**3GPP TSG-CT WG4 Meeting #111-eC4-224207v2**

**E-Meeting, 18th – 26th August 2022**

**Source: ZTE**

**Title: Discussion on UE location provision in PDU Session Update**

**Spec:**

**Agenda item: 5.1**

**Document for: Discussion / Decision**

**1. Introduction**

For a UE that has established a PDU session for IMS service, if the UE detects weak radio signaling, it may reselect another RAN node and initiate RRC connection re-establishment. The AMF thus requests the SMF to release the user plane to the old gNB (e.g. gNB1) and meanwhile requests the SMF to setup user plane to the new gNB (e.g. gNB2), by sending PDU Session Update to the SMF.

In the above procedure, the message for releasing user plane connection to the old gNB and the message for setting up user plane connection to the new gNB may be received by the SMF in wrong sequence, and it thus cause the SMF incorrectly release the user plane connection just established. In this case, downlink data traffic (e.g. SIP INVITE for terminating IMS call) may not be able sent to the UE correctly.

**2. Discussion**

Issues may happen during the RRC connection reestablishment procedure with or without AMF change, illustrated as following scenarios:

**Scenario #1: RRC connection reestablishment with AMF changes**



In scenario#1, the UE detects the mobility is outside the TAI list thus it initiates Registration Request in step 1 (as specified in TS23.502 clause 4.2.2.2.1) and the Registration Request may indicate the target PDU session to be activated. When the AMF1 knows the inter-AMF mobility happens, it determines to release the old NG-AP and old user plane connection to gNB1, similarly as per the handling in Registration procedure with AMF change (ref to TS23.502 clause 4.2.2.2.2).

*<<TS23.502 clause 4.2.2.2.1 - General>>*

*A UE needs to register with the network to get authorized to receive services, to enable mobility tracking and to enable reachability. The UE initiates the Registration procedure using one of the following Registration types:*

*……*

*- Mobility Registration Update upon changing to a new Tracking Area (TA) outside the UE's Registration Area in both CM-CONNECTED and CM-IDLE state, or when the UE needs to update its capabilities or protocol parameters that are negotiated in Registration procedure with or without changing to a new TA, a change in the UE's Preferred Network Behaviour that would create an incompatibility with the Supported Network Behaviour provided by the serving AMF, or when the UE intends to retrieve LADN Information, or with NR satellite access upon changing to a suitable cell indicating multiple TAs for the RPLMN all of which are outside the UE's Registration Area in both CM-CONNECTED and CM-IDLE state, or when the Multi-USIM UE needs a new 5G-GUTI assignment; or*

*……*

*<<TS23.502 clause 4.2.2.2.2 – General Registration>>*

*If the old AMF has an N2 connection for that UE (e.g. because the UE was in RRC Inactive state but has now moved to E-UTRAN or moved to an area not served by the old AMF), the old AMF shall perform AN Release (see clause 4.2.6) with a cause value that indicates that the UE has already locally released the NG-RAN's RRC Connection.*

However, as step 6 may be received by the SMF after step 7, issue may happen to the user plane connection activation and deactivation. One possible issue is that the newly activated user plane connection to gNB2 may later be released.

NOTE 1: If the AMF1 doesn’t initiates step 4-6, later the gNB1 may initiate NG-AP message - UE CONTEXT RELEASE REQUEST to the AMF, indicating the impacted PDU session list, as specified in TS38.413 clause 8.3.2. The AMF thus requests the SMF to deactivate the user plane connection, as specified in TS23.502 clause 4.2.6. In this case, it means the step 6 will anyway be sent to the SMF after step 7.

In the case, to avoid the potential issue regarding to the user plane activation / deactivation, the SMF shall be able to recognize the target RAN node to release or setup user plane, otherwise error may happen to the user plane connection. One possible way is the SMF uses the user location of RAN node provided by the AMF to determine the target RAN node.

**Proposal#1: In RRC connection reestablishment procedure, the AMF shall include correct user location carrying the RAN node ID (e.g. include Global gNB ID in the NrLocation of the UserLocation) to which the user plane is to be activated/deactivated the in the PDU session update message sent to the SMF.**

**Proposal#2: If user location is provided with RAN Node ID in PDU session update procedure, the SMF should take the RAN Node ID in the user location into account to determine which RAN node is the correct one to release / setup user plane of the PDU session.**

**Scenario #2: RRC connection reestablishment without AMF changes**



In scenario#2, the UE detects the mobility is within the stored TAI list thus it initiates Service Request in step 1. The AMF detects the RRC connection is from another gNB thus it determines to release the user plane connection to the old gNB and setup user plane connection to the new gNB.

NOTE 2: In CM-CONNECTED state, an UE may to request activation of a User Plane connection for PDU Sessions and to respond to a NAS Notification message from the AMF (see TS23.502 clause 4.2.3.2, trigger point of initiating Service Request in CM-CONNECTED state).

NOTE 3: Although it is not directly specified in 3GPP specs, the similar handling as inter-AMF Registration should be applied. Otherwise the old gNB (gNB1) may trigger NG-AP UE CONTEXT RELEASE REQUEST to the AMF and it finally causes the SMF to deactivate the newly activated user plane connection.

In this scenario, as there is no AMF change, to avoid wrong sequence of messages, the AMF itself should arrange step 5 and step 6 in correct sequence. However, it is not clear that which user location (gNB1 or gNB2?) should be presented by the AMF in step 5. One possible issue is, if the AMF indicates gNB2 location in the request to release old user plane connection, the user plane connection to the gNB1 will not be released and this may cause issue when sending downlink traffic to the RAN node.

To assist the SMF correctly activate / deactivate the user plane connection, the AMF should indicate the correct user location to the SMF in the PDU session update procedure.

**Proposal#3: In the RRC connection reestablishment procedure, the AMF shall make sure the message sent to the SMF to activate / deactivate user plane of the PDU session in correct sequence, i.e. send the message for deactivate user plane prior to the message for activate user plane.**

**Proposal#4: In the message to SMF to deactivate the user plane, the AMF shall include correct user location carrying the RAN Node ID (e.g. include Global gNB ID in the NrLocation of the UserLocation) to which the user plane is to be deactivated.**

**3. Proposal**

It is proposed to update TS29.502 to:

- clarify the AMF behavior of including user location in SmContextUpdateData data structure;

- clarify the SMF behavior of using the user location to determine the target RAN node to which to release or setup user plane of the PDU session.

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*PROPOSED CHANGES TO TS29.502\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

###### 5.2.2.3.2.1 General

The upCnxState attribute of an SM context represents the state of the User Plane connection of the PDU session. The upCnxState attribute may take the following values:

- ACTIVATED: a N3 tunnel is established between the 5G-AN and UPF (F-TEIDs assigned for both uplink and downlink traffic);

- DEACTIVATED: no N3 tunnel is established between the 5G-AN and UPF;

- ACTIVATING: a N3 tunnel is being established (5G-AN's F-TEID for downlink traffic is not assigned yet).

Clauses 5.2.2.3.2.2 and 5.2.2.3.2.3 specify how the NF Service Consumer (e.g. AMF) request the SMF to activate or deactivate the User Plane connection of the PDU session, e.g. upon receiving a Service Request from the UE requesting to activate a PDU session or upon an AN release procedure respectively. Clause 5.2.2.3.2.3 also applies in case of 5G-AN requested PDU session resource release by sending the NGAP PDU SESSION RESOURCE NOTIFY to the AMF (see step 1d in clause 4.3.4.2 of 3GPP TS 23.502 [3]).

In scenarios where the AMF takes the initiative to activate or deactivate the User Plane connection of the PDU session, e.g. during RRC connection reestablishment, the AMF shall include the user location carrying the RAN node ID of the correct 5G-AN node to which the User Plane connection is to be activated or deactivated in the message sent to the SMF. The SMF may take the RAN Node ID in the user location to determine which 5G-AN node to activate or deactivate the User Plane connection of the PDU session.

In scenarios where the SMF takes the initiative to activate or deactivate the User Plane connection of the PDU session, e.g. during a Network Triggered Service Request or CN-initiated selective deactivation of the User Plane connection of a PDU session respectively, the SMF invokes the Namf\_N1N2MessageTransfer procedure with the inclusion of N2 SM Information (and optionally of a N1 SM Container) as specified in 3GPP TS 23.502 [3] to request the establishment or release of the PDU session's resources in the 5G-AN. The Update SM Context service operation is then used as specified in clause 5.2.2.3.1 to transfer the response to the SMF.

Clause 5.2.2.3.2.4 specifies how the NF Service Consumer (e.g. AMF) indicates to the SMF that the access type of a PDU session can be changed from non-3GPP access to 3GPP access, during a Network Triggered Service Request initiated for a PDU session associated to the non-3GPP access, if the PDU Session for which the UE was paged or notified is in the List Of Allowed PDU Sessions provided by the UE and if the AMF has received N2 SM Information only or N1 SM Container and N2 SM Information for that PDU session from the SMF in step 3a of clause 4.2.3.3 of 3GPP TS 23.502 [3].

##### 6.1.6.2.4 Type: SmContextUpdateData

Table 6.1.6.2.4-1: Definition of type SmContextUpdateData

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Attribute name | Data type | P | Cardinality | Description | Applicability |
| pei | Pei | C | 0..1 | This IE shall be present if it is available and has not been provided earlier to the SMF.When present, this IE shall contain the permanent equipment identifier. |  |
| servingNfId | NfInstanceId | C | 0..1 | This IE shall be present upon inter-AMF change or mobility, or upon a N2 handover execution with AMF change.When present, it shall contain the identifier of the serving NF (e.g. AMF). |  |
| …… |  |  |  |  |  |
| ueLocation | UserLocation | C | 0..1 | This IE shall be present if it is available and if it needs to be reported to the SMF (e.g. the user location has changed or the user plane of the PDU session is to be activated or deactivated).When present, this IE shall contain:- the UE location information (see clause 5.2.3.4); and- the timestamp, if available, indicating the UTC time when the UeLocation information was acquired.(NOTE 1, NOTE X) |  |
| …… |  |  |  |  |  |
| upCnxState | UpCnxState | C | 0..1 | This IE shall be present to request the activation or the deactivation of the user plane connection of the PDU session.When present, it shall be set as specified in clauses 5.2.2.3.2, 5.2.2.3.15 and 5.2.2.3.16. |  |
| hoState | HoState | C | 0..1 | This IE shall be present to request the preparation, execution or cancellation of a handover of the PDU session.When present, it shall be set as specified in clause 5.2.2.3.4. |  |
| …… |  |  |  |  |  |
| NOTE 1: In shared networks, when the message is sent from the VPLMN to the HPLMN, the PLMN ID that is communicated in this IE shall be that of the selected Core Network Operator. In shared networks, when the AMF and SMF pertain to the same PLMN, the Primary PLMN ID shall be communicated in the ECGI or NCGI to the SMF. The Core Network Operator PLMN ID shall be communicated in the TAI and the Serving Network.NOTE 2: The AMF increments the MO Exception Data Counter when the UE establishes/resumes RRC with "MO Exception Data" RRC cause. The AMF may defer sending the moExpDataCounter attribute to the SMF based on local configuration. The AMF resets the MO Exception Data Counter when receiving successful response from the SMF. The SMF however keeps incrementing the counter locally.NOTE 3: If the AMF has received the callback information of the PCF for the UE together with the information of the PDU sessions (i.e. Slice and DNN combination) that are applicable for notification of SM Policy Association events, the AMF shall identify whether any ongoing non-roaming or local breakout PDU session is applicable for SM Policy Association events, i.e, whether the slice and DNN combination of the PDU session is listed in the received PDU session information from the PCF for the UE. If the PDU session is applicable for notification of SM Policy Association events , the AMF shall invoke Update SM context service operation for the PDU session and include the smPolicyNotifyInd IE with the value "true" and the callback information of the PCF for the UE in the request. The SMF shall forward the callback information of the PCF for the UE to the PCF for SM Policy if exists via SM Policy Association Modification. See clause 4.3.3.2 of 3GPP TS 23.502 [3]. The AMF needs not update the SMF if the subscription to the SM Policy Association events for the PDU session is cancelled by the PCF for UE.NOTE X: When the User Plane connection of the PDU session is to be activated or deactivated, the AMF shall together provide the user location carrying the RAN Node ID of the correct RAN node to which the User Plane connection is to be activated or deactivated. The SMF may take the RAN Node ID in the user location to determine which RAN node to activate or deactivate the user plane of the PDU session. |