**3GPP SA WG2 Meeting #164 *S2-2408890***

**Maastricht, NL, 19-23 August 2024 *(was S2-2407881)***

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| *CR-Form-v12.2* |
| **CHANGE REQUEST** |
|  |
|  | **23.273** | **CR** | **0543** | **rev** | **1** | **Current version:** | **18.6.0** |  |
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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 |  | Radio Access Network |  | Core Network | **x** |

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| ***Title:***  | Introduction of LMF enhancement for Direct AI/ML based Positioning |
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| ***Source to WG:*** | Qualcomm Incorporated |
| ***Source to TSG:*** | SA2 |
|  |  |
| ***Work item code:*** | AIML\_CN |  | ***Date:*** | 2024-08-19 |
|  |  |  |  |  |
| ***Category:*** | **B** |  | ***Release:*** | Rel-19 |
|  | *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 canbe 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 for KI#1 in TR 23.700-84, it is proposed to capture the introduction of LMF enhancement for direct AI/ML based positioning feature in 23.273. |
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| ***Summary of change:*** | * Adding the introduction of LMF enhancement for direct AI/ML based positioning.
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| ***Consequences if not approved:*** |  Direct AI/ML based positioning is not supported. |
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| ***Clauses affected:*** |  4.3.8, new 5.16.x |
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|  | **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 ...  |
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| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** | The clause 6.x.1 that referred in this CR is related to the new clause “6.x.1 Data collection at LMF to train the AI/ML model to perform positioning based on UE measurements” in CR# 0532. |

>>>>BEGINNING OF CHANGES <<<<

### 4.3.8 Location Management Function, LMF

The LMF manages the overall co-ordination and scheduling of resources required for the location of a UE that is registered with or accessing 5GCN. It also calculates or verifies a final location and any velocity estimate and may estimate the achieved accuracy. The LMF receives location requests for a target UE from the serving AMF using the Nlmf interface. The LMF interacts with the UE in order to exchange location information applicable to UE assisted and UE based position methods and interacts with the NG-RAN, N3IWF or TNAN in order to obtain location information.

The LMF shall determine the result of the positioning in geographical co-ordinates as defined in TS 23.032 [8] and/or in local co-ordinates as defined in TS 23.032 [8]. If requested and if available, the positioning result may also include the velocity of the UE. The coordinate type(s) is determined by LMF when receiving a location request, based on LCS Client type and supported GAD shapes. If the location request indicates regulatory LCS Client type the LMF shall determine a geographical location and optionally a location in local coordinates. For location request indicates a value added LCS Client type, the LMF may determine the UE location in local coordinates or geographical co-ordinates or both. If the supported GAD shapes is not received or Local Co-ordinates is not included in the supported GAD shapes, the LMF shall determine a geographical location.

NOTE 1: Some RAT independent position methods (e.g. GNSS based position methods) can only determine a UE location in geographical co-ordinates. In such a case, the LMF may translate a UE location in geographical co-ordinates into a location in local co-ordinates when an origin for the local co-ordinates has known global coordinates. When an origin for the local co-ordinates does not have known global coordinates, position methods that can only determine a UE location in geographical co-ordinates cannot be used to determine a UE location in local co-ordinates.

Additional functions which may be performed by an LMF to support location services include the following.

- Support a request for a single location received from a serving AMF for a target UE.

- Support a request for periodic or triggered location received from a serving AMF for a target UE.

- Determine type and number of position methods and procedures based on UE and PLMN capabilities, QoS, UE connectivity state per access type, LCS Client type, co-ordinate type and optionally service type and indication of requiring reliable UE location information.

- Report UE location estimates directly to a GMLC for periodic or triggered location of a target UE.

- Support cancelation of periodic or triggered location for a target UE.

- Support the provision of broadcast assistance data to UEs via NG-RAN in ciphered or unciphered form and forward any ciphering keys to subscribed UEs via the AMF.

- Support change of a serving LMF for periodic or triggered location reporting for a target UE.

- Support of receiving stored UE Positioning Capability from AMF and support of providing updated UE Positioning Capability to AMF.

- Map the UE location to a geographical area where the PLMN is or is not allowed to operate based on the request from AMF.

- Support determination of a UE location at a scheduled location time.

- Support determination of indoor or outdoor for a location estimate.

- Determine whether to use user plane or control plane for positioning.

- Support handling of 5GC-MT-LR, 5GC-NI-LR, 5GC-MO-LR and deferred 5GC-MT-LR for periodic or triggered location over a user plane connection between UE and LMF over TLS.

- Support a request of ML model provision from NWDAF containing MTLF for AI/ML based Positioning.

NOTE 2: How the LMF uses the received UE user plane positioning capability for SUPL [49] is left to the implementation.

- Support collection of GNSS assistance data from AFs.

- Support service level PRU Association, PRU Association update or PRU Disassociation.

- LMF supports verification of a PRU initiated Association or Disassociation by checking whether there is an PRU verified indication from AMF.

- LMF stores the received PRU information contained in service level PRU Association message and removes the PRU information after PRU Disassociation.

- LMF keeps PRU information for PRUs which are in OFF state.

- LMF may indicate support of PRU function to NRF via NF profile and may further send the PRU indication via NF profile update if PRU is stationary PRU.

- LMF may request a PRU to associate to a new LMF by returning a Routing ID of the new LMF.

PRU ON/OFF states indicate temporarily availability of the PRU functionality of a UE at the serving LMF (e.g. PRU OFF due to other high priority tasks/energy saving at the UE, or the UE temporarily loses network coverage).

- Support selection of a PRU based on stored PRU information if the LMF needs to obtain the location measurements from the PRU to assist positioning of a target UE.

- Support to obtain PRU location measurements as described in clause 5.4.5 of TS 38.305 [9] by triggering the procedure in clause 6.11.

- Support to obtain PRU location measurements from other PRU serving LMF(s).

- As a serving LMF of target UE(s), support discovery and selection of other PRU serving LMF(s) by querying the NRF and support to request PRU location measurements from the selected LMF(s).

- As a serving LMF of PRU(s), support to provide PRU location measurements to other LMF(s) after receiving a request from other LMF(s).

- Support to determine UE location by considering obtained PRU location measurements.

NOTE 3: Country, area within a country, or an international area can be supported as different types of geographical area.

- Support a request for user plane reporting from a UE to an LCS Client or AF for a periodic or triggered 5GC-MT-LR. Subsequently, support the transfer of cumulative event reports from the target UE via control plane back to the H-GMLC and LCS Client or AF. Also support any request for assistance data received in a cumulative event report.

- Determine UE location for a UE connecting to a MBSR based on location and velocity of the MBSR and the timing of the location estimations for the target UE and MBSR.

- For a regulatory location service, support reporting of multiple INTERMEDIATE location estimates to GMLC.

>>>> NEXT CHANGES (new clause) <<<<

#### 5.16.x AI/ML Based Positioning

LMF may calculate the location and estimate the achieved accuracy based on AI/ML based Positioning. When receiving the request for a UE location, the LMF selects an appropriate method as described in clause 5.2 to determine the result of the positioning. The result of the positioning may be determinedby using AI/ML based Positioning ML model supported by LMF. The LMF collects location measurement information generated from UE or NG-RAN as input data for the AI/ML based Positioning ML model to derive the final positioning result and provides the positioning result to the consumer. The consumer is not aware whether the positioning result is derived based on AI/ML based positioning or not.

Editor’s note: What location measurement information collected from UE and NG-RAN to LMF for AI/ML based Positioning calculation will be determined by RAN1 and RAN2, and how to collect these measurements information is FFS considering inputs from RAN WGs.

The ML model that is used for AI/ML based positioning in LMF may be trained by LMF. The trigger for data collection and model training in LMF is up to implementation. LMF collects location measurement information for ML model training as described in clause 6.x.1.

LMF may also request an ML model for AI/ML based positioning from NWDAF containing MTLF. LMF discovers a suitable NWDAF containing MTLF via NRF as described in clause 5.2 in TS 23.288 [37]. LMF requests ML model training for AI/ML based positioning with ML Model Filter Information, which may indicate the area of interest. NWDAF containing MTLF collects location measurement information to perform the ML model training and model provision to LMF as described in clause 6.2A in TS 23.288 [37].

Editor’s note: The procedure of NWDAF containing MTLF collects location measurement information for AI/ML based model training is FFS.

Eidtor’s note: The collected Location measurement information for AI/ML based Positioning model training will be determined by RAN1 and RAN2, and how to collect the location measurement information is FFS depending on RAN WG decision.

Either LMF or NWDAF containing MTLF may perform performance monitoring for AI/ML based Positioning. LMF may determine whether to use the AI/ML based positioning to derive the UE location based on the model performance monitoring result. LMF may also trigger the ML model retraining in the training entity based on the result of model performance result.

>>>> NEXT CHANGES<<<<

>>>>END OF CHANGES<<<<