**3GPP TSG-SA WG2 Meeting #155 *S2-230xxxx***

**20 - 24 February 2023, Athens, Greeece (revision of S2-2300636, S2-2211232, S2-2211218, S2-2211012, S2-2210921)**

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| *CR-Form-v12.1* |
| **CHANGE REQUEST** |
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|  | **23.273** | **CR** | **0263** | **rev** | **5** | **Current version:** | **18.0.0** |  |
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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 PRUs |
|  |  |
| ***Source to WG:*** | Qualcomm Incorporated, CATT, Huawei, HiSilicon |
| ***Source to TSG:*** | SA2 |
|  |  |
| ***Work item code:*** | 5G\_eLCS\_Ph3 |  | ***Date:*** | 2023-02-20 |
|  |  |  |  |  |
| ***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 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-15 (Release 15)Rel-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)* |
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| ***Reason for change:*** | The study on enhancement to the 5GC LoCation Services Phase 3 (FS\_eLCS\_Ph3) has reached conclusions on support of PRUs in TR 23.700-71. |
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| ***Summary of change:*** | Procedures for PRU Association and Target UE positioning assistance are added to support PRUs according to the conclusions in TR 23.700-71. In addition to the conclusions in TR 23.700-71, PRU Disassociation procedures are included since a serving LMF for a PRU may not always be available (e.g. may be removed, replaced, modified or temporarily withdrawn for maintenance) and a PRU, similarly, may not always be available . |
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| ***Consequences if not approved:*** | It will not be possible to support PRUs. |
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| ***Clauses affected:*** | 6.11, 6.X (new) |
|  |  |
|  | **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:*** |  |

\*\*\*\* First Change \*\*\*\*

6.11 Common Sub-Procedures

The procedures defined in this sub-clause are applicable to both a UE and PRU. Wherever, a UE is referenced in these procedures, a PRU may be used instead.

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

6.X Procedures applicable to a PRU

6.X.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.

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

**Precondition:**

The PRU is currently registered in the HPLMN. For initial PRU Association, AMF selects the the serving LMF. The criteria could be based on reconfiguration of correlation information between PRU and LMF as per clause 5.1. 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 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).

3. The AMF authenticates the PRU using subscription information from the UDM

4. The AMF selectsthe serving LMF based on criteria in clause 5.1 for initial association or Routing ID for successive association and 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 PRU 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.

NOTE 2: A periodic PRU Association is independent of a periodic NAS.

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 either by using the procedures defined in clause 6.11 or by implementation specific OAM procedures. 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 further includes 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 an 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 it is disassociated.

6.X.2 LMF Initiated PRU Disassociation Procedure

Figure 6.X.2-1 shows a procedure used by a serving LMF to disassociate an already associated PRU. The procedure may be used prior to the serving LMF becoming unavailable (e.g. for maintenance, removal or replacement) or to transfer the PRU to a different serving LMF for other reasons.

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**Figure 6.X.2-1: LMF Initiated PRU Disassociation Procedure**

**Precondition:**

The PRU has previously associated with the serving LMF using the procedure in clause 6.X.1.

1. The serving LMF sends a PRU Disassociation Request as a supplementary services message, using the Namf\_Communication\_N1N2MessageTransfer service operation, and a Correlation ID identifying the serving LMF. The PRU Disassociation Request may include a Routing ID for a new serving LMF

NOTE: The Correlation ID for the serving LMF is transferred to the serving AMF to provide the Routing ID for step 3. The Routing ID for a new serving LMF, if provided, is included inside the PRU Disassociation Request and is not visible to the serving AMF. This Routing ID is different to the Routing ID for steps 3, 4 and 5 and enables the PRU to perform an Association with a new serving LMF at step 8.

2. If the PRU is in CM IDLE state, the serving AMF performs a Network Triggered service request to place the PRU in CM CONNECTED state.

3. The serving AMF forwards the PRU Disassociation Request and a Routing ID equal to the Correlation ID to the PRU using DL NAS TRANSPORT message.

4. The PRU returns a supplementary services PRU Disassociation Accept to the serving AMF in an UL NAS TRANSPORT message and includes the Routing ID received in step 3.

5. The serving AMF forwards the PRU Disassociation Accept to the serving LMF indicated by the Routing ID received at step 4 and includes a Correlation ID equal to the Routing ID.

6. If the serving LMF has indicated the PRU to an NRF during PRU Association, the serving LMF issues 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 remove 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.

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

8. If the PRU received a new Routing ID for a new serving LMF at step 3, the PRU may perform an PRU Association with the new serving LMF as described in clause 6.X.1.6.X.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 prior to the PRU becoming unavailable (e.g. for a SW upgrade or power down) or 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 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.

NOTE 2: Inconsistency between Association in a PRU versus a serving LMF might arise if a PRU is powered off or loses network coverage and if the serving LMF then performs an LMF initiated PRU Disassociation.

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.

6.X.4 Positioning of a 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, LMF decides to use PRU to improve the positioning result.

4. The serving LMF selects one or more PRUs associated with the serving LMF 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, or by PRU and target UE subscription profiles.

NOTE 1: The priority PRU selection criteria is implementation specific and may be based on operator profiles.

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, based on different positioning methods, the serving LMF of the target UE may send one or multiple 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 the location measurements requested from each PRU.

8. The serving LMF of PRU and target UE may prepare the PRU information and/or required measurements based on UE/PRU capabilities and radio environment (including PRS configurations, etc).

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

9. LMF serving target UE and PRU cooperates in the positioning procedure to identify the target UE location.

Editor's note: whether procedure defined in clause 6.11.1 needs to be updated with PRU enhancement needs to be verified by RAN.

10. If step 9 is performed, each of the LMF serving PRU and target UE for step 9 returns the location measurements to identify the location of the target UE.

NOTE 2: Step 4~10 may have multiple iterations.

11. The serving LMF for the target UE determines the location of the target UE.

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 \*\*\*\*