**3GPP TSG SA WG2 Meeting #137E *S2-2002024R01***

**February 24 – 27, 2020, Electronic Meeting *(Revision of S2-20xxxxx)***

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| *CR-Form-v12.0* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **23.502** | **CR** | **2113** | **rev** | **-** | **Current version:** | **16.3.0** |  |
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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 |  | Radio Access Network |  | Core Network | **x** |

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| ***Title:*** | Corrections for CN tunnel info allocation and release | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Ericsson | | | | | | | | | |
| ***Source to TSG:*** | SA2 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | 5GS\_Ph1 | | | | |  | ***Date:*** | | | 2020-02-18 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **F** |  | | | | | ***Release:*** | | | Rel-16 |
|  | *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-12 (Release 12)* *Rel-13 (Release 13) Rel-14 (Release 14) Rel-15 (Release 15) Rel-16 (Release 16)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | It has been agreed that UPF is responsible for allocating GTP-U IP address and TEID. However, the allocation of tunnel endpoint by SMF is still mentioned in several procedures. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | Remove the option where SMF allocates tunnel information. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | Inconsistent and incorrect specification. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 4.2.3.2, 4.3.3.2, 4.11.1.2.1, 4.11.1.2.2.2, 4.11.1.3.2, 4.11.1.3.3, 4.11.1.4.1 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | | **X** |  | Other core specifications | | | | TS 23.501... CR .. 2108. | | |
| ***affected:*** | |  | **X** | Test specifications | | | |  | | |
| ***(show related CRs)*** | |  | **X** | O&M Specifications | | | |  | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | | R1: cover page + editorials + and requests CN Tunnel Info providing the target Network Instance | | | | | | | | |

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* First changes \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

#### 4.2.3.2 UE Triggered Service Request

The UE in CM‑IDLE state initiates the Service Request procedure in order to send uplink signalling messages, user data, or as a response to a network paging request. The UE shall not initiate UE Triggered Service Request from CM-IDLE if there is a Service Gap timer running. After receiving the Service Request message, the AMF may perform authentication. After the establishment of the signalling connection to an AMF, the UE or network may send signalling messages, e.g. PDU Session establishment from UE to the SMF, via the AMF.

The Service Request procedure is used by a UE in CM-CONNECTED to request activatation of a User Plane connection for PDU Sessions and to respond to a NAS Notification message from the AMF. When a User Plane connection for a PDU Session is activated, the AS layer in the UE indicates it to the NAS layer.

For any Service Request, the AMF responds with a Service Accept message to synchronize PDU Session status between UE and network, if necessary. The AMF responds with a Service Reject message to UE, if the Service Request cannot be accepted by network. The Service Reject message may include an indication or cause code requesting the UE to perform Registration procedure.

For this procedure, the impacted SMF and UPF, if any, are all under control of the PLMN serving the UE, e.g. in Home Routed roaming case the SMF and UPF in HPLMN are not involved if V-SMF relocation is not triggered.

For Service Request due to user data, network may take further actions if User Plane connection activation is not successful.

The procedure in this clause 4.2.3.2 is applicable to the scenarios with or without intermediate UPF, and with or without intermediate UPF reselection.

If the UE initiates Service Request procedures via non-3GPP Access, functions defined in the clause 4.12.4.1 are applied.

The User Plane of all PDU Sessions with redundant I-UPFs or with redundant N3/N9 tunnels for URLLC shall be activated during the Service Request procedure if the UE in CM-IDLE state initiates the Service Request procedure from 3GPP access. If the redundant I-UPFs are to be added/replaced/removed, the N4 Session procedure to manage the I-UPF is done for each I-UPF in steps 6c, 6d,7a, 7b, 8a, 8b, 9 ,10, 17a,17b, 20a, 20b, 21a,21b, 22a and 22b of the figure 4.2.3.2-1. If the redundant N3/N9 tunnels are used for URLLC and the I-UPF is to be added/replaced/removed, the N4 Session procedure to update the tunnel is done for each N3/N9 tunnel in steps 6c, 6d,7a, 7b, 8a, 8b, 9, 10, 17a, 17b. 20a, 20b, 21a, and 21b of the figure 4.2.3.2-1.



Figure 4.2.3.2-1: UE Triggered Service Request procedure

1. UE to (R)AN: AN message (AN parameters, Service Request (List Of PDU Sessions To Be Activated, List Of Allowed PDU Sessions, security parameters, PDU Session status, 5G-S-TMSI, [NAS message container], Exempt Indication)).

The NAS message container shall be included if the UE is sending a Service Request message as an Initial NAS message and the UE needs to send non-cleartext IEs, see clause 4.4.6 in TS 24.501 [25].

The List Of PDU Sessions To Be Activated is provided by UE when the UE wants to re-activate the PDU Session(s). The List Of Allowed PDU Sessions is provided by the UE when the Service Request is a response of a Paging or a NAS Notification for a PDU Session associated with non-3GPP access, and identifies the PDU Sessions that can be transferred to 3GPP access.

In case of NG-RAN:

- The AN parameters include 5G-S-TMSI, Selected PLMN ID PLMN ID (or PLMN ID and NID, see TS 23.501 [2], clause 5.30) and Establishment cause. The Establishment cause provides the reason for requesting the establishment of an RRC connection. The AN parameters shall include a CAG Identifier if the UE is accessing the NG-RAN using a CAG cell (see TS 23.501 [2], clause 5.30.3).

- The UE sends Service Request message towards the AMF encapsulated in an RRC message to the NG-RAN. The RRC message(s) that can be used to carry the 5G-S-TMSI and this NAS message are described in TS 38.331 [12] and TS 36.331 [16].

If the Service Request is triggered by the UE for user data, the UE identifies, using the List Of PDU Sessions To Be Activated, the PDU Session(s) for which the UP connections are to be activated in Service Request message. When the UE includes the List Of PDU Sessions To Be Activated, the UE shall indicate PDU Sessions only associated with the access the Service Request is related to. If the Service Request is triggered by the UE for signalling only, the UE doesn't identify any List Of PDU Sessions To Be Activated. If this procedure is triggered for paging response, and the UE has at the same time some user data to be transferred, the UE identifies the PDU Session(s) whose UP connections are to be activated in Service Request message, by the List Of PDU Sessions To Be Activated. Otherwise the UE does not identify any PDU Session(s) in the Service Request message for paging response. As defined in TS 24.501 [25] the UE shall include always-on PDU Sessions which are accepted by the network in the List Of PDU Sessions To Be Activated even if there are no pending uplink data for those PDU Sessions or when the Service Request is triggered for signalling only or when the Service Request is triggered for paging response.

If the Service Request over 3GPP access is triggered in response to the paging or NAS Notification indicating non-3GPP access, the Service Request message shall identify the list of PDU Sessions associated with the non-3GPP access that can be re-activated over 3GPP in the List Of Allowed PDU Sessions, as described in clause 4.2.3.3 (step 6) of this specification and in clause 5.6.8 of TS 23.501 [2].

If the Service Request is triggered to report PS Data Off status change and the UE is in Non-Allowed Area, the UE shall send Service Request message with an indication that the message is exempted from restriction (e.g. Non-Allowed Area). In this case, if the UE is in Non-Allowed Area, the UE shall not include the List Of PDU Sessions To Be Activated and as a result the always-on PDU Session is not re-activated during the Service Request procedure.

The PDU Session status indicates the PDU Sessions available in the UE.

The UE shall not trigger a Service Request procedure for a PDU Session corresponding to a LADN when the UE is outside the area of availability of the LADN.

NOTE 1: A PDU Session corresponding to a LADN is not included in the List Of PDU Sessions To Be Activated when the UE is outside the area of availability of the LADN.

For UE in CM-CONNECTED state, only the List Of PDU Sessions To Be Activated and List Of Allowed PDU Sessions need to be included in the Service Request.

2. (R)AN to AMF: N2 Message (N2 parameters, Service Request).

Details of this step are described in TS 38.413 [10]. If the AMF can't handle the Service Request it will reject it.

When NG-RAN is used, the N2 parameters include the 5G-S-TMSI, Selected PLMN ID (or PLMN ID and NID, see TS 23.501 [2], clause 5.30), Location information and Establishment cause, UE Context Request.

If the UE is in CM-IDLE state, the NG-RAN obtains the 5G-S-TMSI in RRC procedure. NG-RAN selects the AMF according to 5G-S-TMSI. The Location Information relates to the cell in which the UE is camping.

Based on the PDU Session status, the AMF may initiate PDU Session Release procedure in the network for the PDU Sessions whose PDU Session ID(s) were indicated by the UE as not available.

When the Establishment cause is associated with priority services (e.g. MPS, MCS), the AMF includes a Message Priority header to indicate priority information. Other NFs relay the priority information by including the Message Priority header in service-based interfaces, as specified in TS 29.500 [17].

The AMF enforces the Mobility Restrictions as specified in TS 23.501 [2], clause 5.3.4.1.1.

If there is a Service Gap timer running in AMF for the UE and the AMF is not waiting for a MT paging response from the UE and the Service Request is not for regulatory prioritized services like Emergency services or not for exception reporting, the AMF rejects the Service Request with an appropriate cause. In addition, AMF may also provide a UE with a Mobility Management Back-off timer set to the remaining value of the Service Gap timer.

3a) AMF to (R)AN: N2 Request (security context, Mobility Restriction List, list of recommended cells / TAs / NG-RAN node identifiers).

If the 5G-AN had requested for UE Context or there is a requirement for AMF to provide this e.g. the AMF needs to initiate fallback procedure as in clause 4.13.4.2 for Emergency services, AMF initiates NGAP procedure as specified in TS 38.413 [10]. For UE in CM-IDLE state, 5G-AN stores the Security Context in the UE AN context. Mobility Restriction List is described in TS 23.501 [2] clause 5.3.4.1 "Mobility Restrictions".

The 5G-AN uses the Security Context to protect the messages exchanged with the UE as described in TS 33.501 [15].

If the NG-RAN node had provided the list of recommended cells / TAs / NG-RAN node identifiers during the AN Release procedure (see clause 4.2.6), the AMF shall include it in the N2 Request. The RAN may use this information to allocate the RAN Notification Area when the RAN decides to enable RRC Inactive state for the UE.

3. If the Service Request was not sent integrity protected or integrity protection verification failed, the AMF shall reject the Service Request as stated in TS 24.501 [25].

If the UE in CM-IDLE state triggered the Service Request to establish a signalling connection only, after successful establishment of the signalling connection the UE and the network can exchange NAS signalling and steps 4 to 11 and 15 to 22 are skipped.

If the UE in Non-Allowed Area triggered the Service Request with an indication that the message is exempted from restriction (e.g. Non-Allowed Area), the AMF should accept the Service Request. In this case, if the UE is in Non-Allowed Area, the AMF rejects user plane setup request from the SMF except for emergency services.

If the procedure was triggered in response to paging or NAS notification indicating non-3GPP access, and the AMF received N1 SM Container only from the SMF in step 3a of clause 4.2.3.3, the AMF sends the NAS signalling including the N1 SM Container to the UE in step 7 of clause 4.2.3.3 without updating the access associated to the PDU Session.

4. [Conditional] AMF to SMF: Nsmf\_PDUSession\_UpdateSMContext Request (PDU Session ID(s), Operation Type, UE location information, Access Type, RAT Type, UE presence in LADN service area, Indication of Access Type can be changed, [MO Exception Data Counter]).

The Nsmf\_PDUSession\_UpdateSMContext Request is invoked:

- If the UE identifies List Of PDU Sessions To Be Activated in the Service Request message;

- This procedure is triggered by the SMF but the PDU Session(s) identified by the UE correlates to other PDU Session ID(s) than the one triggering the procedure; or

- If this procedure is triggered by the SMF in response to paging or NAS notification indicating 3GPP access, and the current UE location is outside the "Area of validity for the N2 SM information" provided by the SMF in step 3a of clause 4.2.3.3 or the "Area of validity for the N2 SM information" was not provided by the SMF in step 3a of clause 4.2.3.3, the AMF shall not send the N2 information provided by the SMF in step 3a of clause 4.2.3.3. Otherwise, if the current UE location is in the "Area of validity for the N2 SM information", steps 4 to 11 are skipped; or

- If this procedure is triggered by the SMF in response to paging or NAS notification indicating non-3GPP access, and the AMF received N2 SM Information only, or both N1 SM Container and N2 SM Information in step 3a of clause 4.2.3.3.

If the DNN corresponds to an LADN then the "UE presence in LADN service area" indicates if the UE is IN or OUT of the LADN service area. If the AMF does not provide the "UE presence in LADN service area" indication and the SMF determines that the DNN corresponds to a LADN, then the SMF considers that the UE is OUT of the LADN service area.

The AMF determines the PDU Session(s) for which the UP connection(s) shall be activated and sends an Nsmf\_PDUSession\_UpdateSMContext Request to SMF(s) associated with the PDU Session(s) with Operation Type set to "UP activate" to indicate establishment of User Plane resources for the PDU Session(s). The AMF determines Access Type and RAT Type, see clause 4.2.2.2.1. If the RAT type is NB-IoT, the AMF shall ensure that the number of PDU session(s) for which UP connection(s) are active does not exceed 2.

If the procedure was triggered in response to paging or NAS Notification indicating non-3GPP access, the AMF received N2 SM Information in step 3a of clause 4.2.3.3 and the PDU Session for which the UE was paged or notified is not in the List Of Allowed PDU Sessions provided by the UE, the AMF notifies the SMF that the UE is not reachable. For other PDU Sessions in the List Of Allowed PDU Sessions the Service Request Procedure succeeds without re-activating the User Plane of any PDU Sessions, unless they have also been included by the UE in the List Of PDU Sessions To Be Activated.

If the procedure was triggered in response to paging or NAS notification indicating non-3GPP access, and the PDU Session for which the UE was paged or notified is in the List Of Allowed PDU Sessions provided by the UE, and the AMF received N2 SM Information only or N1 SM Container and N2 SM Information from the SMF in step 3a of clause 4.2.3.3, the AMF notifies the SMF that the access type of the PDU session can be changed. The AMF discards any already received N1 SM Container and N2 SM Information. In Home Routed roaming case, the V-SMF triggers Nsmf\_PDUSession\_Update service operation towards the H-SMF to notify the access type of the PDU Session can be changed and the procedure continues as specified in clause 4.3.3.3 from step 1a to step 10.

The AMF updates all (H-)SMFs which have PDU Sessions using N3 data transfer and Small Data Rate Control with the MO Exception Data Counter if the RRC establishment cause is set to "MO exception data" and the UE is accessing via the NB-IoT RAT. The AMF maintains the MO Exception Data Counter for Small Sata Rate Control purposes as described in clause 5.31.14.3 of TS 23.501 [2]. The AMF may immediately send the MO Exception Data Counter to the (H-)SMF. The (H-)SMF, in an N4 Session Modification Request, updates all UPF (PSA)s or NEFs which have PDU Session(s) using Small Data Rate Control as to whether an RRC Connection was established for "MO Exception data" for Small Data Rate Control purposes. The update may be provided by the N4 Session Modification Request in step 6a or step 7a or an N4 Session Modification Request may be triggered if step 6a and step 7a are skipped. Each UPF and NEF should be updated for the first new RRC Connection which is triggered for "MO Exception data" and the first new RRC Connection afterwards without "MO Exception data".

The AMF may receive a Service Request to establish another NAS signalling connection via a NG-RAN while it has maintained an old NAS signalling connection for UE still via NG-RAN. In this case, AMF shall trigger the AN release procedure toward the old NG-RAN to release the old NAS signalling connection as defined in clause 4.2.6 with following logic:

- For the PDU Sessions indicated in the List Of PDU Sessions To Be Activated, the AMF requests the SMF to activate the PDU Session(s) immediately by performing this step 4.

- For the PDU Sessions indicated in the "List of PDU Session ID(s) with active N3 user plane" but not in the List Of PDU Sessions To Be Activated, the AMF requests the SMF to deactivate the PDU Session(s).

5a. [Conditional] SMF to PCF: If the AMF notified the SMF that the access type of the PDU session can be changed in step 4, and if PCC is deployed, the SMF perform an SMF initiated SM Policy Association Modification procedure as defined in clause 4.16.5.1 if Policy Control Request Trigger condition(s) have been met (i.e. change of Access Type). The PCF may provide updated PCC Rule(s).

5b. If the PDU Session ID corresponds to a LADN and the SMF determines that the UE is outside the area of availability of the LADN based on the "UE presence in LADN service area" from the AMF, the SMF decides to (based on local policies) either:

- keep the PDU Session, but reject the activation of User Plane connection for the PDU Session and inform the AMF about it. If the procedure has been triggered by a Network Triggered Service Request as described in clause 4.3.2.3, the SMF may notify the UPF that originated the Data Notification to discard downlink data for the PDU Sessions and/or to not provide further Data Notification messages; or

- to release the PDU Session: the SMF releases the PDU Session and informs the AMF that the PDU Session is released.

In any case of the two cases above the SMF answers to the AMF (step10) with an appropriate reject cause and the User Plane Activation of PDU Session is stopped.

Otherwise, based on the location info received from the AMF, the SMF checks the UPF Selection Criteria according to clause 6.3.3 of TS 23.501 [2], and determines to perform one of the following:

- accepts the activation of UP connection and continue using the current UPF(s);

- accepts the activation of UP connection and selects a new intermediate UPF (or add/remove an intermediate UPF), if the UE has moved out of the service area of the UPF that was previously connecting to the AN, while maintaining the UPF(s) acting as PDU Session Anchor. The steps to perform I-UPF addition/change/removal are described as conditional steps in the following of the current procedure; or

NOTE 2: If the old and/or new I-UPF implements an UL CL or BP functionality and a PDU Session Anchor for connectivity to the local access to the Data Network as described in TS 23.501 [2] clause 5.6.4.2, the signalling described in the current clause is intended as the signalling to add, remove or change the PDU Session Anchor, and must be complemented by the signalling to add, release or changethe UL CL or BP as described respectively in clauses 4.3.5.4, 4.3.5.5 and 4.3.5.7.

- rejects the activation of UP connection of a PDU Session of SSC mode 2, and trigger re-establishment of the PDU Session after Service Request procedure to perform the allocation of a new UPF to act as PDU Session Anchor, e.g. the UE has moved out of the service area of the anchor UPF which is connecting to NG-RAN.

In the case that the SMF fails to find suitable I-UPF, the SMF decides to (based on local policies) either:

- trigger re-establishment of PDU Session. After Service Request procedure, SMF sends N1 SM message to the UE via the AMF by invoking Namf\_Communication\_N1N2MessageTransfer containing the cause indicating PDU Session re-establishment is required for the UE; or

- keep the PDU Session, but reject the activation request of User Plane connection for the PDU Session and inform the AMF about it; or

- release the PDU Session after Service Request procedure.

If the SMF has determined that the UE is performing Inter-RAT mobility to or from the NB-IoT RAT then the SMF uses the "PDU Session continuity at inter RAT mobility" to determine how to handle the PDU Session.

6a. [Conditional] SMF to UPF (PSA): N4 Session Modification Request.

Depending on the network deployment, the CN Tunnel Info of UPF (PSA) allocated for N3 or N9 interface may be changed during the Service Request procedure, e.g. UPF connected to different IP domains. If different CN Tunnel Info need be used, the SMF sends N4 Session Modification Request message to UPF (PSA) and requests CN Tunnel Info providing the target Network Instance .

6b. [Conditional] UPF (PSA) to SMF: N4 Session Modification Response.

The UPF (PSA) sends an N4 Session Establishment Response message to the SMF. The UPF provides CN Tunnel Info to the SMF. The UPF (PSA) associate the CN Tunnel Info with UL Packet detection rules provided by the SMF.

If the redundant I-UPFs are used for URLLC, each I-UPF provides UL CN Tunnel Info for N3 interface to the SMF in the N4 Session Establishment Response message.

If the redundant N3 tunnels are used for URLLC, the UPF (PSA) provides redundant UL CN Tunnel Info for N3 interface to the SMF in N4 Session Establishment Response message.

6c. [Conditional] SMF to new UPF (intermediate): N4 Session Establishment Request.

If the SMF selects a new UPF to act as intermediate UPF for the PDU Session, or if the SMF selects to insert an intermediate UPF for a PDU Session which did not have an intermediate UPF, an N4 Session Establishment Request message is sent to the new UPF, providing Packet detection, Data forwarding, enforcement and reporting rules to be installed on the intermediate UPF. The CN Tunnel Info (on N9) of PSA, i.e. which is used to establish the N9 tunnel, for this PDU Session is also provided to the intermediate UPF.

If the Service Request is triggered by the network and a new UPF is selected by the SMF to replace the old (intermediate) UPF, the SMF may also include a request for the UPF to allocate a second tunnel endpoint for buffered DL data from the old I-UPF. In this case, the UPF begins to buffer the DL data it may receive at the same time from the UPF (PSA) and start a timer.

6d. New UPF (intermediate) to SMF: N4 Session Establishment Response.

The new intermediate UPF sends an N4 Session Establishment Response message to the SMF. The UPF provides DL CN Tunnel Info as requested by SMF in step 6a. The SMF starts a timer, to be used in step 22a to release the resource in old intermediate UPF if there is one.

7a. [Conditional] SMF to UPF (PSA): N4 Session Modification Request.

If the SMF selects a new UPF to act as intermediate UPF for the PDU Session, the SMF sends N4 Session Modification Request message to PDU Session Anchor UPF, providing DL Tunnel Info from new intermediate UPF. If the new intermediate UPF was added for the PDU Session, the UPF (PSA) begins to send the DL data to the new I-UPF as indicated in the DL CN Tunnel Info. The UPF (PSA) sends one or more "end marker" packets for each N9 tunnel to the old I-UPF immediately after switching the path to new I-UPF.

If the Service Request is triggered by the network, and the SMF removes the old I-UPF but does not replace it with a new I-UPF, the SMF may also include a request for the UPF to allocate a second tunnel endpoint for buffered DL data from the old I-UPF. In this case, the UPF (PSA) begins to buffer the DL data it may receive at the same time from the N6 interface and start a timer. The UPF (PSA) sends one or more "end marker" packets for each N9 tunnel to the old I-UPF immediately after switching the path to (R)AN.

7b. The UPF (PSA) sends N4 Session Modification Response message to SMF.

If requested by SMF, the UPF (PSA) sends DL CN tunnel info for the old (intermediate) UPF to the SMF. The SMF starts a timer, to be used in step 22a to release the resource in old intermediate UPF if there is one.

If the UPF that connects to RAN is the UPF (PSA), and if the SMF finds that the PDU Session is activated when receiving the Nsmf\_PDUSession\_UpdateSMContext Request in step 4 with Operation Type set to "UP activate" to indicate establishment of User Plane resources for the PDU Session(s), it deletes the AN Tunnel Info and initiates an N4 Session Modification procedure to remove Tunnel Info of AN in the UPF.

8a. [Conditional] SMF to old UPF (intermediate): N4 Session Modification Request (New UPF address, New UPF DL Tunnel ID)

If the service request is triggered by the network, and the SMF removes the old (intermediate) UPF, the SMF sends the N4 Session Modification Request message to the old (intermediate) UPF, providing the DL Tunnel Info for the buffered DL data. If the SMF allocated new I-UPF, the DL Tunnel Info is from the new (intermediate) UPF acting as N3 terminating point. If the SMF did not allocate a new I-UPF, the DL Tunnel Info is from the new UPF (PSA) acting as N3 terminating point. The SMF starts a timer to monitor the forwarding tunnel as step 6b or 7b.

If the SMF find the PDU Session is activated when receiving the Nsmf\_PDUSession\_UpdateSMContext Request in step 4 with Operation Type set to "UP activate" to indicate establishment of User Plane resources for the PDU Session(s), it deletes the AN Tunnel Info and initiates an N4 Session Modification procedure to remove Tunnel Info of AN in the UPF.

8b. old UPF (intermediate) to SMF: N4 Session Modification Response

The old (intermediate) UPF sends N4 Session Modification Response message to SMF.

9. [Conditional] old UPF (intermediate) to new UPF (intermediate): buffered downlink data forwarding

If the I-UPF is changed and forwarding tunnel was established to the new I-UPF, the old (intermediate) UPF forwards its buffered data to the new (intermediate) UPF acting as N3 terminating point. The new UPF should not send the buffered downlink packet(s) received from the UPF (PSA) until end marker packets were received from the old I-UPF or the timer started at step 6c is expired.

10. [Conditional] old UPF (intermediate) to UPF (PSA): buffered downlink data forwarding

If the old I-UPF is removed and no new I-UPF is assigned for the PDU Session and forwarding tunnel was established to the UPF (PSA), the old (intermediate) UPF forwards its buffered data to the UPF (PSA) acting as N3 Terminating Point. The UPF (PSA) should not send the buffered DL data received from the N6 interface until it receives end marker packets from the old I-UPF or the timer started at step 7a is expired.

11. [Conditional] SMF to AMF: Nsmf\_PDUSession\_UpdateSMContext Response (N2 SM information (PDU Session ID, QFI(s), QoS profile(s), CN N3 Tunnel Info, S-NSSAI, User Plane Security Enforcement, UE Integrity Protection Maximum Data Rate, RSN), N1 SM Container, Cause) to the AMF. If the UPF that connects to RAN is the UPF (PSA), the N3 CN Tunnel Info is the UL CN Tunnel Info of the UPF (PSA). If the UPF that connects to RAN is the new intermediate UPF, the CN N3 Tunnel Info is the UL Tunnel Info of the intermediate UPF.

For the PDU Session with redundant I-UPFs or with redundant N3 tunnels for URLLC, the two UL N3 CN Tunnel Infos are included, the SMF also indicates the NG-RAN that one of the CN Tunnel Info is used as the redundancy tunnel of the PDU session as described in clause 5.33.2.2 of TS 23.501 [2].

The SMF shall send N1 SM Container and/or N2 SM Information to the AMF when applicable. (e.g. when the SMF was notified from the AMF that the access type of the PDU Session can be changed in step 4).

For a PDU Session that the SMF has determined to accept the activation of UP connection in step 5a or 5b, the SMF generates only N2 SM information and sends Nsmf\_PDUSession\_UpdateSMContext Response to the AMF to establish the User Plane(s). The N2 SM information contains information that the AMF shall provide to the NG-RAN. The SMF may indicate for each QoS Flow whether redundant transmission shall be performed by a corresponding redundant transmission indicator. If the SMF decided to change the PSA UPF for the SSC mode 3 PDU Session, the SMF triggers the change of SSC mode 3 PDU Session anchor as an independent procedure described in clause 4.3.5.2 or clause 4.3.5.3 after accepting the activation of UP of the PDU Session.

The SMF can reject the activation of UP of the PDU Session by including a cause in the Nsmf\_PDUSession\_UpdateSMContext Response. Following are some of the cases:

- If the PDU Session corresponds to a LADN and the UE is outside the area of availability of the LADN as described in step 5b;

- If the AMF notified the SMF that the UE is reachable only for regulatory prioritized service, and the PDU Session to be activated is not for a regulatory prioritized service; or

- If the SMF decided to change the PSA UPF for the requested PDU Session as described in step 5b. In this case, after sending Nsmf\_PDUSession\_UpdateSMContext Response, the SMF triggers another procedure to instruct UE to re-establish the PDU Session as described in clause 4.3.5.1 for SSC mode 2.

- If the SMF received negative response in Step 6b due to UPF resource unavailability.

If the PDU Session has been assigned any EPS bearer ID, the SMF also includes the mapping between EPS bearer ID(s) and QFI(s) into the N2 SM information to be sent to the NG-RAN.

The User Plane Security Enforcement information is determined by the SMF upon PDU session establishment as described in clause 5.10.3 of TS 23.501 [2]. If the User Plane Security Enforcement information indicates that Integrity Protection is "Preferred" or "Required", the SMF also includes the UE Integrity Protection Maximum Data Rate.

The RSN is included when applicable, as determined by the SMF during PDU Session establishment as described in clause 5.33.2.1 of TS 23.501 [2].

12. AMF to (R)AN: N2 Request (N2 SM information received from SMF, security context, Mobility Restriction List, UE-AMBR, MM NAS Service Accept, list of recommended cells / TAs / NG-RAN node identifiers, UE Radio Capability, Core Network Assistance Information, Tracing Requirements, UE Radio Capability ID). The Allowed NSSAI for the Access Type for the UE is included in the N2 message. If the subscription information includes Tracing Requirements, the AMF includes Tracing Requirements in the N2 Request.

If the UE triggered the Service Request while in CM-CONNECTED state, only N2 SM information received from SMF and MM NAS Service Accept are included in the N2 Request.

If the Service Request procedure is triggered by the Network (as described in clause 4.2.3.3) while the UE is in CM-CONNECTED state, only N2 SM information received from SMF is included in the N2 Request.

If the Service Request procedure is triggered by the Network (as described in clause 4.2.3.3) while the UE is in CM-IDLE state, only N2 SM information received from SMF and MM NAS Service Accept is included in the N2 Request.

For a UE that was in CM-IDLE state when the Service Request was triggered, the NG-RAN stores the Security Context. If the Service Request is not triggered by UE for a signalling connection only, RAN also stores QoS Information for the QoS Flows of the PDU Sessions that are activated and N3 Tunnel IDs in the UE RAN context and Mobility Restriction List (as described in TS 23.501 [2] clause 5.3.4.1).

MM NAS Service Accept includes PDU Session status in AMF. Any local PDU Session Release during the Session Request procedure is indicated to the UE via the Session Status. PDU Session Reactivation Result is provided in Service Accept for the PDU sessions in the List Of PDU Sessions To Be Activated, and the PDU Session in the List of Allowed PDU Sessions which has caused paging or NAS notification. If the PDU Session Reactivation Result of a PDU Session is failure, the cause of the failure is also provided.

If there are multiple PDU Sessions that involves multiple SMFs, AMF does not need to wait for responses from all SMFs in step 11 before it send N2 SM information to the RAN. However, the AMF shall wait for all responses from the SMFs before it sends MM NAS Service Accept message to the UE.

AMF shall include at least one N2 SM information from SMF if this step is triggered for PDU Session User Plane activation. AMF may send additional N2 SM information from SMFs in separate N2 message(s) (e.g. N2 tunnel setup request), if there is any. Alternatively, if multiple SMFs are involved, the AMF may send one N2 Request message to (R)AN after all the Nsmf\_PDUSession\_UpdateSMContext Response service operations from all the SMFs associated with the UE are received.

If the NG-RAN node had provided the list of recommended cells / TAs / NG-RAN node identifiers during the AN Release procedure (see clause 4.2.6), the AMF shall include it in the N2 Request. The NG-RAN may use this information to allocate the RAN Notification Area when the NG-RAN decides to enable RRC Inactive state for the UE.

The AMF includes the UE's "RRC Inactive Assistance Information" as defined in TS 23.501 [2] clause 5.3.3.2.5.

If the NG-RAN node does not support RACS and the AMF have UE Radio Capability ID but not the UE Radio Capability information, then AMF will use Nucmf\_UECapabilityManagement\_Resolve to try to retrieve the corresponding UE Radio Capability information.

If the NG-RAN node does not support RACS, or the AMF does not have UE Radio Capability ID in UE context, the AMF shall include the UE Radio Capability information, if available, to the NG-RAN node as described in TS 23.501 [2]. If the RAT Type is NB-IoT then NB-IoT specific UE Radio Access Capability Information is included instead, if available.

If AMF has UE Radio Capability ID in UE context and the NG-RAN supports RACS, the AMF signals the UE Radio Capability ID. If the NG-RAN node does not have mapping between the UE Radio Capability ID and the corresponding UE radio capabilities, it shall use the non-UE associated procedure described in TS 38.413 [10] to retrieve the mapping from the AMF.

The AMF may include the Core Network Assistance Information which includes Core Network assisted RAN parameters tuning and Core Network assisted RAN paging information as defined in TS 23.501 [2].

If the UE included support for restriction of use of Enhanced Coverage, the AMF sends Enhanced Coverage Restricted information to the (R)AN in the N2 message.

If the UE and the AMF have negotiated to enable MICO mode and the AMF uses the Extended connected timer, then the AMF provides the Extended Connected time value to NG-RAN (see clause 5.31.7.3 of TS 23.501 [2]) in this step. The Extended Connected Time value indicates the minimum time the RAN should keep the UE in RRC-CONNECTED state regardless of inactivity.

If the AMF accepted MICO mode in the last registration procedure and knows there may be mobile terminated data or signalling pending, the AMF maintains the N2 connection for at least the Extended Connected Time as described in clause 5.31.7.3 of TS 23.501 [2], and provides the Extended Connected Time value to the RAN in N2 message with Service Accept message. The RAN should keep the UE in RRC-CONNECTED state for an Extended Connected Time period in order to ensure the downlink data and/or signalling is delivered to the UE.

If the RAN receives two CN Tunnel Info for a PDU session in step 11 for redundant transmission, RAN also allocates two AN Tunnel Info correspondingly, and indicate to SMF one of the AN Tunnel Info is used as the redundancy tunnel of the PDU session as described in clause 5.33.2.2 of TS 23.501 [2].

13. (R)AN to UE: The NG-RAN performs RRC Connection Reconfiguration with the UE depending on the QoS Information for all the QoS Flows of the PDU Sessions whose UP connections are activated and Data Radio Bearers. For a UE that was in CM-IDLE state, if the Service Request is not triggered by UE for a signalling connection only, the User Plane security is established at this step, which is described in detail in TS 38.331 [12] and TS 36.331 [16]. For a UE that was in CM-IDLE state, if the Service Request is triggered by UE for a signalling connection only, AS security context may be established in this step, which is described in detail in TS 38.331 [12] and TS 36.331 [16].

If the N2 Request includes a NAS message, the NG-RAN forwards the NAS message to the UE. The UE locally deletes context of PDU Sessions that are not available in 5GC.

NOTE 3: The reception of the Service Accept message does not imply the successful activation of the User Plane radio resources.

NOTE 4: In case not all the requested User Plane AN resources are successfully activated, see TS 38.413 [10].

After the User Plane radio resources are setup, the uplink data from the UE can now be forwarded to NG-RAN. The NG-RAN sends the uplink data to the UPF address and Tunnel ID provided in the step 11.

If the NG-RAN can not establish redundant user plane for the PDU Session as indicated by the RSN parameter, the NG-RAN takes the decision on how to proceed with the PDU Session as described in TS 23.501 [2].

14. [Conditional] (R)AN to AMF: N2 Request Ack (List of PDU Sessions To Be Established with N2 SM information (AN Tunnel Info, List of accepted QoS Flows for the PDU Sessions whose UP connections are activated, List of rejected QoS Flows for the PDU Sessions whose UP connections are activated), List of PDU Sessions that failed to be established with the failure cause given in the N2 SM information element).

The message may include N2 SM information(s), e.g. AN Tunnel Info. NG-RAN may respond N2 SM information with separate N2 message (e.g. N2 tunnel setup response) if AMF sends separate N2 message in step 11.

If multiple N2 SM information are included in the N2 Request message in step 12, the N2 Request Ack includes multiple N2 SM information and information to enable the AMF to associate the responses to relevant SMF.

15. [Conditional] AMF to SMF: Nsmf\_PDUSession\_UpdateSMContext Request (N2 SM information, RAT Type, Access Type) per PDU Session to the SMF. The AMF determines Access Type and RAT Type, see clause 4.2.2.2.1.

If the AMF received N2 SM information (one or multiple) in step 14, then the AMF shall forward the N2 SM information to the relevant SMF per PDU Session ID. If the UE Time Zone has changed compared to the last reported UE Time Zone then the AMF shall include the UE Time Zone IE in this message.

If the PDU Session is moved from the non-3GPP access to 3GPP access (i.e. N3 tunnel for the PDU Session is established successfully), the SMF and AMF update associated access of the PDU Session. The UE updates associated access of the PDU Session when the user plane resource for the PDU Session is successfully established.

Procedure for unpausing a charging pause initiated earlier is specified in clause 4.4.4.

If a PDU Session is rejected by the serving NG-RAN with an indication that the PDU Session was rejected because User Plane Security Enforcement is not supported in the serving NG-RAN and the User Plane Enforcement Policy indicates "Required" as described in clause 5.10.3 of TS 23.501 [2], the SMF shall trigger the release of this PDU Session. In all other cases of PDU Session rejection, the SMF can decide whether to release the PDU Session or to deactivate the UP connection of this PDU Session.

If some of the QoS Flows of a PDU Session are not accepted by the serving NG-RAN, the SMF shall initiate the PDU Session Modification procedure to remove the non-accepted QoS Flows from the PDU Session after this procedure is completed.

16. [Optional] SMF to PCF: If dynamic PCC is deployed, SMF may initiate notification about new location information to the PCF (if subscribed) by performing an SMF initiated SM Policy Modification procedure as defined in clause 4.16.5.1. The PCF may provide updated policies.

17a. [Conditional] SMF to new intermediate UPF: N4 Session Modification Request (AN Tunnel Info and List of accepted QFI(s)).

If the SMF selected a new UPF to act as intermediate UPF for the PDU Session in step 5b, the SMF initiates a N4 Session Modification procedure to the new I-UPF and provides AN Tunnel Info. The Downlink Data from the new I-UPF can now be forwarded to NG-RAN and UE.

17b. [Conditional] UPF to SMF: N4 Session Modification Response.

18a. [Conditional] SMF to UPF (PSA): N4 Session Modification Request (AN Tunnel Info, List of rejected QoS Flows).

If a User Plane is to be setup or modified and after the modification there is no I-UPF, the SMF initiates a N4 Session Modification procedure to UPF (PSA) and provides AN Tunnel Info. The Downlink Data from the UPF (PSA) can now be forwarded to NG-RAN and UE.

For QoS Flows in the List of rejected QoS Flows, the SMF shall instruct the UPF to remove the rules (e.g., Packet Detection Rules etc.) which are associated with the QoS Flows.

If SMF decides to perform redundant transmission for one or more QoS Flows of the PDU, the SMF also indicates the UPF (PSA) to perform packet duplication for the QoS Flow(s) in downlink direction by forwarding rules.

18b. [Conditional] UPF to SMF: N4 Session Modification Response.

19. [Conditional] SMF to AMF: Nsmf\_PDUSession\_UpdateSMContext Response.

20a. [Conditional] SMF to new UPF (intermediate): N4 Session Modification Request.

If forwarding tunnel has been established to the new I-UPF and if the timer SMF set for forwarding tunnel at step 8a has expired, SMF sends N4 Session modification request to new (intermediate) UPF acting as N3 terminating point to release the forwarding tunnel.

20b. [Conditional] new UPF (intermediate) to SMF: N4 Session modification response.

New (intermediate) UPF acting as N3 terminating point sends N4 Session Modification response to SMF.

21a. [Conditional] SMF to UPF (PSA): N4 Session Modification Request.

If forwarding tunnel has been established to the UPF (PSA) and if the timer SMF set for forwarding tunnel at step 7b has expired, SMF sends N4 Session modification request to UPF (PSA) acting as N3 Terminating Point to release the forwarding tunnel.

21b. [Conditional] UPF (PSA) to SMF: N4 Session Modification Response.

UPF (PSA) acting as N3 Terminating Point sends N4 Session Modification Response to SMF.

22a. [Conditional] SMF to old UPF: N4 Session Modification Request or N4 Session Release Request.

If the SMF decided to continue using the old UPF in step 5b, the SMF sends an N4 Session Modification Request, providing AN Tunnel Info.

If the SMF decided to select a new UPF to act as intermediate UPF in step 5b, and the old UPF is not PSA UPF, the SMF initiates resource release, after timer in step 6b or 7b expires, by sending an N4 Session Release Request (Release Cause) to the old intermediate UPF.

22b. Old intermediate UPF to SMF: N4 Session Modification Response or N4 Session Release Response.

The old UPF acknowledges with an N4 Session Modification Response or N4 Session Release Response message to confirm the modification or release of resources.

For the mobility related events described in clause 4.15.4, the AMF invokes the Namf\_EventExposure\_Notify service operation after step 4.

Upon reception of the Namf\_EventExposure\_Notify with an indication that the UE is reachable, if the SMF has pending DL data the SMF invokes the Namf\_Communication\_N1N2MessageTransfer service operation to the AMF to establish the User Plane(s) for the PDU Sessions, otherwise the SMF resumes sending DL data notifications to the AMF in case of DL data.

Upon reception of the Namf\_EventExposure\_Notify with an indication that UE is reachable only for regulatory prioritized service, the SMF deactivates the PDU Session if the service of the PDU Session is not regulatory prioritized. For home routed roaming case, the V-SMF triggers the deactivation of the PDU Session, in addition, the H-SMF refrains from sending downlink signalling if the signalling is not related to regulatory prioritized service upon receiving the notification.

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

#### 4.3.3.2 UE or network requested PDU Session Modification (non-roaming and roaming with local breakout)

The UE or network requested PDU Session Modification procedure (non-roaming and roaming with local breakout scenario) is depicted in figure 4.3.3.2-1.



Figure 4.3.3.2-1: UE or network requested PDU Session Modification (for non-roaming and roaming with local breakout)

1. The procedure may be triggered by following events:

1a. (UE initiated modification) The UE initiates the PDU Session Modification procedure by the transmission of an NAS message (N1 SM container (PDU Session Modification Request (PDU session ID, Packet Filters, Operation, Requested QoS, Segregation, 5GSM Core Network Capability, Number Of Packet Filters, [Always-on PDU Session Requested])), PDU Session ID, UE Integrity Protection Maximum Data Rate, [Port Management Information Container]) message. Depending on the Access Type, if the UE was in CM-IDLE state, this SM-NAS message is preceded by the Service Request procedure. The NAS message is forwarded by the (R)AN to the AMF with an indication of User location Information. The AMF invokes Nsmf\_PDUSession\_UpdateSMContext (SM Context ID, N1 SM container (PDU Session Modification Request)).

When the UE requests specific QoS handling for selected SDF(s), the PDU Session Modification Request includes Packet Filters describing the SDF(s), the requested Packet Filter Operation (add, modify, delete) on the indicated Packet Filters, the Requested QoS and optionally a Segregation indication. The Segregation indication is included when the UE recommends to the network to bind the applicable SDF(s) on a distinct and dedicated QoS Flow e.g. even if an existing QoS Flow can support the requested QoS. The network should abide by the UE request, but is allowed to proceed instead with binding the selected SDF(s) on an existing QoS Flow.

NOTE 1: Only one QoS Flow is used for traffic segregation. If UE makes subsequent requests for segregation of additional SDF(s), the additional SDF(s) are multiplexed on the existing QoS Flow that is used for segregation.

The UE shall not trigger a PDU Session Modification procedure for a PDU Session corresponding to a LADN when the UE is outside the area of availability of the LADN.

The PS Data Off status, if changed, shall be included in the PCO in the PDU Session Modification Request message.

For a PDU Session which was established in the EPS, when the UE moves from EPS to 5GS for the first time, the UE includes an Always-on PDU Session Requested indication in the PDU Session Modification Request message if it wants to change the PDU Session to an always-on PDU Session.

When PCF is deployed, the SMF shall further report the PS Data Off status to PCF if the PS Data Off event trigger is provisioned, the additional behaviour of SMF and PCF for 3GPP PS Data Off is defined in TS 23.503 [20].

The 5GSM Core Network Capability is provided by the UE and handled by SMF as defined in TS 23.501 [2] clause 5.4.4b.

The UE Integrity Protection Maximum Data Rate indicates the maximum data rate up to which the UE can support UP integrity protection.

The Number Of Packet Filters indicates the number of supported packet filters for signalled QoS rules as described in TS 23.501 [2] clause 5.17.2.2.2.

Port Management Information Container is received from DS-TT and includes Ethernet-port related management information as defined in TS 23.501 [2] clause 5.28.3.

1b. (SMF requested modification) The PCF performs a PCF initiated SM Policy Association Modification procedure as defined in clause 4.16.5.2 to notify SMF about the modification of policies. This may e.g. have been triggered by a policy decision or upon AF requests, e.g. Application Function influence on traffic routing as described in step 5 in clause 4.3.6.2 or AF to provide Port management information Container.

If the QoS Monitoring for URLLC is requested by the AF, the PCF generates the QoS Monitoring policy for the corresponding service data flow, and provides the policy in the PCC rules to the SMF in this step.

1c. (SMF requested modification) The UDM updates the subscription data of SMF by Nudm\_SDM\_Notification (SUPI, Session Management Subscription Data). The SMF updates the Session Management Subscription Data and acknowledges the UDM by returning an Ack with (SUPI).

1d. (SMF requested modification) The SMF may decide to modify PDU Session. This procedure also may be triggered based on locally configured policy or triggered from the (R)AN (see clause 4.2.6 and clause 4.9.1). It may also be triggered if the UP connection is activated (as described in Service Request procedure) and the SMF has marked that the status of one or more QoS Flows are deleted in the 5GC but not synchronized with the UE yet.

If the SMF receives one of the triggers in step 1b ~ 1d, the SMF starts SMF requested PDU Session Modification procedure.

1e. (AN initiated modification) (R)AN shall indicate to the SMF when the AN resources onto which a QoS Flow is mapped are released irrespective of whether notification control is configured. (R)AN sends the N2 message (PDU Session ID, N2 SM information) to the AMF. The N2 SM information includes the QFI, User location Information and an indication that the QoS Flow is released. The AMF invokes Nsmf\_PDUSession\_UpdateSMContext (SM Context ID, N2 SM information).

(AN initiated notification control) In case notification control is configured for a GBR QoS Flow, (R)AN sends a N2 message (PDU Session ID, N2 SM information) to SMF when the (R)AN decides the QoS targets of the QoS Flow cannot be fulfilled or can be fulfilled again, respectively. The N2 SM information includes the QFI and an indication that the QoS targets for that QoS Flow cannot be fulfilled or can be fulfilled again, respectively. When QoS targets cannot be fulfilled, the N2 SM information indicates a reference to the Alternative QoS Profile matching the values of the QoS parameters that the NG-RAN is currently fulfilling as specified in clause 5.7.2.4 of TS 23.501 [2]. The AMF invokes Nsmf\_PDUSession\_UpdateSMContext (SM Context ID, N2 SM information). If the PCF has subscribed to the event, SMF reports this event to the PCF for each PCC Rule for which notification control is set in step 2.

1f. (AMF initiated modification) If the UE supports CE mode B and use of CE mode changes from restricted to unrestricted or vice versa in the Enhanced Coverage Restriction information in the UE context in the AMF and the UE has already established PDU sessions, then the AMF shall trigger a PDU session modification to the SMFs serving the UE's PDU sessions and include the extended NAS-SM indication only if use of CE mode B is now unrestricted in the Enhanced Coverage Restriction information in the UE context in the AMF.

Based on the extended NAS-SM timer indication, the SMF shall use the extended NAS-SM timer setting for the UE as specified in TS 24.501 [25].

2. The SMF may need to report some subscribed event to the PCF by performing an SMF initiated SM Policy Association Modification procedure as defined in clause 4.16.5.1. This step may be skipped if PDU Session Modification procedure is triggered by step 1b or 1d. If dynamic PCC is not deployed, the SMF may apply local policy to decide whether to change the QoS profile.

Steps 2a to 7 are not invoked when the PDU Session Modification requires only action at a UPF (e.g. gating).

2a. If redundant transmission has not been activated to the PDU session and the SMF decides to perform redundant transmission for the QoS Flow, the SMF indicates to the UPF to perform packet duplication and elimination for the QoS Flow.

If redundant transmission has been activated on the PDU Session, and the SMF decides to stop redundant transmission, the SMF indicates the UPF to release the CN Tunnel Info which is used as the redundancy tunnel of the PDU Session, and also indicates the UPF to stop packet duplication and elimination for the corresponding QoS Flow(s).

NOTE 2: The method to perform elimination and reordering on RAN/UPF based on the packets received from the two GTP-U tunnels is up to RAN/UPF implementation. The two GTP-U tunnels are terminated at the same RAN node and UPF.

If redundant transmission has not been activated to the PDU Session and the SMF decides to perform redundant transmission for the QoS Flow with two I-UPFs between the PSA UPF and the NG-RAN, the SMF sends a N4 Session Establishment Request messages to the I-UPFs including UL CN Tunnel Info of the PSA UPF and a request to allocate CN Tunnel Info.

2b. The UPF(s) respond to the SMF. If redundant transmission has not been activated to the PDU session and the SMF indicated the UPF to perform packet duplication and elimination for the QoS Flow in step 2a, the UPF allocates an additional CN Tunnel Info. The additional CN Tunnel Info is provided to the SMF.

If redundant transmission has not been activated to the PDU Session and the SMF decides to perform redundant transmission for the QoS Flow with two I-UPFs in step 2a, the UPFs allocate CN Tunnuel Info. The CN Tunnel Info of each I-UPFs is provided to the SMF.

3a. For UE or AN initiated modification, the SMF responds to the AMF through Nsmf\_PDUSession\_UpdateSMContext Response ([N2 SM information (PDU Session ID, QFI(s), QoS Profile(s), [Alternative QoS Profile(s)], Session-AMBR], [CN Tunnel Info(s)]), N1 SM container (PDU Session Modification Command (PDU Session ID, QoS rule(s), QoS rule operation, QoS Flow level QoS parameters if needed for the QoS Flow(s) associated with the QoS rule(s), Session-AMBR, [Always-on PDU Session Granted], [Port Management Information Container]))). See TS 23.501 [2] clause 5.7 for the QoS Profile, Alternative QoS Profile, and QoS rule and QoS Flow level QoS parameters. Alternative QoS Profile is only valid for AN initiated modification.

If the PDU Session Modification was requested by the UE to modify a PDU Session to an always-on PDU Session, the SMF shall include an Always-on PDU Session Granted indication in the PDU Session Modification Command to indicate whether the PDU Session is to be changed to an always-on PDU Session or not via the Always-on PDU Session Granted indication in the PDU Session Modification Command.

The N2 SM information carries information that the AMF shall provide to the (R)AN. It may include the QoS profiles and the corresponding QFIs to notify the (R)AN that one or more QoS flows were added, or modified. It may include only QFI(s) to notify the (R)AN that one or more QoS flows were removed. The SMF may indicate for each QoS Flow whether redundant transmission shall be performed by a corresponding redundant transmission indicator. If the SMF decides to activate redundant transmission in step 2a, the SMF includes the allocated additional CN Tunnel Info in the N2 SM information. If the SMF decides to perform redundant transmission for new QoS Flow with two I-UPFs in step 2a, the SMF includes the allocated CN Tunnel Info of the two I-UPFs in the N2 SM information. If the PDU Session Modification was triggered by the (R)AN Release in step 1e the N2 SM information carries an acknowledgement of the (R)AN Release. If the PDU Session Modification was requested by the UE for a PDU Session that has no established User Plane resources, the N2 SM information provided to the (R)AN includes information for establishment of User Plane resources.

If redundant transmission has been activated on the PDU Session, and the SMF decides to stop redundant transmission, the SMF indicates the (R)AN to release the AN Tunnel Info which is used as the redundancy tunnel of the PDU Session. The SMF also indicates the (R)AN to stop packet duplication and elimination for the corresponding QoS Flow(s).

The N1 SM container carries the PDU Session Modification Command that the AMF shall provide to the UE. It may include the QoS rules, QoS Flow level QoS parameters if needed for the QoS Flow(s) associated with the QoS rule(s) and corresponding QoS rule operation and QoS Flow level QoS parameters operation to notify the UE that one or more QoS rules were added, removed or modified.

If port number and a Port Management Information Container have been received from PCF in Step 2 and the port number matches the port number assigned for the DS-TT Ethernet port for this PDU session, then SMF includes the Port Management Information Container in the N1 SM container.

The SMF may need to send transparently through NG-RAN the PDU Session Modification Command to inform the UE about changes in the QoS parameters (i.e. 5QI, GFBR, MFBR) that the NG-RAN is currently fulfilling after the SMF receives QoS Notification Control as defined in TS 23.501 [2] clause 5.7.2.4. When the SMF sends on the PDU Session Modification Command transparently through NG-RAN, the N2 SM information is not included as part of the Namf\_Communication\_N1N2MessageTransfer.

3b. For SMF requested modification, the SMF invokes Namf\_Communication\_N1N2MessageTransfer ([N2 SM information] (PDU Session ID, QFI(s), QoS Profile(s), [Alternative QoS Profile(s)], Session-AMBR, [CN Tunnel Info(s)] , QoS Monitoring indication, QoS Monitoring reporting frequency, [TSCAI(s)]), N1 SM container (PDU Session Modification Command (PDU Session ID, QoS rule(s), QoS Flow level QoS parameters if needed for the QoS Flow(s) associated with the QoS rule(s), QoS rule operation and QoS Flow level QoS parameters operation, Session-AMBR))).

The SMF may indicate for each QoS Flow whether redundant transmission shall be performed by a corresponding redundant transmission indicator. If the SMF decides to activate redundant transmission in step 2a, the SMF includes the allocated additional CN Tunnel Info in the N2 SM information. If the SMF decides to perform redundant transmission for new QoS Flow with two I-UPFs in step 2a, the SMF includes the allocated CN Tunnel Info of the two I-UPFs in the N2 SM information.

The SMF indicates the request for QoS Monitoring for the QoS Flow according to the information received from the PCF in step 1b, or based on SMF local policy, e.g. when the RAN rejected the creation of a specific QoS Flow for URLLC. In the case of receiving the QoS Monitoring indication, the RAN enables the packet delay measurement of Uu interface for the QoS Flow and the QoS Monitoring reporting frequency is used by RAN to determine the packet delay measurement frequency of Uu interface. The TSCAI is defined in TS 23.501 [2] clause 5.27.2.

If the UE is in CM-IDLE state and an ATC is activated, the AMF updates and stores the UE context based on the Namf\_Communication\_N1N2MessageTransfer and steps 4, 5, 6 and 7 are skipped. When the UE is reachable e.g. when the UE enters CM-CONNECTED state, the AMF forwards the N1 message to synchronize the UE context with the UE.

3c. For SMF requested modification due to updated SMF-Associated parameters from the UDM, the SMF may provide the SMF derived CN assisted RAN parameters tuning to the AMF. The SMF invokes Nsmf\_PDUSession\_SMContextStatusNotify (SMF derived CN assisted RAN parameters tuning) towards the AMF. The AMF stores the SMF derived CN assisted RAN parameters tuning in the associated PDU Session context for this UE.

4. The AMF may send N2 ([N2 SM information received from SMF], NAS message (PDU Session ID, N1 SM container (PDU Session Modification Command))) Message to the (R)AN.

5. The (R)AN may issue AN specific signalling exchange with the UE that is related with the information received from SMF. For example, in case of a NG-RAN, an RRC Connection Reconfiguration may take place with the UE modifying the necessary (R)AN resources related to the PDU Session or if only N1 SM container is received in step 4 from AMF, RAN transports only the N1 SM container to the UE.

The (R)AN may consider the updated CN assisted RAN parameters tuning to reconfigure the AS parameters.

As part of this, the N1 SM container is provided to the UE. If the N1 SM container includes a Port Management Information Container then the UE provides the container to DS-TT.

6. The (R)AN may acknowledge N2 PDU Session Request by sending a N2 PDU Session Ack (N2 SM information (List of accepted/rejected QFI(s), AN Tunnel Info, PDU Session ID, Secondary RAT usage data), User location Information) Message to the AMF. In case of Dual Connectivity, if one or more QFIs were added to the PDU Session, the Master RAN node may assign one or more of these QFIs to a NG-RAN node which was not involved in the PDU Session earlier. In this case the AN Tunnel Info includes a new N3 tunnel endpoint for QFIs assigned to the new NG-RAN node. Correspondingly, if one or more QFIs were removed from the PDU Session, a (R)AN node may no longer be involved in the PDU Session anymore, and the corresponding tunnel endpoint is removed from the AN Tunnel Info. The NG-RAN may reject QFI(s) if it cannot fulfil the User Plane Security Enforcement information for a corresponding QoS Profile, e.g. due to the UE Integrity Protection Maximum Data Rate being exceeded. When receiving the request for QoS Monitoring, the (R)AN may indicate its rejection to perform QoS Monitoring, e.g. due to the (R)AN load condition.

If the PLMN has configured secondary RAT usage reporting, the NG-RAN node may provide RAN Usage Data Report.

If the redundant transmission has not been activated to the PDU session, and the SMF indicates to the RAN that one of the QoS Flow shall perform redundant transmission, the RAN includes an additional AN tunnel info in N2 SM information.

7. The AMF forwards the N2 SM information and the User location Information received from the AN to the SMF via Nsmf\_PDUSession\_UpdateSMContext service operation. The SMF replies with a Nsmf\_PDUSession\_UpdateSMContext Response. N2 SM information may include Secondary RAT Usage Data.

If the (R)AN rejects QFI(s) the SMF is responsible of updating the QoS rules and QoS Flow level QoS parameters if needed for the QoS Flow(s) associated with the QoS rule(s) in the UE accordingly.

If the PDU Session modification is UE triggered and the N2 SM information indicates modification failure, the SMF shall reject the PDU session modification by including a N1 SM container with a PDU Session Modification Reject message (see clause 8.3.3 of TS 24.501 [25]) in the Nsmf\_PDUSession\_UpdateSMContext Response in step 7b. Step 8 is skipped in this case.

8. The SMF may update N4 session of the UPF(s) that are involved by the PDU Session Modification by sending N4 Session Modification Request message to the UPF (see NOTE 3).

If new QoS Flow(s) are to be created, the SMF updates the UPF with UL Packet Detection Rules of the new QoS Flow.

NOTE 3: This allows the UL packets with the QFI of the new QoS Flow to be transferred.

If an additional AN Tunnel Info is returned by RAN in step 6, the SMF informs the UPF about this AN Tunnel Info for redundant transmission. In the case of redundant tramsmission with two I-UPFs, the SMF provides AN Tunnel Info to two I-UPFs. If CN Tunnel Info of two I-UPFs is allocated by the UPFs in step 2b, the SMF also provides the DL CN Tunnel Info of two I-UPFs to the UPF (PSA).

If the QoS Monitoring for URLLC is enabled for the QoS Flow, the SMF provides the N4 rules containing the QoS Monitoring policy generated according to the information received in step 1b to the UPF via the N4 Session Modification Request message.

If port number and a Port Management Information Container have been received from PCF in Step 2 and the port number matches the port number of the NW-TT Ethernet port for this PDU session, then SMF includes the Port Management Information Container in the N4 Session Modification Request. If the N4 Session Modification Request includes a Port Management Information Container, then UPF also includes a Port Management Information Container in the N4 Session Modification Reponse.

9. The UE acknowledges the PDU Session Modification Command by sending a NAS message (PDU Session ID, N1 SM container (PDU Session Modification Command Ack, [Port Management Information Container])) message.

10. The (R)AN forwards the NAS message to the AMF.

11. The AMF forwards the N1 SM container (PDU Session Modification Command Ack) and User Location Information received from the AN to the SMF via Nsmf\_PDUSession\_UpdateSMContext service operation. The SMF replies with a Nsmf\_PDUSession\_UpdateSMContext Response.

If the SMF initiated modification is to delete QoS Flows (e.g. triggered by PCF) which do not include QoS Flow associated with the default QoS rule and the SMF does not receive response from the UE, the SMF marks that the status of those QoS Flows is to be synchronized with the UE.

12. The SMF may update N4 session of the UPF(s) that are involved by the PDU Session Modification by sending N4 Session Modification Request (N4 Session ID) message to the UPF. For a PDU Session of Ethernet PDU Session Type, the SMF may notify the UPF to add or remove Ethernet Packet Filter Set(s) and forwarding rule(s).

NOTE 4: The UPFs that are impacted in the PDU Session Modification procedure depends on the modified QoS parameters and on the deployment. For example in case of the session AMBR of a PDU Session with an UL CL changes, only the UL CL is involved. This note also applies to the step 8.

13. If the SMF interacted with the PCF in step 1b or 2, the SMF notifies the PCF whether the PCC decision could be enforced or not by performing an SMF initiated SM Policy Association Modification procedure as defined in clause 4.16.5.1. If SMF received a Port Management Information Container from either UE or UPF, then SMF provides the Port Management Information Container and the port number of the related port to the PCF in this step.

SMF notifies any entity that has subscribed to User Location Information related with PDU Session change.

If step 1b is triggered to perform Application Function influence on traffic routing by step 5 in clause 4.3.6.2, the SMF may reconfigure the User Plane of the PDU Session as described in step 6 in clause 4.3.6.2.

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

##### 4.11.1.2.1 5GS to EPS handover using N26 interface

Figure 4.11.1.2.1-1 describes the handover procedure from 5GS to EPS when N26 is supported.

In the case of handover to a shared EPS network, the source NG-RAN determines a PLMN to be used in the target network as specified by TS 23.501 [2]. The source NG-RAN shall indicate the selected PLMN ID to be used in the target network to the AMF as part of the TAI sent in the HO Required message.

In the case of handover from a shared NG-RAN, the AMF may provide the MME with an indication that the 5GS PLMN is a preferred PLMN at later change of the UE to a 5GS shared networks.

During the handover procedure, as specified in clause 4.9.1.3.1, the source AMF shall reject any PGW-C+SMF initiated N2 request received since handover procedure started and shall include an indication that the request has been temporarily rejected due to handover procedure in progress.

Upon reception of a rejection for an PGW-C+SMF initiated N2 request(s) with an indication that the request has been temporarily rejected due to handover procedure in progress, the PGW-C+SMF behaves as specified in TS 23.401 [13].



Figure 4.11.1.2.1-1: 5GS to EPS handover for single-registration mode with N26 interface

The procedure involves a handover to EPC and setup of default EPS bearer and dedicated bearers for QoS Flows that have EBI assigned, in EPC in steps 1-16 and re-activation, if required, of dedicated EPS bearers for non-GBR QoS Flows that have no EBI assigned, in step 19. This procedure can be triggered, for example, due to new radio conditions, load balancing or in the presence of QoS Flow for normal voice or IMS emergency voice, the source NG-RAN node may trigger handover to EPC.

For Ethernet and Unstructured PDU Session Types, the PDN Type Ethernet and non-IP respectively are used, when supported, in EPS.

When EPS supports PDN Type non-IP but not PDN type Ethernet, PDN type non-IP is used also for Ethernet PDU sessions. The SMF shall also set the PDN Type of the EPS Bearer Context to non-IP in this case. After the handover to EPS, the PDN Connection will have PDN Type non-IP, but it shall be locally associated in UE and SMF to PDU Session Type Ethernet or Unstructured respectively.

In the roaming home routed case, the PGW-C+SMF always provides the EPS Bearer ID and the mapped QoS parameters to UE. The V-SMF caches the EPS Bearer ID and the mapped QoS parameters obtained from H-SMF for this PDU session. This also applies in the case that the HPLMN operates the interworking procedure without N26.

NOTE 1: The IP address preservation cannot be supported, if PGW-C+SMF in the HPLMN doesn't provide the mapped QoS parameters.

1. NG-RAN decides that the UE should be handed over to the E-UTRAN. If NG-RAN is configured to perform Inter RAT mobility due to IMS voice fallback triggered by QoS flow setup and request to setup QoS flow for IMS voice was received, NG-RAN responds indicating rejection of the QoS flow establishment because of mobility due to fallback for IMS voice via N2 SM information and triggers handover to E-UTRAN. The NG-RAN sends a Handover Required (Target eNB ID, Direct Forwarding Path Availability, Source to Target Transparent Container, inter system handover indication) message to the AMF. NG-RAN indicates bearers corresponding to the 5G QoS Flows for data forwarding in Source to Target Transparent Container.

Direct Forwarding Path Availability indicates whether direct forwarding is available from the NG-RAN to the E-UTRAN. This indication from NG-RAN can be based on e.g. the presence of IP connectivity and security association(s) between the NG-RAN and the E-UTRAN.

If the handover is triggered due to Emergency fallback, the NG-RAN may forward the Emergency indication to the target eNB in the Source to Target Transparent Container, and the target eNB allocates radio bearer resources taking received indication into account.

2. The AMF determines from the 'Target eNB Identifier' IE that the type of handover is Handover to E-UTRAN. The AMF selects an MME as described in TS 23.401 [13] clause 4.3.8.3.

In the case of HR roaming, the AMF by using Nsmf\_PDUSession\_Context Request requests the V-SMF to provide SM Context that also includes the mapped EPS Bearer Contexts. The AMF provides the target MME capability to SMF in the request to allow the V-SMF to determine whether to include EPS Bearer context for Ethernet PDN Type or non-IP PDN Type or not. For PDU Sessions with PDU Session Type Ethernet, if the UE and target MME supports Ethernet PDN type, the SMF provides SM Context for Ethernet PDN Type, otherwise if the target MME does not support Ethernet Type but support non-IP Type, the SMF provides SM Context for non-IP PDN Type. For PDU Sessions with PDU Session Type Unstructured, the SMF provides SM Context for non-IP PDN Type.

In the case of non roaming or LBO roaming, the AMF request PGW-C+SMF to provide SM Context by using Nsmf\_PDUSession\_ContextRequest. The AMF provides the target MME capability to PGW-C+SMF in the request to allow the PGW-C+SMF to determine whether to include EPS Bearer context for Ethernet Type or non-IP PDN Type or not. For PDU Sessions with PDU Session Type Ethernet, if the UE and target MME supports Ethernet PDN type, the SMF provides SM Context for Ethernet PDN Type, otherwise if the target MME does not support Ethernet but support non-IP PDN Type, the SMF provides SM Context for non-IP PDN Type. For PDU Sessions with PDU Session Type Unstructured, the SMF provides SM Context for non-IP PDN Type. The PGW-C+SMF send N4 Session modification to PGW-U+UPF to establish the CN tunnel for each EPS bearer and provide EPS Bearer Contexts to AMF, as described in step 8 of clause 4.11.1.4.1. The PGW-U+UPF is ready to receive the uplink packet from E-UTRAN.

This step is performed with all the PGW-C+SMFs corresponding to PDU Sessions of the UE which are associated with 3GPP access and have EBI(s) allocated to them.

NOTE 2: The AMF knows the MME capability to support Ethernet PDN type and/or non-IP PDN type or not through local configuration.

NOTE 3: In home routed roaming scenario, the UE's SM EPS Contexts are obtained from the V-SMF.

3. The AMF sends a Forward Relocation Request as in step 3 in clause 5.5.1.2.2 (S1-based handover, normal) in TS 23.401 [13], with the following modifications and clarifications:

- Parameter "Return preferred" may be included. Return preferred is an optional indication by the MME of a preferred return of the UE to the 5GS PLMN at a later access change to a 5GS shared network. An MME may use this information as specified by TS 23.501 [2].

- The SGW address and TEID for both the control-plane or EPS bearers in the message are such that target MME selects a new SGW.

- The AMF determines, based on configuration and the Direct Forwarding Path Availability, the Direct Forwarding Flag to inform the target MME whether direct data forwarding is applicable.

- The AMF includes the mapped SM EPS UE Contexts for PDU Sessions with and without active UP connections.

4-5. Step 4 and 4a respectively in clause 5.5.1.2.2 (S1-based handover, normal) in TS 23.401 [13].

6. Step 5 (Handover Request) in clause 5.5.1.2.2 (S1-based handover, normal) in TS 23.401 [13] with the following modification:

- Handover Request may contain information Handover Restriction List with information about PLMN IDs as specified by TS 23.251 [35], clause 5.2a for eNodeB functions.

- The target eNB should establish E-RABs indicated by the list of EPS bearer to be setup provided by the MME, even if they are not included in the source to target container.

7-9. Step 5a through 7 in clause 5.5.1.2.2 (S1-based handover, normal) in TS 23.401 [13].

10a. If data forwarding applies, the AMF sends the Nsmf\_PDUSession\_UpdateSMContext Request (data forwarding information) to the PGW-C+SMF. If multiple PGW-C+SMFs serves the UE, the AMF maps the EPS bearers for Data forwarding to the PGW-C+SMF address(es) based on the association between the EPS bearer ID(s) and PDU Session ID(s). In home-routed roaming case, the AMF requests the V-SMF to create indirect forwarding tunnel if indirect forwarding applies.

10b. If indirect data forwarding applies, the PGW-C+SMF may select an intermediate PGW-U+UPF for data forwarding. The PGW-C+SMF maps the EPS bearers for Data forwarding to the 5G QoS flows based on the association between the EPS bearer ID(s) and QFI(s) for the QoS flow(s) in the PGW-C+SMF, and then sends the QFIs, Serving GW Address(es) and TEID(s) for data forwarding to the PGW-U+UPF. The CN Tunnel Info is provided by the PGW-U+UPF to PGW-C+SMF in this response. In home-routed roaming case, the V-SMF selects the V-UPF for data forwarding.

10c. The PGW-C+SMF returns an Nsmf\_PDUSession\_UpdateSMContext Response (Cause, Data Forwarding tunnel Info, QoS flows for Data Forwarding). Based on the correlation between QFI(s) and Serving GW Address(es) and TEID(s) for data forwarding, the PGW-U+UPF maps the QoS flow(s) into the data forwarding tunnel(s) in EPC.

11. The AMF sends the Handover Command to the source NG-RAN (Transparent container (radio aspect parameters that the target eNB has set-up in the preparation phase), Data forwarding tunnel info, QoS flows for Data Forwarding). The source NG-RAN commands the UE to handover to the target access network by sending the HO Command. The UE correlates the ongoing QoS Flows with the indicated EPS Bearer IDs to be setup in the HO command. The UE locally deletes the PDU Session if the QoS Flow associated with the default QoS rule in the PDU Session does not have an EPS Bearer ID assigned. If the QoS Flow associated with the default QoS rule has an EPS Bearer ID assigned, the UE keeps the PDU Session (PDN connection) and for the remaining QoS Flow(s) that do not have EPS bearer ID(s) assigned, the UE locally deletes the QoS rule(s) and the QoS Flow level QoS parameters if any associated with those QoS Flow(s) and notifies the impacted applications that the dedicated QoS resource has been released. The UE deletes any UE derived QoS rules. The EPS Bearer ID that was assigned for the QoS flow of the default QoS rule in the PDU Session becomes the EPS Bearer ID of the default bearer in the corresponding PDN connection.

If indirect data forwarding is applied, Data forwarding tunnel info includes CN tunnel info for data forwarding per PDU session. For the QoS Flows indicated in the "QoS Flows for Data Forwarding", NG-RAN initiate data forwarding via to the PGW-U+UPF based on the CN Tunnel Info for Data Forwarding per PDU Session. Then the PGW-U+UPF maps data received from the data forwarding tunnel(s) in the 5GS to the data forwarding tunnel(s) in EPS, and sends the data to the target eNodeB via the Serving GW.

If direct data forwarding is applied, Data forwarding tunnel info includes E-UTRAN tunnel info for data forwarding per EPS bearer. NG-RAN initiate data forwarding to the target E-UTRAN based on the Data Forwarding Tunnel Info for Data Forwarding per EPS bearer.

12-12c. Step 13 to step 14 from clause 5.5.1.2.2 (S1-based handover, normal) in TS 23.401 [13] with the following clarification:

- The AMF request the release of the PDU Session which is associated with 3GPP access, not expected to be transferred to EPC, i.e. no EBI(s) allocated to them, and corresponding to the PGW-C+SMF which is not contacted by AMF for SM context at step 2.

12d. The AMF acknowledges MME with Relocation Complete Ack message. A timer in AMF is started to supervise when resource inNG-RAN shall be released.

12e. In case of home routed roaming, the AMF invokes Nsmf\_PDUSession\_ReleaseSMContext Request(V-SMF only indication) to the V-SMF. This service operation request the V-SMF to remove only the SM context in V-SMF, i.e. not release PDU Session context in the PGW-C+SMF.

If indirect forwarding tunnel(s) were previously established, the V-SMF starts a timer and releases the SM context on expiry of the timer. If no indirect forwarding tunnel has been established, the V-SMF immediately releases the SM context and its UP resources for this PDU Sesssion in V-UPF locally.

13. Step 15 from clause 5.5.1.2.2 (S1-based handover, normal) in TS 23.401 [13].

14a. Step 16 (Modify Bearer Request) from clause 5.5.1.2.2 (S1-based handover, normal) in TS 23.401 [13] with the following clarification:

- If the PDU Session (PDN connection) has QoS Flows that do not have EPS bearer ID(s) assigned, the PGW-C+SMF deletes the PCC rule(s) associated with those QoS Flows and informs the PCF about the removed PCC rule(s).

NOTE 4: If the QoS flow is deleted, the IP flows of the deleted QoS rules will continue flowing on the default EPS bearer if it does not have an assigned TFT. If the default EPS bearer has an assigned TFT, the IP flows of the deleted QoS Flow may be interrupted until step 19 when dedicated bearer activation is triggered by a request from the PCF.

The PGW-C+SMF may need to report some subscribed event to the PCF by performing an SMF initiated SM Policy Association Modification procedure as defined in clause 4.16.5.

15. The PGW-C+SMF initiates a N4 Session Modification procedure towards the UPF+PGW-U to update the User Plane path, i.e. the downlink User Plane for the indicated PDU Session is switched to E-UTRAN. The PGW-C+SMF releases the resource of the CN tunnel for PDU Session in UPF+PGW-U.

16. Step 16a (Modify Bearer Response) from clause 5.5.1.2.2 (S1-based handover, normal) in TS 23.401 [13]. At this stage the User Plane path is established for the default bearer and the dedicated EPS bearers between the UE, target eNodeB, Serving GW and the PGW-U+UPF. The PGW-C+SMF uses the EPS QoS parameters as assigned for the dedicated EPS bearers during the QoS Flow establishment. PGW-C+SMF maps all the other IP flows to the default EPS bearer (see NOTE 4).

If indirect forwarding tunnel(s) were previously established, the PGW-C+SMF starts a timer, to be used to release the resource used for indirect data forwarding.

17. Step 17 from clause 5.5.1.2.2 (S1-based handover, normal) in TS 23.401 [13].

18. The UE initiates a Tracking Area Update procedure as specified in step 11 of clause 5.5.1.2.2 (S1-based handover, normal) in TS 23.401 [13].

This includes the deregistration of the old AMF for 3GPP access from the HSS+UDM as specified in clause 4.11.1.5.3. Any registration associated with the non-3GPP access in the old AMF is not removed (i.e. an AMF that was serving the UE over both 3GPP and non-3GPP accesses does not consider the UE as deregistered over non 3GPP access and will remain registered and subscribed to subscription data updates in UDM).

NOTE 5: The behavior whereby the HSS+UDM cancels location of CN node of the another type, i.e. AMF, is similar to HSS behavior for MME and Gn/Gp SGSN registration (see TS 23.401 [13]). The target AMF that receives the cancel location from the HSS+UDM is the one associated with 3GPP access.

When the UE decides to deregister over non-3GPP access or the old AMF decides not to maintain a UE registration for non-3GPP access anymore, the old AMF then deregisters from UDM by sending a Nudm\_UECM\_Deregistration service operation, unsubscribes from Subscription Data updates by sending an Nudm\_SDM\_Unsubscribe service operation to UDM and releases all the AMF and AN resources related to the UE.

19. If PCC is deployed, the PCF may decide to provide the previously removed PCC rules to the PGW-C+SMF again thus triggering the PGW-C+SMF to initiate dedicated bearer activation procedure. This procedure is specified in TS 23.401 [13], clause 5.4.1 with modification captured in clause 4.11.1.5.4. This step is applicable for PDN Type IP or Ethernet, but not for non-IP PDN Type.

20. Step 21 from clause 5.5.1.2.2 (S1-based handover, normal) in TS 23.401 [13].

21. In the case of home routed roaming, at the expiry of the timer at V-SMF started at step 12e, the V-SMF locally releases the SM context and the UP resource for the PDU Session including the resources used for indirect forwarding tunnel(s) that were allocated at step 10.

In non-roaming or local breakout roaming, if PGW-C+SMF has started a timer in step 16, at the expiry of the timer, the PGW-C+SMF sends N4 Session Modification Request to PGW-U+UPF to release the resources used for the indirect forwarding tunnel(s) that were allocated at step 10.

When the timer set in step 12d expires, AMF also sends a UE Context Release Command message to the source NG RAN. The source NG RAN releases its resources related to the UE and responds with a UE Context Release Complete message.

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

4.11.1.2.2.2 Preparation phase

Figure 4.11.1.2.2.2-1 shows the preparation phase of the Single Registration-based Interworking from EPS to 5GS procedure.



Figure 4.11.1.2.2.2-1: EPS to 5GS handover using N26 interface, preparation phase

This procedure applies to the Non-Roaming (TS 23.501 [2] Figure 4.3.1-1), Home-routed roaming (TS 23.501 [2] Figure 4.3.2-1) and Local Breakout roaming Local Breakout (TS 23.501 [2] Figure 4.3.2-2) cases.

- For non-roaming scenario, V-SMF, v-UPF and v-PCF are not present

- For home-routed roaming scenario, the PGW-C+SMF and UPF+PGW-U are in the HPLMN. v-PCF are not present

- For local breakout roaming scenario, V-SMF and v-UPF are not present. PGW-C+SMF and UPF+PGW-U are in the VPLMN.

In local-breakout roaming case, the v-PCF interacts wit the PGW-C+SMF.

1 - 2. Step 1 - 2 from clause 5.5.1.2.2 (S1-based handover, normal) in TS 23.401 [13].

3. Step 3 from clause 5.5.1.2.2 (S1-based handover, normal) in TS 23.401 [13] with the following modifications:

An additional optional parameter Return preferred. Return preferred is an optional indication provided by the MME to indicate a preferred return of the UE to the last used EPS PLMN at a later access change to an EPS shared network. Based on the Return Preferred indication, the initial AMF may store the last used EPS PLMN ID in the UE Context.

The initial AMF converts the received EPS MM Context into the 5GS MM Context. This includes converting the EPS security context into a mapped 5G security context as described in TS 33.501 [15]. The MME UE context includes IMSI, ME Identity, UE security context, UE Network Capability, and EPS Bearer context(s), and may also include LTE-M Indication. The MME EPS Bearer context(s) include for each EPS PDN connection the IP address and FQDN for the S5/S8 interface of the PGW-C+SMF and APN, and for each EPS bearer the IP address and CN Tunnel Info at the UPF+PGW-U for uplink traffic. If the AMF received the LTE-M indication in the EPS MM Context, then it considers that the RAT Type is LTE-M.

The initial AMF queries the (PLMN level) NRF in serving PLMN by issuing the Nnrf\_NFDiscovery\_Request including the FQDN for the S5/S8 interface of the PGW-C+SMF, and the NRF provides the IP address or FQDN of the N11/N16 interface of the PGW-C+SMF.

If the initial AMF cannot retrieve the address of the corresponding SMF for a PDN connection, it will not move the PDN connection to 5GS.

NOTE 1: If the initial AMF holds a native 5G security context for the UE, the initial AMF may activate this native 5G security context by initiating a NAS SMC upon completing the handover procedure.

4. The initial AMF invokes the Nsmf\_PDUSession\_CreateSMContext service operation (UE EPS PDN Connection, initial AMF ID, data Forwarding information, Target ID) on the SMF identified by the PGW-C+SMF address and indicates HO preparation indication (to avoid switching the UP path). The initial AMF ID uniquely identifies the initial AMF serving the UE. This step is performed for each PDN Connection and the corresponding PGW-C+SMF address/ID in the UE context the initial AMF received in step 3. The SMF finds the corresponding PDU Session based on EPS Bearer Context(s).

Based on configuration and the Direct Forwarding Flag received from the MME, the initial AMF determines the applicability of data forwarding and indicates to the SMF whether the direct data forwarding or indirect data forwarding is applicable.

Target ID corresponds to Target ID provided by the MME in step 3.

For home-routed roaming scenario, the initial AMF selects a default V-SMF per PDU Session and invokes the Nsmf\_PDUSession\_CreateSMContext service operation (UE PDN Connection Contexts, initial AMF ID, SMF + PGW-C address, S-NSSAI). The S-NSSAI is the S-NSSAI configured in initial AMF for interworking, which is associated with default V-SMF. The default V-SMF put this S-NSSAI in the N2 SM Information container in step 7.

The default V-SMF selects the PGW-C+SMF using the received H-SMF address as received from the initial AMF, and initates a Nsmf\_PDUSession\_Create service operation with the PGW-C+SMF.

5. If dynamic PCC is deployed, the SMF+ PGW-C (default V-SMF via H-SMF for home-routed scenario) may initiate SMF initiated SM Policy Modification towards the PCF.

6. In the case of non roaming or LBO roaming, the PGW-C+SMF may send N4 Session modification to PGW-U+UPF to establish the CN tunnel for PDU Session. The PGW-U+UPF is ready to receive the uplink packets from NG-RAN. The PGW-U+UPF allocates the PGW-U CN Tunnel Info for PDU Session and send it to the PGW-C+SMF. This step is performed at all PGW-C+SMFs allocated to the UE for each PDU Session of the UE.

NOTE 2: If the CN Tunnel info is not available in the PGW-U+UPF at this step, when the UE moves to the target RAT the PGW-U+UPF cannot receive UL data until the CN Tunnel Info is provided to the PGW-U+UPF. This causes a short interruption to the UL data during the handover execution phase.

7. The PGW-C+SMF (default V-SMF in the case of home-routed roaming scenario only) sends a Nsmf\_PDUSession\_CreateSMContext Response (PDU Session ID, S-NSSAI, N2 SM Information (PDU Session ID, S-NSSAI, QFI(s), QoS Profile(s), EPS Bearer Setup List, Mapping between EBI(s) and QFI(s), CN Tunnel-Info, cause code)) to the initial AMF.

For home-routed roaming scenario the step 8 need be executed first. The CN Tunnel-Info provided to the initial AMF in N2 SM Information is the V-CN Tunnel-Info.

The SMF includes mapping between EBI(s) and QFI(s) as part of N2 SM Information container. If the P-GW-C+SMF (H-SMF in the case of home-routed scenario) determines that seamless session continuity from EPS to 5GS is not supported for the PDU Session, then it does not provide SM information for the corresponding PDU Session but includes the appropriate cause code for rejecting the PDU Session transfer within the N2 SM Information. If neither indirect forwarding nor direct forwarding is applicable, the SMF shall further include a "Data forwarding not possible" indication in the N2 SM information container. If SMF is indicated that Direct Forwarding is applicable, the SMF shall further include a "Direct Forwarding Path Availability" indication in the N2 SM information container. In home routed roaming case, the S-NSSAI included in N2 SM Information container is the S-NSSAI received in step 4.

The initial AMF stores an association of the PDU Session ID, S-NSSAI and the SMF ID.

If the PDN Type of a PDN Connection in EPS is non-IP, and is locally associated in SMF to PDU Session Type Ethernet, the PDU Session Type in 5GS shall be set to Ethernet. In case the PDN type of a PDN Connection in EPS is non-IP, and is locally associated in UE and SMF to PDU Session Type Unstructured, the PDU Session Type in 5GS shall be set to Unstructured.

NOTE 3: If the non-IP PDN Type is locally associated in SMF to PDU Session Type Ethernet, it means that Ethernet PDN Type is not supported in EPS.

In the case of PDU Session Type Ethernet, that was using PDN type non-IP in EPS, the SMF creates QoS rules and QoS Flow level QoS parameters for the QoS Flow(s) associated with the QoS rule(s) based on the PCC Rules received from PCF.

8. For home-routed roaming scenario only: The default V-SMF selects a default v-UPF and initiates an N4 Session Establishment procedure with the selected default v-UPF. The default V-SMF provides the default v-UPF with packet detection, enforcement and reporting rules to be installed on the UPF for this PDU Session, including H-CN Tunnel Info.

The default v-UPF acknowledges by sending an N4 Session Establishment Response message. The V-CN Tunnel info is allocated by the v-UPF and provided to the default V-SMF in this step.

8a. Based on the received S-NSSAI from the PGW-C+SMF, the Initial AMF may reselect a target AMF as described in clause 5.15.5.2.1 of TS 23.501 [2], and invokes Namf\_Communication\_CreateUEContext request (SUPI, Target 5GAN Node ID, Source to Target Transparent Container, 5GS MM Context, MME Tunnel Endpoint Identifier for Control Plane, MME Address for Control plane,PDU Session ID and its associated S-NSSAI of the VPLMN value for each PDU Session, the corresponding S-NSSAI of HPLMN value for home routed PDU Session(s), PGW-C+SMF ID of each PDU Session, default V-SMF ID and SM Context ID of each PDU Session, allocated EBIs of each PDU Session, allowed NSSAI received from NSSF) to the selected target AMF.

9. The target AMF sends a Handover Request (Source to Target Transparent Container, N2 SM Information (PDU Session ID, S-NSSAI, QFI(s), QoS Profile(s), EPS Bearer Setup List, V-CN Tunnel Info, Mapping between EBI(s) and QFI(s)), Mobility Restriction List, UE Radio Capability ID) message to the NG-RAN. The target AMF provides NG-RAN with a PLMN list in the Mobility Restriction List containing at least the serving PLMN, taking into account the last used EPS PLMN ID and the Return preferred indication. The Mobility Restriction List contain information about PLMN IDs as specified by TS 23.501 [2].

NG-RAN can use the source to target transparent container and N2 SM Information container to determine which QoS flows have been proposed for forwarding and decide for which of those QoS flows it accepts the data forwarding or not.

If the UE Radio Capability ID is included in the Handover Request message, when there is no corresponding UE radio capabilities set for UE Radio Capability ID at NG-RAN, NR-RAN shall request the T-AMF to provide the UE radio capabilities set corresponding to UE Radio Capability ID to the NG-RAN.

10. The NG-RAN sends a Handover Request Acknowledge (Target to Source Transparent Container, List of PDU Sessions to Hand-over with N2 SM response (PDU Session ID, list of accepted QFI(s), AN Tunnel Info, Data Forwarding Tunnel Info), List of PDU Sessions that failed to be established with the failure cause given in the N2 SM information element) message to the target AMF.

If indirect data forwarding is applied, the NG-RAN includes one assigned TEID/TNL address per PDU Session (for which there is at least one QoS flow for which it has accepted the forwarding) within the SM Info container. It also includes the list of QoS flows for which it has accepted the forwarding. According to the mapping between EBI(s) and QFI(s), if one EPS bearer in EPS is mapped to multiple QoS flows in 5GS, all such QoS flows need to be accepted to support indirect data forwarding during EPS to 5GS mobility. Otherwise, the NG RAN rejects the indirect data forwarding for the QoS flows which are mapped to the EPS bearer.

If direct data forwarding is applied, the NG-RAN includes one assigned TEID/TNL per E-RAB accepted for direct data forwarding.

11. The target AMF sends an Nsmf\_PDUSession\_UpdateSMContext Request (PDU Session ID, N2 SM response received from NG-RAN in step 10) message to the SMF for updating N3 tunnel information. In home routed roaming case, the Data Forwarding Tunnel Info is handled by the default V-SMF and will not be sent to the PGW-C+SMF.

12. PGW-C+SMF (default V-SMF in home-routed roaming scenario) performs preparations for N2 Handover by indicating N3 UP address and Tunnel ID of NG-RAN to the UPF if N2 Handover is accepted by NG-RAN. If indirect data forwarding is applied, PGW-C+SMF indicates the mapping between the TEID where the UPF receives data forwarded by the source SGW and the QFI(s) and N3 Tunnel Info for data forwarding where the UPF is selected to forward such data (e.g. an intermediate UPF). If the EPS bearer is mapped to multiple QoS flows and an intermediate UPF is selected for data forwarding, only one QFI is selected by the PGW-C+SMF from QFIs corresponding to the QoS flows.

If indirect data forwarding is applied in home routed roaming case, the default V-SMF sends a default V-UPF for data forwarding the mapping between the TEID where the UPF receives data forwarded by the source SGW and the QFI and N3 Tunnel Info for data forwarding. If the EPS bearer is mapped to multiple QoS flows and an intermediate UPF is selected for data forwarding, only one QFI is selected by the PGW-C+SMF from QFIs corresponding to the QoS flows.

If N2 Handover is not accepted by NG-RAN, PGW-C+SMF deallocates N3 UP address and Tunnel ID of the selected UPF.

The EPS Bearer Setup list is a list of EPS bearer Identifiers successfully handover to 5GC, which is generated based on the list of accepted QFI(s).

If a PDU Session is rejected by the Target NG-RAN with an indication that the PDU session was rejected because User Plane Security Enforcement is not supported in the Target NG-RAN and the User Plane Enforcement Policy indicates "Required" as described in clause 5.10.3 of TS 23.501 [2], the SMF triggers the release of this PDU Session. In all other cases of PDU Session rejection, the SMF can decide whether to release the PDU Session or to deactivate the UP connection of this PDU Session.

If some of the QoS Flows of a PDU Session are not accepted by the Target NG-RAN, the SMF shall initiate the PDU Session Modification procedure to remove the non-accepted QoS Flows from the PDU Session(s) after the handover procedure is completed.

13. PGW-C+SMF (default V-SMF in home-routed roaming scenario) to target AMF: Nsmf\_PDUSession\_UpdateSMContext Response (PDU Session ID, EPS Bearer Setup List). The data forwarding information is included in the EPS Bearer Setup List. In home routed roaming case, the default V-SMF provides the tunnel information for data forwarding.

This message is sent for each received Nsmf\_PDUSession\_UpdateSMContext\_Request message.

13a. The target AMF invokes Namf\_Communication\_CreateUEContext response (Cause) to the initial AMF.

14. The target AMF sends the message Forward Relocation Response (Cause, Target to Source Transparent Container, Serving GW change indication, EPS Bearer Setup List, target AMF Tunnel Endpoint Identifier for Control Plane, Addresses and TEIDs). The EPS Bearer Setup list is the combination of EPS Bearer Setup list from different PGW-C+SMF(s).

15. Step 8 from clause 5.5.1.2.2 (S1-based handover, normal) in TS 23.401 [13] is executed if the source MME determines that indirect data forwarding applies.

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

##### 4.11.1.3.2 5GS to EPS Idle mode mobility using N26 interface

In case of network sharing the UE selects the target PLMN ID according to clause 5.18.3 of TS 23.501 [2].

Clause 4.11.1.3.2 covers the case of idle mode mobility from 5GC to EPC. UE performs Tracking Area Update procedure in E-UTRA/EPS when it moves from NG-RAN/5GS to E-UTRA/EPS coverage area.

The procedure involves a Tracking Area Update to EPC and setup of default EPS bearer and dedicated bearers in EPC in steps 1-11 and re-activation, if required.



Figure 4.11.1.3.2-1: 5GS to EPS Idle mode mobility using N26 interface

The TAU procedure in TS 23.401 [13] is used with the following 5GS interaction:

1. Step 1 from clause 5.3.3.1 (Tracking Area Update procedure with Serving GW change) in TS 23.401 [13].

2. Step 2 from clause 5.3.3.1 (Tracking Area Update procedure with Serving GW change) in TS 23.401 [13] with the modification captured in clause 4.11.1.5.3.

3-4. Steps 3-4 from clause 5.3.3.1 (Tracking Area Update procedure with Serving GW change) in TS 23.401 [13].

5a. The AMF verifies the integrity of the TAU request message:

In non-roaming or LBO roaming, the AMF requests the PGW-C+SMF to provide SM Context by using Nsmf\_PDUSession\_ContextRequest that also includes the mapped EPS Bearer Contexts. The AMF provides the target MME capability to SMF in the request to allow the SMF to determine whether to include EPS Bearer context for Ethernet PDN type or non-IP PDN Type or not. This step is performed with all the PGW-C+SMFs corresponding to PDU Sessions of the UE which are associated with 3GPP access and have EBI(s) allocated to them.

In Home Routed roaming, the AMF requests the V-SMF to provide SMF Context by using Nsmf\_PDUSession\_ContextRequest.

NOTE 1: The AMF knows the MME capability to support Ethernet PDN Type and/or non-IP PDN type or not through local configuration.

5b. For Non-roaming or roaming with local breakout scenario, the SMF sends N4 Session Modification Request to PGW-U+UPF to establish the tunnel for each EPS bearers, and PGW-U+UPF provides the PGW-U Tunnel Info for each EPS bearers to PGW-C+SMF.

NOTE2: In home routed roaming case, the CN Tunnel Info for each EPS bearer has been prepared by the PGW-C+SMF and provided to the V-SMF as specified in clause 4.11.1.4.1.

5c. For PDU Sessions that are anchored a UPF, in non-roaming or roaming with local breakout, the PGW-C+SMF returns mapped EPS bearer contexts, which includes PGW-C control plane tunnel information of the PDN connection corresponding to the PDU session, EBI for each EPS bearer, PGW-U tunnel information for each EPS bearer, and EPS QoS parameters for each EPS bearer. For PDU Sessions with PDU Session Type Ethernet, if the UE and target MME supports Ethernet PDN type, the PGW-C+SMF provides SM Context for Ethernet PDN Type, otherwise if the UE or target MME does not support Ethernet Type but support non-IP Type, the PGW-C+SMF provides SM Context for non-IP PDN Type. For PDU Sessions with PDU Session Type Unstructured, the SMF provides SM Context for non-IP PDN Type. In home routed roaming, V-SMF provides the SM Context.

For PDU Sessions that are anchored at an NEF, the SMF returns an SCEF+NEF ID and an EBI for each PDN connection corresponding to a PDU Session.

If the PGW-C+SMF has marked that the status of one or more QoS Flows are deleted in the 5GC but not synchronized with the UE yet according to clause 4.3.3.2, the PGW-C+SMF does not return to the AMF the EPS context(s) if all its associated QoS Flows are marked as deleted, that is, the PGW-C+SMF returns to the AMF the EPS bearer contexts mapped from QoS Flows where at least one of the QoS Flow for the EPS bearer is not marked as deleted.

6. The AMF responds with a Context Response message carrying mapped MM context (including mapped security context), Return preferred and SM EPS UE Context (default and dedicated GBR bearers) to the MME. If the verification of the integrity protection fails, the AMF returns an appropriate error cause. Return preferred is an optional indication by the AMF of a preferred return of the UE to the 5GS PLMN at a later access change to a 5GS shared network. The AMF may start an implementation specific (guard) timer for the UE context.

From the received context and the Tracking Area indicated by the RAN, the MME can determine whether the UE is performing Inter-RAT mobility to or from NB-IoT.

7 - 14. Steps 6-12 from clause 5.3.3.1 (Tracking Area Update procedure with Serving GW change) in TS 23.401 [13] are performed with following addition and modification:

In the step 10, if the PDU Session (PDN connection) has QoS Flows that do not have EPS bearer ID(s) assigned, the PGW-C+SMF deletes the PCC rule(s) associated with those QoS Flows and informs the PCF about the removed PCC rule(s).

In the step 11, the PGW-C+SMF requests the PGW-U+UPF to establish the tunnel for each EPS bearer by providing SGW-U Tunnel Info. If the DL data is buffered in the PGW-C+SMF, the PGW-C+SMF forwards the buffered data to the PGW-U+UPF and the data is delivered to S-GW. If the DL data is buffered in the PGW-U+UPF, the data is delivered to the S-GW.

In step 10, the PGW-C+SMF may need to report some subscribed event to the PCF by performing an SMF initiated SM Policy Association Modification procedure as defined in clause 4.16.5.

Step 9a from clause 5.3.3.1 (Tracking Area Update procedure with Serving GW change) in TS 23.401 [13] with the modification captured in clause 4.11.1.5.3

If the SCEF connection is to be established, the steps 9-13 are replaced with the steps 2-3 from clause 5.13.1.2 of TS 23.682 [23]. The SCEF+NEF ID and the EBI received from the AMF are included in the Create SCEF Connection Request.

15-15c. The HSS+UDM invokes Nudm\_UECM\_DeregistrationNotification to notify the AMF associated with 3GPP access with reason as 5GS to EPS Mobility. If the timer started in step 6 is not running, the old AMF removes the UE context. Otherwise, the AMF may remove UE context when the timer expires. The AMF request the release of the PDU Session which is associated with 3GPP access, not expected to be transferred to EPC, i.e. no EBI(s) allocated to them, and corresponding to the PGW-C+SMF which is not contacted by AMF for SM context at step 5a. The AMF requests the release of the SM context in the V-SMF only and the V-SMF releases resource in the V-UPF, for Home Routed PDU Session with EBIs allocated. The 5GC may also keep UE context to allow the use of native security parameters when UE moves back from EPS to 5GS later.

If PCC is enabled, the AMF initiates AM Policy Association Termination procedure as defined in clause 4.16.3.2 and UE Policy Association Termination procedure as defined in clause 4.16.13.1.

Registration associated with the non-3GPP access in the AMF is not removed (i.e. an AMF that was serving the UE over both 3GPP and non-3GPP accesses does not consider the UE as deregistered over non 3GPP access and will remain registered and subscribed to subscription data updates in UDM).

When the UE decides to deregister over non-3GPP access or the old AMF decides not to maintain a UE registration for non-3GPP access anymore, the old AMF then deregisters from UDM by sending a Nudm\_UECM\_Deregistration service operation, unsubscribes from Subscription Data updates by sending an Nudm\_SDM\_Unsubscribe service operation to UDM and releases all the AMF and AN resources related to the UE.

16 - 18. Steps 17-21 from clause 5.3.3.1 (Tracking Area Update procedure with Serving GW change) in TS 23.401 [13] with the following modification:

- The MME may provide the eNodeB with a PLMN list in the Handover Restriction List taking into account the last used 5GS PLMN ID and the Return preferred indication. The Handover Restriction List contains a list of PLMN IDs as specified by TS 23.251 [35] clause 5.2a for eNodeB functions.

- The MME may not release the signalling connection with the UE based on the indication received in the step 1 that the UE is moving from 5GC.

19. [conditional] Step 19 from clause 4.11.1.2.1 applies.

If some of the QoS Flow(s) for an EPS bearer were marked as deleted, the PGW-C+SMF may initiate bearer modification as specified in clause 5.4.3 of TS 23.401 [13] to remove the TFT filter(s) corresponding to the Packet Filter Set(s) in the QoS rules.

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

##### 4.11.1.3.3 EPS to 5GS Mobility Registration Procedure (Idle and Connected State) using N26 interface

Figure 4.11.1.3.3-1 describes the mobility registration procedure from EPS to 5GS when N26 is supported for idle and connected states.



Figure 4.11.1.3.3-1: EPS to 5GS mobility for single-registration mode with N26 interface

1. The Registration procedure is triggered, e.g. the UE moves into NG-RAN coverage. Step 2 to 9 except step 5, 6 and 8 follow the Registration procedure in clause 4.2.2 with following enhancement.

2. The UE sends Registration Request with registration type set to "Mobility Registration Update".

The UE includes 5G-GUTI mapped from EPS GUTI as the old GUTI, the native 5G-GUTI (if available) as additional GUTI and indicating that the UE is moving from EPC. The UE includes the UE Policy Container containing the list of PSIs, indication of UE support for ANDSP and OSId if available.

When the Registration Request is triggered due to UE mobility from EPS to 5GS, if the UE has locally deleted the EPS bearer which has allocated 5GS parameters and the EPS bearer status has not been synchronized with the network, the UE shall include the EPS earer status in the Registration Request.

The Additional GUTI is provided both in Idle state and Connected state, if available. The Additional 5G-GUTI enables the AMF to retrieve the UE's MM context from the old AMF (if available). The UE includes the S-NSSAIs associated with the established PDN connections in the Requested NSSAI in RRC and NAS (as described in TS 23.501 [2] clause 5.15.7). In the case of Configured NSSAI applicable to this PLMN or an Allowed NSSAI are not present in the UE, the associated HPLMN S-NSSAI(s) shall be provided in the mapping of Requested NSSAI in the NAS as described in the clause 5.15.5.2.1 TS 23.501 [2].

In the case of idle mode mobility the UE additionally includes a TAU request message integrity protected using the EPS security context (for further security verification by the MME) in the Registration Request. If the UE holds a native 5G-GUTI for this PLMN then the UE also includes the GUAMI part of the native 5G-GUTI in RRC to enable the NG-RAN to route the Registration Request to the same AMF (if available), and otherwise the UE provides in RRC signalling a GUAMI mapped from the EPS GUTI and indicates it as "Mapped from EPS".

The UE integrity protects the Registration Request message using a 5G security context (if available).

3-4. Steps 2-3 of clause 4.2.2.2.2 are performed.

In the case of idle mode mobility, the AMF derives S-NSSAIs values for the Serving PLMN based on the S-NSSAIs values for the HPLMN, received in NAS Registration Request, associated with the established PDN connections, the AMF may send the S-NSSAIs values for the HPLMN to NSSF by invoking Nnssf\_NSSelection\_Get service operation and NSSF provides corresponding S-NSSAIs values for VPLMN to AMF.

NOTE 1: In connected mode mobility, the AMF dervices S-NSSAIs values during the handover procedure.

Steps 5 and 8 are not performed when this procedure is part of EPS to 5GS handover.

5a. [Conditional] This step is only performed for IDLE mode mobility. The AMF derives the MME address and 4G GUTI from the old 5G-GUTI and sends Context Request to MME including EPS GUTI mapped from 5G-GUTI and the TAU request message according to TS 23.401 [13]. The MME validates the TAU message.

5b. [Conditional] If step 5a is performed, step 5 from clause 5.3.3.1 (Tracking Area Update procedure with Serving GW change) in TS 23.401 [13] is performed with the modification captured in clause 4.11.1.5.3.

The AMF converts the received EPS MM Context into the 5GS MM Context. The received EPS UE context includes IMSI, ME Identity, UE EPS security context, UE Network Capability, and EPS Bearer context(s), and may also include LTE-M Indication. The MME EPS Bearer context includes for each EPS PDN connection the IP address and FQDN for the S5/S8 interface of the PGW-C+SMF and APN. If the SCEF connection is invoked, the MME EPS Bearer context includes the SCEF+NEF ID of the PDN connection, EBI, APN, User Identity. The AMF disregards any LTE-M Indication received in the EPS UE context, and instead takes into account the LTE M Indication received from NG-RAN, at step 1.

The AMF can determine the whether the UE is performing Inter-RAT mobility to or from NB-IoT based on the received "TAI of last TAU" in the EPC MM Context and the RAT Type used for the Registration Request.

If the Context Response includes the FQDN for the S5/S8 interface of the PGW-C+SMF, the AMF queries the NRF in serving PLMN by issuing the Nnrf\_NFDiscovery\_Request including the FQDN for the S5/S8 interface of the PGW-C+SMF, and the NRF provides the IP address or FQDN of the N11/N16 interface of the PGW-C+SMF.

If the Context Response includes an SCEF+NEF ID, the AMF performs the SMF selection.

The Context Response may include new information Return Preferred. Return Preferred is an indication by the MME of a preferred return of the UE to the last used EPS PLMN at a later access change to an EPS shared network. Based on the Return Preferred indication, the AMF may store the last used EPS PLMN ID in UE Context.

If the AMF cannot retrieve the address of the corresponding SMF for a PDN connection, it will not move the PDN connection to 5GS.

Step 6 is performed only if the AMF is different from the old AMF and the old AMF is in the same PLMN as the AMF.

6a. [Conditional] If the UE includes the 5G-GUTI as Additional GUTI in the Registration Request message, the AMF sends message to the old AMF. The old AMF validates the Registration request message.

The AMF retrieves UE's SUPI and MM Context, event subscription information by each consumer NF and the list of SM PDU Session ID/associated SMF ID for the UE using one of the following three options:

- AMF may invoke the Namf\_Communication\_UEContextTransfer to the old AMF identified by the additional 5G-GUTI; or

- if the old AMF and the AMF are in the same AMF Set and UDSF is deployed, AMF may invoke Nudsf\_UnstructuredDataManagement\_Query service operation for the UE identified by the additional 5G-GUTI from the UDSF; or

- if the old AMF and the AMF are in the same AMF Set, AMF may use implementation specific means to share UE context.

6b. [Conditional] If step 6a is performed, the response is performed as described in step 5 in clause 4.2.2.2.2. If a native 5G security context for 3GPP access is available in the AMF (or has been retrieved in step 6a), the AMF may continue to use this security context. Otherwise, the AMF shall either derive a mapped security context from the EPS security context obtained from the MME or initiate an authentication procedure to the UE.

7. [Conditional] If the AMF determines to initiate the authentication procedure to the UE in step 6b (e.g. the AMF can not obtain the UE MM context from AMF or other reasons), steps 8-9 of clause 4.2.2.2.2 are optionally performed.

7a. In the case of idle mode mobility, the AMF decide whether a new AMF needs to be selected. If a new AMF is to be selected, the AMF reroute the Registration request to the new AMF as described in clause 4.11.1.3.4, where the initial AMF refers to the AMF.

8. [Conditional] If step 5b is performed and the AMF accepts to serve the UE, the AMF sends Context Acknowledge (Serving GW change indication) to MME according to TS 23.401 [13].

9. Steps 11-12 of clause 4.2.2.2.2 are optionally performed.

10. Void.

11. Steps 13-14e of clause 4.2.2.2.2 are performed: This includes that if an MM context is retrieved from the old AMF in step 6 (i.e. corresponding to an existing UE registration for non-3GPP access in 5GC), then the AMF indicates to the UDM that the AMF identity to be registered in the UDM applies to both 3GPP and non-3GPP accesses by sending separate/independent Nudm\_UECM\_Registration service operations for "3GPP Access" and "non-3GPP Access".

12. Void.

13. Void.

14-14f. Step 16 of clause 4.2.2.2.2 (AM Policy Association Establishment) is optionally performed.

In the home-routed roaming case and connected state mobility, based on the S-NSSAI value for the Serving PLMN of the PDU Session(s), the AMF decides whether V-SMF change is needed or not. If the V-SMF reallocation is not needed, and if the two values (i.e. the S-NSSAI value configured in AMF for interworking and S-NSSAI value for the Serving PLMN) are different, the AMF invokes Nsmf\_PDUSession\_UpdateSMContext (PDU Session ID, S-NSSAI value for the Serving PLMN). The V-SMF updates 5G AN with the new S-NSSAI of VPLMN by sending a N2 SM message to 5G AN via AMF. If the V-SMF change is needed, the AMF performs as the case of I-SMF change defined in clause 4.23.4.3.

In the home-routed roaming case and idle state mobility, the AMF selects a default V-SMF per PDU Session and invokes Nsmf\_PDUSession\_CreateSMContext service operation of the V-SMF to create an association with the AMF. It includes UE EPS PDN Connection, H-SMF ID, S-NSSAI and indicates all the PDU Session(s) to be re-activated as received in the Registration request message along with List Of PDU Sessions To Be Activated. The S-NSSAI is the S-NSSAI configured in AMF for interworking, which is associated with default V-SMF. The V-SMF creates the association and based on the received SMF ID, the V-SMF invokes Nsmf\_PDUSession\_Create request service operation of the H-SMF and provides the information received from the AMF. Before invoking PDUSession\_Create service operation, the V-SMF request the V-UPF to provide the CN tunnel info. The subsequent handling is performed as follows:

- The H-SMF finds the corresponding PDU Session based on the PDN Connection Context in the request. The H-SMF initiates N4 Session modification procedure to establish the CN tunnel for the PDU Session.The tunnel info for PDU Session is allocated by PGW-U+UPF and provided to the PGW-C+SMF. The H-SMF responds V-SMF with the PDU Session ID corresponding to the PDN Connection Context in the request, the allocated EBI(s) information, the S-NSSAI of the PDU Session, S-NSSAI of HPLMN, UE EPS PDN connection(s), and other PDU session parameters, such as PDU Session Type, Session AMBR in the Nsmf\_PDUSession\_Create response.

- The V-SMF updates its SM contexts and returns a Nsmf\_PDU\_Session\_CreateSMContextResponse message including the information received from the H-SMF. The V-SMF updates the V-UPF of the CN tunnel info of PGW-C+SMF. The V-SMF also includes the N2 SM Context in the response message sent to the AMF if the corresponding PDU Session is in the received List Of PDU Sessions To Be Activated. The V-SMF stores an association of the PDU Session ID and the H-SMF ID. The AMF stores the V-SMF ID and it also stores S-NSSAI and the allocated EBI(s) associated to the PDU Session ID. Based on the S-NSSAI value for the Serving PLMN of the PDU Session(s) the AMF decides whether V-SMF relocation is needed or not. If V-SMF relocation is not needed, and if the two values (i.e. the S-NSSAI value configured in AMF for interworking and S-NSSAI value for the Serving PLMN) are different, the AMF sends the S-NSSAI value for the Serving PLMN to V-SMF by invoking Nsmf\_PDUSession\_UpdateSMContext service operation. The V-SMF updates NG RAN with the S-NSSAI value for the Serving PLMN via N2 SM message. If V-SMF relocation is needed, the AMF performs V-SMF relocation as defined in clause 4.23.4.3.

In non-roaming and LBO cases and idle state mobility, AMF invokes Nsmf\_PDUSession\_CreateSMContext Request (UE EPS PDN Connection) service operation of the PGW-C+SMF and indicates all the PDU Session(s) to be re-activated as received in the Registration request message along with List Of PDU Sessions To Be Activated. This step is performed for each PDN Connection and the corresponding PGW-C+SMF address/ID in the UE context the AMF received in Step 6.

If the P-GW-C+SMF (H-SMF in case of home-routed roaming case) determines that seamless session continuity from EPS to 5GS is not supported for the PDU Session, then it does not provide SM information for the corresponding PDU Session but includes the appropriate cause code for rejecting the PDU Session transfer within the N2 SM Information. The PGW-C+SMF finds the corresponding PDU Session based on the PDN Connection Context in the request. The PGW-C+SMF initiates N4 Session modification procedure to establish the CN tunnel for the PDU Session, and for Idle state mobility registration, releases the resource of the CN tunnels for EPS bearers corresponding to the PDU session as well. If the PGW-C+SMF has not yet registered for this PDU Session ID, the PGW-C+SMF registers with the UDM using Nudm\_UECM\_Registration (SUPI, DNN, PDU Session ID) for a given PDU Session as in step 4 of PDU Session Establishment Procedure in clause 4.3.2. The tunnel info for PDU Session is allocated by PGW-U+UPF and provided to the PGW-C+SMF. The PGW-C+SMF updates its SM contexts and returns the AMF a Nsmf\_PDUSession\_CreateSMContext Response message including the PDU Session ID corresponding to the PDN Connection Context in the request, the allocated EBI(s) information, the S-NSSAI of the PDU Session, and the N2 SM Context if the corresponding PDU Session is in the received List Of PDU Sessions To Be Activated. The AMF stores an association of the PDU Session ID and the SMF ID, S-NSSAI, and the allocated EBI(s) associated to the PDU Session ID. Based on the allocated EBI(s) information received from all the related PGW-C+SMF for this UE, an EPS bearer status, which reflects all existing EPS bearer, is generated by the AMF.

NOTE 2: For Connected State mobility registration, the release of CN tunnels for EPS bearers and UDM registration for the session corresponding to the PDU session is performed in the handover execution phase.

If the PDN Type of a PDN Connection in EPS is non-IP, and it was originally established as Ethernet PDU Session when UE was camping in 5GS (known based on local context information that was set to PDU Session Type Ethernet in UE and SMF), the PDU Session Type in 5GS shall be set to Ethernet by the SMF and UE. In case the PDN type of a PDN Connection in EPS is non-IP, and is locally associated in UE and SMF to PDU Session Type Unstructured, the PDU Session Type in 5GS shall be set to Unstructured by the SMF and UE.

NOTE 3: If the non-IP PDN Type is originally established as Ethernet PDU Session, it means that Ethernet PDN Type is not supported in EPS.

If the AMF has received the EPS Bearer Status in the Registration Request from UE, the AMF shall send the EPS Bearer Status to all corresponding PGW-C+SMFs. If the PGW-C+SMF receives the EPS Bearer Status from AMF, the PGW-C+SMF shall check whether the EPS bearer(s) has been deleted by UE but not notified to network. If yes, the PGW-C+SMF shall release those EPS bearer(s), the corresponding 5G QoS Rule(s) and the QoS Flow level QoS parameters locally.

If the SCEF+NEF ID is provided to the SMF, the SMF establishes the SMF-NEF connection as described in steps 2-3 from clause 4.25.2, the SMF provides the SCEF+NEF ID, EBI, APN, User Identity to the SCEF+NEF, and the SCEF+NEF updates the SM contexts and returns the NEF ID, PDU Session ID, DNN and User Identity to the SMF.

If the UE is performing Inter-RAT mobility to or from NB-IoT, the (H-)SMF will maintain, reconnect, release or leave PDU Session handling to the local VPLMN policy in case of roaming for each PDU session according to the "PDU Session continuity at inter RAT mobility" subscription information. If the (H-)SMF does not have "PDU Session continuity at inter RAT mobility" for a PDU session, the (H-)SMF reterives it from the UDM before determining any action. The SMF may use local policy to determine the handling a PDU Session if "PDU Session continuity at inter RAT mobility" cannot be reterived from the UDM.

15 - 16a. HSS+UDM cancels the location of the UE in the MME as defined in steps 13 - 14 from clause 5.3.3.1 (Tracking Area Update procedure with Serving GW change) in TS 23.401 [13]. Subsequently, the steps 18 - 19 from clause 5.3.3.1 (Tracking Area Update procedure with Serving GW change) in TS 23.401 [13] are also executed with the following modification:

According to configuration, for the PDN connections which are anchored in a standalone PGW, the MME initiates PDN connection release procedure as specified in TS 23.401 [13].

17-18. These steps follow the steps 21, 21b and 22 of Registration procedure in clause 4.2.2.2.2.

The Registration Accept message shall include the updated 5G-GUTI to be used by the UE in that PLMN over any access. If the active flag was included in the Registration request, The AMF may provide NG-RAN with a Mobility Restriction List taking into account the last used EPS PLMN ID and the Return preferred indication. The Mobility Restriction List contains a list of PLMN IDs as specified by TS 23.501 [2]. The Allowed NSSAI in the Registration Accept message shall contain at least the S-NSSAIs corresponding to the active PDN Connection(s) and the corresponding mapping to the HPLMN S-NSSAIs.

The AMF shall include the EPS bearer status, which is generated at step 14, in the Registration Accept message. Based on the received EPS bearer status information, the UE shall check whether there are QoS Flow(s) existing locally but no associated EPS bearer(s) in the received EPS bearer status. The UE shall locally delete the 5G QoS Rule(s) and QoS Flow level QoS parameters of the QoS Flow(s) if the associated EPS bearer(s) do not exist in the received EPS bearer status.

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

##### 4.11.1.4.1 EPS bearer ID allocation

Following procedures are updated to allocate EPS bearer ID(s) towards EPS bearer(s) mapped from QoS flow(s) and provide the EPS bearer ID(s) to the NG-RAN:

- UE requested PDU Session Establishment (Non-roaming and Roaming with Local Breakout (clause 4.3.2.2.1) including Request Types "Initial Request" and "Existing PDU Session".

- UE requested PDU Session Establishment (Home-routed Roaming (clause 4.3.2.2.2) including Request Types "Initial Request" and "Existing PDU Session".

- UE or network requested PDU Session Modification (non-roaming and roaming with local breakout) (clause 4.3.3.2).

- UE or network requested PDU Session Modification (home-routed roaming) (clause 4.3.3.3).

- UE Triggered Service Request (clause 4.2.3.2) to move PDU Session(s) from non-3GPP access to 3GPP access

EBI allocation shall apply to PDU Session via 3GPP access supporting EPS interworking with N26. EBI allocation shall not apply to PDU Session via 3GPP access supporting EPS interworking without N26 and shall not apply to PDU Session via non-3GPP access supporting EPS interworking.



Figure 4.11.1.4.1-1: Procedures for EPS bearer ID allocation

1. Procedure as listed in this step is initiated as specified in the relevant clauses of this specification. The relevant steps of the procedure as specified in the figure above are executed.

2. If the PGW-C+SMF (or H-SMF in case of home routed case), determines, based on the indication of EPS interworking support with N26 as defined in clauses 4.11.5.2, 4.11.5.3 and 4.11.5.4, and operator policies e.g. User Plane Security Enforcement information, Access Type, that EPS bearer ID(s) needs to be assigned to the QoS flow(s) in the PDU Session, PGW-C+SMF invokes Namf\_Communication\_EBIAssignment Request (PDU Session ID, ARP list) (via V-SMF Nsmf\_PDUSession\_Update in case of home routed case). When V-SMF receives Nsmf\_PDUSession\_Update request from H-SMF for EPS bearer ID allocation request, V-SMF needs to invoke Namf\_Communication\_EBIAssignment Request (PDU Session ID, ARP list). If the PGW-C+SMF (or H-SMF in case of home-routed roaming) serves multiple PDU sessions for the same DNN but different S-NSSAIs for a UE, then the SMF shall only request EBIs for PDU sessions served by a common UPF (PSA). In case different UPF (PSA) are serving those PDU sessions, then the SMF chooses one of the UPF (PSA) for this determination based on operator policy. When the PDU session is established via non-3GPP access, the PGW-C+SMF shall not trigger EBI allocation procedure.

Steps 3 to 6 apply only when AMF needs to revoke EBI previously allocated for an UE in order to serve a new SMF request of EBI for the same UE.

3. [Conditional] If the AMF has no available EBIs, the AMF may revoke an EBI that was assigned to QoS flow(s) based on the ARP(s) and S-NSSAI stored during PDU Session establishment, EBIs information in the UE context and local policies. If an assigned EBI is to be revoked, the AMF invokes Nsmf\_PDUSession\_UpdateSMContext (EBI(s) to be revoked) to request the related SMF (called "SMF serving the released resources") to release the mapped EPS QoS parameters corresponding to the EBI to be revoked. The AMF stores the association of the assigned EBI, ARP pair to the corresponding PDU Session ID and SMF address.

4. The "SMF serving the released resources" that receives the request in step 3 shall invoke Namf\_Communication\_N1N2Message Transfer (N2 SM information (PDU Session ID, EBI(s) to be revoked), N1 SM container (PDU Session Modification Command (PDU Session ID, EBI(s) to be revoked))) to inform the (R)AN and the UE to remove the mapped EPS QoS parameters corresponding to the EBI(s) to be revoked. In home routed roaming scenario, the H-SMF includes EBI(s) to be revoked to V-SMF to inform V-SMF to remove the mapped EPS bearer context corresponding to the EBI(s) to be revoked.

NOTE 1: The SMF can also decide to remove the QoS flow if it is not acceptable to continue the service when no corresponding EPS QoS parameters can be assigned.

For home routed roaming scenario, the "SMF serving the released resources" sends an N4 Session Modification Request to request the PGW-U+UPF to release N4 Session corresponding to the revoked EBI(s).

In home routed roaming case, the V-SMF starts a VPLMN initiated QoS modification for the PDU Session and the Namf\_Communication\_N1N2Message Transfer is invoked by the V-SMF based on the corresponding QoS modification message received from H-SMF.

5. If the UE is in CM-CONNECTED state, the AMF sends N2 PDU Session Request (N2 SM information received from SMF, NAS message (PDU Session ID, N1 SM container (PDU Session Modification Command))) Message to the (R)AN.

If the UE is in CM-IDLE state and an ATC is activated, the AMF updates and stores the UE context based on the Namf\_Communication\_N1N2MessageTransfer and step 5-6 are skipped. When the UE is reachable, e.g. when the UE enters CM-CONNECTED state, the AMF forwards the N1 message to synchronize the UE context with the UE.

6. The rest steps of the procedure are executed as specified in the figure above.

7 If the AMF successfully assigns EBI(s), it responds with the assigned EBI(s). Otherwise, it responds with a cause indicating EBI assignment failure. If the PDU Session is associated to an S-NSSAI subject for Network Slice-Specific Authentication and Authorization the AMF should indicate EBI assignment failure.

If a PDU Session from another SMF already exists towards the same DNN, the AMF either rejects the EBI assignment request, or revokes the EBI(s) from the existing PDU Session(s) to the same DNN but different SMFs if the AMF makes the decision based on the operator policy, that the existing PDU Session cannot support EPS interworking N26.

The AMF stores the DNN and PGW-C+SMF in which the PDU Session(s) support EPS interworking to UDM in clause 4.11.1.6.

NOTE 2: The above applies only when the S-NSSAI(s) for the PDU Sessions are different, otherwise the same SMF is selected for PDU Sessions to the same DNN.

8. The PGW-C+SMF sends an N4 Session Establishment/Modification Request to the PGW-U+UPF.

For home routed roaming scenario, if the EBI is assigned successfully, the PGW-C+SMF prepares the CN Tunnel Info for each EPS bearer. The PGW-U+UPF allocates the PGW-U tunnel info for the EPS bearer and sends it to the PGW-C+SMF. The PGW-U+UPF is ready to receive uplink packets from E-UTRAN.

NOTE 3: In the home routed roaming scenario the PGW-C+SMF prepares the CN Tunnel Info for each EPS bearer and provide it to V-SMF. Thus when the UE move to EPC network, the V-SMF does not need interact with the PGW-C+SMF to get the EPS bearer context(s).

NOTE 4: void

9. If the PGW-C+SMF receives any EBI(s) from the AMF, it adds the received EBI(s) into the mapped EPS bearer context(s).

In home routed roaming scenario, the PGW-C+SMF generates EPS bearer context which includes per EPS bearer PGW-U tunnel information. In addition, if the default EPS bearer is generated for the corresponding PDN Connection of PDU Session (i.e. during the PDU Session establishment procedure), the PGW-C+SMF generates the PGW-C tunnel information of the PDN connection and include it in UE EPS PDN connection.

9a. [Conditional] In non-roaming or LBO scenario, the PGW-C+SMF includes the mapped EPS bearer context(s) and the corresponding QoS Flow(s) to be sent to the UE in the N1 SM container. PGW-C+SMF also indicates the mapping between the QoS Flow(s) and mapped EPS bearer context(s) in the N1 SM container. PGW-C+SMF also includes the mapping between the received EBI(s) and QFI(s) into the N2 SM information to be sent to the NG-RAN. The PGW-C+SMF sends the N1 SM container and N2 SM information to AMF via the Nsmf\_PDUSession\_UpdateSMContext Response in case of the PDU Session Modification procedure triggered by UE or AN, or UE Triggered Service Request procedure that results in session transfer from N3GPP to 3GPP, otherwise, via the Namf\_Communication\_N1N2MessageTransfer.

9b [Conditional] In home routed roaming scenario, the PGW-C+SMF sends mapped EPS bearer context(s), the mapping between the received EBI(s) and QFI(s), and EPS bearer context to V-SMF via Nsmf\_PDUSession\_Create Response in case of PDU Session Establishment, or via Nsmf\_PDUSession\_Update Request in case of PDU Session Modification. The V-SMF stores the EPS bearer context, and generates N1 SM container and N2 SM information, and forwards them to AMF via the Nsmf\_PDUSession\_UpdateSMContext Response in case of the PDU Session Modification procedure triggered by UE or AN, or UE Triggered Service Request procedure that results in session transfer from N3GPP to 3GPP, otherwise, via the Namf\_Communication\_N1N2MessageTransfer.

10. The N1 SM container and N2 SM information are sent to the UE and NG-RAN respectively. The relevant steps of the procedure as specified in the figure above are executed.

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* End of changes \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*