**3GPP TSG-RAN WG2 Meeting #125 *R2-2401243***

**Athens, Greece, February 26 – March 1, 2024**

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| *CR-Form-v12.2* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
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|  | **38.305** | **CR** | **0158** | **rev** | **-** | **Current version:** |  |  |
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| *For* [***HE******LP***](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 | **x** |

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| ***Title:*** | Miscellaneous Stage 2 Corrections and Alignments | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Qualcomm Incorporated | | | | | | | | | |
| ***Source to TSG:*** | R2 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_pos\_enh2 | | | | |  | ***Date:*** | | | 2024-01-16 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | F |  | | | | | ***Release:*** | | | Rel-18 |
|  | *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-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18) Rel-19 (Release 19)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | 1. In an LS from SA2 R2-2400074 (S2-2313889), the following SA2 agreements are stated (among others):    1. RSPP includes SLPP messages and Supplementary Service messages transferring between UE and LMF. RSPP also includes SLPP messages and Supplementary RSPP signalling messages transferring over SR5.    2. SLPP is used between SL Positioning Server UE and UE1 for transferring capability, assistance data and Location estimate request/response of UE1.    3. Supplementary RSPP signalling is used between SL Positioning Server UE and UE1 for transferring capability, assistance data, Location info of UE2/…/UEn, Application ID of UE2/…/UEn, Ranging/SL Positioning Service Request and any other information.   Attached to the above mentioned LS is a CR to 23.273, which imply that the above agreements also hold for the interactions between an LMF and a target UE for SL-MO-LR and SL-MT-LR, which however, was ambiguous in the description. At SA2#160-Ad Hoc-e, SA2 resolved this ambiguity and agreed CR#0504 to TS 23.273 (S2-2401379).   The procedures currently described in clause 7.3A for SL-MO-LR and SL-MT-LR do not entirely conform to the corresponding procedures in TS 23.273 (S2-2401379) and need some correction.   1. The procedure for UE only SL positioning operation described in clause 7.12 is in agreement with 1b/c above, but a small step is missing to clarify the position calculation entity in the case of no separate Server UE is selected. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | 1. The definition of RSPP in clause 3.1 is updated to include both, Supplementary Services messages and Supplementary RSPP signalling messages. The procedures in clause 7.3A are aligned with the corresponding procedures in TS 23.273. 2. A Step 18 is added to the procedure in Figure 7.12-1 to clarify that the ranging/SL positioning results calculation is performed by UE1 in the case of no separatee server UE is selected. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | Inconsitency between TS 38.305 and TS 23.273 will remain. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 2, 3.1, 7.3A, 7.12 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **x** | Other core specifications | | | |  | | |
| ***affected:*** | |  | **x** | Test specifications | | | |  | | |
| ***(show related CRs)*** | |  | **x** | O&M Specifications | | | |  | | |
|  | |  | | | | | | | | |
| ***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.

[46] 3GPP TS 23.586: "Architectural Enhancements to support Ranging based services and Sidelink Positioning".

[47] 3GPP TS 38.355: "NR; Sidelink Positioning Protocol (SLPP); Protocol specification".

[48] 3GPP TS 23.287: "Architecture enhancements for 5G System (5GS) to support Vehicle-to-Everything (V2X) services".

[49] 3GPP TS 23.304: "Proximity based Services (ProSe) in the 5G System (5GS)".

[50] 3GPP TS 38.211: "NR; Physical channels and modulation".

[51] Bluetooth Special Interest Group: "Bluetooth Core Specification v5.4", February 2023.

[52] 3GPP TS 38.300: "NR; NR and NR-RAN Overall Description; Stage 2".

[53] 3GPP TS 24.080: "Supplementary services specification; Formats and coding".

[54] 3GPP TS 24.514: "Ranging based services and sidelink positioning in 5G system (5GS); Stage 3".

# 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". For sidelink positioning, an operation in which measurements are provided by a SL Target UE to a server (SL Server UE or LMF) to be used in the computation of a position estimate is described as "SL Target UE-assisted" (and could also be called "server-based"), while one in which the SL Target UE computes its own position is described as "SL Target UE-based".

**Alert Limit (AL)**: The maximum allowable positioning error for the purpose of integrity. If the positioning error is beyond this limit, the integrity results of the calculated location may not meet the integrity requirement.

**Mobile TRP:** a TRP belonging to a mobile IAB-node.

**Positioning integrity**: A measure of the trust in the accuracy of the position-related data and the ability to provide associated alerts.

**Pre-configured assistance data**: Refers to the DL-PRS assistance data (with associated validity criteria) that can be provided to the UE (before or during an ongoing LPP positioning session), to be then utilized for potential positioning measurements at a future time (e.g. for deferred MT-LR). Pre-configured DL-PRS assistance data may consist of multiple instances, where each instance is applicable to a different area within the network.

**Protection Level (PL):** A statistical upper-bound of the Positioning Error (PE) that ensures that, the probability per unit of time of the true error being greater than the AL and the PL being less than or equal to the AL, for longer than the TTA, is less than the TIR, i.e., the PL satisfies the following inequality:   
 *Prob per unit of time* [((*PE>AL*) & (*PL<=AL*)) *for longer than TTA*] *< TIR*  
When the PL bounds the positioning error in the horizontal plane or on the vertical axis then it is called Horizontal Protection Level (HPL) or Vertical Protection Level (VPL) respectively.  
A specific equation for the PL is not specified as this is implementation-defined. For the PL to be considered valid, it must simply satisfy the inequality above.

NOTE 1: the PL inequality is valid for all values of the AL.

NOTE 2: the TIR may correspond to the achievable TIR in the case that the requested TIR cannot be satisfied.

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

**PRS Processing Window (PPW):** The PRS Processing Window is configured by the network to a UE for NR DL-PRS measurements without measurement gap.

**Ranging/SL Positioning Protocol (RSPP):** RSPP comprises SLPP messages defined in TS 38.355 [47], Supplementary Services messages defined in TS 24.080 [53], and Supplementary RSPP signalling messages defined in TS 24.514 [54].

**Ranging:** Refers to the determination of the distance between two UEs or more UEs and/or the direction of one UE from another UE via sidelink interface.

**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.

**Relative Position:** An estimate of the UE position relative to other network elements or relative to other UEs.

**Rx Time Delay:** From a signal reception perspective, there will be a time delay from the time when the RF signal arrives at the Rx antenna to the time when the signal is digitized and time-stamped at the baseband.

**Rx Timing Error:** Result of Rx time delay involved in the reception of a signal before reporting measurements that are obtained from the signal. It is the uncalibrated Rx time delay, or the remaining delay after the UE/TRP internal calibration/compensation of the Rx time delay, involved in the reception of the DL-PRS/UL SRS signals. The calibration/compensation may also include the calibration/compensation of the relative time delay between different RF chains in the same UE/TRP and may also possibly consider the offset of the Rx antenna phase centre to the physical antenna centre.

**Sidelink Positioning:** A functionality which determines geographical or relative location and possibly velocity using sidelink measurements.

**SL Anchor UE:** A UE, supporting positioning of target UE, e.g. by transmitting and/or receiving reference signals for positioning, providing positioning-related information, etc. using Sidelink.

**SL Server UE:** A UE offering position method determination, assistance data distribution and/or location calculation functionalities for sidelink positioning and ranging based services. It interacts with other UEs over PC5 as necessary in order to determine a ranging/SL position method, distribute assistance data and calculate the location of the target UE. A Target UE or SL Anchor UE can act as SL Server UE if any of the functionalities is supported.

**SL Target UE:** A UE whose distance, direction and/or position is measured with the support from one or multiple SL Anchor UEs using sidelink.

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

**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.

**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.

**TRP Rx 'Timing Error Group' (TRP Rx TEG):** Rx timing errors, associated with TRP reporting of one or more UL measurements, that are within a certain margin.

**TRP RxTx 'Timing Error Group' (TRP RxTx TEG):** Rx timing errors and Tx timing errors, associated with TRP reporting of one or more gNB Rx-Tx time difference measurements, which have the 'Rx timing errors+Tx timing errors' differences within a certain margin.

**TRP Tx 'Timing Error Troup' (TRP Tx TEG):** Tx timing errors, associated with TRP transmissions on one or more DL-PRS resources, that are within a certain margin.

**Tx Time Delay:** From a signal transmission perspective, the time delay from the time when the digital signal is generated at baseband to the time when the RF signal is transmitted from the Tx antenna.

**Tx Timing Error:** Result of Tx time delay involved in the transmission of a signal. It is the uncalibrated Tx time delay, or the remaining delay after the TRP/UE internal calibration/compensation of the Tx time delay, involved in the transmission of the DL-PRS/UL SRS signals. The calibration/compensation may also include the calibration/compensation of the relative time delay between different RF chains in the same TRP/UE and may also possibly consider the offset of the Tx antenna phase centre to the physical antenna centre.

**U2N Relay UE**: A UE that provides functionality to support connectivity to the network for U2N Remote UE(s).

**U2N Remote UE**: A UE that communicates with the network via a U2N Relay UE.

**UE Rx 'Timing Error Group' (UE Rx TEG):** Rx timing errors, associated with UE reporting of one or more DL measurements (RSTD), that are within a certain margin.

**UE RxTx 'Timing Error Group' (UE RxTx TEG):** Rx timing errors and Tx timing errors, associated with UE reporting of one or more UE Rx-Tx time difference measurements, which have the 'Rx timing errors+Tx timing errors' differences within a certain margin.

**UE Tx 'Timing Error Group' (UE Tx TEG):** Tx timing errors, associated with UE transmissions on one or more UL SRS resources for positioning purpose, that are within a certain margin.

## 7.3A Service Layer Support for Sidelink Positioning

### 7.3A.1 General

As described in TS 23.273 [35], UE-positioning-related services can be instigated from the 5GC for an SL-MT‑LR location service to obtain ranging/sidelink positioning location results for a group of UEs, or from the UE in case of an SL-MO-LR location service to obtain sidelink positioning/ranging location results using one or more other UEs with the assistance of an LMF. The complete sequence of operations in the 5GC is defined in TS 23.273 [35]. This clause defines the overall sequences of operations that occur in the LMF and UE.

### 7.3A.2 SL-MT-LR Service Support

Figure 7.3A.2-1 shows the sequence of operations for an SL-MT-LR location service, starting at the point where the AMF initiates the service in the LMF.



Figure 7.3A.2-1: UE Positioning Operations to support an SL-MT-LR.

1. The AMF serving UE1 sends a location request to the LMF including information on the required location results of the n UEs (e.g., absolute location, relative location or ranges and directions between pairs of UE(s)), the required LCS QoS and the Application Layer IDs of the UEs when available, as described in TS 23.273 [35].

2. The LMF sends an SL-MT-LR request to UE1 (via serving AMF) including the types of required location results (e.g., absolute location, relative locations or distances and/or directions) and the Application Layer IDs of the other UEs 2 to n.

3. UE1 attempts to discover the other UEs 2 to n using their Application Layer IDs if not already discovered, as described in TS 23.273 [35].

4. UE1 obtains the sidelink positioning capabilities of the discovered UEs using the SLPP capability transfer procedures specified in clause 7.11.2.1.

5. UE1 returns a SL-MT-LR Response to the LMF (via serving AMF) indicating which of the UEs 2 to n have been discovered and the sidelink positioning capabilities of the discovered UEs, if obtained.

6a. The LMF may send a SLPP Request Capabilities message to UE1 to request the SL positioning and ranging capabilities of UE1 as described in clause 7.11.2.1.

6b. The LMF may request from UE1 the SL positioning and ranging capabilities of UEs 2 to n using the Supplementary RSPP Procedure. The Supplementary RSPP message includes embedded SLPP Request Capabilities messages for UEs 2 to n together with their Application Layer IDs.

6c. UE1 may instigate the SLPP Capability Transfer procedure specified in clause 7.11.2.1 with UEs 2 to n to obtain the sidelink positioning capabilities for UEs 2 to n, if not already obtained (e.g., at step 4).

6d. UE1 may provide its SL positioning and ranging capabilities as requested at step 6a to the LMF in a SLPP Provide Capabilities message.

6e. UE1 may provide the SL positioning and ranging capabilities of UEs 2 to n as requested at step 6b to the LMF using the Supplementary RSPP Procedure. The Supplementary RSPP message includes embedded SLPP Provide Capabilities messages from UEs 2 to n together with their Application Layer IDs.

7a. UE1 may send a SLPP Request Assistance Data message to the LMF to request SL positioning assistance data.

7b. UE1 may request SL positioning assistance data for UEs 2 to n using the Supplementary RSPP Procedure. The Supplementary RSPP message includes embedded SLPP Request Assistance Data messages for UEs 2 to n together with their Application Layer IDs.

7c. The LMF may send a SLPP Provide Assistance Data message to UE1.

7d. The LMF may provide assistance data for UEs 2 to n to UE1 using the Supplementary RSPP Procedure. The Supplementary RSPP message includes embedded SLPP Provide Assistance Data messages for UEs 2 to n together with their Application Layer IDs.

7e. UE1 may instigate the SLPP Assistance Data Transfer procedure specified in clause 7.11.2.2 with UEs 2 to n to provide the received assistance data from step 7d to the UEs 2 to n. The assistance data may assist UEs 1 to n to obtain sidelink location measurements and/or may assist UE1 to calculate sidelink positioning/ranging location results.

8a. The LMF sends a SLPP Request Location Information message to UE1. The request may include an indication whether location calculation should be performed by the UE (SL Target UE-based), or whether location measurements should be provided for location calculation at the LMF (SL Target UE-assisted).

8b. The LMF may request location information from UEs 2 to n using the Supplementary RSPP Procedure. The Supplementary RSPP message includes embedded SLPP Request Location Information messages for UEs 2 to n together with their Application Layer IDs.

8c. UE1 instigates the SLPP Location Information Transfer procedure specified in clause 7.11.2.3 among UEs 1 to n in which UE1 to n obtain sidelink location measurements and UEs 2 to n transfer their sidelink location measurements to UE1.

8d. UE1 sends a SLPP Provide Location Information message to the LMF with the location information requested at step 8a.

8e. UE1 provides the location information requested at step 8b for UEs 2 to n to the LMF using the Supplementary RSPP Procedure. The Supplementary RSPP message includes embedded SLPP Provide Location Information messages for UEs 2 to n together with their Application Layer IDs.

NOTE: Steps 6a-6e, 7a-7e, and 8a-8e could be performed in any order and may also overlap.

9. The LMF returns a location response to the AMF with any sidelink positioning/ranging location results obtained as a result of steps 6 to 8.

### 7.3A.3 SL-MT-LR Service Support for periodic, triggered Location Events

Figure 7.3A.3-1 shows the sequence of operations for an SL-MT-LR location service for periodic and triggered location events, starting at the point where the AMF initiates the service in the LMF.



Figure 7.3A.3-1: UE Positioning Operations to support an SL-MT-LR for periodic, triggered Location Events.

1. The AMF serving UE1 sends a location request to the LMF to request periodic or triggered sidelink positioning/ranging location results of the n UEs (e.g., absolute locations, relative location or ranges and directions between pairs of UE(s)). The request includes information on the time interval between successive location reports, the total number of reports, and/or the details of the trigger event (e.g., change of location or ranges), the SUPI of UE1, the required LCS QoS and the Application Layer IDs of the UEs when available, as described in TS 23.273 [35].

2. The LMF sends a Periodic-Triggered SL-MT-LR request to UE1 (via serving AMF) including the information of the periodic or triggered event, the types of required location results (e.g., absolute location, relative locations or distances and/or directions) and the Application Layer IDs of the other UEs 2 to n.

3. UE1 attempts to discover the other UEs 2 to n using their Application Layer IDs if not already discovered, as described in TS 23.273 [35].

4. UE1 obtains the sidelink positioning capabilities of the discovered UEs using the SLPP capability transfer procedures specified in clause 7.11.2.1.

5. UE1 returns a Periodic-Triggered SL-MT-LR Response to the LMF (via serving AMF) indicating which of the UEs 2 to n have been discovered, whether the UEs 1 to n accept the periodic or triggered location request, and the sidelink positioning capabilities of the discovered UEs, if obtained.

6a. The LMF may instigate one or more SLPP and Supplementary RSPP procedures with UE1 to transfer sidelink positioning capabilities for UEs 1 to n, to transfer SLPP assistance data for UEs 1 to n, and to transfer sidelink location information for UEs 1 to n (e.g., sidelink ranging and/or location measurements or location estimates obtained at step 6b), as described in steps 6a/b/d/e, 7a/b/c/d, and 8a/b/d/e in Figure 7.3A.2-1.

6b. UE1 may instigate one or more SLPP procedures among UEs 1 to n to transfer sidelink positioning capabilities, provide sidelink assistance data to the UEs 2 to n, and/or obtain sidelink location information for UEs 1 to n (e.g., sidelink ranging and/or location measurements or location estimates) as described in steps 6c, 7e, and 8c in Figure 7.3A.2-1.

7. The LMF returns a location response to the AMF indicating that the SL-MT-LR for periodic, triggered Location Events has been successfully initiated and with any initial sidelink positioning/ranging location results obtained as a result of steps 6.

8. The UEs 1 to n may periodically perform sidelink positioning/ranging in order to support steps 9 and 10. The UE may perform steps 6c, 7e, and 8c in Figure 7.3A.2-1.

9. The UE monitors for occurrence of the trigger or periodic event requested at step 2.

10. UE1 sends an event report message to the LMF (via serving AMF) indicating the type of event being reported and may include sidelink location results obtained at step 8.

11. The LMF (via serving AMF) returns an event report acknowledgement to UE1.

12. If sidelink location results are needed for event reporting and not received at step 10, the LMF may instigate one or more SLPP and Supplementary RSPP procedures with UE1 as described in step 6a/6b.

13. The LMF returns the event report and any sidelink location results to the LCS Client or AF.

14. The UEs 1 to n continue to periodically perform sidelink positioning/ranging as in step 8.

15. The UE1 continues to monitor for further periodic or trigger events as in step 9 and instigates steps 10-12 each time a periodic or trigger event is detected.

### 7.3A.4 SL-MO-LR Service Support

Figure 7.3A.4-1 shows the sequence of operations for an SL-MO-LR service instigated by UE1 to obtain sidelink positioning/ranging location results using one or more other UEs with the assistance of an LMF.



Figure 7.3A.4-1: UE Positioning Operations to support an SL-MO-LR

1. Based on a trigger of service request (e.g., received from the application layer in UE1) UE1 discovers the other UEs 2 to n, as described in TS 23.273 [35].

2. UE1 may obtain the sidelink positioning capabilities of the discovered UEs using the SLPP capability transfer procedures specified in clause 7.11.2.1.

3. UE1 sends an SL-MO-LR Request to the LMF via the serving AMF, including the Application Layer IDs of the other UEs 2 to n together with an indication on any sidelink assistance data needed, position calculation assistance from the LMF needed, and/or whether location results should be transferred to an LCS client or AF. For position calculation assistance from the LMF, the SL-MO-LR Request may include information on the type of sidelink positioning/ranging location results (e.g., absolute location, relative location or distances and directions between pairs of UEs) and desired QoS.

4a. The LMF may send a SLPP Request Capabilities message to UE1 to request the SL positioning and ranging capabilities of UE1 as described in clause 7.11.2.1.

4b. The LMF may request from UE1 the SL positioning and ranging capabilities of UEs 2 to n using the Supplementary RSPP Procedure. The Supplementary RSPP message includes embedded SLPP Request Capabilities messages for UEs 2 to n together with their Application Layer IDs.

4c. UE1 may instigate the SLPP Capability Transfer procedure specified in clause 7.11.2.1 with UEs 2 to n to obtain the sidelink positioning capabilities for UEs 2 to n, if not already obtained (e.g., at step 2).

4d. UE1 may provide its SL positioning and ranging capabilities as requested at step 4a to the LMF in a SLPP Provide Capabilities message.

4e. UE1 may provide the SL positioning and ranging capabilities of UEs 2 to n as requested at step 4b to the LMF using the Supplementary RSPP Procedure. The Supplementary RSPP message includes embedded SLPP Provide Capabilities messages from UEs 2 to n together with their Application Layer IDs.

5a. UE1 may send a SLPP Request Assistance Data message to the LMF to request SL positioning assistance data, if this request was not already included at step 3.

5b. UE1 may request SL positioning assistance data for UEs 2 to n using the Supplementary RSPP Procedure, if this request was not already included at step 3. The Supplementary RSPP message includes embedded SLPP Request Assistance Data messages for UEs 2 to n together with their Application Layer IDs.

5c. The LMF may send a SLPP Provide Assistance Data message to UE1.

5d. The LMF may provide assistance data for UEs 2 to n to UE1 using the Supplementary RSPP Procedure. The Supplementary RSPP message includes embedded SLPP Provide Assistance Data messages for UEs 2 to n together with their Application Layer IDs.

5e. UE1 may instigate the SLPP Assistance Data Transfer procedure specified in clause 7.11.2.2 with UEs 2 to n to provide the received assistance data from step 5d to the UEs 2 to n. The assistance data may assist UEs 1 to n to obtain sidelink location measurements and/or may assist UE1 to calculate sidelink positioning/ranging location results.

6a. If UE1 requested position calculation assistance from the LMF or location transfer to an LCS client or AF at step 3, the LMF sends a SLPP Request Location Information message to UE1. The request may include an indication whether location calculation should be performed by the UE (SL Target UE-based), or whether location measurements should be provided for location calculation at the LMF (SL Target UE-assisted).

6b. If UE1 requested position calculation assistance from the LMF or location transfer to an LCS client or AF at step 3 and if location measurements are required from UEs 2 to n, the LMF requests the location information using the Supplementary RSPP Procedure. The Supplementary RSPP message includes embedded SLPP Request Location Information messages for UEs 2 to n together with their Application Layer IDs.

6c. UE1 instigates the SLPP Location Information Transfer procedure specified in clause 7.11.2.3 among UEs 1 to n in which UE1 to n obtain sidelink location measurements and UEs 2 to n transfer their sidelink location measurements to UE1.

6d. UE1 sends a SLPP Provide Location Information message to the LMF with the location information requested at step 6a.

6e. UE1 provides the location information requested at step 6b for UEs 2 to n to the LMF using the Supplementary RSPP Procedure. The Supplementary RSPP message includes embedded SLPP Provide Location Information messages for UEs 2 to n together with their Application Layer IDs.

NOTE: Steps 4a-4e, 5a-5e, and 6a-6e could be performed in any order and may also overlap.

7. The LMF sends a SL-MO-LR Response to the AMF which forwards the SL-MO-LR Response to UE1. If UE1 requested position calculation assistance at step 3, the SL-MO-LR Response includes the calculated UE locations obtained from step 6.

8. If requested at step 3, the AMF provides the location results to the AF/LCS Client.

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## 7.12 General UE-only sidelink positioning and ranging procedure

Figure 7.12-1 shows the sequence of operation for sidelink positioning and ranging in the UE only mode of operation as further defined in TS 23.586 [46].



Figure 7.12-1: Procedure for sidelink positioning and ranging (UE-only operation)

1. UE1 (e.g., target UE) may receive a Ranging/SL Positioning Service Request from a client UE or from its own application layer as defined in TS 23.586 [46].

2. UE1 discovers UEs 2 to n, as described in TS 23.586 [46], if not already discovered.

3. UE1 may obtain the sidelink positioning capabilities from UEs 2 to n using the SLPP Capability Transfer procedure described in clause 7.11.2.1.

4. If UE1 does not support SL Server UE functionality or decides to select a different SL Server UE, a SL Server UE may be discovered (if not already discovered at step 2) and selected as described in TS 23.586 [46].

5. If step 4 was performed, UE1 may send a Supplementary RSPP SL Positioning/Ranging Service Request message to the SL Server UE including the Application Layer IDs of UEs 1 to n together with an indication of location results requested (e.g., absolute location, relative location or distances and directions) and desired QoS.

6. If step 4 was performed, the SL Server UE may request the SL positioning and ranging capabilities of UE1 using the SLPP Capability Transfer procedure described in clause 7.11.2.1.

7. If step 4 was performed, the SL Server UE may request the SL positioning and ranging capabilities of UEs 2 to n using the Supplementary RSPP Procedure. The Supplementary RSPP messages may include embedded SLPP Capability Transfer messages for UEs 2 to n together with their Application Layer IDs. If step 3 did not occur, UE1 obtains the sidelink positioning capabilities from UEs 2 to n using the SLPP Capability Transfer procedure described in clause 7.11.2.1 at this step.

8. If step 4 was performed, the SL Server UE may provide assistance data for UE1 using the SLPP Assistance Data Transfer procedure described in clause 7.11.2.2.

9. If step 4 was performed, the SL Server UE may provide assistance data for UEs 2 to n using the Supplementary RSPP Procedure. The Supplementary RSPP messages may include embedded SLPP Assistance Data Transfer messages for UEs 2 to n together with their Application Layer IDs.

10. UE1 may provide assistance data to UEs 2 to n using the SLPP Assistance Data Transfer procedure described in clause 7.11.2.2. If step 9 was performed, the SLPP Provide Assistance Data message includes the assistance data received from the SL Server UE at step 9.

11. If step 4 was performed, the SL Server UE may send a SLPP Request Location Information message to UE1 as described in clause 7.11.2.3 if the ranging/positioning result determination is performed by the SL Server UE.

12. If step 4 was performed, the SL Server UE may request location information for UEs 2 to n using the Supplementary RSPP Procedure if the ranging/positioning result determination is performed by the SL Server UE. The Supplementary RSPP messages may include embedded SLPP Request Location Information messages for UEs 2 to n together with their Application Layer IDs.

13. UE1 may send a request for sidelink location information to UEs 2 to n using the SLPP Location Information Transfer procedure described in clause 7.11.2.3. If step 12 was performed, the SLPP Location Information Request message includes the information received from the SL Server UE at step 12.

14. If step 11 was performed, UE1 sends a SLPP Provide Location Information message containing the sidelink location information obtained by UE1 to the SL Server UE as described in clause 7.11.2.3.

15. If step 12 was performed, UE1 provides the sidelink location information from UEs 2 to n to the SL Server UE using the Supplementary RSPP procedure. The Supplementary RSPP messages may include embedded SLPP Provide Location Information messages for UEs 2 to n together with their Application Layer IDs.

16. If steps 11 or 12 (and 14 or 15) were performed, the SL Server UE performs the ranging/SL positioning results calculation.

17. If step 5 was performed, the SL Server UE sends a SL Positioning/Ranging Service Response to UE1 including the results requested in step 5.

18. If step 5 was not performed, UE1 performs the ranging/SL positioning results calculation as requested at step 1.

19. The ranging/positioning result is delivered to the requestor from step 1.