**3GPP TSG-WG SA2 Meeting #170S2-2507584**

**Goteborg, Sweden, August 25 - 29, 2025**

|  |
| --- |
| *CR-Form-v12.3* |
| **CHANGE REQUEST** |
|  |
|  |  | **CR** | **0747** | **rev** | **2** | **Current version:** |  |  |
|  |
| *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)*.* |
|  |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***Proposed change affects:*** | UICC apps |  | ME |  | Radio Access Network |  | Core Network | **X** |

|  |
| --- |
|  |
| ***Title:***  | Clarification on data collection for LMF-based AI/ML positioning |
|  |  |
| ***Source to WG:*** | CATT, Nokia, vivo, Huawei, HiSilicon |
| ***Source to TSG:*** | S2 |
|  |  |
| ***Work item code:*** | AIML\_CN |  | ***Date:*** | 2025-08-15 |
|  |  |  |  |  |
| ***Category:*** | F |  | ***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) Rel-20 (Release 20)* |
|  |  |
| ***Reason for change:*** | 1. For NWDAF discovery for LMF-based AI/ML Positioning, the parameters should be aligned with TS 23.288.2. Since the procedure of LMF collecting input data from UE in clause 6.22.2 is not supported in this release, so the related descriptions and clause references should be removed.3. The Nlmf\_Location\_MeasurementData service operation is used to collect the location measurements of PRUs close to a Target UE to improve the positioning result of the Target UE (see clause 6.17.4), and the mandatory input of this service operation is “Target UE cell ID”. Therefore, the Nlmf\_Location\_MeasurementData service operation is not applicable in the case of data collection for AI/ML positioning, as there is no “target UE” in this case. Since the Nlmf\_DataExposure\_Subscribe service operation is already defined to collect data for AI/ML positioning, so it is proposed to change the “Nlmf\_Location\_MeasurementData Request” in step 2 to “Nlmf\_DataExposure\_Subscribe”.4. LMF may request the UE Positioning Capability and UE User Plane Positioning Capabilities from AMF for selecting UEs for data collection.5. According to R1-2501525, “Working Assumption [R1-2405782]For training data generation of AI/ML based positioning Case 3b, the label and its related data (e.g., time stamp) can be generated by:* PRU
* Non-PRU UE with estimated location
* LMF.”

Based on this, clarification on how the LMF obtains the ground truth data for model training is proposed.6. The definition of input parameter "Data samples" for Nlmf\_DataExposure\_Notify service operation is unclear.7. In Figure 6.22.3-1, step 9 "Nudm\_SDM\_Notify" should be "Nudm\_SDM\_Notification". |
|  |  |
| ***Summary of change:*** | 1. Add LMF-based AI/ML positioning indication and its purpose for NWDAF discovery to align with TS 23.288.2. Remove the descriptions and clauses related to the clause 6.22.2.3. Change the “Nlmf\_Location\_MeasurementData Request” in step 2 to “Nlmf\_DataExposure\_Subscribe”.4. Add that LMF may request the UE Positioning Capability and UE User Plane Positioning Capabilities from AMF.5. Clarify how the LMF obtains the ground truth data for model training.6. Clarify the input parameter "Data samples" for Nlmf\_DataExposure\_Notify service operation.7. Correct step 9 in Figure 6.22.3-1. |
|  |  |
| ***Consequences if not approved:*** | It is unclear how the LMF obtains the ground truth data for model training. Inappropriate service operation and incomplete procedure for LMF-based AI/ML positioning. |
|  |  |
| ***Clauses affected:*** | 5.18.0, 6.3.4, 6.22.3, 6.22.4, 8.3.4.3 |
|  |  |
|  | **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:*** |  |

\* \* \* Start of Change \* \* \* \*

5.18.0 General

The LMF may calculate the UE location and estimate the achieved accuracy by using LMF-based AI/ML Positioning. When receiving the request from AMF for determining a UE location, the LMF selects an appropriate positioning method as described in clause 5.2 to determine the result of the positioning. The result of the positioning may be calculated by using LMF-based AI/ML Positioning ML model supported by LMF. The LMF collects input data from NG-RAN for the LMF-based AI/ML Positioning to perform location calculation and provide the location to the consumer.

NOTE 1: Whether to select LMF-based AI/ML Positioning for location result calculation is determined by LMF.

NOTE 2: The specific measurement data collected by LMF from NG-RAN for LMF-based AI/ML Positioning are in the scope of RAN specifications and not in the scope of this specification.

Editor's note: What input data collected from UE and NG-RAN to LMF for LMF-based AI/ML Positioning will be determined by RAN WG1.

The ML model that is used for LMF-based AI/ML Positioning may be trained by LMF. The trigger for data collection required for model training in LMF is up to implementation. The LMF collects measurement data from NG-RAN and the ground truth data for ML model training as described in clause 6.22.3.

The LMF may also request a trained ML model for LMF-based AI/ML Positioning from NWDAF containing MTLF as described in clause 6.22.5. The LMF discovers a suitable NWDAF containing MTLF via NRF as described in clause 5.2 of TS 23.288 [37] with the following considerations:

- The LMF provides an LMF-based AI/ML positioning indication that indicates the NWDAF shall support ML Model training for the LMF-based AI/ML Positioning.

- The LMF may provide the positioning case information (i.e. NG RAN node assisted LMF-based AI/ML Positioning case).

NOTE 3: The positioning case information only indicates the NG RAN node assisted LMF-based AI/ML Positioning in this release.

- The LMF provides an Area of Interest, and may include the ML Model Interoperability indicator to discover an NWDAF that can provide an AI/ML Model.

- The LMF may request a NWDAF with ML Model accuracy checking capability to report when the model is degraded (i.e. for ML model performance monitoring).

NOTE 4: Other NWDAF discovery parameters listed in clause 5.2 of TS 23.288 [37] such as Analytics ID, FL capability type and related time period, S-NSSAI or any roaming capabilities are not included by LMF.

The LMF requests the NWDAF containing MTLF to provide an ML Model for LMF-based AI/ML Positioning as described in clause 6.2A of TS 23.288 [37] with the following considerations:

- The LMF provides the following input parameters in the Nnwdaf\_MLModelProvision\_Subscribe or Nnwdaf\_MLModelInfo\_Request:

- LMF-based AI/ML positioning indication that indicates the ML Model is for LMF-based AI/ML Positioning.

- Optionally, Vendor ID, ML Model Filter Information (e.g. Area of Interest), Positioning case information, Target of ML Model Reporting, ML Model Target Period, Time when model is needed, Inference Input Data information and ML Model Monitoring Information.

- If vendor specific information is required, then the ML Model Interoperability Information is included.

- If the LMF supports multiple AI/ML Models, indication of support for multiple ML Models, optionally with Number of ML Models and Accuracy level(s) of Interest.

The NWDAF containing MTLF collects input data to perform the ML model training as described in clause 6.22.4, and the NWDAF containing MTLF performs ML model provision to LMF as described in clause 6.2A of TS 23.288 [37] with the following considerations:

- The NWDAF containing MTLF provides the ML Model identifier and ML Model Information for the ML Model for UE Positioning, and optionally, the following parameters:

- ML Model Filter Information and/or Target of ML Model Reporting, if the ML Model provisioning request includes multiple ML Model Filter Information and/or Target of ML Model Reporting;

- Indication of whether the ML Model identifier is updated (e.g. retrained ML model).

- Validity period, Spatial validity, Training Input Data Information, ML Model accuracy Information.

Once the ML model for LMF-based AI/ML Positioning is trained and available in the LMF, the LMF may use it to perform UE Positioning after receiving a location determination request from AMF.

Editor's note: Whether user consent for UE positioning calculation is needed apart from the existing GMLC check of the LCS privacy profile is FFS.

For ML model training, performance monitoring and UE positioning calculation using LMF-based AI/ML Positioning, the LMF checks with UDM the user consent status before collecting UE related data, see clause 6.22.3 and clause 6.22.4.

Either LMF or NWDAF containing MTLF may perform performance monitoring for LMF-based AI/ML Positioning. When the ML model that is used for LMF-based AI/ML Positioning is trained by LMF, the LMF monitors the performance of the ML model. When the ML model that is used for LMF-based AI/ML Positioning in LMF is trained by NWDAF containing MTLF, then the NWDAF containing MTLF monitors the performance of the ML model. LMF may determine whether to use the LMF-based AI/ML Positioning to perform location calculation based on the model performance monitoring result. LMF or the NWDAF containing MTLF may also trigger the ML model retraining based on the model performance monitoring result.

\* \* \* Next Change \* \* \* \*

6.3.4 Cancellation of Reporting of data collection by a UE

The procedure described in Figure 6.3.4-1 enables a UE to cancel a data collection by LMF to train the LMF-based AI/ML Positioning model as described in clause 6.22.3, for example if the UE is powered off or if the UE cancels the data collection based on user's input (e.g. UE is not willing to report input data).

****

**Figure 6.3.4-1: UE Cancellation of a data collection**

1. The LMF performs a data collection procedure as defined in clause 6.22.3.

2. Same as step 2 in clause 6.3.2.

3. same as step 6 in clause 6.3.2.

\* \* \* Next Change \* \* \* \*

### 6.22.3 Data collection to train models for LMF-based AI/ML positioning based on NG RAN measurements

The procedure for data collection from NG-RAN is used to e.g. train the ML Model for LMF-based AI/ML positioning.



Figure 6.22.3-1: Data collection by LMF to train the AI/ML based positioning model using NG-RAN measurements

1. The LMF determines that data collection from the NG-RAN is required e.g. to train an ML Model for UE positioning for a number of UEs or to monitor the ML Model performance. The LMF may also initiate the data collection upon the request of an NWDAF containing MTLF as described in step 3 in figure 6.22.4-1.

2. The LMF may know the SUPIs of the UEs for which to collect location measurement data from the NG-RAN, e.g. when training an ML model using the PRU(s) associated to this LMF. The LMF may optionally invoke an Nnrf\_NFDiscovery\_Request to an NRF to discover other PRU serving LMF(s) which has associated PRUs in the area of interest, and send an Nlmf\_DataExposure\_Subscribe request to the selected PRU serving LMFs to collect the PRU locations and the measurement data from the NG-RAN for the PRUs; the following steps may be skipped in this case.

 If the LMF does not know the SUPIs of the UEs for which to collect location measurement data from the NG-RAN, the LMF tries to get the list of SUPIs from the AMF. Before that the LMF discovers the AMF(s) that serves the area of interest via the NRF using Nnrf\_NFDiscovery\_Request.

3. The LMF subscribes to the list of SUPIs in an area of interest from the AMF(s) using Namf\_EventExposure\_Subscribe request (Target of Event Reporting = "any UE", Event ID = "UEs in/out area of interest", indication of requesting UE Positioning Capability).

 The AMF sends Namf\_EventExposure\_Subscribe response or Namf\_EventExposure\_Notify (list of SUPIs in the area of interest). If UE Positioning Capability is also requested, AMF includes UE Positioning Capability and optionally UE User Plane Positioning Capabilities, if available, for each UE in the response message sent to LMF.

 For each SUPI in the area of interest, the following steps are performed.

4. The LMF checks whether the SUPI provided user consent for data collection for a purpose with UDM using Nudm\_SDM\_Get including subscription data type set to "User consent" for this SUPI.

 The LMF may further determine the UEs from the list of SUPIs that are received from AMF in step 3 for data collection based on e.g. UE Positioning Capability, UE User Plane Positioning Capabilities, the PRU information available in the LMF and operator's policy. The LMF may retrieve UE Positioning Capability and optionally UE User Plane Positioning Capabilities if not received in step 3.

5. The LMF subscribes to UDM to notifications of changes on subscription data type "User consent" for this SUPI using Nudm\_SDM\_Subscribe. If user consent is granted, then step 6 follows, otherwise no data is collected for this SUPI, i.e. the following steps are not performed.

Editor's note: Further details on user consent for data collection for a specific purpose, e.g. for model training and/or for performance monitoring for LMF-based AI/ML positioning will be aligned with SA WG3.

6. The LMF requests input data for the UE from the NG-RAN using the Measurement Information Transfer procedures in NRPPa as specified in clause 8.5 of TS 38.455 [15].

NOTE: The NG-RAN can reject the data collection request from the LMF (e.g. considering current NG-RAN load status).

7. To obtain ground truth data, the LMF collects location information from the UE and/or determines UE location by itself, using the procedures as described in clause 6.11, clause 6.17 and step 15-17 of clause 6.3.1, where the UE can be a PRU or non-PRU UE. The LMF then decides whether to use the UE location information as the ground truth data taking into account the quality of UE location information.

 The UE may reject the data collection request from the LMF (e.g. considering UE status, user's input). If the UE accepts data collection request, the UE may cancel the data collection later as defined in clause 6.3.4.

8. The LMF may determine that the UE is no longer in the area of interest, based on the AMF notification using Namf\_EventExposure service, then the LMF performs step 10 and step 11, the LMF may unsubscribe to be notified on user consent updates if the UE is not in the area of interest any longer.

9. The UDM may notify the LMF on changes of user consent at any time after step 5 using Nudm\_SDM\_Notification including SUPI and Subscription data type set to "User consent". If user consent is no longer granted for a user for which data has been collected the LMF performs step 10 and step 11. The LMF may unsubscribe to be notified of user consent updates from UDM for each SUPI for which data consent has been revoked, using Nudm\_SDM\_Unsubscribe including SUPI and Subscription data type set to "User consent".

10. The LMF requests NG-RAN to stop reporting input data for the UE.

11. The LMF stops any retrieval of ground truth data for the UE.

The measurements from NG-RAN and ground truth data from PRU/UE are used for ML model training. The UE location is derived from the measurements data by using LMF-based AI/ML Positioning. The derived UE location and ground truth data are used for ML model performance monitoring.

The LMF may initiate data collection for multiple UEs simultaneously, as such steps 6 and 7 may occur in parallel for a number of SUPIs as determined by the LMF.

\* \* \* Next Change \* \* \* \*

### 6.22.4 Input data collection by NWDAF for AI/ML positioning ML model training or ML model performance monitoring

The NWDAF containing MTLF may subscribe to input data (i.e. location measurement data and ground truth UE location) from LMF for ML model training or ML model performance monitoring for LMF-based AI/ML Positioning.



Figure 6.22.4-1: Procedure of input data collection from LMF

1. NWDAF containing MTLF determines to train a ML model for LMF-based AI/ML Positioning based on the request from LMF or internal trigger, or the NWDAF containing MTLF determines to perform ML model performance monitoring for LMF-based AI/ML Positioning.

2. The NWDAF invokes an Nnrf\_NFDiscovery\_Request service operation to an NRF to discover an LMF, the service operation includes an AoI and the Nlmf\_DataExposure service as discovery parameters. If the NWDAF wants to collect the input data of PRUs, the NWDAF may also include a PRU existence indication for discovering the LMF(s) associated with PRUs (the PRU association procedures are defined in clause 6.17). The NRF selects one or more LMFs based on the AoI, the Nlmf\_DataExposure service, and the PRU existence indication (if available), and sends an Nnrf\_NFDiscovery\_Request Response which includes the profiles of the selected LMFs to the NWDAF.

3. The NWDAF subscribes to or cancels subscription to input data from LMF by invoking Nlmf\_DataExposure\_Subscribe / Nlmf\_DataExposure\_UnSubscribe service operation. The NWDAF includes an AoI and a notification target address to request the input data from LMF. The NWDAF may also include requested number of data samples, time window of data samples, quality threshold, ML model identifier (for ML model performance monitoring), data source type (i.e. NG-RAN measurement). The quality threshold indicates to the LMF to provide ground truth data only when the ground truth data meets the quality threshold. The detailed parameters are defined in clause 8.3.4.

NOTE 1: If the quality threshold is included in step 3 and the collected data sample does not include quality indicator of the ground truth data, the LMF does not send this data sample to the NWDAF.

NOTE 2: The data source type only indicates NG-RAN measurement in this release.

4. For ML model training and ML model performance monitoring, the LMF performs the procedure for data collection in clause 6.22.3 to collect data from PRUs/UEs and/or the NG-RAN. For ML model performance monitoring, the LMF may also calculate the location estimation of PRU(s)/UE(s) using the collected data and the ML model identified by the ML model identifier if received in step 3.

5. The LMF sends the collected data samples (i.e. location measurement data from the NG-RAN, the corresponding ground truth data (i.e. location of PRUs or UEs) and the quality indicator of the ground truth data) to the NWDAF by invoking Nlmf\_DataExposure\_Notify service operation. The LMF may send a cause code to the NWDAF when the requested number of data samples cannot be met. The LMF may also send the location estimation of PRU(s)/UE(s) calculated in step 4 (if applicable). Then the NWDAF trains the ML model or performs ML model performance monitoring based on the data samples received from the LMF.

\* \* \* Next Change \* \* \* \*

#### 8.3.4.3 Nlmf\_DataExposure\_Notify service operation

**Service operation name:** Nlmf\_DataExposure\_Notify

**Description:** Allow the consumer NF to get notification about the input data used for ML model training or ML model performance monitoring for LMF-based AI/ML Positioning.

**Input, Required:** Notification Correlation ID.

**Input, Optional:** Data samples (i.e. location measurement data from the NG-RAN, Ground truth data (i.e. location of PRUs or UEs) and the corresponding quality indicator of the ground truth data), ML model identifier (applicable for ML model performance monitoring), location estimation of PRU(s)/UE(s) (applicable for ML model performance monitoring), Subscription Correlation ID (this parameter shall be present if the notification is for informing the assignment of a new Subscription Correlation ID by the LMF), cause code.

**Output, Required:** Operation execution result indication.

**Output, Optional:** None.

\* \* \* End of Changes \* \* \* \*