**3GPP TSG-WG SA2 Meeting #156-e *S2-2305127r02***

**Elbonia, April 17 – 21, 2023 (revision of S2-230xxxx)**

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| *CR-Form-v12.1* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
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|  | **23.273** | **CR** | **0369** | **rev** | **-** | **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:*** | Further clarification on the support of PRUs and related procedures | | | | | | | | | |
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| ***Source to WG:*** | Huawei, HiSilicon | | | | | | | | | |
| ***Source to TSG:*** | SA2 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | 5G\_eLCS\_Ph3 | | | | |  | ***Date:*** | | | 2023-04-07 |
|  |  | | | |  | |  | | |  |
| ***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-15 (Release 15) Rel-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18)* | |
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| ***Reason for change:*** | | This CR address the following 2 issues:   1. Correct that the PRU information is maintained at the associated LMF, and not necessary all received from the PRU association message. E.g., could be locally configured at the LMF. 2. Resolve the EN of ‘It is FFS whether PRU static/mobile type and ON/OFF state is needed in PRU information   ON/OFF indicates activation/deactivation of a PRU when the PRU is associated with its serving LMF. It could be used for different purposes: such as PRU temporarily with a bad network connection, or temporary have other high-priority service to serve than PRU functionality. Using PRU ON/OFF state allows for flexible management of PRU and resuming the usage of a PRU fast whenever the PRU is available again.It can not be replaced by de-association and re-association. De-association would mean the PRU information of the UE (including the location information, location capability), the information whether a UE can serve as a PRU as well as the allocated network resource for the PRU is completely removed from its associated LMF. This introduces unecessary signaling overhead and latency when the PRU is re-associated with the same LMF. Meanwhile, de-association is also used in case a PRU moves to another LMF. Distinguish the PRU on/off from PRU mobility case can avoid the signaling to track the PRU. | | | | | | | | |
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| ***Summary of change:*** | | Justification and Procedures for PRU support with ON/OFF state. | | | | | | | | |
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| ***Consequences if not approved:*** | | EN in PRU clasue is not resolved. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 4.3.8, 4.3.11, 6.17.1, 6./17.3, 6.17.4 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **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 \* \* \* \*

### 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.

- 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 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.

- LMF may indicate support of PRU function to NRF via NF profile and may further send the PRU information to NRF via NF profile update.

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

- Stores and updates the PRU information of the associated PRUs. The PRU information can be either received from the PRU (e.g., positioning capability), or locally configured at the associated LMF (e.g., known location). The PRU information contains one or more than one of the following aspects:

- PRU Positioning Capabilities.

- Location information if known.

- PRU on/off state.

Editor's Note: It is FFS whether PRU static/mobile type is needed in PRU information.

- 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.

Editor's Note: Whether and how AF provides PRU information (e.g., known location) on behalf of a PRU to network is FFS.

NOTE 2: Country, area within a country, or an international area can be supported as different types of geographical area.

\* \* \* \* Next change \* \* \* \*

### 4.3.11 Positioning Reference Unit, PRU

A UE may support the functions of a PRU. The PRU supports the following functions including functions defined in TS 38.305 [9]:

- Support service level association, association update and disassociation with a serving LMF.

- The PRU sends service level association, association update or disassociation to LMF via LCS supplementary service message.

- Support association with multiple LMFs. e.g. for the case a PRU is in multiple LMF overlapped serving areas.

- The PRU sends PRU information in a PRU association or PRU association update message.

\* \* \* \* Next change \* \* \* \*

6.17.1 PRU Association Procedure

Figure 6.X.1-1 shows a procedure used by a PRU to associate as a PRU with a serving LMF. The procedure is used for initial PRU Association with the serving LMF which may occur when the PRU first starts to access the HPLMN. The procedure can also be used to perform a PRU Association update to inform the serving LMF of the continued availability of the PRU or to inform the serving LMF of some change to the PRU such as a change of location (e.g. a change of tracking area or change of serving AMF) or a change of the PRU positioning capabilities. The PRU shall only perform the Association procedure in the HPLMN.

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**Figure 6.X.1-1: PRU Association Procedure**

**Precondition:**

The PRU is currently registered in the HPLMN. For initial PRU Association, a Routing Identifier may have been configured in the PRU indicating the serving LMF. For subsequent PRU Association, a Routing ID indicating a serving LMF has been returned to the PRU at step 6a or 6b of a previous PRU Association procedure.

NOTE 1: A Correlation ID and a Routing ID are different terms for the same identifier. The term "Correlation ID" is used for an identifier in service operations between an AMF and LMF while the term "Routing ID" is used for an identifier in a NAS message sent over the N1 reference point between a PRU and AMF.

1. The PRU performs a UE Triggered Service Request if in CM IDLE state.

2. The PRU sends a supplementary services PRU Association Request to the serving AMF in an UL NAS TRANSPORT message and includes any preconfigured Routing ID for an initial Association or the Routing ID if received at step 6a or step 6b for a previous PRU Association procedure. The PRU Association Request is included in the UL NAS TRANSPORT message at the NAS level. The PRU Association Request includes a reason for the PRU Association (e.g. initial PRU Association, or PRU Association update), the PRU’s positioning capabilities, location information (if known) and optional PRU on/off state.

3. The AMF verifies whether the sender of the PRU Association Request is a PRU using subscription information from the UDM.

4. The AMF selects the serving LMF based on the criteria defined in clause 5.1 or one of the Routing ID if included in the UL NAS TRANSPORT message of step 2. The AMF may override the Routing ID based on criteria of clause 5.1. The AMF transfers the PRU Association Request to the serving LMF using an Namf\_Communication\_N1MessageNotify service operation. The AMF includes in the Namf\_Communication\_N1MessageNotify service operation an indication of whether the request corresponds to a PRU subscription. The AMF also includes the SUPI, TAI and cell ID of the PRU.

5a. If the AMF indicates in step 4 that the request corresponds to a PRU and if the LMF can accept the PRU Association, the serving LMF returns a PRU Association Accept, as a supplementary services message, using Namf\_Communication\_N1N2MessageTransfer service operation towards the AMF, and a Correlation ID. The Correlation ID is assigned by the serving LMF to identify the serving LMF and optionally the PRU. The PRU Association Accept indicates conditions for performing PRU Association updates with the serving LMF which may include a periodic PRU Association update timer and PRU Association update based on a change of PRU location, change of PRU TAI, change of serving AMF or change of PRU on/off state.

NOTE 2: A periodic PRU Association is independent of a periodic NAS Registration and may occur with greater, equal or lesser frequency.

6a. The serving AMF forwards the PRU Association Accept and a Routing ID equal to the Correlation ID to the PRU in a DL NAS TRANSPORT message. The PRU stores the Routing ID which is used for any further PRU Association update with the serving LMF. This Routing ID overrides any Routing ID used in previous Association updates, if any.

5b. If the AMF indicates in step 4 that the request does not correspond to a PRU subscription or if the serving LMF cannot accept the PRU Association for some other reason (e.g. the serving LMF is not the correct serving LMF for the PRU), the serving LMF returns a PRU Association Reject message, using Namf\_Communication\_N1N2MessageTransfer service operation towards the AMF, and may include the Routing ID of a new serving LMF if the request at step 4 corresponds to a PRU.

6b. The serving AMF forwards the PRU Association Reject in a DL NAS TRANSPORT message to the PRU.

7. If PRU Association is performed successfully as in steps 5a and 6a, the serving LMF may optionally verify any PRU location provided at step 4 or obtain a more accurate location of the PRU using the procedures defined in clause 6.11. The LMF also stores information received for the PRU.

8. If PRU Association is performed successfully as in steps 5a and 6a and if this is an initial PRU Association or if this is a PRU Association update and information for the PRU has changed, the serving LMF may optionally instigate an Nnrf\_NFManagement\_NFUpdate Request service operation towards an NRF and includes an existence indication of a PRU associated with a TAI and may further include PRU information which may include positioning capabilities, a PRU identifier (which may be local or global) and the location of the PRU. If this is a PRU Association update, the LMF may only inform the NRF about the changed PRU information (e.g. PRU location). If the PRU identifier already exists in the NRF for the serving LMF (from a previous Association), the NRF overwrites the old PRU information with the new PRU information. Otherwise, the NRF adds the PRU information to the information stored in the NRF for the serving LMF.

For the case that LMF only sends TAI associated PRU existence indication to the NRF, the LMF indicates the existence of PRU(s) to NRF only when the PRU Association is the first one in this TAI. The LMF also indicates to the NRF to remove the TAI associated existence of PRU(s) when there are no longer any PRUs associated in the LMF for this TAI.

9. The NRF returns a confirmation response to the serving LMF.

10. After being rejected at step 6b, if there are new available Routing ID(s), the PRU may perform a PRU Association procedure with the new serving LMF.

NOTE 3: The PRU may be configured with a limit on the number and/or duration of unsuccessful PRU Association attempts. When this limit is reached the PRU considers itself disassociated.

\* \* \* \* Next change \* \* \* \*

6.17.3 PRU Initiated PRU Disassociation Procedure

Figure 6.X.3-1 shows a procedure used by a PRU to disassociate from a serving LMF. The procedure may be used when the PRU will be transferred to a different serving LMF.

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**Figure 6.X.3-1: PRU Initiated PRU Disassociation Procedure**

**Precondition:**

The PRU has previously associated with the serving LMF using the procedure in clause 6.X.1 and is currently registered in the HPLMN.

1. The PRU performs a UE Triggered Service Request if in CM IDLE state.

2. The PRU sends a supplementary services PRU Disassociation Request to the serving AMF in an UL NAS TRANSPORT message and includes the Routing ID received at step 6a for the procedure in clause 6.X.1 for a previous PRU Association procedure. The PRU also indicates whether an acknowledgment is expected. The PRU Disassociation Request is included in the UL NAS TRANSPORT message at the NAS level.

NOTE 1: A PRU could indicate whether an acknowledgment is expected according to whether the PRU expects to be still able to receive the acknowledgment at a later time.

3. The AMF verifies whether the sender of the PRU Disassociation Request is a PRU using subscription information from the UDM.

4. The AMF selects the serving LMF based on the Routing ID and optionally the current TAI and transfers the PRU Disassociation Request to the serving LMF using an Namf\_Communication\_N1MessageNotify service operation. The AMF includes in the Namf\_Communication\_N1MessageNotify service operation an indication of whether the sender of the PRU Disassociation Request is a PRU. The AMF also includes the SUPI of the PRU.

5. The serving LMF verifies that the PRU is currently associated in the serving LMF. If the PRU is not currently associated in the serving LMF, the serving LMF performs steps 6 and 7 but not steps 8 and 9.

If a PRU is temporarily unavailable, e.g., powered off or loses network coverage, the PRU could be inactivated (set PRU state from ON to OFF).

6. If the PRU has indicated that an acknowledgment is expected, the serving LMF returns a PRU Disassociation Accept, as a supplementary services message, using an Namf\_Communication\_N1N2MessageTransfer service operation towards the AMF, and a Correlation ID.

7. The serving AMF forwards the PRU Disassociation Accept and a Routing ID equal to the Correlation ID to the PRU in a DL NAS TRANSPORT message.

8. If the serving LMF has indicated the PRU to an NRF during a previous PRU Association, the serving LMF invokes an Nnrf\_NFManagement\_NFUpdate Request service operation towards the NRF and includes an indication of PRU removal and the PRU identifier if PRU information was sent to the NRF. The NRF then removes the TAI associated PRU existence indication and further removes PRU information in the NRF for this PRU for the serving LMF.

For the case that the LMF only sends TAI associated PRU existence indication to the NRF, the LMF indicates to the NRF to remove the existence of PRU(s) when all PRUs in a TAI have been disassociated.

9. The NRF returns a confirmation response to the serving LMF.

\* \* \* \* Next change \* \* \* \*

6.17.4 Positioning of a target UE

Editor’s Note: The procedure may be further updated based on RAN WG feedback regarding the support of simultaneous measurements of PRU(s) and target UE.

Figure 6.X.4-1 shows a procedure used by a serving LMF for a target UE to obtain a location of the target UE using location information provided by one or more PRUs.



**Figure 6.X.4-1: Location of a target UE using PRUs**

1. The serving LMF for the target UE and other PRU serving LMFs may use the procedures defined in clause 6.11 to obtain location information from one or more PRUs associated in the serving LMF and in the other PRU serving LMFs that is not related to the target UE. For example, the location information may include location information for the PRU(s) or for the NG-RAN or both.

2. The serving LMF for the target UE receives a location request from the serving AMF for the target UE. The location request may be included in an Nlmf\_Location\_DetermineLocation Request service operation for a 5GC-MO-LR, 5GC-MT-LR or 5GC-NI-LR for the target UE. Alternatively, the location request may be implied by receipt of an Namf\_Communication\_N1MessageNotify service operation carrying a supplementary services event report from the target UE for a periodic or triggered 5GC-MT-LR.

3. The serving LMF uses the procedures defined in clause 6.11 to obtain location information for the target UE from the target UE and/or from the NG-RAN. During the procedures, the LMF decides to use PRUs to improve the positioning result.

4. The serving LMF selects one or more PRUs associated with the serving LMF based on the PRU information to assist in locating the target UE. The selected PRU(s) may be nearby to an initial location estimate for the target UE obtained at step 3 or indicated by a serving cell identifier for the target UE received at step 2.

NOTE 1: The PRU selection criteria are implementation specific and may be based on operator policies.

5. The serving LMF may optionally invoke an Nnrf\_NFDiscovery Request service operation to an NRF. The service operation includes a PRU indication and an area which could be a list of cells or TAs decided by the serving LMF of the target UE based on the serving cell of the target UE.

6. If step 5 is performed, the NRF selects one or more other PRU serving LMFs based on the PRU indication and the area received in step 5 and sends an Nnrf\_NFDiscovery Response to the serving LMF of target UE. The service operation includes the profiles of the other PRU serving LMFs selected by the NRF. Each profile may include PRU information, e.g. a PRU identifier, PRU location.

7. If steps 5 and 6 are performed, the serving LMF of the target UE may send an Nlmf\_Location\_MeasurementData Request service operation to one or more of the other PRU serving LMFs indicated at step 6. The service operation for each of the other PRU serving LMFs includes target UE cell ID or one or more PRU identifiers received at step 6 for this LMF, and an indication of location measurements requested from each PRU.

8. The serving LMF uses the procedure defined in clause 6.11.1 to obtain location information related to the target UE from the PRU(s) selected at step 4.

Editor's note: Location information for a target UE obtained from a PRU needs to be verified by RAN.

9. If steps 5-7 are performed and if PRU information is included in the PRU serving LMF profile sent by the NRF to the target UE serving LMF, each of the other PRU serving LMFs for step 7 uses the procedure defined in clause 6.11.1 to obtain the location measurements requested at step 7 from each of the PRUs identified at step 7 for this LMF.

If steps 5-7 are performed and if PRU information is not included in the PRU serving LMF profile sent by the NRF to the target UE serving LMF, each of the other PRU serving LMFs for step 7 selects one or more PRUs based on the locally associated PRU information and information in the location measurements requested (e.g., the target UE cell ID), and uses the procedure defined in clause 6.11.1 to obtain the location measurements requested at step 7 from each of the selected PRUs.

NOTE 2: Steps 3, 8 and 9 can be performed in any order, including simultaneously. A common scheduled location time may be used if the LMF determines that simultaneous measurements for UE and PRU(s) are desirable.10. If step 9 is performed, each of the other PRU serving LMFs for step 9 returns the location measurements obtained from PRUs at step 9 to the serving LMF for the target UE.

11. The serving LMF for the target UE determines the location of the target UE based on the location information obtained at step 1 (if step 1 is performed), step 3, step 8 and step 10.

12a. If an Nlmf\_Location\_DetermineLocation Request service operation for a 5GC-MO-LR, 5GC-MT-LR or 5GC-NI-LR was received at step 2, the serving LMF returns the location estimate of the target UE to the serving AMF.

12b. If an Namf\_Communication\_N1MessageNotify service operation carrying a supplementary services event report from the target UE for a periodic or triggered 5GC-MT-LR was received at step 2, the serving LMF sends an event report for the target UE to a GMLC with the location estimate obtained at step 11 as described in clause 6.3.1.

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