AN-initiated Session Modification Procedure

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Feature Summary and Revision History

Summary Data

Table 1: Summary Data

Applicable Product(s) or FunctionalArea	SMF
Applicable Platform(s)	SMI
Feature Default Setting	Enabled – Always-on
Related Changes in this Release	Not Applicable
Related Documentation	Not Applicable

Revision History

Table 2: Revision History

Revision Details	Release
First introduced.	2020.02.0

Feature Description

This procedure releases the logical NG-AP signalling connection for the UE between the (R)AN and the AMF and the associated N3 User Plane connections, and (R)AN signalling connection between the UE and the (R)AN and the associated (R)AN resources.

How it Works

When the NG-AP signaling connection is lost due to (R)AN or AMF failure, the AN release is performed locally by the AMF or the (R)AN as described in the following procedure without using or relying on any of the signaling shown between (R)AN and AMF. The AN release causes all UP connections of the UE to be deactivated.

The initiation of AN release may be due to:

- (R)AN-initiated with cause, for example, O&M Intervention, Unspecified Failure, (R)AN (for example, Radio) Link Failure, User Inactivity, Inter-System Redirection, request for establishment of QoS Flow for IMS voice, Release due to UE-generated signaling connection release, mobility restriction, Release Assistance Information (RAI) from the UE, and so on, or

- AMF-initiated with cause like Unspecified Failure, and so on

Both (R)AN-initiated and AMF-initiated AN Release procedures are shown in the following figure.

If Service Gap Control is applied for the UE and the Service Gap timer is not already running, the Service Gap timer is started in AMF and UE when entering CM-IDLE, unless the connection was initiated after a paging of an MT event, or after a Registration procedure without Uplink data status.

For this procedure, the impacted SMF and UPF are all under control of the PLMN serving the UE, for example, in Home-Routed roaming case the SMF and UPF in HPLMN are not involved.
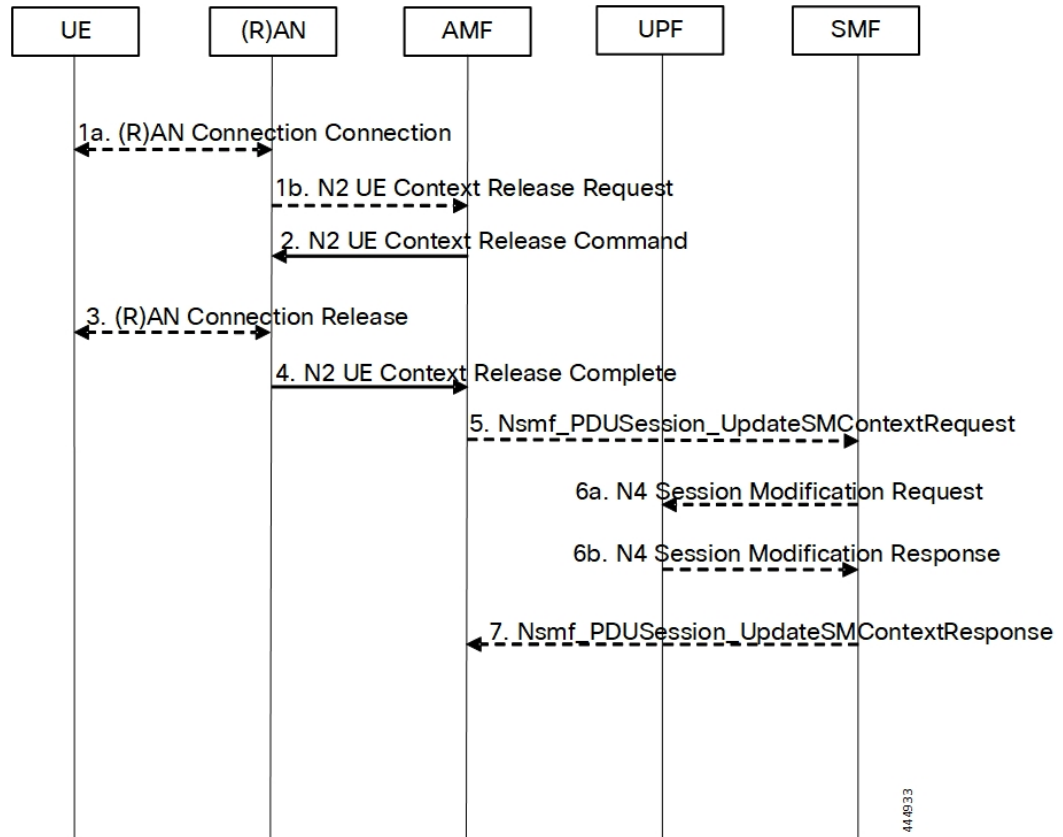
Figure 1: RAN-initiated AN Release Call Flow

Table 3: RAN-initiated AN Release Call Flow Description

Step	Description
1.	If there is some confirmed (R)AN conditions like Radio Link Failure or for other (R)AN internal reason, the (R)AN may decide to initiate the UE context release in the (R)AN. In this case, the (R)AN sends an N2 UE Context Release Request (Cause, List of PDU Session IDs with active N3 user plane) message to the AMF. Cause indicates the reason for the release (for example, AN Link Failure, O&M intervention, unspecified failure, and so on). The List of PDU Session IDs indicates that the PDU sessions served by (R)AN of the UE.
	If the reason for the release is the NG-RAN received an AS Release Assistance Indicator, NG-RAN does not release the RRC connection but sends an N2 UE Context Release Request message to the AMF. If the AS RAI indicates that only a single downlink transmission is expected, then NG-RAN sends only the N2 UE Context Release Request after a single downlink NAS PDU or N3 data PDU has been transferred.
	If N2 Context Release Request cause indicates the release, then release is requested due to user inactivity or AS RAI. Then, the AMF continues with the AN Release procedure unless the AMF is aware of pending MT traffic or signaling.

Step	Description
2.	If the AMF receives the N2 UE Context Release Request message or due to an internal AMF event, including the reception of Service Request or Registration Request to establish another NAS signaling connection through (R)AN, the AMF sends an N2 UE Context Release Command (Cause) to the (R)AN. The Cause indicates either the Cause from (R)AN in step 1 or the Cause due to an AMF event. In case the (R)AN is an NG-RAN this step, "UE Context Release (AMF initiated)". In case the (R)AN is an N3IWF/TNGF/W-AGF this step. If the AMF receives Service Request or Registration Request to establish another NAS signaling connection through (R)AN, after successfully authenticating the UE, the AMF releases the old NAS signaling connection, and then continues the Service Request or Registration Request procedure.
3.	If the (R)AN connection (for example, RRC connection or NWu connection) with the UE is not already released (step 1), either: **1.** The (R)AN requests the UE to release the (R)AN connection. Upon receiving (R)AN connection release confirmation from the UE, the (R)AN deletes the UE's context, or **2.** If the Cause in the N2 UE Context Release Command indicates that the UE has already locally released the RRC connection, the (R)AN locally releases the RRC connection.
4.	The (R)AN confirms the N2 Release by returning an N2 UE Context Release Complete (List of PDU Session ID(s) with active N3 user plane, User Location Information, Age of Location Information) message to the AMF. The List of PDU Session ID(s) indicates that the PDU Sessions served by (R)AN of the UE. The AMF always stores the latest UE Radio Capability information or NB-IoT specific UE Radio Access Capability Information received from the NG-RAN node received. The N2 signaling connection between the AMF and the (R)AN for that UE is released. The (R)AN provides the list of recommended cells / TAs / NG-RAN node identifiers for paging to the AMF. If the PLMN has configured secondary RAT usage reporting, the NG-RAN node provides RAN usage data Report. This step is performed immediately after step 2, for example, in a situation where the UE does not acknowledge the RRC Connection Release. The NG-RAN includes Paging Assistance Data for CE capable UE, if available, in the N2 UE Context Release Complete message. The AMF stores the received Paging Assistance Data for CE capable UE in the UE context for subsequent Paging procedure.
5.	For each of the PDU Sessions in the N2 UE Context Release Complete, the AMF invokes Nsmf_PDUSession_UpdateSMContext Request (PDU Session ID, PDU Session Deactivation, Cause, Operation Type, User Location Information, Age of Location Information, N2 SM Information (Secondary RAT usage data)). The Cause in step 5 is the same Cause in step 2. If List of PDU Session ID(s) with active N3 user plane is included in step 1b, the step 5 through step 7 are performed before step 2. The Operation Type is set to "UP deactivate" to indicate deactivation of user plane resources for the PDU Session. For PDU Sessions using Control Plane CIoT 5GS Optimization and if the UE has negotiated the use of extended Idle mode DRX, the AMF informs the SMF immediately that the UE is not reachable for downlink data. For PDU Sessions using Control Plane CIoT 5GS Optimization and if the UE has negotiated the use of MICO mode with Active Time, the AMF informs the SMF that the UE is not reachable for downlink data once the Active Time has expired.

Step	Description
6.	The SMF sends N4 Session Modification Request (AN or N3 UPF Tunnel Info to be removed, Buffering on/off) to the UPF.
	For PDU Sessions not using Control Plane CIoT 5GS Optimization, the SMF initiates an N4 Session Modification procedure indicating the need to remove Tunnel Info of AN or UPF terminating N3. Buffering on/off indicates whether the UPF has to buffer incoming DL PDU or not.
	If the SMF has received an indication from the AMF that the UE is not reachable for downlink data for PDU Sessions using Control Plane CIoT 5GS Optimization, the SMF initiates an N4 Session Modification procedure to activate buffering in the UPF.
	If multiple UPFs are used in the PDU Session and the SMF determines to release the UPF terminating N3, step 6a is performed towards the UPF (for example, PSA) terminating N9 towards the current N3 UPF. The SMF then releases the N4 session towards the N3 UPF (the N4 release is not shown in the call flow).
	If the cause of AN Release is because of User Inactivity, or UE Redirection, the SMF preserves the GBR QoS Flows. Otherwise, the SMF triggers the PDU Session Modification procedure for the GBR QoS Flows of the UE after the AN Release procedure is completed.
	If the redundant I-UPFs are used for URLLC, the N4 Session Modification Request procedure is done for each I-UPF. In this case, the SMF selects both the redundant I-UPFs to buffer the DL packets for this PDU Session or drop the DL packets for this PDU session or forward the DL packets for this PDU session to the SMF, based on buffering instruction provided by the SMF.
	If the redundant N3 tunnels are used for URLLC, the N4 Session Modification Request procedure to the UPF of N3 terminating point is to remove the dual AN Tunnel Info for N3 tunnel of the corresponding PDU Session.
6b.	The UPF sends N4 Session Modification Response acknowledging the SMF request to the SMF.
7.	The SMF sends Nsmf_PDUSession_UpdateSMContext Response for step 5 to the AMF. Once the procedure is completed, the AMF considers the N2 and N3 as released and enters CM-IDLE state. After completion of the procedure, the AMF reports towards the NF consumers.

Dual Connectivity Support

This procedure is used to transfer QoS flows to and from Secondary RAN Node. During this procedure, the SMF, and UPF are never re-allocated. The presence of IP connectivity between the UPF and the Primary RAN node, as well as between the UPF and the Secondary RAN node is assumed.

If QoS flows for multiple PDU sessions need to be transferred to or from Secondary RAN Node, the procedure shown in the below figure below is repeated for each PDU session.

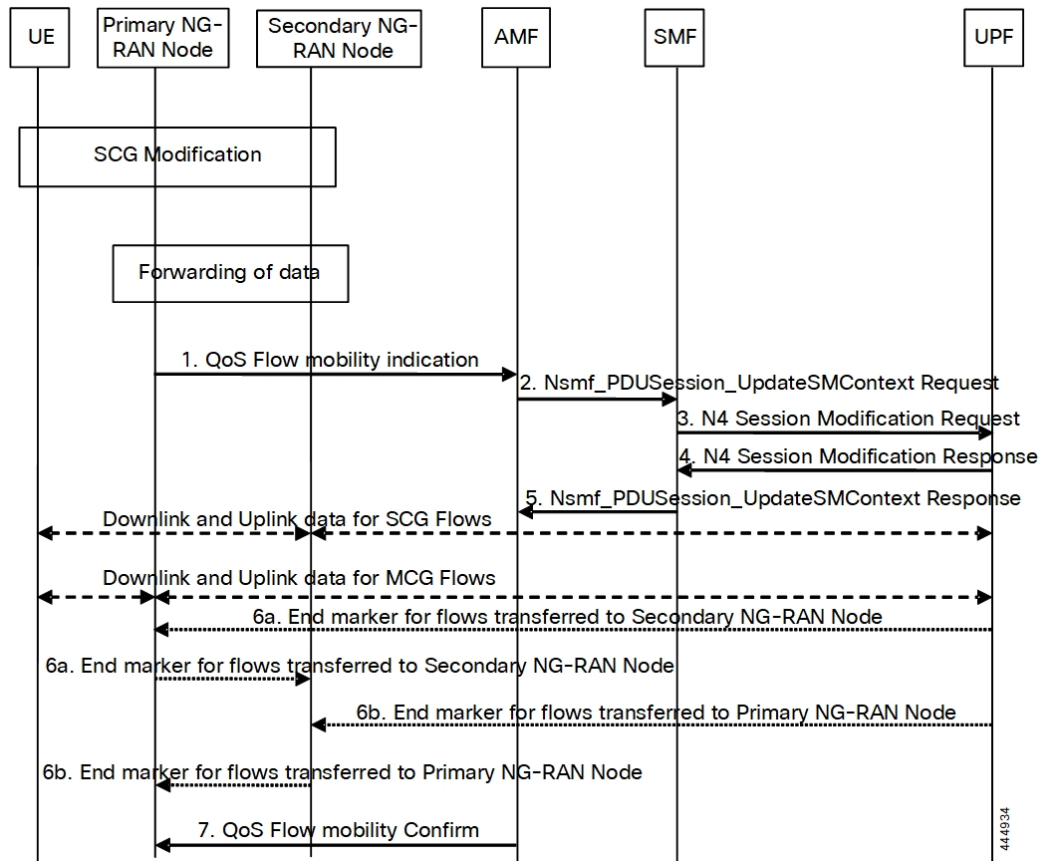*Figure 2: NG-RAN initiated QoS Flow Mobility Procedure*

Table 4: NG-RAN initiated QoS Flow Mobility Call Flow Description

Step	Description
1.	The Primary RAN node sends a N2 QoS Flow mobility Indication (PDU Session ID, QFI(s), AN Tunnel Info) message to the AMF. AN Tunnel Info includes the new RAN tunnel endpoint for the QFI(s) for which the AN Tunnel Info shall be modified.
2.	AMF to SMF, Nsmf_PDUSession_UpdateSMContext request (N2 QoS Flow mobility Indication message PDU Session ID).
3.	The SMF sends an N4 Session Modification Request (PDU Session ID(s), QFI(s), AN Tunnel Info for downlink user plane) message to the UPF.
4.	The UPF returns an N4 Session Modification Response (CN Tunnel Info for uplink traffic) message to the SMF after requested QFIs are switched. **Important** Step 7 can occur anytime after receipt of N4 Session Modification Response at the SMF.

Step	Description
5.	SMF to AMF, Nsmf_PDUSession_UpdateSMContext response (N2 SM information (CN Tunnel Info for uplink traffic)) for QFIs of the PDU Session which have been switched successfully. If none of the requested QFIs are switched successfully, the SMF sends an N2 QoS Flow mobility Failure message.
6.	In order to assist the reordering function in the Primary RAN node and/or Secondary RAN node, for each affected N3 tunnel the UPF sends one or more "end marker" packets on the old tunnel immediately after switching the tunnel for the QFI. The UPF starts sending downlink packets to the Target NG-RAN.
7.	The AMF relays message 5 to the Primary RAN node.