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**Title: Support for DualSteer devices in 5GS**

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*Abstract of the contribution: This paper proposes solution for KI#1.x to support DualSteer devices in 5GS.*

# 1 Discussion

This paper provides a model for DualSteer device and proposes enhancements in subscription data and UE registration, and session management procedures to support steering and switching of application traffic via two 3GPP access.

The solution is applicable to both DualSteer device that does not support simultaneous transmission over two 3GPP access and that supports simultaneous transmission over two 3GPP access.

# 2 Proposal

**It is proposed to update TR 23.700-54 as follows:**

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

## 6.0 Mapping of Solutions to Key Issues

Table 6.0-1: Mapping of DualSteer Solutions to Key Issues

|  |  |
| --- | --- |
|  | Key Issues for DualSteer |
| Solution# | Key Issue #1.1 | Key Issue #1.2 | Key Issue #1.3 | Key Issue #1.4 |
| #X | X | X | X | X |
|  |  |  |  |  |

Table 6.0-2: Mapping of ATSSS\_Ph4 Solutions to Key Issues

|  |  |
| --- | --- |
|  | Key Issues for ATSSS\_Ph4 |
| Solution# | Key Issue #2.1 | Key Issue #2.2 |
| #2.1 | X |  |
| #2.2 |  | X |
| #2.3 | X |  |
| #2.4 | X |  |
| #2.5 | X |  |
| #2.6 |  | X |
| #2.7 |  | X |
| #2.8 |  | X |

 **\* \* \* \* Next Change (all text are new) \* \* \* \***

### 6.1.X Solution #X: E2E Solution to support DualSteer devices in 5GS

#### 6.1.X.1 Description

##### 6.1.X.1.0 Background

This solution provides a model for DualSteer device and proposes enhancements in subscription data and UE registration and session management procedures to support steering and switching of traffic via two 3GPP access. The solution is applicable to both DualSteer device that does not support simultaneous transmission over two 3GPP access and that supports simultaneous transmission over two 3GPP access.

##### 6.1.X.1.1 DualSteer device in 5GS



Figure 6.1.X.1.1-1: **DualSteer** device in 5GS

As per DualSteer requirements, a DualSteer device has two subscriptions/SUPIs that are linked to a single subscription profile from the same operator.

It is clear that to perform steering and switching of application traffic between the two SUPIs there is a need for a DualSteer layer in the DualSteer device as shown in Figure 6.1.X.1.1-1.

The DualSteer layer shall be provided with rules for steering and/or switching of traffic across two 3GPP access networks and the HPLMN is assumed to have full control over the rules and policies provided to the UE and to the network.

As can be seen from the Figure 6.1.X.1.1-1, the DualSteer device can access two 3GPP access networks using two different SUPIs. From the network point of view, these two SUPIs of a DualSteer device are associated with two different UEs, performing independent registration and PDU Session establishment procedures.

The DualSteer rules provided by the network to one UE with a certain SUPI is destined to the DualSteer layer that is controlling the steering and switching of the traffic. The DualSteer rules provided by the network shall identify each 3GPP access leg uniquely. As the SUPI is a private identity of the subscriber, it is proposed to use a new identifier called Registration-Id or Reg-ID between DualSteer layer and UE to identify the 3GPP access leg uniquely as shown in Figure 6.1.X.1.1-2.



Figure 6.1.X.1.1-1: **DualSteer** device Reg-ID to identify the 3GPP access leg

With the Reg-ID used to identify the 3GPP access leg, the DualSteer rules at the DualSteer layer may look like this:

"Traffic Descriptor: TCP, DestAddr 1.2.3.4", "DualSteer Active path=Reg-ID-1, DualSteer Standby path=Reg-ID-2";

NOTE: Above is just an example of how the Reg-ID can be used in the DualSteer rules. The exact rules and policies provided to the UE and to the network to support steering and switching of application traffic is further explained in 6.1.X.1.3.

##### 6.1.X.1.2 Registration and subscription data impacts to support DualSteer device

The two UEs of a DualSteer device perform individual registration and PDU Session establishment using the two SUPIs. The two subscriptions identified by the two SUPIs are linked together in the home operator network. This subscription level association of the two SUPIs is communicated to the AMF during registration, so that for PDU Sessions that are subject to traffic switching, the AMF can select one single SMF serving these PDU Sessions.

In addition, only specific traffic from a DualSteer device may require switching, which means not for all DNN, S-NSSAIs traffic switching is required. The AMF shall be provided with information on the subscribed DNN, S-NSSAIs for which traffic switching is possible. Consequently, below subscription data changes are proposed:

- The Access and Mobility subscription data is enhanced to contain:

- An indication that the SUPI is part of a DualSteer subscription

- The linked 2nd SUPI of the DualSteer subscription

- DNN, S-NSSAI that are allowed for DualSteer switching

- The SMF Selection Subscription data is also enhanced with a list of combinations of DNN, S-NSSAI for which traffic switching between the two UEs is applicable along with the selected SMF for the given DNN, S-NSSAI.

NOTE 1: How the subscription data is used for session management is further explained in 6.1.x.1.3 and 6.1.x.2.

NOTE 2: Whether AM subscription data changes are required will depend on the solution selected for session management.

Further as explained in clause 6.1.X.1.1, the DualSteer rules provided to the DualSteer device contains a new identifier i.e. "Reg-ID", to identify the 3GPP access leg. This identifier may be either allocated by the DualSteer layer and communicated to the network via each UE registered access or alternatively the network may allocate an identifier during UE registration and communicate the "Reg-ID" to the UE which forwards the Reg-ID to the DualSteer layer. It is proposed to introduce below enhancements in the registration procedure:

- When the UE sends the Registration Request, the UE includes an indication that the SUPI is located a DualSteer device and also includes a "Reg-ID" that is associated with the SUPI (allocated by the DualSteer Layer) in the Registration Request. The "Reg-ID" is then further conveyed by the AMF to the UDM and the UDM stores the "Reg-ID" in the subscriber profile, which is then further used by the network (e.g. PCF or SMF) to generate the DualSteer rules. The network (i.e. AMF) also confirms to the UE in Registration Accept whether the network supports the feature; Or

Editor’s Note: It is FFS whether indication that the SUPI is located in a DualSteer device is needed when the UE provides Reg-ID that already indicates that it is used with a DualSteer device.

- Alternatively, when the UE sends the Registration Request, the UE includes an indication that the SUPI is part of a DualSteer device. If the SUPI has a DualSteer subscription, then the UDM assigns a "Reg-ID" for this registration and provides the "Reg-ID" (along with other subscription data) to the AMF. The AMF then conveys the "Reg-ID" to the UE in the Registration Accept.

##### 6.1.X.1.3 Session Management and subscription data impacts to support DualSteer device

For PDU Sessions established via the two different UEs of a DualSteer device that may be subject to traffic switching, it is necessary to select a common PSA UPF. To achieve this, it is proposed that the PDU Sessions associated with a DNN and S-NSSAI combination subject to potential traffic switching, are served by the same SMF (and also potentially the same PCF).

The Session Management (SM) subscription data in UDM from clause 5.2.3.3.1 of TS 23.502 is enhanced as follows:

- the DNN, S-NSSAI related SM subscription information of one SUPI contains a linkage to the second SUPI together with the DNN, S-NSSAI of the second SUPI for which DualSteer of traffic between the two SUPIs is applicable.

- Information about the SMF (e.g. SMF set, SMF instance, URI for N11/N16 services) serving the PDU Session of the linked SUPI to the DNN, S-NSSAI of the DualSteer session.

The new subscription information may be used for:

- Ensuring that the same SMF is serving the PDU Sessions from both the SUPIs of the DualSteer device, to the DNN, S-NSSAI of the DualSteer session.

- For selecting a common PSA UPF for the PDU Sessions from both the SUPIs.

- For selecting the same PCF for PDU Session for the PDU Sessions from both the SUPIs.

During the PDU Session establishment, the UE includes an indication that the PDU session is applicable for potential DualSteer switching. The UE also provides the Reg-ID associated with the SUPI and if available, the PDU Session ID of the 2nd SUPI of the DualSteer device to which this PDU Session shall be linked. When a PDU Session is established for the first SUPI-1 of the DualSteer device, the SMF that is selected to serve the PDU session is registered in the UDM and its reference (e.g. SMF set, SMF instance, URI for N11/N16 services) can be used during the PDU session establishment procedure of the second SUPI-2 of the DualSteer device.

When the SMF receives a PDU session establishment request from SUPI-2 of a DualSteer device including an indication that "PDU session is applicable for potential DualSteer switching", the Reg-ID and the linked PDU Session ID of SUPI-1, the SMF receives from the SM Subscription data of the Linked SUPI-1 and corresponding DNN, S-NSSAI of the linked SUPI-1. Based on this information (i.e. the linked PDU Session ID of SUPI-1 received from SUPI-2 and SM subscription data), the SMF links the two PDU sessions from the two SUPIs of DualSteer device and select the same UPF to serve the PDU Session from SUPI-2.

The SMF provides DualSteer related information to the UPF at PFCP session creation/modification which include:

- indication that the PFCP session is a DualSteer PFCP session

- information linking the two PFCP sessions of the two PDU Sessions

If the UPF is responsible for UE IP address allocation, based on the above information the UPF links the two PFCP sessions and assigns the same UE IP address for both the sessions. If the SMF is responsible for UE IP address allocation, then the SMF provides the UPF with the UE IP address already assigned to the first PFCP session, when establishing the second PFCP session.

The processing of DL packets by UPF is further proposed to be enhanced to cope with two DualSteer PFCP sessions sharing the same UE IP address. The Packet Detection Rules (PDRs) provided to the UPF includes information linking the two PFCP sessions. When the UPF determines that a DL packet matches a PFCP session of a DualSteer PDU Session and if the second PFCP session is also established, then the UPF matches the DL packet with the DL PDR with the highest precedence among all DL PDRs of both PFCP sessions and processes the DL packets accordingly.

Alternatively, the SMF may provision common packet processing rules (e.g. DualSteer Rule, QER, URR) only once to the UPF, via either of the two PFCP sessions, while enabling these rules to apply to both PFCP sessions of a DualSteer PDU Session e.g., by associating DL PDRs of both PFCP sessions with these common rules (e.g. DL PDRs of both PFCP sessions include the DualSteer Rule ID, QER ID, URR ID) or by explicitly indicating in the rule that the rule is applicable to any N4/PDU session of the Dual steer grouping. These common rules may be modified or deleted via the same PFCP session that was used to provision them, or via the other PFCP session. When one of the DualSteer PDU sessions is deleted, common rules are maintained. Common rules are only deleted when both DualSteer PDU sessions are deleted.

Upon detecting that the SMF serving the PFCP sessions of a DualSteer PDU Session is no longer responsive, the UPF moves both the PFCP sessions to a same alternative SMF of the SMF set. The UPF can leverage the DualSteer related information above from the PFCP Session to do so.

The SMF also selects the same PCF and provides the DualSteer information to the PCF in SM policy association establishment that include:

- Indication that the SM policy association relates to a DualSteer PDU Session

- SUPI associated with the PDU Session and the linked SUPI of the DualSteer device

- The Reg-ID associated with the SUPI

- DualSteer ID allocated for the SM Policy Association and if available, a new Linked DualSteer ID set to the DualSteer ID of the SM Policy Association of the other PDU Session of the DualSteer session.

- Alternatively, the same DualSteer ID can be assigned to both DualSteer SM Policy Associations and SMF may provide the same DualSteer ID during both the SM Policy Association Establishment.

When the PCF provides PCC rules on a SM Policy Association it may indicate whether the PCC rule applies only to the corresponding PDU session or applies to both PDU Sessions in the DualSteer bundle. When one of the DualSteer PDU sessions is deleted, common rules are maintained. Common rules are only deleted when both DualSteer PDU sessions in the DualSteer bundle are deleted. As multiple PDU sessions related with a DualSteer bundle and established on a (DNN, S-NSSAI) share the same IP address, the PCF shall be able to retrieve both PDU sessions part of the same DualSteer bundle at session binding.

Upon detecting that the SMF serving a PDU session of a DualSteer bundle is no longer responsive, the PCF shall move both SM Policy Association related to this DualSteer bundle to a same alternative SMF of the SMF set. The PCF can leverage the DualSteer related information received at SM Policy Association creation/modification to determine all impacted SM Policy Associations.

##### 6.1.X.1.4 Policy to support DualSteer

If dynamic PCC is to be used for DualSteer, the PCF may take DualSteer steering and switching policy decisions and create PCC rules that contain the DualSteer PDU Session Control information, which determines how the uplink and the downlink traffic should be distributed across the two 3GPP accesses from the two SUPIs associated with the DualSteer device. If dynamic PCC is not deployed, local policy in SMF is used.

When the SMF receives the PCC rules with an indication that the rules apply for DualSteer, it maps these rules into (a) DualSteer rules, which are sent to the UE, and (b) N4 rules, which are sent to the UPF. The DualSteer rules received by the UE are further provided to the DualSteer layer and are applied by the DualSteer layer to enforce the policy in the uplink (UL) direction. The N4 Rules are applied by the UPF to enforce the policy in the downlink direction.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Information name | Description | Category | SMF permitted to modify in a PDU context | Scope |
| **Rule identifier** | Unique identifier to identify the DualSteer Rule | Mandatory | No | PDU context |
| Rule Precedence | Determines the order in which the DualSteer rule is evaluated by the DualSteer device. | Mandatory(NOTE 1) | Yes | PDU context |
| **Traffic Descriptor** | *This part defines the Traffic descriptor components for the DualSteer rule.* | Mandatory |  |  |
| Application descriptors | One or more application identities that identify the application(s) generating the traffic. | Optional | Yes | PDU context |
| IP descriptors(NOTE 4) | One or more 5-tuples that identify the destination of IP traffic. | Optional | Yes | PDU context |
| Non-IP descriptors(NOTE 4) | One or more descriptors that identify the destination of non-IP traffic, i.e. of Ethernet traffic. | Optional | Yes | PDU context |
| **DualSteer Access Selection Descriptor** | *This part defines the Access Selection Descriptor components for the ATSSS rule.* | Mandatory |  |  |
| Steering Mode | Identifies the steering mode that should be applied for the matching traffic and associated parameters. | Mandatory | Yes | PDU context |
| NOTE 1: Each DualSteer rule has a different precedence value from the other DualSteer rules. |

The DualSteer layer evaluates the DualSteer rules in priority order.

Each DualSteer rule contains a Traffic Descriptor that determines when the rule is applicable. A DualSteer rule is determined to be applicable when every component in the Traffic Descriptor matches the considered service data flow (SDF). A "match all" Traffic Descriptor may be provided, which matches all SDFs.

Each DualSteer rule contains an Access Selection Descriptor that contains the following components:

- Steering Mode, which determines how the traffic of the matching SDF should be distributed the two across 3GPP accesses of the two SUPIs of a DualSteer device. The following Steering Modes are supported:

- Active-Standby: It is used to steer a SDF through the 3GPP access of one SUPI (the Active SUPI), when this access is available, and to switch the SDF to the available other 3GPP access of the second SUPI (the Standby SUPI), when the 3GPP access through the Active SUPI becomes unavailable. When the 3GPP access through the Active SUPI access becomes available again, the SDF is switched back to this access.

- Smallest Delay: It is used to steer a SDF through the 3GPP access of one of the two SUPIs that is determined to have the smallest Round-Trip Time (RTT). Measurements may be obtained by the DualSteer device and UPF to determine the RTT over the 3GPP access of both SUPI-1 and SUPI-2. If 3GPP access of one SUPI becomes unavailable, all SDF traffic is switched to the other available 3GPP access of the second SUPI. It can only be used for DualSteer device that support simultaneous transmission over the 3GPP accesses of the two SUPIs.

As an example, the following DualSteer rules could be provided to DualSteer device:

a) "Traffic Descriptor: UDP, DestAddr 1.2.3.4", "Steering Mode: Active-Standby, Active=Reg-ID-1, Standby=Reg-ID-2":

- This rule means "steer UDP traffic with destination IP address 1.2.3.4 to the active 3GPP access which is of SUPI-1 and identified by DualSteer device as Reg-ID-1, if available. If the active path is not available, use the standby 3GPP access which is of SUPI-2 and identified by DualSteer device as Reg-ID-2".

b) "Traffic Descriptor: TCP, DestPort 8080", "Steering Mode: Smallest Delay":

- This rule means "steer TCP traffic with destination port 8080 to the 3GPP access of one of the two SUPIs of the DualSteer device that is determined to have the smallest Round-Trip Time (RTT)". The DualSteer device needs to measure the RTT over 3GPP access of both SUPIs, in order to determine which SUPI's 3GPP access has the smallest delay.

In the above examples, it is assumed that the DualSteer device identifies the two SUPIs associated with it using a unique identifier (e.g. Reg-ID) as explained in 6.1.X.1.1.

There are two alternatives proposed regarding how the DualSteer rules with Reg-ID of each SUPI is provided to the DualSteer layer.

**Alternative-1: Individual UE/SUPI specific rules are provided by network that is further aggregated at the DualSteer layer**

In this case the DualSteer rule is provided by the network (e.g. SMF) to each UE/SUPI of the DualSteer device and implicitly identifies the behaviour of the corresponding UE/SUPI. For example:

- In the rule example a) above, since the goal is to have UE1/SUPI1 to be active for a flow while UE2/SUPI2 is Standby, the network sends a rule (traffic filter, status = Active) to UE1/SUPI1 and another rule (same traffic filter, status = Standby) to UE2/SUPI2. The UE1/SUPI1 (identified as Reg-ID-1 by DualSteer device) and UE2/SUPI2 (identified as Reg-ID-2 by DualSteer device) further provides the received rules to the DualSteer layer and the DualSteer layer forms the aggregated DualSteer rule as "Traffic Descriptor: UDP, DestAddr 1.2.3.4", "Steering Mode: Active-Standby, Active=Reg-ID-1, Standby=Reg-ID-2"

In this alternative, the "Reg-ID" is internally managed by the DualSteer device and the network is not aware of the internal arrangements of the DualSteer device to identify each UE/SUPI of the DualSteer device. In this alternative, the UE does not need to provide the "Reg-ID" to the network as proposed in registration enhancements or in PDU Session establishment.

**Alternative-2: Complete DualSteer rule is provided via either of the UE/SUPI which is further forwarded by the UE/SUPI to the DualSteer layer**

In this case the DualSteer rule is provided by the network (e.g. SMF) to either of the UE/SUPI of the DualSteer device, and identifies the behaviour of each UE/SUPI of the DualSteer device. For example:

- In the rule example a) above, the network sends a DualSteer rule as "Traffic Descriptor: UDP, DestAddr 1.2.3.4", "Steering Mode: Active-Standby, Active=Reg-ID-1, Standby=Reg-ID-2". And the UE/SUPI that received the DualSteer rule from the network further forwards it to the DualSteer layer of the DualSteer device.

In this alternative, the "Reg-ID" included in the rule provided to a UE/SUPI, hence the network shall be aware of the internal arrangements of the DualSteer device to identify each UE/SUPI of the DualSteer device. In this alternative, the UE/SUPI shall provide the "Reg-ID" to the network. Reg-ID is included in the rules provided by the network to the UE/SUPI instead of the individual SUPI values to avoid any privacy issues i.e. UE1/SUPI1 of a DualSteer device shall not be allowed to know the SUPI2 of the DualSteer device.

#### 6.1.X.2 Procedures

##### 6.1.X.2.1 Enhancements to Registration procedure



Figure 6.1.X.2.1-1: Registration procedure for a DualSteer device SUPI

Figure 6.1.X.2.1‑1 above shows the registration flow of the SUPIs associated with a DualSteer device.

NOTE 1: Figure 6.1.X.2.1‑1 shows two UEs in the DualSteer device as the two SUPIs of a DualSteer device act as separate logical UEs in the context of the network. The registration procedure shown in Figure 6.1.X.2.1‑1 is applicable for both DualSteer device with a single UE and DualSteer device with two UEs.

NOTE 2: The two SUPIs of a DualSteer device are served by different RAN and may be registered to the same or different AMF(s).

NOTE 3: This solution does not describe when and how the second UE registration is triggered and is assumed that other solutions that address this aspect can be considered if required.

NOTE 4: This solution assumes that the Reg-ID will not change throughout the registration.

Following changes are proposed in the general registration procedure in clause 4.2.2.2.2 of TS 23.502:

Step 1: In Registration Request the UE shall include [Indication of usage with DualSteer device] and [DualSteer Reg-ID].

Steps 14a-c: The AMF provides the "Indication of usage with DualSteer device" and "Reg-ID" in Nudm\_UECM\_Registration request. The UDM stores the "Reg-ID" against the SUPI if the SUPI is authorized to use DualSteer service. If the SUPI is not authorized, the UDM may reject the request.

 If the SUPI is authorized to use DualSteer service the UDM provides the 2nd SUPI associated with the DualSteer device and the list of (DNN, S-NSSAI)s that are allowed for switching as part of Access and Mobility Subscription data in Nudm\_SDM\_Get response.

Alternatively, if the UE did not include the "Reg-ID" in the Registration Request, then based on the presence of "Indication of usage with DualSteer device", the UDM allocates a "Reg-ID" for the SUPI and also provides the "Reg-ID" as part of Access and Mobility Subscription data in Nudm\_SDM\_Get response. The "Reg-ID" may be stored in the subscription data or dynamically generated by the UDM.

As part of the SMF Selection Subscription data in Nudm\_SDM\_Get response, the UDM provides a list of combinations of DNN, S-NSSAI for which DualSteer of traffic between the two SUPIs associated with this subscription is applicable along with the selected SMF for the given (DNN, S-NSSAI).

Editor’s Note: It is FFS, how the Reg-ID is used to derive the DualSteer policies at the network, when the UE provides the Reg-ID to the network.

Step 21: If "Reg-ID" was allocated by the network (i.e. UDM), the AMF provides the allocated "Reg-ID" to the UE in Registration Accept message. If the "Reg-ID" is not allocated by the network (i.e. UDM), the AMF provides a confirmation to the UE that DualSteer feature is supported, in Registration Accept message.

##### 6.1.X.2.2 Selecting same SMF for serving PDU Sessions from two SUPIs



Figure 6.1.X.2.2-1: Selecting the same SMF for two SUPIs of a DualSteer device

Figure 6.1.X.2.2‑1 above proposes two alternative proposals for selecting the same SMF for PDU Sessions from the two SUPIs of a DualSteer device.

Step 1: UE-1 with SUPI-1 of the DualSteer device registers to the network as explained in Clause 6.1.X.2.1

Step 2: UE-1/SUPI-1 of the DualSteer device establishes the first PDU Session to DNN, S-NSSAI with indication that DualSteer switching is required. The UE determines based on URSP rules, if for a detected application DualSteer is required. The enhancements proposed in Step 4 through 11 below are applicable for the first PDU Session establishment also.

Step 3: UE-2 with SUPI-2 of the DualSteer device registers to the network as explained in Clause 6.1.X.2.1

When the UE-2/SUPI-2 requests for PDU Session establishment to the DNN, S-NSSAI for which DualSteer switching is required and UE-1/SUPI-1 already had established a PDU Session, below two alternatives are proposed while selecting the same SMF that is serving the PDU Session of UE-1/SUPI-1 to the DNN, S-NSSAI for serving the PDU Session requested by UE-2/SUPI‑2:

**Alternative-1, common SMF selection by the H-SMF:**

Step 4: When the UE-2/SUPI-2 initiates PDU Session establishment request, it includes an indication on whether "DualSteer required = TRUE" for the requested PDU Session. The PDU Session request may also include the "Reg-ID" associated with the SUPI-2 and if available, the linked PDU Session ID of the PDU Session from UE-1/SUPI-1 of the DualSteer device.

Step 5: SMF-2 receives the Nsmf\_PDUSession\_CreateSMContext Request from AMF-2, that includes the indication "DualSteer required = TRUE", "Reg-ID" associated with the UE-2/SUPI-2 and the linked PDU Session ID of the PDU Session from SUPI-1 of the DualSteer device.

Step 6: SMF-2 retrieves the Session Management Subscription data for SUPI-2 using Nudm\_SDM\_Get request. The request may include "DualSteer required = TRUE" indication.

Step 7: In response from the UDM, the SMF-2 also receives the Linked SUPI-1, the DNN, S-NSSAI of the SUPI-1 for which DualSteer of traffic between the two SUPIs is applicable and the reference to SMF-1 (e.g. SMF set, SMF instance, URI for N11/N16 services) that is serving the PDU Session established in Step 2 above for UE-1/SUPI-1 to the DNN, and S-NSSAI.

Step 8: Based on this information received from UDM in step 7, the SMF-2 determines that the PDU Session needs to be served by SMF-1. The SMF-2 then can:

- Either send a HTTP REDIRECT to the AMF-2 with SMF-1 information (Step 8a), triggering the AMF-2 to further send the Nsmf\_PDUSession\_CreateSMContext Request to SMF-1 (Step 8b).

Editor’s Note: It is FFS whether HTTP REDIRECT can work for different SMF Sets.

NOTE 1: In case of Home Routed Roaming scenario, the H-SMF can send a HTTP REDIRECT to V-SMF and the V-SMF will then send the PDU Session Create to the other H-SMF.

- Or forward the Nsmf\_PDUSession\_CreateSMContext Request received from AMF-2 to SMF-1, including the subscription data retrieved from the UDM.

Step 9: SMF-1 provides Nsmf\_PDUSession\_CreateSMContext response back to the AMF-2.

If step 8c was followed to forward the Nsmf\_PDUSession\_CreateSMContext request to SMF-1 from SMF-2, then the Nsmf\_PDUSession\_CreateSMContext response also goes via the SMF-2 (not shown in the figure). The subsequent communication between AMF-2 and SMF-1 happens without involving SMF-2.

**Alternative-2, common SMF selection by the serving AMF:**

Step 4: When the UE-2/SUPI-2 initiates PDU Session establishment request, it includes an indication on whether “DualSteer required = TRUE” in the NAS MM message UL NAS Transport that carries the NAS SM message PDU Session Establishment Request. The PDU Session request may also include the “Reg-ID” associated with the SUPI-2 and if available, the linked PDU Session ID of the PDU Session from UE-1/SUPI-1 of the DualSteer device.

Step 5: As described in procedure 6.1.X.2.1, during registration AMF-2 received from the UDM and stored in UE context in AMF that the SUPI-2 is associated with a DualSteer subscription and the linked SUPI=SUPI-1. The AMF-2 also received a list of (DNN, S-NSSAI)s that are allowed for switching. Based on this UE context stored in the AMF, if the DNN, S-NSSAI requested by the SUPI-2 is allowed for switching, the AMF-2 determines that the requested PDU Session from SUPI-2 shall be served by the same SMF that is serving the PDU Session of SUPI-1 to the DNN, S-NSSAI associated with DualSteer Session.

 If the SMF Selection Subscription data received for SUPI-2 from the UDM contains the SMF information that is serving the PDU Session of SUPI-1 to the DNN, S-NSSAI associated with DualSteer Session, then the AMF-2 selects the same SMF and Steps 6, 7 below are skipped. If the SMF information is not available in SMF Selection Subscription data, then the AMF-2 performs Steps 6,7 below to select the SMF.

Step 6: AMF queries the UDM to retrieve the SMF registration data for SUPI-1 and DNN, S-NSSAI associated with DualSteer Session.

Step 7: UDM returns SMF-1 information.

Step 8: AMF-2 sends Nsmf\_PDUSession\_CreateSMContext Request to SMF-1. The request also includes the indication "DualSteer required = TRUE", the linked SUPI=SUPI-1, "Reg-ID" associated with the SUPI-2 and the linked PDU Session ID of the PDU Session from SUPI-1.

Step 9: SMF-1 provides Nsmf\_PDUSession\_CreateSMContext response back to the AMF-2.

After selecting the same SMF as SUPI-1 for serving the PDU Session of SUPI-2 below enhancements are proposed to link the two PDU Sessions:

Step 10: SMF-1 then handles the PDU Session request from SUPI-2, selects the same UPF that is serving the PDU Session of SUPI-1 to the DNN, S-NSSAI applicable for DualSteer and creates the second N4 session with the UPF with the PDU Session information for SUPI-2. The N4 session management impacts are further described in 6.1.X.2.3.

Step 11: SMF-1 also selects the same PCF for PDU Session that is also serving the PDU Session of SUPI-1 to the DNN, S-NSSAI applicable for DualSteer. The SM Policy Association Establishment request contains indication that the SM Policy Association relates to a DualSteer PDU Session, the SUPI-2 associated with this PDU Session, the linked SUPI-1 of the DualSteer session. The SMF-1 also includes a DualSteer ID allocated for this SM policy association and a linked DualSteer ID of the SM Policy Association of SUPI-1 or alternatively, SMF-1 may allocate a single DualSteer ID and use the same DualSteer ID for both the SM policy association. The DualSteer ID is used by the PCF to link the two SM policy associations for the two PDU Session from the two SUPIs of the DualSteer device. When the PCF provides PCC rules on the SM Policy Association it also includes an indication whether the PCC rule applies only this PDU session only or if it applies to both the PDU Sessions in the DualSteer bundle.

Step 12: PDU Session establishment procedure continues as described in step 11 through 21 of clause 4.3.2.2.1 of TS 23.502

##### 6.1.X.2.3 Enhancements to PFCP session management



Figure 6.1.X.2.3-1: DualSteer PFCP sessions and SM policy association establishment

Figure 6.1.X.2.3‑1 above shows the enhancements in PFCP session between SMF and UPF and SM policy association establishment between SMF and PCF to support the DualSteer.

1. UE-1 is registered over 3GPP access-1 and establishes a DualSteer PDU session-1 (PDU1) over 3GPP access-1.

Whether step 2 or step 3 takes place first depends on SMF local policies.

2. The SMF establishes a PFCP session for this first PDU Session. As part of this the SMF may send:

- a DualSteer PFCP session Indication, and a Dual Steer bundle ID (global bundle Id allocated by the SMF and the same value is sent in step 7 for the second PFCP session) and a request to allocate an UE IP address (and/or IPV6 prefix) or

- alternatively, a DualSteer PFCP session Indication and a Dual Steer Session Id (allocated by the SMF to the PDU session and the same value is sent in step 7 as linked Dual Steer Session Id for the second PFCP session)], and a request to allocate an UE IP address (and/or IPV6 prefix)

The UPF answers with the UE IP address/prefix that it has allocated.

3. The SMF establishes an SM Policy Association for this first PDU Session as described in TS 23.502 clause 4.16.4 with following modifications:

The SMF may send within Npcf\_SMPolicyControl\_Create request the SUPI-1, the UE IP address (and/or IPV6 prefix), a DualSteer SM Policy Association Indication and:

- a Dual Steer bundle ID (global bundle Id allocated by the SMF and the same value is sent in step 6 for the second SM Policy Association) or

- alternatively, a Dual Steer Session Id (allocated by the SMF to the PDU session and the same value is sent in step 6 as linked Dual Steer Session Id for the second SM Policy Association)

The PCF answers with policy information. This may include policy information targeting the DualSteer bundle which is indicated by a dedicated tag in the corresponding PCC rules or PDU session related policy information (for example the Session MBR information that may apply for the bundle). This may include DL PDR(s) and their DualSteer Rule.

4. The PDU session establishment proceeds further and the SMF answers to the first PDU session establishment request of the UE.

5. UE-2 is registered over 3GPP access 2 and establishes a DualSteer PDU session-2 (PDU2) over 3GPP access-2.

6. The SMF establishes an SM Policy Association for this second PDU Session as described in TS 23.502 clause 4.16.4 with following modifications:

The SMF may send within Npcf\_SMPolicyControl\_Create request the SUPI-2, the UE IP address (and/or IPV6 prefix), a DualSteer SM Policy Association Indication and:

- a Dual Steer bundle ID (same value as sent in step 3) or

- alternatively, a Dual Steer Session Id (allocated by the SMF to the PDU session, and then the same value is sent as linked bundle Id on the first SM Policy Association), and a linked Dual Steer Session Id (same value as the Dual Steer Session Id sent in step 3 on the first SM Policy Association)

The PCF answers with policy information. This may include policy information targeting the bundle which is indicated by a dedicated tag in the corresponding PCC rules or PDU session related policy information (for example the Session MBR information that may apply for the DualSteer bundle). This may include DL PDR(s) and their DualSteer Rule.

7. The SMF establishes a PFCP session for the second PDU Session. As part of this the SMF may send

- a DualSteer PFCP session Indication, a Dual Steer bundle ID (global bundle Id allocated by the SMF and the same value is sent in step 7 for the second PFCP session) and the already allocated UE IP address (and/or IPV6 prefix) or

- alternatively, a DualSteer PFCP session Indication, a Dual Steer Session Id (allocated by the SMF to the PDU session, then the same value is sent in step 8 as linked bundle Id for the first PFCP session), a linked DualSteer Session Id (same value as allocated by the SMF in step 2) and the already allocated UE IP address (and/or IPV6 prefix)

8 The SMF may update the first PCFP session for example to provide the linked bundle Id (Dual Steer Session Id allocated in step 8).

9. The PDU session establishment proceeds further and the SMF answers to the second PDU session establishment request of the UE.

#### Editor’s Note: It is FFS how the PCF processes AF requests targeting a UE IP address, when there are 2 SM Policy associations for the two PDU Session of the DualSteer device.6.1.X.3 Impacts on services, entities and interfaces

**UE:**

- provides an indication of usage with DualSteer device in Registration request

- provides DualSteer Reg-ID in Registration request (for the alternative where Reg-ID is allocated by DualSteer device and provided to the network during registration).

- receives a confirmation of support for DualSteer feature from AMF in Registration Accept.

- receives a DualSteer Reg-ID in Registration Accept (for the alternative where Reg-ID is allocated by the network and provided to the UE during registration).

- includes in PDU Session Establishment request an indication on whether "DualSteer required" for the requested PDU Session, the "Reg-ID" associated with the SUPI, the PDU Session ID of the linked PDU Session from the second SUPI of the DualSteer device.

- receives DualSteer rules from the network and provides it to the DualSteer layer

- receives an indication in the URSP rules, whether DualSteer is required for the detected application traffic

**AMF:**

- receives an indication from UE in Registration request about usage with DualSteer device

- receives DualSteer Reg-ID of the UE in Registration request and provide the same to the UDM (for the alternative where Reg-ID is allocated by DualSteer device and provided to the network during registration).

- provides a confirmation of support for DualSteer feature to UE in Registration Accept

- receives a DualSteer Reg-ID from UDM and provides the same to the UE in Registration Accept (for the alternative where Reg-ID is allocated by the network and provided to the UE during registration)

- receives an indication on whether "DualSteer required" from UE in the NAS MM message UL NAS Transport that carries the NAS SM message PDU Session Establishment Request and select the same SMF as explained in 6.1.X.2.2 (for alternative-2 where common SMF selection is done by the serving AMF)

- receive and store in UE context in AMF the new AM Subscription data related to the DualSteer subscription

- use the SMF selection subscription data and/or query SM subscription data during PDU Session Establishment for selection of same SMF (for alternative-2 where common SMF selection is done by the serving AMF)

**UDM:**

- support the enhancements proposed in AM Subscription data and SMF selection subscription data as proposed in 6.1.X.1.2

- support the enhancements proposed in SM subscription data as proposed in 6.1.X.1.3

- receive from AMF the DualSteer Reg-ID of the UE during UE registration (when DualSteer device allocates Reg-ID and provides to the network during registration) or provide the DualSteer Reg-ID of the UE during UE registration to the AMF (when UDM allocates Reg-ID)

**SMF:**

- receives in PDU Session Establishment request an indication on whether "DualSteer required" for the requested PDU Session, the "Reg-ID" associated with the SUPI, the PDU Session ID of the linked PDU Session from the second SUPI of the DualSteer device.

- receives from UDM the SMF information that is serving the linked PDU Session of the other SUPI of a DualSteer device and either redirects the AMF to the appropriate SMF or forwards the Nsmf\_PDUSession\_CreateSMContext Request to the appropriate SMF.

- selects the same UPF and same PCF to serve the two linked PDU Session from the two SUPIs of the DualSteer device

- includes within Npcf\_SMPolicyControl\_Create/Update request a DualSteer SM Policy Association Indication, the Reg-ID associated with the SUPI, the linked SUPI and [{a Dual Steer bundle ID} or {a Dual Steer Session Id and a linked Dual Steer Session Id}]

- receives DualSteer rules from PCF and provides them to the UE and to the UPF

- provides to the UPF in N4 session, a DualSteer PFCP session Indication and information linking the two PFCP sessions of the two PDU Sessions of a DualSteer session

**PCF:**

- URSP rules include an indication of whether DualSteer is required for an application identified by the Traffic Descriptor.

- receives within Npcf\_SMPolicyControl\_Create/Update request a DualSteer SM Policy Association Indication, the Reg-ID associated with the SUPI, the linked SUPI and [{a Dual Steer bundle ID} or {a Dual Steer Session Id and a linked Dual Steer Session Id}]

- provides DualSteer rules as explained in 6.1.X.1.4 to the SMF

- provides PCC rules with indication whether the PCC rule applies only to the corresponding PDU session or applies to both the PDU Sessions in the DualSteer bundle

- As two PDU sessions related with a DualSteer bundle share the same IP address, the PCF shall be able to retrieve both the PDU sessions part of the same DualSteer bundle at session binding.

**UPF:**

- receives in N4 session, a DualSteer PFCP session Indication and information linking the two PFCP sessions of the two PDU Sessions of a DualSteer session. Based on this information the UPF links the two PFCP sessions and assigns the same UE IP address for both the sessions.

- DL packets processing by UPF as explained in 6.1.X.1.3

 **\* \* \* \* End of Changes \* \* \* \***