**3GPP TSG-WG SA2 Meeting #157 *S2-2306781***

**Berlin, Germany, May 22 – 26, 2023 (revision of S2-2305748)**

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| *CR-Form-v12.2* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
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|  | **23.273** | **CR** | **0321** | **rev** | **4** | **Current version:** | **18.1.0** |  |
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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 |  | Core Network | **x** |

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| ***Title:*** | Support of MT-LR for Ranging and Sidelink Positioning | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | [Qualcomm Incorporated], Huawei, HiSilicon | | | | | | | | | |
| ***Source to TSG:*** | SA2 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | Ranging\_SL | | | | |  | ***Date:*** | | | 2023-05-12 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **B** |  | | | | | ***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)* | |
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| ***Reason for change:*** | | Based on the conclusion in FS\_Ranging\_SL study (TR 23.700-86) , this CR provides the SL-MT-LR based procedure for Ranging and Sidelink Positioning. | | | | | | | | |
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| ***Summary of change:*** | | Add SL-MT-LR based procedure for Ranging and Sidelink Positioning.  In rev 4, further clarifiy that:   1. 5GC-MT-LR service and SL-MT-LR service are two different services. 2. To clarify the information included in SL-MT-LR request/response message between UE and LMF. | | | | | | | | |
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| ***Consequences if not approved:*** | | Incomplete Ranging and Sidelink Positioning support. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 3.2; (new) 6.x | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **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:*** | |  | | | | | | | | |

\* \* \* \* First change \* \* \* \*

## 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].

APN Access Point Name

APN-NI APN Network Identifier

EDT Early Data Transmission

E-SMLC Evolved Serving Mobile Location Centre

GMLC Gateway Mobile Location Centre

HGMLC Home GMLC

LCS LoCation Services

LDR Location Deferred Request

LIR Location Immediate Request

LMF Location Management Function

LPI LCS Privacy Indicator

LRF Location Retrieval Function

MBSR Mobile Base Station Relay

MO-LR Mobile Originated Location Request

MT-LR Mobile Terminated Location Request

NI-LR Network Induced Location Request

PMD Pseudonym mediation device functionality

POI Privacy Override Indicator

SDT Small Data Transmission

TNAN Trusted Non-3GPP Access Network

TNAP Trusted Non-3GPP Access Point

TWAP Trusted WLAN Access Point

VGMLC Visited GMLC

SL-MT-LR Sidelink Mobile Terminating Location Request

\* \* \* \* next change \* \* \* \*

## 6.x Network based Ranging/Sidelink Positioning procedures6.x.y SL-MT-LR Procedure

The SL-MT-LR procedure is used to estimate the relative locations or distances and/or directions between the UEs.

Figure 6.x.y-1 illustrates a procedure to enable an LCS Client or AF to obtain Ranging/Sidelink Positioning location results for a group of n UEs (n ≥ 2), i.e. UE1, UE2, … UEn. In the procedure, the GMLC determines a UE among the n UEs to be designated UE1 (i.e. Target UE in TS 23.586 [40]) and one or more other UEs designated UE2, UE3, … UEn (n ≥ 2) (i.e. Reference/Located UEs in TS 23.586 [40]). The Ranging/Sidelink Positioning location results may include relative locations or ranges and directions related to the UEs, based on the service request.

Procedure for periodic and triggered SL-MT-LR is defined in clause 6.x.n.



Figure 6.x.y-1: SL-MT-LR Procedure

**Precondition:**

At least one of the n UEs is in coverage and registered with a serving PLMN.

1. The LCS Client or the AF (via NEF) sends an LCS service request to the (H)GMLC for Ranging/Sidelink Positioning location results for the n UEs which may each be identified by a GPSI or a SUPI. The request may include the required QoS, the required location results (e.g. relative locations or distances and/or directions related to the UEs), the SL reference UE(s) in case of relative locations, distance, or direction.. The (H)GMLC or NEF authorizes the LCS Client or the AF for the usage of the LCS service. If the authorization fails, the remaining steps are skipped and the (H)GMLC or NEF responds to the LCS Client or the AF with the failure of the service authorization.

In addition, an Application Layer ID shall be included for each of the n UEs to enable discovery of the UEs at step 12.

Editor's Note: Whether Application Layer ID will be included in LPP operation is FFS and needs the coordination with RAN WGs.

2. The (H)GMLC invokes a Nudm\_SDM\_Get service operation towards the UDM of each of the n UEs to get the privacy settings of the UE identified by its GPSI or SUPI. The UDM returns the UE Privacy setting of the UE. The (H)GMLC checks the UE LCS privacy profile.

3. The (H)GMLC invokes a Nudm\_UECM\_Get service operation towards the UDM of each of the n UEs (for which GPSI or SUPI is available), one at a time, using the GPSI or SUPI of each UE. The (H)GMLC selects the UE (e.g. which is treated as UE1 in following steps) that initiates the Ranging/SL Positioning and selects the corresponding serving AMF.

NOTE 2: The UDM is aware of the serving AMF address at UE registration on an AMF as defined in clause 4.2.2.2.2 of TS 23.502 [19]. The UDM is aware of a serving VGMLC address at UE registration on an AMF as defined in clause 4.2.2.2.2 of TS 23.502 [19].

4. For a non-roaming case, this step is skipped. In the case of roaming, the HGMLC may receive an address of a VGMLC (together with the network address of the current serving AMF) from the UDM in step 3, otherwise, the HGMLC may use the NRF service in the HPLMN to select an available VGMLC in the VPLMN, based on the VPLMN identification contained in the AMF address received in step 3. The HGMLC then sends the location request to the VGMLC by invoking the Ngmlc\_Location\_ProvideLocation service operation towards the VGMLC. In the cases when the HGMLC did not receive the address of the VGMLC, or when the VGMLC address is the same as the HGMLC address, or when both PLMN operators agree, the HGMLC sends the location service request message to the serving AMF. In this case, step 4 is skipped. The H-GMLC also provides the LCS client type of AF, if received in step 1, or LCS client type of LCS client and other attributes to be sent to AMF in step 5.

5. In the case of roaming, the VGMLC first authorizes that the location request is allowed from this HGMLC, PLMN or from this country. If not, an error response is returned. The (H)GMLC or VGMLC invokes the Namf\_Location\_ProvidePositioningInfo service operation towards the AMF serving UE1 to request Sidelink positioning/ranging location results of the n UEs. The service operation includes the SUPI of UE1, the Application layer IDs of the UEs those were determined by the (H)GMLC or VGMLC to participate in the procedure, the client type and may include the required LCS QoS, the required location results (e.g. relative locations or ranges and directions related to the UEs) and other attributes as received or determined in step 1.

6. If UE1 is in CM IDLE state, the AMF initiates a network triggered Service Request procedure to establish a signalling connection with UE1.

If signalling connection establishment fails, steps 7-17 are skipped.

7-8. If the indicator of privacy check indicates an action is needed, then Same operation as that of step 7-8 of clause 6.1.2 is carried out.9. The serving AMF selects an LMF serving UE1 (e.g. an LMF that supports Ranging/Sidelink Positioning) and sends an Nlmf\_Location\_DetermineLocation service operation towards the LMF with the information received at step 5 e.g. required location results (e.g. relative locations or ranges and directions between pairs of UEs). The service operation includes a LCS Correlation identifier.

10. The LMF sends an SL-MT-LR request to the serving AMF as a supplementary services message, using the Namf\_Communication\_N1N2MessageTransfer service operation, and the session ID parameter is set to the LCS Correlation identifier.

The SL-MT-LR request may include the application layer IDs of the other UEs 2 to n, the types of required location results (e.g. relative locations or distances and/or directions).

Editor's note: Whether supplementary services message or lpp will be sent from LMF to UE is FFS and needs the coordination with RAN WGs.

11. The serving AMF forwards the SL-MT-LR request and a Routing identifier equal to the LCS Correlation identifier to UE1 using a DL NAS TRANSPORT message.

12. UE1 attempts to discover the other UE 2 to n using their Application Layer IDs if not already discovered using procedure defined in 6.4 of TS 23.586[40].

13. UE1 obtains the sidelink positioning capabilities of the discovered UEs via the SLPP if not already obtained.

14. UE1 returns a supplementary services SL-MT-LR response to the serving AMF in an UL NAS TRANSPORT message and includes the Routing identifier received in step 11.

The SL-MT-LR response indicates which of UEs 2 to n have been discovered, and the sidelink positioning capabilities of the discovered UEs.

15. The serving AMF forwards the SL-MT-LR response to the LMF indicated by the Routing identifier received at step 14 and includes a LCS Correlation identifier equal to the Routing identifier.

16. Ranging/Sidelink Positioning of UE1 and the other discovered UEs occurs as for an SL-MO-LR as described for steps 10-19 of Figure 6.x.z-1 with the difference that Ranging/Sidelink Positioning location measurement data or results are always returned to the LMF and the LMF indicates to UE1 at step 13 or step 14 of Figure 6.x.z-1 whether the Ranging/Sidelink Positioning location results will be calculated by the LMF (at step 19) or by UE1 (at step 17). For some undiscovered UEs among the other UEs 2 to n, the LMF interacts with GMLC to initiate the 5GC-MT-LR procedure for UE2 to n to get their absolute locations, and calculates the relative locations or distances and/or directions related to the UEs.

17-20. The LMF returns the Sidelink positioning/ranging location results to the LCS Client or AF as in steps 13-15 and step 24 of clause 6.1.2. The results also include failure information of the UE(s) that was not discovered.

## 6.x.m 5GC-MT-LR Procedure

The procedure is used to estimate the location of a UE by using the location of one or more Located UEs and the distance and/or direction between the UE and the Located UE(s).

Procedure of Figure 6.1.2-1 can be reused, with step 12 of Figure 6.1.2-1 replaced by the step 10-16 of Figure 6.x.y-1 with the following adaptations:

* UE1 is the target UE, and UEs 2 to n are Located UEs.
* In step 10, the types of required location results is absolute solution, and the other UEs 2 to n are the candidate Located UE(s) if included. SL-MT-LR request also includes the indication of Target UE/LMF selecting Located UE.
* In step 14, if UE1 receives the indication of LMF selecting Located UE in SL-MT-LR request, SL-MT-LR response includes the obtained information of all the discovered Located UEs. If UE1 receives the indication of Target UE selecting Located UE in SL-MT-LR request, UE1 performs the Located UE selection, and SL-MT-LR response includes the selected Located UEs ID.

## 6.x.n Periodic and Triggered SL-MT-LR Procedure

The periodic and triggered SL-MT-LR procedure is based on SL-MT-LR procedure in clause 6.x.y, and used to estimate the relative locations or distances and/or directions between the UEs periodically or following certain trigger events. LCS Client or AF to obtain Ranging/Sidelink Positioning location results for a group of n UEs (n ≥ 2), i.e. UE1, UE2 …UEn either periodically or when certain trigger events occur.

Besides relative locations, ranges, directions as defined in clause 6.x.y, for periodic and triggered SL-MT-LR procedure, and the Ranging/Sidelink Positioning location results may additionaly include velocities and relative velocities related to the UEs based on the service request. Figure 6.x.n-1 illustrates the procedure.



Figure 6.x.n-1: Periodic and Triggered SL-MT-LR Procedure

The following additions apply compared to the procedure in clause 6.x.y:

1. The LCS service request further includes periodic or trigger event parameters. For periodic location, the LCS Service Request includes the time interval between successive location reports and the total number of reports. For triggered location. the LCS Service Request includes details of the trigger event, the duration of event reporting, the minimum and maximum time intervals between successive event reports, the maximum event sampling interval, whether location estimates shall be included in event reports, and whether only one location report is required or more than one. Trigger events can be one of the following;

- ranging event with range threshold and threshold type (a, b, c or d): a trigger event occurs if the ranges between at least one UE of the n UEs and each of the other UEs are such that any range for the one UE is less than the threshold (type a), any range for the one UE exceeds the threshold (type b), all ranges for the one UE are less than the threshold (type c), or all ranges for the one UE exceed the threshold (type d).

4. In the message sent by (H)GMLC, the (H)GMLC also includes a contact address for the (H)GMLC (Notification Target Address, e.g. a URI) and an LDR reference number (Notification correlation ID) to be used for event reporting at steps 24-31 defined for periodic and triggered SL-MT-LR procedure only. The LDR reference number is either allocated by (H-)GMLC based on predefined rule or allocated by NEF, if the location request is sent by an NEF at step 1.

5. The message Namf\_Location\_ProvidePositioningInfo service operation towards the AMF is to request periodic or triggered sidelink positioning/ranging location results of the n UEs. The service operation further includes the periodic or trigger event parameters and other attributes as received or determined in steps 1 and 4.

NOTE 1: The location request is sent to one VGMLC at step 4 for roaming and to one AMF at step 5, which is the serving AMF for UE1.

10. The LMF sends a Periodic-Triggered SL-MT-LR request to the serving AMF. The LCS Periodic-Triggered SL-MT-LR request further includes a deferred routing identifier, which can be the identification of the LMF when the LMF will act as a serving LMF or a default LMF identification otherwise. The LCS Periodic-Triggered SL-MT-LR request may include the QoS and allowed or required location results at step 24 for each location event reported. The LCS Periodic-Triggered SL-MT-LR request also includes the application IDs of UEs 1 to m, the address for the (H)GMLC and LDR reference number. The LCS Periodic-Triggered SL-MT-LR request also includes the identities of the target UEs. The requested location results (e.g. absolute locations, relative locations, ranges, directions, velocities and relative velocities) for the target UEs and QoS.

11. The SL-MT-LR request from AMF is Periodic-Triggered, and the Routing identifier is immediate Routing identifier.

NOTE 2: The deferred routing identifier may be global (e.g. an IP address, UUID or URI) or may be local. The deferred routing identifier is used for routing in steps 24 and 25. The immediate routing identifier included by the AMF in step 11 is used for routing in steps 14 and 15.

14. The SL-MT-LR response from UE1 is Periodic-Triggered, and Routing identifier is immediate Routing identifier. The supplementary services Periodic-Triggered SL-MT-LR response indicates whether UE1 and other UEs 2 to m accept the periodic or triggered location request and which of UEs 2 to m were discovered by UE1 at step 12.

15. The SL-MT-LR response forwarded by AMF is Periodic-Triggered, and Routing identifier is immediate Routing identifier.

NOTE 3: Step 16 in clause 6.x.y enables the LMF to obtain the capabilities and initial location results for the UEs 1 to n.

17-20. The sidelink positioning/ranging location results returned by LMF to LCS Client is initial one.

The following additional steps are dedicated for Periodic and Triggered SL-MT-LR Procedure:

21. The UEs 1 to m periodically perform sidelink positioning/ranging in order to support steps 22 and 24.

NOTE 3: The UEs 1 to m may perform sidelink positioning/ranging at intervals of the maximum event sampling interval provided at step 1.

22. UE1 monitors for occurrence of the trigger or periodic event requested in step 11. For a trigger event, UE1 monitors the requested event at intervals equal to or less than the maximum event sampling interval. An event trigger is detected by UE1 when any of the following occur: (i) a requested non-periodic trigger event has been detected and the minimum reporting time interval has elapsed since the last report (if this is not the first event report); (ii) a requested periodic location event has occurred; or (iii) the maximum reporting time for a non-periodic trigger event has expired.

23. UE1 performs a UE triggered service request as defined in clause 4.2.3.2 of TS 23.502 [19] if in CM-IDLE state in order to establish a signalling connection with the AMF.

24. UE1 sends a supplementary services event report message to the serving AMF using the Namf\_Communication\_N1N2MessageTransfer service operation, and includes the deferred Routing ID received in step 11. The event report indicates the type of event being reported (e.g. whether a normal event or expiration of the maximum reporting interval) and may include location results obtained at step 21. UE1 also includes the (H)GMLC contact address, the LDR reference number, whether location results are to be reported and if so the location QoS in the event report.

25. The AMF forwards the event report to the LMF indicated by the deferred Routing ID received at step 24 and includes a Correlation ID equal to the deferred Routing ID.

26. When the LMF receives the event report and if it can handle this event report, the LMF updates the status of event reporting (e.g. the number of event reports so far received from UE1 and/or the duration of event reporting so far) and returns a supplementary services acknowledgment for the event report to the serving AMF using the Namf\_Communication\_N1N2MessageTransfer service operation, and a Correlation ID identifying the LMF. The acknowledgment may optionally include a new deferred routing identifier indicating a new serving LMF or a default (any) LMF.

27. The serving AMF forwards the event report Ack and an immediate Routing ID equal to the Correlation ID to UE1 using a DL NAS TRANSPORT message. If UE1 does not receive any response from the LMF after a predefined time, i.e. the current LMF does not support the deferred location request (for temporary or permanent reasons) or due to some radio access failures, UE1 may re-send the report one or more times.

NOTE 4: Inclusion of a new deferred routing identifier in the event report acknowledgment at step 26 may be used to change the serving LMF (e.g. if a UE moves into an area that is better supported by a different LMF or if the serving LMF is overloaded) or to enable a default LMF to become a serving LMF.

28. If location results are needed for event reporting and not received at step 25, the LMF may instigate Ranging/Sidelink Positioning of UEs 1 to m as at step 16.

29-31. The LMF returns the event report and any location results obtained at step 25 or step 28 to the LCS Client or AF as in steps 28-30 of clause 6.3.1.

32. UEs 1 to m continue to periodically perform sidelink positioning/ranging as in step 21.

33. UE1 continues to monitor for further periodic or trigger events as in step 22 and instigates steps 23-31 each time a periodic or trigger event is detected.

\* \* \* \* End of changes \* \* \* \*