth aggregation of received downlink signals in order to perform measurements on a wider effective signal bandwidth. Depending on UE capabilities, the UE may perform measurements using receive frequency hopping based on the request from the positioning server.

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 and/or UL-RSCP) 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 and/or UL-RSCP) 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 RPs may optionally use bandwidth aggregation of received uplink signals in order to perform measurements on a wider effective signal bandwidth.

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/or 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-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 RPs may optionally use bandwidth aggregation of received uplink signals in order to perform measurements on a wider effective signal bandwidth.

The operation of the UL-AoA positioning method is described in clause 8.14.

*Next Change*

## 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 SP Positioning SRS Activation/Deactivation 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. The UL-SRS for positioning configuration in RRC\_INACTIVE state may be associated with an SRS Validity Area. The SRS Validity Area contains a list of cells in which the SRS for positioning configuration in RRC\_INACTIVE state is valid. When configured with an SRS configuration for positioning along with SRS Validity Area, if the UE reselects to another cell within the SRS Validity Area during SRS transmission, the UE continues the SRS transmission, subject to validation for SRS transmission as specified in TS 38.321 [39] and TS 38.331 [14]. When the UE reselects out of the SRS for positioning Validity Area during SRS transmission, the UE may send an "RRC Resume Request" message to the network for SRS configuration request.

NOTE: Aperiodic UL-SRS transmission for positioning is not supported in RRC\_INACTIVE.

The SRS for positioning configuration in RRC\_INACTIVE state may be pre-configured in the target device. The target device may send an "RRC Resume Request" message to the network when a configured periodic or triggered location event has been detected to request activation of the pre-configured SRS for positioning. For preconfigured multiple SRS configurations, the UE is configured with only one SRS for positioning configuration for each validity area.

For UEs in RRC\_INACTIVE state, eDRX cycle beyond 10.24s as specified in TS 38.300 [52] is supported.

## 7.10 Positioning in RRC\_IDLE state

Positioning measurements may be performed when a UE is in RRC\_IDLE state and reported when in RRC\_CONNECTED state (see also clause 6.4.2). For UEs in RRC\_IDLE state, eDRX cycle beyond 10.24s as specified in TS 38.300 [52] is supported.

A UE may utilize the positioning assistance data received via broadcast (see clause 7.5) or the positioning assistance data received while in RRC\_CONNECTED state when performing positioning measurements in RRC\_IDLE state.

*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/or UL-SRS-RSRPP and/or UL-RSCP) 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. The LMF may request the serving gNB to direct the UE to transmit SRS signals using transmit frequency hopping by providing the serving gNB with the SRS frequency hopping configuration. 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.

NOTE: UL-TDOA positioning with aperiodic or semi-persistent SRS is not supported for a U2N Remote UE.

*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/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. The LMF may request the serving gNB to direct the UE to transmit SRS signals using transmit frequency hopping by providing the serving gNB with the SRS frequency hopping configuration. 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.

NOTE: UL-AoA positioning with aperiodic or semi-persistent SRS is not supported for a U2N Remote UE.

*End of Changes*