**3GPP SA WG2 Meeting #161**

**Athens, Greece, 2024‑02‑26 -- 2024‑03‑01** *(was S2-2402323)*

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| *CR-Form-v12.2* |
| **CHANGE REQUEST** |
|  |
|  | **23.502** | **CR** | **4677** | **rev** | **1** | **Current version:** | **18.4.0** |  |
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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:***  | Clarifications on processing AF request for HR-SBO session |
|  |  |
| ***Source to WG:*** | Ericsson, Nokia, Nokia Shanghai Bell |
| ***Source to TSG:*** | SA2 |
|  |  |
| ***Work item code:*** | EDGE\_Ph2 |  | ***Date:*** | 2024-02-14 |
|  |  |  |  |  |
| ***Category:*** | **F** |  | ***Release:*** | Rel-18 |
|  | *Use one of the following categories:****F*** *(correction)****A*** *(mirror corresponding to a change in an earlier release)****B*** *(addition of feature),* ***C*** *(functional modification of feature)****D*** *(editorial modification)*Detailed explanations of the above categories canbe found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | *Use one of the following releases:Rel-8 (Release 8)Rel-9 (Release 9)Rel-10 (Release 10)Rel-11 (Release 11)…Rel-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)Rel-19 (Release 19)* |
|  |  |
| ***Reason for change:*** | At SA2#158, a rough procedure for determining whether HR-SBO applies to AF request or not was agreed. It was also agreed during SA2#160 that it will need some more thoughts and updates otherwise HR-SBO is not fully specified. In SA#160-AH-e discussions continued and the CR was postponed |
|  |  |
| ***Summary of change:*** | One discussion that was held was what keys to use for subscription. IP address and PLMN ID together with DNN and S-NSSAI was agreed, but also SUPI together with DNN and S-NSSAI. Hence, this CR proposes the procedure for all possible cases.Based on procedure defined in clause 6.7.2.6 of TS 23.548, as part of Serving PLMN Change notification with local offload possible information, the AF may have HPLMN ID, DNN, S-NSSAI of HR-SBO session. Hence, the AF can provide HPLMN ID, DNN and S-NSSAI of HR-SBO session to the serving NEF (V-NEF).Based on Note 2 of clause 5.2.6.7.2, external group identifier and/or external subscriber category cannot be used by AFs in VPLMN to influence traffic for HR sessions. Hence, there is no mapping from external group identifier(s) to internal group identifier(s) expected for AF requests for HR-SBO session. Therefore, in clause 4.3.6.5, the internal group identifier cannot be used as a Data Key by V-SMF to subscribe to V-UDR.Moreover, in clause 4.3.6.5, the current text refers to clause 4.3.6.2 with modifications to steps 0, 4 and 5. However, there is a need to modify some other steps exist in clause 4.3.6.2 in order to complete the flow based on HR-SBO related aspects.Rev 2 vs rev 1:When IP adress is used, IP address is used as one part of the Key in UDR.New flows for the different cases |
|  |  |
| ***Consequences if not approved:*** | HR-SBO not fully specified |
|  |  |
| ***Clauses affected:*** | 4.3.6.1, 4.3.6.5.1 (new), 4.3.6.5.2 (new), 4.3.6.5.3 (new),4.3.6.5.4 (new), 4.3.6.5.5 (new), 4.3.2.2.2, 4.4.1.2, 4.15.10, 5.2.26.3.2, 5.2.8.3.1, 5.2.6.27.2 |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **N** |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** |  | **N** |  Test specifications | TS/TR ... CR ...  |
| ***(show related CRs)*** |  | **N** |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

### 4.3.6 Application Function influence on traffic routing and service function chaining

#### 4.3.6.1 General

Clause 4.3.6 describes the procedures between an Application Function and the SMF to maintain an efficient user plane path and/or to provide N6-LAN service function chaining for Application Functions that require it.

As described in clauses 5.6.7 and 5.6.16 of TS 23.501 [2], an Application Function may send requests to influence SMF routeing decisions for User Plane traffic of PDU Sessions. The AF requests may influence UPF (re)selection and allow routeing of user traffic to a local access (identified by a DNAI) to a Data Network and/or influence the steering of user traffic to service function chain(s) identified by SFC identifier(s). The AF may also provide in its request subscriptions to SMF events. A V-SMF supporting HR-­SBO provides, SUPI, an indication of support for HR-SBO, and HPLMN DNN and S-NSSAI related to the PDU session to the L-PSA UPF at PDU session establishment.

NOTE x: NEF uses the SUPI to derive PLMN ID of the UE.

The following cases can be distinguished:

NOTE 1: Such requests target an on-going PDU Session.

NOTE x: For roaming cases, it is up to AF implementation and configuration if AF selects a NEF in HPLMN or in VPLMN for traffic influence on routing.

 When receiving an AF request on Application Function influence on traffic routing targeting an individual UE IP address the NEF needs to determine whether the target PDU Session is working in HR-SBO mode. If the target PDU Session is NOT working in HR-SBO mode (non roaming or LBO PDU Session) then the NEF contacts the PCF of the PDU Session as further defined in the clause 4.3.6.4; If the target PDU Session is working in HR-SBO mode, the NEF does not contact the PCF of the PDU session but needs to store the AF request in UDR as defined in clause 4.3.6.5.

 The NEF determines whether the PDU Session that the AF requests to influence is working in HR-SBO mode or not and in the former case determines the HPLMN of the UE, the DNN/ and S-NSSAI of the PDU Session as follows:

If the AF has determined based on procedure in 4.3.6.5.2 that the PDU session is home routed, the AF provides IP address of the UE (assigned by HPLMN) and HPLMN ID, HPLMN DNN and S-NSSAI, and the NEF determines if the PDU session is subject to HR-SBO using the provided information and proceeds as per clause 4.3.6.5.2.

If the AF has provided an IP address of the UE known to the AF (IP address not assigned by HPLMN), and DNN and S-NSSAI, the NEF determines if the PDU session is subject to HR-SBO based on local configuration. If PDU session is not subject to HR-SBO, the NEF proceeds as per clause 4.3.6.4. If PDU session is subject to HR-SBO the NEF determines the HPLMN and proceeds from as per clause 4.3.6.5.2, excluding steps 0a and 0b.

NOTE x: The DNN can be unique for a PLMN (see TS 23.003 [33]) and can be mapped to a HPLMN, or the IP address can be within a range that can be mapped to a HPLMN.

 If the AF has not provided the (H)PLMN ID, DNNand S-NSSAI:

- If the IP address of the UE in the AF request is a private IP address, the NEF determines if the request relates to HR-SBO or not based on local configuration, or based on interactions with SMF, since the V-SMF shall have provided an indication that the PDU Session is working in HR-SBO mode, SUPI and the HPLMN DNN and S-NSSAI of the PDU Session to the L-PSA UPF. If the request relates to HR-SBO, the NEF proceeds as per clause 4.3.6.5.3, else it proceeds as per clause 4.3.6.4.

NOTE x: Weather or not NEF interact with UPF to determine if HR-SBO applies is based on configuration. If NEF does not interact with UPF, the 5GC in PLMN can be configured to have separate private IP address ranges for HR-SBO related PDU sessions. This would allow for NEF to distinguish AF request for influence on traffic routing for HR-SBO PDU sessions from non-roaming and LBO PDU sessions.

- If the IP address of the UE in the AF request is a public IP address:

- If this Public IP address belongs to an IP range not owned by the PLMN of the NEF, then the target PDU Session is working in HR-SBO mode and the NEF proceeds as per clause 4.3.6.5.4.

- If the UE IP Address in the AF request is an IP address NATed by the PLMN that the NEF belongs to, the NEF invokes steps 3 to 6 of clause 4.15.10 to get the corresponding private UE IP address. If HR-SBO applies, the V-SMF shall have provided an indication that the PDU Session is working in HR-SBO mode, SUPI and the HPLMN DNN and S-NSSAI of the PDU Session to the L-PSA UPF. Thus, the NEF can also receive these parameters and the NEF proceeds as per clause 4.3.6.5.3. Else, the NEF proceeds as per clause 4.3.6.4.

NOTE 2: In this Release, the HPLMN allows HR-SBO for a PDU session only if the UE IP address of the PDU Session has not been allocated in a range that may overlap with other PDU sessions to the same DNN and S-NSSAI of that HPLMN.

NOTE 3: It is assumed that the NEF is configured with the NATed IP range of its own PLMN. It is assumed that the NEF is configured based on HR-SBO roaming agreements for the Public IP address ranges with an HPLMN ID.

NOTE 4: Whether the AF needs to use the NEF or not is according to local deployment. If the AF request is expected to possibly address PDU Sessions in HR-SBO mode, then the AF sends its requests via the NEF.

 When AF requests are routed (by the AF or by the NEF) to an individual PCF this may use the BSF. This case applies to both AF influence on traffic routing as well as AF influence on Service Function Chaining. This is described in clause 4.3.6.4.

- AF requests described in clause 5.6.7 of TS 23.501 [2] or clause 5.6.16 of TS 23.501 [2] targeting a group of UE(s), or any UE accessing a combination of DNN and S-NSSAI and optionally PLMN ID of the DNN and S-NSSAI, or targeting individual UE(s) by one or more GPSI(s) or targeting UEs with External Subscriber Category(s) which can be combined with External Group ID(s) or any UE as described in table 5.6.7-1. These AF requests may also affect UE(s) with an established PDU session. For such requests the AF shall contact the NEF and the NEF stores the AF request information in the UDR. For non-roaming and LBO cases, the PCF(s) receive a corresponding notification if they had subscribed to the create/update/delete operations of the AF request information corresponding to UDR Data Keys / Data Sub-Keys. This is defined in clause 6.3.7.2 of TS 23.501 [2] and further described in clause 4.3.6.2. For HR-SBO case, V-SMF(s) receive a corresponding notification if it has subscribed to the create/update/delete operation of the AF request information corresponding to UDR Data Keys /Data Sub-Keys, this is described in clause 4.3.6.5.5. For a single UE, NEF determines if HR-SBO applies for the PDU session based on the local configuration using the received GPSI. For "any UE", both PCF(s) and SMF(s) (via NEF) may need to subscribe to creates/updates/deletes of AF influence on traffic routing data in UDR depending on if a specific PLMN is targeted.NOTE 5: Such requests can target on-going or future PDU Sessions.

 If the AF request targets any UE the procedure described in clause 4.3.6.5 may also be performed. In that case if the HPLMN Id, DNN and S-NSSAI has not been provided by the AF, the NEF determines the target HPLMN Id, DNN and S-NSSAI based on the description given above.

 This version of the specification does not supportAF influence on traffic routing for home routed PDU session, if the AF request targets an external group ID, or UE(s) identified by SUPI.

If the AF interacts with 5GC via the NEF, the NEF performs the following mappings or determinations where needed:

- Map the AF-Service-Identifier into DNN and S-NSSAI combination, determined by local configuration.

- Map the AF-Service-Identifier into a list of DNAI(s) and Routing Profile ID(s) determined by local configuration.

 The NEF can only provide this mapping when the DNAI(s) being used by the applications are statically defined. When the DNAI(s) where applications are instantiated may vary dynamically, the AF should provide the target DNAI(s) in its request together with either Routing Profile ID(s) or with N6 traffic routing information.

- Map the GPSI in Target UE Identifier into SUPI, according to information received from UDM.

- Map the External Group Identifier in Target UE Identifier into Internal Group Identifier, according to information received from UDM.

- Map the External Subscriber Category(s) and any UE, or External Subscriber Category and External Group ID(s) to, Internal Group ID(s) or Internal Group ID(s) and Subscriber Category(s).

- Map the geographical area in Spatial Validity Condition into areas of validity, determined by local configuration.

- Determine whether an AF request targeting an UE IP address corresponds to HR-SBO and if yes determine as defined above the HPLMN of UE, the DNN/S-NSSAI of the PDU Session based on the description given above.

NOTE 6: As a user can be associated with multiple Subscriber Category(s), some values of Subscriber Category(s) can correspond to an SLA between an application provider represented by an AF and the 5GC operator. In the NEF API, the combination of application identifier and External Subscriber Category can also be used to refer to this SLA.

#### 4.3.6.5 Processing AF requests to influence traffic routing for HR-SBO session

##### 4.3.6.5.1 General

##### Processing an AF requests to influence traffic routing for HR-SBO session are based on procedure described in clauses 4.3.6.5.2 – 4.3.6.5.5.4.3.6.5.2 AF traffic influence request includes HPLMN DNN, S-NSSAI information



**Figure 4.3.6.5.2-1: Processing an AF request to influence traffic routing for HR-SBO session when AF provides HPLMN DNN and S-NSSAI**

0a. AF subscribes to H-SMF regarding the change of serving PLMN change event and is notified after V-SMF insertion/inter-PLMN V-SMF change as described in clause 6.7.2.6 of 23.548 [74]. The notification takes place as soon as the H-SMF has received an indication of Handover Complete.

0b. V-SMF supporting HR-SBO subscribes to notification of AF request by invoking Nnef\_TrafficInfluenceData\_Subscribe service from V-NEF (Data Set = Application Data; Data Subset = AF traffic influence request information; Data Key = HPLMN S-NSSAI and/or DNN and HPLMN ID and UE IP address) and (Data Set = Application Data; Data Subset = AF traffic influence request information; Data Key = HPLMN S-NSSAI and/or DNN and HPLMN ID and “any UE” indication) and (Data Set = Application Data; Data Subset = AF traffic influence request information; Data Key = HPLMN S-NSSAI and/or DNN and SUPI).

NOTE X: Using SUPI as a Data Key is for the case when AF request targeting GPSI.

- For any UE, the V-SMF supporting HR-SBO performs the above subscription using HPLMN ID, S-NSSAI and/or DNN as Data Key.

- For individual UE, when a PDU Session is authorized for HR-SBO as described in clause 6.7 of TS 23.548 [74], the V-SMF serving the PDU Session performs the above subscription using HPLMN ID, HPLMN S-NSSAI and DNN and UE IP address; and HPLMN S-NSSAI and DNN and SUPI as Data Key.

 V-NEF subscribes to notification of AF request by invoking Nudr\_DM\_Subscribe service from V-UDR using the same Data Set and Data Key as V-SMF.

1. As it is Step 1 of Figure 4.3.6.2-1.

2. The AF sends its traffic influence request to V-NEF with the HPLMN ID, HPLMN DNN and S-NSSAI of the UE. The AF request also includes UE IP address or GPSI or “any UE” indication as described in clause 4.3.6.1.

3. Based on the provided HPLMN ID, HPLMN DNN and S-NSSAI as part of traffic influence request, V-NEF identifies that the AF request is targeting a HR-SBO PDU session via VPLMN.

4a. V-NEF creates/updates/delete the information at V-UDR as follows:

(in the case of Nnef\_TrafficInfluence\_Create or Update): The V-NEF stores the AF request information in the V-UDR (Data Set = Application Data; Data Subset, Data Key = AF Transaction Internal ID, HPLMN ID (not used if SUPI is used) , HPLMN S-NSSAI and DNN and either, SUPI or UE IP address or “any UE” indication). The Data Subset identifies whether the information relates to AF traffic influence request information for traffic routing, as described in Table 5.2.12.2.1-1.

(in the case of Nnef\_TrafficInfluence\_delete): The V-NEF deletes the AF requirements in the V-UDR (Data Set = Application Data; Data Subset, Data Key = AF Transaction Internal ID). The Data Subset identifies whether the information relates to AF traffic influence request information for traffic routing.

4b. the V-NEF responds to the AF.

5. The V-UDR notifies the subscribed V-NEF of the AF traffic influence request information.

6. The V-NEF notifies the subscribed V-SMF of the AF traffic influence request information.

7. As similar to Step 6 of Figure 4.3.6.2-1, when V-SMF receives notification from V-NEF, the V-SMF may take appropriate actions to reconfigure the User plane of the PDU Session; and as Step 7 of Figure 4.3.6.2-1, V-SMF sends Nsmf\_PDUSession\_SMContextStatusNotify to AMF.

##### 4.3.6.5.3 AF traffic influence request without HPLMN DNN, S-NSSAI information for a single UE, private IP address or public IP address owned by VPLMN

VPLMN HPLMN

AF

H-PLMN

UDR

V-SMF

V-UPF

V-NEF

1. PDU session establishment as per clause 4.3.2.2.2

2. Nnef\_TrafficInfluenceData\_Subscribe

3. Nudr\_DM\_subscribe

4. Nnef\_TrafficInfluence\_Create/Update/Delete req./resp.

5. Determine if HR-SBO

6. Nupf\_GetUEPrivateIPaddrAndIdentifiers\_Get req

7. Nupf\_GetUEPrivateIPaddrAndIdentifiers\_Get resp.

8. Creating/Updating/Deleting the Traffic Influence data.

9. Nudr\_DM\_ notify

10. Nnef\_TrafficInfluenceData\_Notfy

11. Routing re-configuration

**Figure 4.3.6.5.3-1 Processing AF requests in VPLMN to influence traffic of a HR-SBO PDU Session**

1. During HR-SBO PDU Session establishment procedure, the V-SMF provides an indication that the UE PDU session is working in HR-SBO mode, SUPIof the UE and the HPLMN DNN and S-NSSAI of the PDU session to UPF (i.e. L-PSA in VPLMN). During the lifetime of the PDU session, if L-PSA changed or added, the V-SMF provides the above informations to the new L-PSA.

2. V-SMF subscribes to Traffic Influence data to V-NEF(Data Set = Application Data; Data Subset = AF traffic influence request information. Data Key = HPLMN ID, HPLMN S‑NSSAI and DNN and UE IP address).

NOTE 1: HPLMN ID is derived from the SUPI by V-SMF.

3. The V-NEF subscribes to Traffic Influence data using the same Data Set and Data Key as step 2.

4. AF influence on traffic routing including IP address of the UE (e.g. UE IP for public IP case) known to the AF.

5. The V-NEF determines if the AF influence request relates to a HR-SBO as per clauses 4.3.6.1.

6. If the step 4 was a create operation, V-NEF contacts UPF to get information related to the IP address received from AF (i.e. IEs provided by V-SMF in step 1, and additional private IP before NAT for NATed IP case) by Nupf\_GetUEPrivateIPaddrAndIdentifiers\_Get request (IP address).

7 UPF returns the UE IP address, SUPI of the UE, an indication on if HR-SBO applies, and HPLMN DNN and S-NSSAI for the PDU session, in the response.

8. The V-NEF creates/updates/deletes the AF Traffic Influence data in the UDR (Data Set = Application Data; Data Subset = AF traffic influence request information. Data Key = HPLMN ID, HPLMN S‑NSSAI and DNN and UE IP address).

NOTE 1: HPLMN ID is derived from the SUPI by V-NEF.

9. UDR notifies to V-NEF that Traffic Influence Data has been created/updated/deleted.

10. V-NEF notifies V-SMF of the created/updated/deleted Traffic Influence data.

11. Based on the Traffic Influence data the V-SMF may do traffic routing reconfiguration. Examples of such are listed in step 6 in clause 4.3.6.2.

##### NOTE 2: The V-NEF instance used by V-SMF and AF can be different.4.3.6.5.4 AF traffic influence request without HPLMN DNN, S-NSSAI information for a single UE, UE IP address owned and assigned by HPLMN

VPLMN HPLMN

AF

H-PLMN

UDR

V-SMF

V-UPF

V-NEF

1. PDU session establishment as per clause 4.3.2.2.2

2. Nnef\_TrafficInfluenceData\_Subscribe

3. Nudr\_DM\_subscribe

4. Nnef\_TrafficInfluence\_Create/Update/Delete req./resp.

5. Determine if HR-SBO

6. Nupf\_GetUEPrivateIPaddrAndIdentifiers\_Get req

7. Nupf\_GetUEPrivateIPaddrAndIdentifiers\_Get resp.

8. Creating/Updating/Deleting the Traffic Influence data.

9. Nudr\_DM\_ notify

10. Nnef\_TrafficInfluenceData\_Notfy

11. Routing re-configuration

**Figure 4.3.6.5.4-1 Processing AF requests in VPLMN to influence traffic of a HR-SBO PDU Session**

1. If HR-SBO applies to the PDU Session, the H-SMF may provide an indication that the PDU Session is working in HR-SBO mode, SUPI, HPLMN DNN and S-NSSAI of the PDU session to UPF.

2. V-SMF subscribes to Traffic Influence data from V-NEF (Data Set = Application Data; Data Subset = AF traffic influence request information. Data Key = HPLMN ID, HPLMN S‑NSSAI and DNN and UE IP address).

NOTE 1: HPLMN ID is derived from the SUPI by V-SMF.

3. The V-NEF subscribes to Traffic Influence data using the same Data Set and Data Key as step 2.

4. AF request for traffic routing including IP address of the UE know by the AF (i.e. public IP address within an IP address range owned by HPLMN) .

5. The V-NEF determines if the AF influence request relates to a HR-SBO as per clauses 4.3.6.1.

If service operation is a create, then the procedure continues at step 6, else it continues at step 10.

6. V-NEF contacts H-NEF to get data related to the IP address received from AF by Nnef\_UEId\_Get request service operation (IP address)

7. H-NEF contacts H-UPF to get data related to the IP address received from AF by Nupf\_GetUEPrivateIPaddrAndIdentifiers\_Get request (IP address)

8 H-UPF returns the UE IP address, and optionally HPLMN DNN and S-NSSAI for the PDU session, in the response. If H-UPF does not provide HPLMN DNN and S-NSSAI, H-NEF may be configured with those parameters.

9. H-NEF responds with Nnef\_UEId\_Get response (UE IP address, and optionally HPLMN DNN and S-NSSAI). If H-NEF does not provide the HPLMN DNN and S-NSSAI in the response, V-NEF needs to be configured with those parameters.

NOTE 2: Whether H-NEF or V-NEF is responsible for assigning HPLMN DNN and S-NSSAI depends on roaming agreements.

10. The V-NEF creates/updates/deletes the AF Traffic Influence data in the UDR (Data Set = Application Data; Data Subset = AF traffic influence request information. Data Key = HPLMN ID, HPLMN S‑NSSAI and DNN and UE IP address).

11. UDR notifies to V-NEF that Traffic Influence Data has been created/updated/deleted.

12. V-NEF notifies V-SMF of the created/updated/deleted Traffic Influence data.

13. Based on the Traffic Influence data the V-SMF may do traffic routing reconfiguration. Examples of such are listed in step 6 in clause 4.3.6.2.

NOTE 3: The V-NEF instance used by V-SMF and AF can be different.

##### 4.3.6.5.5 AF traffic influence request for GPSI or any UE

If target is GPSI, the NEF determines PLMN owning the GPSI. If the PLMN owning the GPSI is not the serving PLMN of the NEF, the NEF determines that HR-SBO applies for the PDU session. Then the NEF in VPLMN contacts NEF of the PLMN owning the GPSI, and the NEF of the PLMN owning the GPSI retrieves the SUPI from UDM, and assignes HPLMN DNN and S-NSSAI based on local configuration, and provides these parameters to the NEF of VPLMN.

NOTE x: If the GPSI is in the form of External Identifier (see TE 23.003 [33]) the NEF can determine the HPLMN of UE based on Domain Identifier in the GPSI.

When SUPI is retrieved or "any UE" is provided by AF, the procedure of clause 4.3.6.2 applies with the following differences:

SMF and PCF(s) in Figure 4.3.6.2-1 are replaced with V-SMF.

Step 0: PCF(s) is replaced with V-SMF(s) and V-SMF(s) may add HPLMN ID in the subscription Data Key if target is "any UE". V-SMF subscribes to UDR via NEF in VPLMN.

Step 2: AF always uses NEF. AF may add HPLMN ID in the request.

Step 4: UDR notifies V-SMF via NEF

Step 5: Does not apply.

##### 4.3.2.2.2 Home-routed Roaming

This procedure is used in the case of home-routed roaming scenarios.



Figure 4.3.2.2.2-1: UE-requested PDU Session Establishment for home-routed roaming scenarios

1. This step is the same as step 1 in clause 4.3.2.2.1.

2. For NR satellite access, the AMF may decide to verify the UE location as described in clause 5.4.11.4 of TS 23.501 [2].

 As in step 2 of clause 4.3.2.2.1 except that, if the UE does not include an S-NSSAI in the PDU Session request, both a Serving PLMN S-NSSAI (in the Allowed NSSAI or Partially Allowed NSSAI) and its corresponding HPLMN S-NSSAI values are selected by the AMF. Also, the AMF in the serving PLMN selects both an SMF in the Serving PLMN using the S-NSSAI of the Serving PLMN mapping to the S-NSSAIs of the HPLMN used for the PDU Session and additionally, an SMF in the HPLMN using the S-NSSAI of the HPLMN used for the PDU Session, as described in clause 4.3.2.2.3. The AMF may also receive alternative H-SMFs from the NRF. If Control Plane CIoT 5GS Optimisation is enabled for the PDU Session, the AMF selects V-SMF and H-SMF that supports the Control Plane CIoT 5GS Optimisation (see clause 6.3.2 of TS 23.501 [2]). The AMF stores the association of the S-NSSAI(s), the DNN, the PDU Session ID, the SMF ID in VPLMN as well as Access Type of the PDU Session. Whether to perform DNN replacement is based on operator agreement.

 In step 3 of clause 4.3.2.2.1, in local breakout roaming case, if V-SMF responds to AMF indicating that V-SMF is not able to process some part of the N1 SM information, the AMF proceeds with home routed case from this step and may select an SMF in the VPLMN different from the V-SMF selected earlier.

3a. As in step 3 of clause 4.3.2.2.1 with the addition that:

- the AMF also provides the identity of the H-SMF it has selected in step 2 and both the VPLMN S-NSSAI from the Allowed NSSAI or Partially Allowed NSSAI and the corresponding S-NSSAI of the HPLMN, which is in the mapping the VPLMN S-NSSAI from the Allowed NSSAI or Partially Allowed NSSAI. The H-SMF is provided when the PDU Session is home-routed. The AMF may also provide the identity of alternative H-SMFs, if it has received in step 2. If the AMF determines to replace the HPLMN S-NSSAI received from the UE with the HPLMN Alternative S-NSSAI or the AMF receives the HPLMN Alternative S-NSSAI and the HPLMN S-NSSAI provided by the UE, the AMF selects the H-SMF based on the HPLMN Alternative S-NSSAI.

- The V-SMF does not use DNN Selection Mode received from the AMF but relays this information to the H-SMF.

 If the AMF is reusing an already established association with a V-SMF for the PDU Session ID provided by the UE (e.g. when Request Type indicates "existing PDU Session"), the AMF invokes the Nsmf\_PDUSession\_UpdateSMContext Request.

 The AMF may include the H-PCF ID in this step and V-SMF will pass it to the H-SMF in step 6. This will enable the H-SMF to select the same H-PCF in step 9a.

 If Control Plane CIoT 5GS Optimisation is used for the PDU Session and the "Invoke NEF indication" in the subscription data is set for the S-NSSAI / DNN combination, the AMF includes an "Invoke NEF" flag in Nsmf\_PDUSession\_CreateSMContext Request.

 If Disaster Roaming service indication is received, the V-SMF stores the indication in PDU session context and includes the indication in charging data. V-SMF may also apply policy and charging control based on the indication according to roaming agreement.

3b: This step is the same as step 5 of clause 4.3.2.2.1. If the PDU Session Type is Unstructured and the V-SMF received an "Invoke NEF" flag in step 3a, then it skips steps 4 and 5.

4. The V-SMF selects a UPF in VPLMN as described in clause 6.3.3 of TS 23.501 [2].

5. The V-SMF initiates an N4 Session Establishment procedure with the selected V-UPF:

5a. The V-SMF sends an N4 Session Establishment Request to the V-UPF. The V-SMF provides Trace Requirements to the V-UPF if the V-SMF has received Trace Requirements from AMF. If V-SMF supports HR-SBO and receives HR-SBO allowed indication from AMF for this PDU session, V-SMF includes SUPI of the UE, HPLMN DNN and S-NSSAI, and an indication that the UE PDU session is working in HR-SBO mode.

5b. The V-UPF acknowledges by sending an N4 Session Establishment Response. The CN Tunnel Info is provided to V-SMF in this step.

6. V-SMF to H-SMF: Nsmf\_PDUSession\_Create Request (SUPI, GPSI (if available), V-SMF SM Context ID, DNN, S-NSSAI with the value defined by the HPLMN, [HPLMN Alternative S-NSSAI], PDU Session ID, V-SMF ID, V-CN-Tunnel-Info, PDU Session Type, PCO, Number Of Packet Filters, User location information, Access Type, RAT Type, PCF ID, [Small Data Rate Control Status], SM PDU DN Request Container, DNN Selection Mode, Control Plane CIoT 5GS Optimisation Indication, [Always-on PDU Session Requested], AMF ID, Serving Network, [ECS Address Configuration Information asscociated with PLMN ID of visited network], the QoS constraints from the VPLMN, Satellite backhaul category, Disaster Roaming service indication) or Nsmf\_PDUSession\_Update Request (V-CN-Tunnel-Info, PCO, User location information, Access Type, RAT Type, SM PDU DN Request Container, Control Plane CioT 5GS Optimisation Indication, [Always-on PDU Session Requested], Serving Network, Satellite backhaul category). Protocol Configuration Options may contain information that H-SMF may needs to properly establish the PDU Session (e.g. SSC mode or SM PDU DN Request Container to be used to authenticate the UE by the DN-AAA as defined in clause 4.3.2.3). The H-SMF may use DNN Selection Mode when deciding whether to accept or reject the UE request. If the V-SMF does not receive any response from the H-SMF due to communication failure on the N16 interface, depending on operator policy the V-SMF may create the PDU Session to one of the alternative H-SMF(s) if additional H-SMF information is provided in step 3a, as specified in detail in TS 29.502 [36]. The Small Data Rate Control Status is included if received from the AMF. The Control Plane CioT 5GS Optimisation Indication is set by the V-SMF, if the PDU Session is intended for Control Plane CioT 5GS Optimisation. The QoS constraints from the VPLMN are specified in clause 5.7.1.11 of TS 23.501 [2]. The Disaster Roaming service indication is included if the indication is received from AMF in step 3a above.

NOTE 1: The QoS constraints from the VPLMN are provided by the VPLMN to avoid the risk that V-SMF rejects the PDU Session in step 13 when controlling SLA with the HPLMN.

 V-SMF SM Context ID contains the addressing information it has allocated for service operations related with this PDU Session. The H-SMF stores an association of the PDU Session and V-SMF Context ID for this PDU Session for this UE.

 If the H-SMF needs to use V-SMF services for this PDU Session (invoking Nsmf\_PDUSession\_Update Request) before step 13, at the first invocation of Nsmf\_PDUSession\_Update Request the H-SMF provides the V-SMF with the H-SMF SM Context ID it has allocated for service operations related with this PDU Session.

 If the RAT type was included in the message, then the H-SMF stores the RAT type in SM Context.

 ECS Address Configuration Information associated with PLMN ID of visited network is an optional information that may only be provided when HR-SBO is supported for roamers of HPLMN.

 If the V-SMF has an association with the H-SMF for the indicated PDU Session ID, the V-SMF invokes Nsmf\_PDUSession\_Update Request. Otherwise the V-SMF invokes Nsmf\_PDUSession\_Create Request.

 If the V-SMF receives the HPLMN Alternative S-NSSAI and the HPLMN S-NSSAI from the AMF, the V-SMF sends both the HPLMN Alternative S-NSSAI and the HPLMN S-NSSAI to the H-SMF.

7-12b. These steps are the same as steps 4-10 in clause 4.3.2.2.1 with the following differences:

- These steps are executed in Home PLMN;

- If the S-NSSAI of this PDU Session is subject to network slice usage control, the H-SMF configures the PDU Session inactivity timer in the H-UPF as described in clause 5.15.15 of TS 23.501 [2]. Otherwise, the H-SMF does not provides the inactivity timer to the H-UPF as described in step 10a in clause 4.3.2.2.1.

- If the QoS constraints from the VPLMN is provided in step 6 and PCF is deployed, the H-SMF provides the QoS constraints from the VPLMN to PCF. The PCF takes this into account when making policy decisions. In case dynamic PCC is not deployed, the SMF takes this into account when generating the default QoS rule.

- Step 5 of clause 4.3.2.2.1 is not executed.

- If Disaster Roaming service indication is received, the SMF stores the indication in PDU session context and includes the indication in charging data. H-SMF may also apply policy and charging control based on the indication according to roaming agreement.

 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].

12c. This step is the same as step 16c in clause 4.3.2.2.1 with the following difference:

- The H-SMF registers for the PDU Session with the UDM using Nudm\_UECM\_Registration (SUPI, DNN, S-NSSAI with the value defined by the HPLMN, PDU Session ID).

13. H-SMF to V-SMF: Nsmf\_PDUSession\_Create Response (QoS Rule(s), QoS Flow level QoS parameters if needed for the QoS Flow(s) associated with the QoS rule(s), PCO including session level information that the V-SMF is not expected to understand, selected PDU Session Type and SSC mode, Reliable Data Service Support, H-CN Tunnel Info, QFI(s), QoS profile(s), Session-AMBR, Reflective QoS Timer (if available), information needed by V-SMF in the case of EPS interworking such as the PDN Connection Type, User Plane Policy Enforcement, [ECS Address Configuration Information for the serving PLMN]).

 If the PDU Session being established was requested to be an always-on PDU Session, the H-SMF shall indicate to the V-SMF whether the request is accepted or not via the Always-on PDU Session Granted indication in the response message to V-SMF. If the PDU Session being established was not requested to be an always-on PDU Session but the H-SMF determines that the PDU Session needs to be established as an always-on PDU Session, the H-SMF shall indicate it to the V-SMF by including Always-on PDU Session Granted indication that the PDU Session is an always-on PDU Session.

 The information that the H-SMF may provide is the same than defined for step 11 of Figure 4.3.2.2.1-1.

 The H-CN Tunnel Info contains the tunnel information for uplink traffic towards H-UPF.

 Multiple QoS Rules and QoS Flow level QoS parameters for the QoS Flow(s) associated with the QoS rule(s) may be included in the Nsmf\_PDUSession\_Create Response.

 The V-SMF may apply VPLMN policies related with the SLA negotiated with the HPLMN or with QoS values supported by the VPLMN to evaluate the QoS parameters received from H-SMF; such policies may result in that V-SMF does not accept the PDU Session or does not accept some of the QoS Flows requested by the H-SMF. If the V-SMF does not accept the PDU Session, the V-SMF triggers the V-SMF initiated PDU Session Release procedure from step 1b-3b as defined in clause 4.3.4.3. When the V-SMF accepts at least one QoS flow, it transfers (via the AMF) the corresponding N2 (and NAS) request towards the 5G AN (and the UE) but does not issue requests for the QoS Flow(s) it has rejected due these policies. The V-SMF notifies the H-SMF about the rejected QoS Flows in step 23 below.

NOTE 2: QoS enforcement in V-UPF is not expected on the QoS parameters received from H-SMF.

 If Control Plane CioT 5GS Optimisation is enabled for the PDU Session, certain information, e.g. H-CN tunnel info, is not provided in the response to V-SMF.

 V-SMF stores the indication of Small Data Rate Control applicability on this PDU Session, if it is received in Nsmf\_PDUSession\_Create Response.

13a-13b. The V-SMF initiates an N4 Session Modification procedure with the V-UPF. The V-SMF may provide N4 rules to the V-UPF for this PDU Session, including rules to forward UL traffic to the H-UPF.

14-18. These steps are the same as steps 11-15 in clause 4.3.2.2.1 with the following differences:

- These steps are executed in Visited PLMN;

- The V-SMF stores an association of the PDU Session and H-SMF ID for this PDU Session for this UE;

- If the H-SMF indicates the PDU Session can be established as an always-on PDU Session, the V-SMF shall further check whether the PDU Session can be established as an always-on PDU Session based on local policies. The V-SMF notifies the UE whether the PDU Session is an always-on PDU Session or not via the Always-on PDU Session Granted indication in the PDU Session Establishment Accept message.

- If the N2 SM information indicates failure of user plane resource setup and the V-SMF rejected the PDU session establishment as described in step 15 in clause 4.3.2.2.1, step 19 is skipped and instead the V-SMF releases the N4 Session with V-UPF.

- If an alternative H-SMF is selected for the PDU Session and the corresponding selected alternative H-SMF ID has not been previously provided to the AMF, the V-SMF provides the selected alternative H-SMF ID to the AMF.

NOTE 3: The selected alternative H-SMF ID can be provided to AMF earlier, e.g. in step 8 if PDU Session Authentication/Authorization is performed.

- If Control Plane CioT 5GS Optimisation is enabled for the PDU Session, steps 19, 20 and 23 below are omitted.

19a. The V-SMF initiates an N4 Session Modification procedure with the V-UPF. The V-SMF may provide N4 rules to the V-UPF for this PDU Session, including rules to forward DL traffic to the AN.

19b. The V-UPF provides a N4 Session Modification Response to the V-SMF.

 After this step, the V-UPF delivers any down-link packets to the UE that may have been buffered for this PDU Session.

20. This step is the same as step 17 in clause 4.3.2.2.1 with the following differences:

- The SMF is a V-SMF. The H-SMF and V-SMF subscribe to UE reachability event from AMF.

21. This step is same as step 18 in clause 4.3.2.2.1. In addition, if during the procedure, after step 14, the PDU Session establishment is not successful as specified in step 15 of clause 4.3.2.2.1, the V-SMF triggers the V-SMF initiated PDU Session Release procedure from step 1b-3b as defined in clause 4.3.4.3.

22. H-SMF to UE, via H-UPF and V-UPF in VPLMN: In the case of PDU Session Type Ipv6 or Ipv4v6, the H-SMF generates an Ipv6 Router Advertisement and sends it to the UE via N4 and the H-UPF and V-UPF. If the Control Plane CioT 5GS Optimisation is enabled for this PDU session the V-UPF forwards the Ipv6 Router Advertisement to the V-SMF for transmission to the UE using the Mobile Terminated Data Transport in Control Plane CioT 5GS Optimisation procedures (see clause 4.24.2).

23. If the V-SMF received in step18 an indication that the ®AN has rejected some QFI(s) or if the V-SMF has rejected some QFI(s) in step 13, the V-SMF notifies the H-SMF via a Nsmf\_PDUSession\_Update Request. The H-SMF is responsible of updating accordingly 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.

24. This step is the same as step 20 in clause 4.3.2.2.1 with the following differences:

- this step is executed in the Home PLMN;

- the SMF also deregisters for the given PDU Session using Nudm\_UECM\_Deregistration (SUPI, DNN, PDU Session ID). The UDM may update corresponding UE context by Nudr\_DM\_Update (SUPI, Subscription Data, UE context in SMF data).

NOTE 4: The SMF in HPLMN can initiate H-SMF initiated PDU Session Release procedure as defined in clause 4.3.4.3, already after step 13.

#### 4.4.1.2 N4 Session Establishment procedure

The N4 Session Establishment procedure is used to create the initial N4 session context for a PDU Session at the UPF. The SMF assigns a new N4 Session ID and provides it to the UPF. The N4 Session ID is stored by both entities and used to identify the N4 session context during their interaction. The SMF also stores the relation between the N4 Session ID and PDU Session for a UE.



Figure 4.4.1.2-1 N4 Session Establishment procedure

1. SMF receives the trigger to establish a new PDU Session or change the UPF for an established PDU Session.

2. The SMF sends an N4 session establishment request message to the UPF that contains the structured control information which defines how the UPF needs to behave. If the SMF is a V-SMF and it supports HR-SBO for the PDU session, V-SMF includes SUPI, HPLMN DNN and S-NSSAI, and an indication that the UE PDU session is working in HR-SBO mode.

3. The UPF responds with an N4 session establishment response message containing any information that the UPF has to provide to the SMF in response to the control information received.

 If the UPF (by configuration or other means) utilizes an NWDAF, UPF adds the NWDAF serving the UE identified by the NWDAF instance ID. Per NWDAF service instance the Analytics ID(s) are also included.

NOTE: The SMF can use this NWDAF related information and can forward it to the PCF using the SMF initiated SM Policy Modification procedure, as a result of a Policy Control Request Trigger.

4. The SMF interacts with the network function which triggered this procedure (e.g. AMF or PCF).

### 4.15.10 AF specific UE ID retrieval

This clause contains the detailed description and the procedures for the AF specific UE ID retrieval. The AF specific UE Identifier is represented by the External Identifier as defined in TS 23.003 [33].

NOTE 1: After retrieving AF specific UE ID, the AF can invoke NEF provided services (e.g. location monitoring).

NOTE 2: As described in subclauses of clause 4.3.6, NEF can invoke steps 3 to 6 of this procedure to get the assigned UE IP address, SUPI and DNN and S-NSSAI, and if HR-SBO applies, the DNN and S-NSSAI is the HPLMN's, and also an indication that the PDU Session is working in HR-SBO mode.



Figure 4.15.10-1: AF specific UE ID retrieval

1. AF requests to retrieve UE ID via the Nnef\_UEId\_Get service operation. The request message shall include UE address (IP address or MAC address) and AF Identifier, it may include, Port Number associated with the IP address, MTC Provider Information, Application Port ID, IP domain. The MTC Provider Information identifies the MTC Service Provider and/or MTC Application. If available, the AF may also provide the corresponding DNN and/or S-NSSAI.

NOTE 3: The MTC Provider Information can be used by any type of Service Providers (MTC or non-MTC) or Corporate or External Parties for, e.g. to distinguish their different customers.

NOTE 4: The combination of IP address and Port Number can be used by 5GC to derive the UE private IP address assigned by 5GC if the UE is behind a NAT, see steps 3-6 below.

NOTE 5: The Application Port ID is as defined in Nnef\_Trigger\_Delivery.

NOTE 6: The NEF can validate the provided MTC Provider Information and override it to a NEF selected MTC Provider Information based on configuration. How the NEF determines the MTC Provider Information, if not present, is left to implementation (e.g. based on the requesting AF).

2. The NEF authorizes the AF request. If the authorisation is not granted, the NEF replies to the AF with a Result value indicating authorisation failure; otherwise the NEF proceeds with the following steps. The NEF determines corresponding DNN and/or S-NSSAI information: this may have been provided by the AF or is determined by the NEF based on the requesting AF Identifier, MTC Provider Information.

If the NEF has received a Port Number in step 1, based on configuration, the NEF may recognize the address received is an IP address which is different from the actual private UE IP address assigned by 5GC, i.e. the UE is behind a NAT in UPF. If so, the NEF performs steps 3 to 6. Otherwise, steps 3 to 6 are skipped.

3. The NEF uses the Nnrf\_NFDiscovery service operation to obtain the address of the UPF implementing NAT functionality for the UE (public) IP address. The request includes the UE (public) IP address. The NEF may also include the DNN and S-NSSAI associated with the AF ID, as well as the IP domain.

4. The NRF responds with a Nnrf\_NFDiscovery response message including the UPF address of the UPF implementing NAT functionality for the UE (public) IP address.

5. The NEF uses the Nupf\_GetUEPrivateIPaddrAndIdentifiers\_Get service operation to request UE's (private) IP address from the UPF. The request includes the UE (public) IP address and Port Number and optionally IP domain, DNN and S-NSSAI associated with the AF ID.

6. The UPF responds with the Nupf\_GetUEPrivateIPaddrAndIdentifiers\_Get response message including UE's IP address and optionally, the IP domain. If the UPF has applied a NAT functionality, the UE's IP address returned by the UPF is the private UE IP address. If IP domain of UE private IP address is returned from UPF, it always takes precedence regardless of whether the IP domain information also provided by AF when it invokes Nnef\_UEId\_Get service operation. If UPF has the SUPI or GPSI of the UE, the UPF may return SUPI or GPSI and in this case steps 7-8 are skipped.

 For HR-SBO case as described in clause 4.3.6.1 and in TS 23.548[74], an indication that the UE PDU session is working in HR-SBO mode, SUPI and HPLMN DNN and S-NSSAI of the PDU session are also provided by UPF.

NOTE 7: The SUPI/GPSI is only available when the SMF provides it to the UPF for the purposes defined in TS 29.244 [69].

7-8. The NEF uses the Nbsf\_Management\_Discovery service operation with UE address and IP domain and /or DNN and/or S-NSSAI to retrieve the session binding information of the UE. If no SUPI is received in the session binding information from the BSF, the NEF replies to the AF with a Result value indicating that the UE ID is not available.

9. The NEF interacts with UDM to retrieve the AF specific UE Identifier via the Nudm\_SDM\_Get service operation. The request message includes SUPI or GPSI and at least one of Application Port ID, MTC Provider Information or AF Identifier.

10. The UDM responds to the NEF with an AF specific UE Identifier represented as an External Identifier for the UE which is uniquely associated with the Application Port ID, MTC provider Information and/or AF Identifier.

11. The NEF further responds to the AF with the information (including the AF specific UE Identifier represented as an External Identifier) received from the UDM.

1.

#### 5.2.26.3 Nupf\_GetUEPrivateIPaddrAndIdentifiers service

##### 5.2.26.3.1 General

This service provides the UE IP address translation information.

##### 5.2.26.3.2 Nupf\_GetPrivateUEIPaddrAndIdentifiers\_Get service operation

**Service operation name:** Nupf\_GetUEPrivateIPaddrAndIdentifiers\_Get

**Description:** NF service consumer gets the UE private IP address and IP domain assigned by 5GC.

**Inputs, Required:** IP address and port, (e.g. a public IP address).

The provided IP address and port uniquely identifies the UE IP address behind a NAT.

**Inputs, Optional:** IP domain, DNN, S-NSSAI.

**Outputs, Required:** UE (private) IP address allocated by 5GC.

**Outputs, Optional:** IP domain of UE private IP address, SUPI, GPSI, an indication that the associated PDU session is working in HR-SBO mode, DNN and S-NSSAI (HPLMN DNN and S-NSSAI if UPF is in VPLMN).

##### 5.2.8.3.1 General

**Service description:** This service provides events related to PDU Sessions towards consumer NF. The service operations exposed by this service allow other NFs to subscribe and get notified of events happening on PDU Sessions. The following are the key functionalities of this NF service.

- Allow consumer NFs to Subscribe and unsubscribe for an Event ID on PDU Session(s);

- Allow the NWDAF to collect data for network data analytics from SMF as specified in TS 23.288 [50] and from UPF as specified in clause 4.15.4.5;

- Notifying events on the PDU Session to the subscribed NFs; and

- Allow consumer NFs to acknowledge or respond to an event notification.

The following events can be subscribed by a NF consumer (Event ID is defined in clause 4.15.1):

- UE IP address / Prefix allocation/change: The event notification may contain a new UE IP address / Prefix or an indication of which UE IP address / Prefix has been released.

- PDU Session Establishment and/or PDU Session Release.

 The event notification may contain following information:

- PDU Session Type.

- DNN.

- UE IP address/Prefix.

- UP path change: a notification corresponding to this event is sent when the UE IP address / Prefix and / or DNAI and /or the N6 traffic routing information has changed.

 The event notification may contain following information:

- the type of notification ("EARLY" or "LATE").

- for both the source and target UP path between the UE and the DN, the corresponding information is provided when it has changed:

- DNAI.

- UE IP address / Prefix.

- N6 traffic routing information.

- Candidate DNAI(s) for the PDU Session.

- Change of common EAS.

NOTE 1: UP path change notification, DNAI and N6 traffic routing information are further described in clause 5.6.7 of TS 23.501 [2].

- QoS Monitoring: the event notification may contain the QoS Monitoring report for the QoS parameter(s) to be measured defined in clause 5.45 of TS 23.501 [2]. Implicit subscription of the PCF on behalf of the NEF/AF as part of setting PCC rule(s) may trigger SMF to send this event notification.

- Change of Access Type; The event notification contains the new Access Type for the PDU Session. For MA PDU Session the Change of Access Type may include two Access Type information that the user is currently using.

- Change of RAT Type; the event notification contains the new RAT Type for the PDU Session.

- PLMN change; The event notification contains the new PLMN Identifier for the PDU Session and may indicate:

- whether local traffic offload is possible, i.e., mobility of the PDU session either towards HPLMN or towards a VPLMN where HR-SBO is supported and allowed; and

- DNN and S-NSSAI of HPLMN.

- Change of satellite backhaul category; The event notification contains the new satellite backhaul category for the PDU session.

- Downlink data delivery status. The event notification contains the status of downlink data buffering in the core network including:

- First downlink packet per source of the downlink IP traffic in extended buffering and Estimated maximum wait time.

- First downlink packet per source of the downlink IP traffic discarded.

- First downlink packet per source of the downlink IP traffic transmitted after previous buffering and/or discarding of corresponding packet(s).

- QFI allocation: The event notification is sent when a new QoS flow is established within a PDU session and contains:

- If the Target of Event Reporting is a PDU session, both the allocated QFI and either one of the following (Application Identifier or IP Packet Filter Set or Ethernet Packet Filter Set). The 5QI corresponding to the QoS flow and the DNN, S-NSSAI corresponding to the PDU session are also sent.

- If the Target of Event Reporting is a SUPI, both the allocated QFI and either one of the following (Application Identifier or IP Packet Filter Set or Ethernet Packet Filter Set) for each PDU session ID established for this SUPI. The 5QI corresponding to the QoS flow and the DNN, S-NSSAI corresponding to each PDU session are also sent.

- If the Target of Event Reporting is an Internal-Group-Id or any UE, multiple instances of the tuple (allocated QFI and either one of the following (Application Identifier or IP Packet Filter Set or Ethernet Packet Filter Set). PDU session ID, SUPI). The 5QI corresponding to the QoS flow and the DNN, S-NSSAI corresponding to each PDU session are also sent.

- Total number of Session Management transactions:

- The total number of Session Management transaction is used to collect the number of SM transactions of a SUPI or Internal Group ID, for example Dispersion Analytics as specified in TS 23.288 [50]. The transaction count is incremented when the NAS transactions from PDU Session Establishment, PDU Session Authentication, PDU Session Modification and PDU Session Release procedures is concluded. Only the periodic reporting mode applies.

- Information on PDU Session for WLAN (i.e. Access Type is Non-3GPP and RAT Type is TRUSTED\_WLAN).

NOTE 2: When the consumer NF is the NWDAF, the event QFI allocation is used to collect data for Observed Service Experience analytics, UE communication analytics, QoS Sustainability analytics and end-to-end data volume transfer time analytics as specified in TS 23.288 [50].

- User plane status information: The event notification contains:

- PDU Session ID.

- User Plane Inactivity Timer (as specified in TS 29.244 [69]).

- PDU Session status (activated, deactivated).

NOTE 3: When the consumer NF is the NWDAF, the event user plane status information is used to collect data for UE Communication analytics as specified in TS 23.288 [50].

- Session Management Congestion Control Experience for PDU Session: The event notification contains the data related to Session Management Congestion Control experience per PDU Session as described in TS 23.288 [50].

- UE session behaviour trends (see clause 4.15.4.3);

- UE communications trends (see clause 4.15.4.3);

- UP with redundant transmission: the event notification indicates if redundant transmission (see clause 5.33.2.2 of TS 23.501 [2]) has been activated or not for the PDU session;

- User Data Usage Measures (see clause 4.15.4.5): SMF conveys the subscription to UPF on behalf of the consumer. Consumer receives the events directly from UPF; and

- User Data Usage Trends (see clause 4.15.4.5): SMF conveys the subscription to UPF on behalf of the consumer. Consumer receives the events directly from UPF.

When the consumer NF is the NWDAF, the event Information on PDU Session for WLAN is used to collect data for WLAN performance analytics as specified in TS 23.288 [50].

When the consumer NF is the NWDAF, the event Session Management Congestion Control Experience for PDU Session is used to collect data for Session Management Congestion Control Experience analytics as specified in TS 23.288 [50].

When the consumer NF is the NWDAF, the events QoS Monitoring, User Data Usage Measures and User Data Usage Trends are used to collect data from UPF for analytics as specified in clause 4.15.4.5 and in TS 23.288 [50]. SMF conveys the subscription to UPF on behalf of the NWDAF.

The consumer NF may request to subscribe the UPF exposure events (including event ID of exposed UPF event of QoS monitoring, User Data Usage Measures and User Data Usage Trends) via SMF indirectly by Nsmf\_EventExposure. After receiving this subscription request, the SMF does a third-party subscription onto UPF on behalf of this consumer. The consumer should also provide the subscribed UPF event to SMF.

Event Filters are used to specify the conditions to match for notifying the events (i.e. "List of Parameter values to match"). If there are no conditions to match for a specific Event ID, then the Event Filter is not provided. The following table provides as an example how the conditions to match for event reporting can be specified for various Event IDs for SMF exposure.

Table 5.2.8.3.1-1: Example of Event Filters for SMF exposure events

|  |  |
| --- | --- |
| Event ID for SMF exposure | Event Filter (List of Parameter Values to Match) |
| DNAI Change | None |
| Candidate DNAI(s) has changed | None |
| PDU Session Release | <Parameter Type = S-NSSAI, Value = S-NSSAI1> |
| PDU Session Establishment | <Parameter Type = S-NSSAI, Value = S-NSSAI1> |
| QoS Monitoring | <Parameter Type = S-NSSAI, Value = S-NSSAI1><Parameter Type = DNN, Value = DNN1><Parameter Type = Application Identifier, Value = Application Identifier1><Parameter Type = AoI, value = AoI1><Parameter Type = UPF Id, value = UPF Id1><Parameter Type = DNAI, value = DNAI1> |
| QFI allocation | <Parameter Type = DNN, Value = DNN1><Parameter Type = S-NSSAI, Value = S-NSSAI1> |
| QFI allocation | <Parameter Type = Application Identifier, Value = Application Identifier1> |
| Transaction Count | <Parameter Type = TAI, Value = TA1> (NOTE)<Parameter Type = S-NSSAI, Value = S-NSSAI1> |
| Uiser plane status information | <Parameter Type = Application Identifier, Value = Application Identifier1><Parameter Type = SUPI, Value = SUPI1> |
| Information on PDU Session for WLAN | <Parameter Type = Access Type, Value = Non-3GPP> && <Parameter Type = RAT Type, Value = TRUSTED\_WLAN> |
| Session Management Congestion Control Experience for PDU Session | <Parameter Type = DNN, Value = DNN1><Parameter Type = S-NSSAI, Value = S-NSSAI1> |
| UP with redundant transmission | <Parameter Type = DNN, Value = DNN1> |
| User Data Usage Measures | <Parameter Type = S-NSSAI, Value = S-NSSAI1><Parameter Type = DNN, Value = DNN1><Parameter Type = Application Identifier, Value = Application Identifier1> (NOTE 2)<Parameter Type = Flow Info, Value = Packet Filter Set1> (NOTE 2)<Parameter Type = AoI, value = AoI1><Parameter Type = SSID/BSSID, Value = SSID/BSSID1> |
| User Data Usage Trends | <Parameter Type = S-NSSAI, Value = S-NSSAI1><Parameter Type = DNN, Value = DNN1><Parameter Type = Application Identifier, Value = Application Identifier1> (NOTE 2)<Parameter Type = Flow Info, Value = Packet Filter Set1> (NOTE 2)<Parameter Type = AoI, value = AoI1> |
| NOTE 1: Optionally the SMF can fetch the location information from the AMF but transaction information correlation at the location can also be achieved without it and through transaction information associated with the requested time period, which corresponds to the UE's time span at the location of interest.NOTE 2: These Parameters are exclusive and only one of them can be provided. |

The target of SMF event reporting may correspond to a PDU Session ID, an UE ID (SUPI), an Internal Group Identifier, an indication that any UE is targeted (e.g. on a specific DNN), or an indication that any PDU session is the target.

When acknowledgment is expected the SMF also provides Notification Correlation Information to the consumer NF in the event notification.

The consumer NF may provide the following event-specific information when acknowledging an event notification:

- For UP path change event:

- N6 traffic routing information related to the target DNAI.

NOTE 4: Acknowledgement to a UP path change event notification is further described in clause 5.6.7 of TS 23.501 [2].

##### 5.2.6.27.2 Nnef\_UEId\_Get operation

**Service operation name:** Nnef\_UEId\_Get

**Description:** Get the UE identifier.

**Inputs, Required:** GPSI or UE address (i.e. IPv4/IPv6 address or MAC address) or External Group Identifier(s).

NOTE 1: External Group Identifier(s) cannot be used for HR-SBO sessions.

**Inputs, Optional:** DNN, S-NSSAI, Port number (e.g. TCP or UDP port), IP domain, Application port ID, MTC Provider Information, AF Identifier.

**Outputs, Required:** Result, AF specific UE Identifier represented as an External Identifier or SUPI or Internal Group Identifier(s).

NOTE 2: SUPI can only be exposed to roaming partners.

**Outputs, Optional:** None.

##### 5.2.12.2.1 General

The operations defined for Nudr\_DM service use following set of parameters defined in this clause:

- Data Set Identifier: uniquely identifies the requested set of data within the UDR (see clause 4.2.5).

- Data Subset Identifier: it uniquely identifies the data subset within each Data Set Identifier. As specified in the procedures in clause 4, e.g. subscription data can consist of subsets particularised for specific procedures like mobility, session, etc.

- Data Keys defined in Table 5.2.12.2.1-1

For Nudr\_DM\_Subscribe and Nudr\_DM\_Notify operations:

- The Target of Event Reporting is made up of a Data Key and possibly a Data Sub Key both defined in Table 5.2.12.2.1-1. When a Data Sub Key is defined in the table but not present in the Nudr\_DM\_Subscribe this means that all values of the Data Sub Key are targeted.

- The Data Set Identifier plus (if present) the (set of) Data Subset Identifier(s) corresponds to a (set of) Event ID(s) as defined in clause 4.15.1

An NF Service Consumer may include an indicator when it invokes Nudr\_DM Query/Create/Update service operation to subscribe the changes of the data, to avoid a separate Nudr\_DM\_Subscribe service operation.

Depending on the use case, it is possible to use a Data Key and/or one or multiple Data sub keys to further identify the corresponding data, as defined in Table 5.2.12.2.1-1 below.

Table 5.2.12.2.1-1: Data keys

|  |  |  |  |
| --- | --- | --- | --- |
| Data Set | Data Subset | Data Key | Data Sub Key |
|  | Access and Mobility Subscription data | SUPI | Serving PLMN ID and optionally NID |
|  | SMF Selection Subscription data | SUPI | Serving PLMN ID and optionally NID |
|  | UE context in SMF data | SUPI | PDU Session ID or DNN |
| Subscription Data (see clause 5.2.3.3.1) | SMS Management Subscription data | SUPI | Serving PLMN ID and optionally NID |
|  | SMS Subscription data | SUPI | Serving PLMN ID and optionally NID |
|  | Session Management Subscription data | SUPI | S-NSSAI |
|  |  |  | DNN |
|  |  |  | Serving PLMN ID and optionally NID |
|  | Slice Selection Subscription data | SUPI | Serving PLMN ID and optionally NID |
|  | Group Data(NOTE 5) | Internal Group Identifier orExternal Group Identifier | - |
|  | Identifier translation | GPSI |  |
|  |  | SUPI | Application Port ID, MTC Provider Information, AF Identifier |
|  | Intersystem continuity Context | SUPI | DNN |
|  | LCS privacy | SUPI | - |
|  | LCS mobile origination | SUPI | - |
|  | UE reachability | SUPI | - |
|  | Group Identifier Translation | Internal Group Identifier orExternal Group Identifier | - |
|  | UE context in SMSF data | SUPI | - |
|  | V2X Subscription data | SUPI | - |
|  | A2X Subscription data | SUPI | - |
|  | ProSe Subscription data | SUPI | - |
|  | User consent | SUPI | Purpose |
|  | ECS Address Configuration Information (See Table 4.15.6.3d-1) | SUPI, Internal group identifier or external group identifier or any UE | DNN, S-NSSAI, (Serving) PLMN ID (NOTE 7) |
|  | MBS Subscription data(see clause 6.4.3 of TS 23.247 [78]) | SUPI | - |
|  | Ranging/Sidelink Positioning Subscription data | SUPI | - |
|  | Operator Determined Barring data (see clause 2.3 of TS 23.015 [90] and TS 29.505 [91]) | SUPI | - |
|  | Shared data | Shared Data ID | - |
| Application data | Packet Flow Descriptions (PFDs) (NOTE 11) | Application Identifier |  |
|  | AF traffic influence request information for traffic routing | AF transaction internal ID |  |
|  | (See clause 5.6.7 and clause 6.3.7.2 of TS 23.501 [2]) | For non-roaming and LBO:S-NSSAI and DNN , accompanied with Internal Group Identifier(s) and/or Subscriber Category(s) or SUPI or "any UE" indication For HR-SBO:HPLMN S-NSSAI and DNN and either: HPLMN ID and IP address, or SUPI, or "any UE" indication, or "any UE" indication and HPLMN ID. (NOTE 4) (NOTE 6) (NOTE 12) |  |
|  | AF traffic influence request information for service function chaining | AF transaction internal ID |  |
|  | (See clause 5.6.16 and clause 6.3.7.2 of TS 23.501 [2]) | S-NSSAI and DNNandInternal Group Identifier or SUPI or "any UE" indication (NOTE 4) |  |
|  | Background Data Transfer(NOTE 3) | Internal Group Identifier or SUPI |  |
|  | Service specific information (See clause 4.15.6.7) | S-NSSAI and DNNorInternal Group Identifier or SUPI or "any UE" indication (NOTE 4) or "PLMN ID(s) of inbound roamer" |  |
|  | EAS Deployment Information(See clause 7.1 of TS 23.548 [74]) | DNN and/or S-NSSAI | Application Identifier and/or Internal Group Identifier |
|  | AM influence information (See clause 4.15.6.9.3) | AF transaction internal ID |  |
|  |  | S-NSSAI and DNNand/orInternal Group Identifier or SUPI or "any UE" indication or any inbound roaming UEs (NOTE 4, NOTE 8) |  |
|  | AF request for QoS information (See clause 4.15.6.14) | AF transaction internal ID |  |
|  |  | S-NSSAI and DNNand/orInternal Group Identifier or SUPI or "any UE" indication (NOTE 4) |  |
| Policy Data | UE context policy control data(See clause 6.2.1.3 of TS 23.503 [20]) | SUPI |  |
|  | PDU Session policy control data | SUPI | S-NSSAI |
|  | (See clause 6.2.1.3 of TS 23.503 [20]) |  | DNN |
|  | Policy Set Entry data(See clause 6.2.1.3 of TS 23.503 [20]) | SUPI (for the UDR in HPLMN) |  |
|  |  | PLMN ID (for the UDR in VPLMN) |  |
|  | Remaining allowed Usage data | SUPI | S-NSSAI |
|  | (See clause 6.2.1.3 of TS 23.503 [20]) |  | DNN |
|  | Sponsored data connectivity profiles (See clause 6.2.1.6 of TS 23.503 [20]) | Sponsor Identity |  |
|  | Background Data Transfer data(See clause 6.2.1.6 of TS 23.503 [20]) | Background Data Transfer Reference ID. (NOTE 2) |  |
|  |  | None. (NOTE 1) |  |
|  | Network Slice Specific Control Data(See clause 6.2.1.3 of TS 23.503 [20]) | S-NSSAI |  |
|  | 5G VN Group Specific Control Data (See clause 6.2.1.3 of TS 23.503 [20]) | S-NSSAI and DNNand/orInternal Group Identifier |  |
|  | Operator Specific Data | SUPI or GPSI |  |
|  | Planned Data Transfer with QoS requirements data(See clause 6.2.1.6 of TS 23.503 [20]) | PDTQ Reference ID. (NOTE 10) |  |
|  |  | None. (NOTE 9) |  |
| Exposure Data | Access and Mobility Information | SUPI or GPSI | PDU Session ID or  |
| (see clause 5.2.12.1) | Session Management information | SUPI or GPSI | UE IP address or DNN |
|  | DNAI mapping information | DNN and/or S-NSSAI |  |
| NOTE 1: Retrieval of the stored Background Data Transfer data for all ASP identifiers in the UDR requires Data Subset but no Data Key or Data Subkey(s).NOTE 2: Update of a Background Data Transfer data in the UDR requires a Data key to refer to a Background Data Transfer data as input data.NOTE 3: The Background Data Transfer includes the Background Data Reference ID and the ASP Identifier that requests to apply the Background Data Reference ID to the UE(s). Furthermore, the Background Data Transfer includes the relevant information received from the AF as defined in clause 6.1.2.4 of TS 23.503 [20].NOTE 4: When the Data Key targets "any UE", then the request to UDR applies on Application data that applies on all subscribers of the PLMN. For encoding, see TS 29.519 [82].NOTE 5: Group Data includes 5G VN group configuration, DNN and S-NSSAI specific Group Parameters and any other data related to a group stored in the UDR.NOTE 6: If a list of Internal Group IDs is used, the AF traffic influence request information request applies to the UEs that belong to every one of these groups, i.e. a single UE needs to be a member of every group in the list of Internal Group IDs.NOTE 7: When the Data Key targets "PLMN ID", then the request to UDR applies on subscription data about subscribers roaming in this PLMN.NOTE 8: In LBO roaming scenarios, when the AF request targets "any inbound roaming UEs", the AM influence information applies to the roaming subscribers from a PLMN or from any PLMN.NOTE 9: Retrieval of the stored Planned Data Transfer with QoS requirements data for all ASP identifiers in the UDR requires Data Subset but no Data Key or Data Subkey(s).NOTE 10: Update of a Planned Data Transfer with QoS requirements data in the UDR requires a Data key to refer to a Planned Data Transfer with QoS requirements data as input data.NOTE 11: Each PFD (as defined in TS 23.503 [20]) may be complimented with a source NF type which indicates the type of NF that has generated the PFD (i.e. AF or NWDAF). Absence of a source NF type indicates that the AF is the source of the PFD.NOTE 12: For further information about HR-SBO case and how these keys are used, see clause 4.3.6.1.  |

The content of the UDR storage for (Data Set Id= Application Data, Data Subset Id = AF TrafficInfluence request information) is specified in clause 5.6.7, Table 5.6.7-1 of TS 23.501 [2]. This information is written by the NEF and read by the PCF(s). PCF(s) may also subscribe to changes onto this information.

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* END of Changes \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*