3GPP TSG SA WG2#164 S2-2408867

Maastricht, 19-23 August 2024 (revision of S2-2408560)

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| *CR-Form-v12.3* |
| **CHANGE REQUEST** |
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|  |  | **CR** | **5604** | **rev** | **1** | **Current version:** |  |  |
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| *For* [***HELP***](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:***  |  I-SMF selection/insertion based on local offloading allowed indication |
|  |  |
| ***Source to WG:*** |  |
| ***Source to TSG:*** | SA2 |
|  |  |
| ***Work item code:*** | eEDGE\_5GC\_Ph3 |  | ***Date:*** | 2024-08-09 |
|  |  |  |  |  |
| ***Category:*** | B |  | ***Release:*** | Rel-19 |
|  | *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-17 (Release 17)Rel-18 (Release 18)Rel-19 (Release 19) Rel-20 (Release 20)* |
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| ***Reason for change:*** | To address the outcome of KI#1 in approved eEDGE\_5GC\_Ph3 WID SP-240996 on reducing the impact on central 5GC NFs by using I-SMF based approach, I-SMF selection/insertion based on local offloading allowed indication in the subscription data is introduced. |
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| ***Summary of change:*** | Introduce I-SMF selection/insertion based on local offloading allowed indication |
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| ***Consequences if not approved:*** | Missing functionality. |
|  |  |
| ***Clauses affected:*** |  5.13, 5.34.1, 6.2.2, 6.3.2, 6.3.23 |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **X** |  Other core specifications  | TS/TR ... CR ... |
| ***affected:*** |  | **x** |  Test specifications | TS/TR ... CR ...  |
| ***(show related CRs)*** |  | **x** |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** | Rev1: Changes on 5.34.3 are removed. EN is added on the granularity of local offloading management allowed indication. |

FIRST CHANGE

## 5.13 Support for Edge Computing

Edge computing enables operator and 3rd party services to be hosted close to the UE's access point of attachment, so as to achieve an efficient service delivery through the reduced end-to-end latency and load on the transport network. Edge Computing support by 5GC is specified in this specification and in TS 23.548 [130].

NOTE: Edge Computing typically applies to non-roaming and LBO roaming scenarios. For HR roaming scenarios, Edge Computing applies only for "Home Routed with Session Breakout in VPLMN (HR-SBO)" which is described in clause 6.7 of TS 23.548 [130].

The 5G Core Network selects a UPF close to the UE and forwards traffic to enable the local access to the DN via a N6 interface according to the provided traffic steering rules to the UPF. This may be based on the UE's subscription data, UE location, the information from Application Function (AF) as defined in clause 5.6.7, the EAS information reported from EASDF (as defined in TS 23.548 [130]), policy or other related traffic rules.

Due to user or Application Function mobility, the service or session continuity may be required based on the requirements of the service or the 5G network.

The 5G Core Network may expose network information and capabilities to an Edge Computing Application Function.

NOTE: Depending on the operator deployment, certain Application Functions can be allowed to interact directly with the Control Plane Network Functions with which they need to interact, while the other Application Functions need to use the external exposure framework via the NEF (see clause 6.2.10 for details).

Edge computing can be supported by one or a combination of the following enablers:

- User plane (re)selection: the 5G Core Network (re)selects UPF to route the user traffic to the local part of the DN as described in clause 6.3.3;

- Local Routing and Traffic Steering: the 5G Core Network selects the traffic to be routed to the applications in the local part of the DN;

- this includes the use of a single PDU Session with multiple PDU Session Anchor(s) (UL CL / IP v6 multi-homing) as described in clause 5.6.4 and the use of a PDU Session with Distributed Anchor Point using SSC mode 2/3.

- Session and service continuity to enable UE and application mobility as described in clause 5.6.9;

- An Application Function may influence UPF (re)selection and traffic routing via PCF or NEF as described in clause 5.6.7;

- Network capability exposure: 5G Core Network and Application Function to provide information to each other via NEF as described in clause 5.20 or directly as described in clause 4.15 of TS 23.502 [3] or from the UPF as described in clause 6.4 of TS 23.548 [130];

- QoS and Charging: PCF provides rules for QoS Control and Charging for the traffic routed to the local part of the DN;

- Support of Local Area Data Network: 5G Core Network provides support to connect to the LADN in a certain area where the applications are deployed as described in clause 5.6.5.

- Discovery and re-discovery of Edge Applications Servers as described in TS 23.548 [130].

- Support of Edge Relocation as described in TS 23.548 [130] and the case of involving AF change as described in clauses 4.3.6.2, 4.3.6.3 and 4.3.6.4 of TS 23.502 [3]. Support of 5GC triggered Edge relocation within the same hosting PLMN's EHEs.

- Support of (I-)SMF (re)selection based on DNAI as described in clauses 4.3.5.1, 4.3.5.2 and 4.23.5.1 of TS 23.502 [3].

- Support of finer sets of UEs.

- Support of common EAS discovery and common DNAI determination for set of UEs as described in clause 6.2 of TS 23.548 [130].

- Support of mapping information between EAS IP/IP range and DNAI as described in clause 6.8 of TS 23.548 [130].

- Support of AF request for DNAI as described in clause 6.8 of TS 23.548 [130].

- Support of I-SMF (re)selection based on local offloading management as described in clauses 4.23.2 and 4.23.5.4 of TS 23.502 [3] and in clause 6.X of TS 23.548 [130].

Second CHANGES

### 5.34.1 General

When the UE is outside of the SMF Service Area, or current SMF cannot serve the target DNAI for the traffic routing for local access to the DN or when the UE is within the SMF service area and a local offloading management (see TS 23.548 [130]) is allowed, an I-SMF is inserted between the SMF and the AMF. The I-SMF has a N11 interface with the AMF and a N16a interface with the SMF and is responsible of controlling the UPF(s) that the SMF cannot directly control. The exchange of the SM context and forwarding of tunnel information if needed are done between two SMFs directly without involvement of AMF.

Editor’s Note: It is FFS whether the local offloading management allowed indication is per DNAI or per DNN and/or S-NSSAI.

Depending on scenario, a PDU Session in non-roaming case or local breakout is either served by a single SMF or served by an SMF and an I-SMF. When a PDU Session is served by both an SMF and an I-SMF, the SMF is the NF instance that has the interfaces towards the PCF and CHF.

In this Release of the specification, deployments topologies with specific SMF Service Areas apply only for 3GPP access.

The SMF shall release or reject the PDU Session if the DNN of the PDU Session corresponds to a LADN and the I-SMF is inserted to the PDU Session.

NOTE 1: This implies that operators need to plan the LADN deployment in such a way that the LADN Service area needs to be within the SMF Service Area, but not across SMFs' Service Areas.

NOTE 2: This is to cover the case where the UE is not in or moves out of SMF Service Area and an I-SMF is inserted to the PDU Session e.g. during PDU Session Establishment, Service Request. If the PDU Session is maintained with I-SMF, the SMF is not be able to enforce the LADN Service control, e.g. SMF is not notified in the case of Service Request.

Independent of whether deployments topologies with specific SMF Service Areas apply, the SMF may trigger the PDU Session re-establishment to the same DN, if the PDU Session is associated with the SSC mode 2 or SSC mode 3.

NOTE 3: SSC mode 2 or SSC mode 3 can be used to optimize SMF location for a PDU Session and/or, depending on deployment, ensure that the UE is always within the service area of the SMF controlling the PDU Session. In this case (when PDU Session continuity over the PLMN is not required) procedures described in this clause are not needed.

In this Release, how TSC (as defined in clauses 5.27 and 5.28) is supported for PDU Sessions involving an I-SMF is not specified.

In this Release, Redundant User Plane Paths as defined in clause 5.33.2.2 is not supported for PDU Sessions involving an I-SMF.

Redundant PDU sessions support as defined in clause 5.33.2.1 is supported for PDU Sessions involving an I-SMF, when different S-NSSAIs are used for the redundant PDU sessions.

Redundant User Plane Paths as defined in clause 5.33.2.3 is supported for PDU Sessions involving an I-SMF only if this PDU session is established for a S-NSSAI referring to network instances requiring redundant transmission at transport layer.

QoS monitoring (as defined in clause 5.33.3) is supported as long as SMF and not I-SMF initiates the QoS monitoring function.

Dynamic CN PDB provisioning (as defined in clause 5.7.3.4) is supported for PDU Sessions involving an I-SMF.

In this Release, no dedicated functionality is specified for I-SMF and N16a in order to support NPN.

When an I-SMF is inserted to support local traffic offloading to manage edge computing information locally, EAS deployment information management, EASDF configuration and DNS message handling are performed by I-SMF as described in 23.548 [130].

Third CHANGES

### 6.2.2 SMF

The Session Management function (SMF) includes the following functionality. Some or all of the SMF functionalities may be supported in a single instance of a SMF:

- Session Management e.g. Session Establishment, modify and release, including tunnel maintain between UPF and AN node.

- UE IP address allocation & management (including optional Authorization). The UE IP address may be received from a UPF or from an external data network.

- DHCPv4 (server and client) and DHCPv6 (server and client) functions.

- Functionality to respond to Address Resolution Protocol (ARP) requests and / or IPv6 Neighbour Solicitation requests based on local cache information for the Ethernet PDUs. The SMF responds to the ARP and / or the IPv6 Neighbour Solicitation Request by providing the MAC address corresponding to the IP address sent in the request.

- Selection and control of UP function, including controlling the UPF to proxy ARP or IPv6 Neighbour Discovery, or to forward all ARP/IPv6 Neighbour Solicitation traffic to the SMF, for Ethernet PDU Sessions.

- Configures traffic steering at UPF to route traffic to proper destination.

- 5G VN group management, e.g. maintain the topology of the involved PSA UPFs, establish and release the N19 tunnels between PSA UPFs, configure traffic forwarding at UPF to apply local switching, N6-based forwarding or N19-based forwarding, manage traffic forwarding in the case that a SMF Set or multiple SMF Sets are serving a 5G VN.

- Termination of interfaces towards Policy control functions.

- Lawful intercept (for SM events and interface to LI System).

- Support for charging.

- Control and coordination of charging data collection at UPF.

- Termination of SM parts of NAS messages.

- Downlink Data Notification.

- Initiator of AN specific SM information, sent via AMF over N2 to AN.

- Determine SSC mode of a session.

- Support for Control Plane CIoT 5GS Optimisation.

- Support of header compression.

- Act as I-SMF in deployments where I-SMF can be inserted, removed and relocated.

- Provisioning of external parameters (Expected UE Behaviour parameters or Network Configuration parameters).

- Support P-CSCF discovery for IMS services.

- Act as V-SMF with following roaming functionalities:

- Handle local enforcement to apply QoS SLAs (VPLMN).

- Charging (VPLMN).

- Lawful intercept (in VPLMN for SM events and interface to LI System).

- Support for interaction with external DN for transport of signalling for PDU Session authentication/authorization by external DN.

- Instructs UPF and NG-RAN to perform redundant transmission on N3/N9 interfaces.

- Generation of the TSC Assistance Information based on the TSC Assistance Container received from the PCF.

- Support for RAN feedback for BAT offset and adjusted periodicity as defined in clause 5.27.2.5.

NOTE: Not all of the functionalities are required to be supported in an instance of a Network Slice.

In addition to the functionalities of the SMF described above, the SMF may include policy related functionalities as described in clause 6.2.2 of TS 23.503 [45].

In addition to the functionality of the SMF described above, the SMF may include the following functionality to support monitoring in roaming scenarios:

- Normalization of reports according to roaming agreements between VPLMN and HPLMN; and

- Generation of charging information for Monitoring Event Reports that are sent to the HPLMN.

The SMF may also include following functionalities to support Edge Computing enhancements (further defined in TS 23.548 [130]):

- Selection of EASDF, obtain and/or provision DNS security information of the EASDF and provision of its address to the UE as the DNS Server for the PDU session;

- Usage of EASDF services as defined in TS 23.548 [130];

- For supporting the Application Layer Architecture defined in TS 23.558 [134]: Provision and updates of ECS Address Configuration Information to the UE;

- For supporting the HR-SBO as defined in clause 6.7 of TS 23.548 [130].

NOTE: In case an I-SMF is inserted to locally manage edge computing related information and the traffic is locally offloaded, only the I-SMF performs the EASDF selection and uses the EASDF services for the locally offloaded PDU sessions.

The SMF and SMF+ PGW-C may also include following functionalities to support Network Slice Admission Control:

- Support of NSAC for maximum number of PDU sessions as defined in clauses 5.15.11.2, 5.15.11.3 and 5.15.11.5.

- Support of NSAC for maximum number of UEs as defined in clauses 5.15.11.3 and 5.15.11.5.

The SMF may also include following functionalities:

- Providing per-QoS flow Non-3GPP QoS assistance information to the UE (e.g. PEGC) and formulation of the CN PDB based on non-3GPP delay budget from UE (e.g. PEGC) as described in clause 5.44.3.4.

- Support of PDU Set based handling as described in clause 5.37.5.

In addition to the functionalities of the SMF described above, the SMF may also include functionalities to support Network Slice Replacement as described in clause 5.15.19.

The SMF may also include functionalities to support indirect UPF event exposure service subscription on behalf of the consumer NF(s) as described in clause 4.15.4.5 of TS 23.502 [3].

Fourth CHANGES

### 6.3.2 SMF discovery and selection

The SMF selection functionality is supported by the AMF and SCP and is used to allocate an SMF that shall manage the PDU Session. The SMF selection procedures are described in clause 4.3.2.2.3 of TS 23.502 [3].

The SMF discovery and selection functionality follows the principles stated in clause 6.3.1.

If the AMF does discovery, the AMF shall utilize the NRF to discover SMF instance(s) unless SMF information is available by other means, e.g. locally configured on AMF. The AMF provides UE location information to the NRF when trying to discover SMF instance(s). The NRF provides NF profile(s) of SMF instance(s) to the AMF. In addition, the NRF also provides the SMF service area of SMF instance(s) to the AMF. The SMF selection functionality in the AMF selects an SMF instance and an SMF service instance based on the available SMF instances obtained from NRF or on the configured SMF information in the AMF.

NOTE 1: Protocol aspects of the access to NRF are specified in TS 29.510 [58].

The SMF selection functionality is applicable to both 3GPP access and non-3GPP access.

The SMF selection for Emergency services is described in clause 5.16.4.5.

The following factors may be considered during the SMF selection:

a) Selected Data Network Name (DNN). The formulation of the DNN considers the information provided in f) below. In the case of the home routed roaming, the DNN is not applied for the V-SMF selection.

b) S-NSSAI of the HPLMN (for non-roaming and home-routed roaming scenarios), and S-NSSAI of the VPLMN (for roaming with local breakout and home-routed roaming scenarios).

c) NSI-ID.

NOTE 2: The use of NSI -ID in the network is optional and depends on the deployment choices of the operator. If used, the NSI ID is associated with S-NSSAI.

d) Access technology being used by the UE.

e) Support for Control Plane CIoT 5GS Optimisation.

f) Subscription information from UDM, e.g.

- per DNN: whether LBO roaming is allowed.

- per DNN: whether HR-SBO roaming is allowed.

- per S-NSSAI: the subscribed DNN(s).

- per (S-NSSAI, subscribed DNN): whether LBO roaming is allowed.

- per (S-NSSAI, subscribed DNN): whether HR-SBO roaming is allowed.

- per (S-NSSAI, subscribed DNN): whether EPC interworking is supported.

- per (S-NSSAI, subscribed DNN): whether selecting the same SMF for all PDU sessions to the same S-NSSAI and DNN is required.

- per (S-NSSAI, DNN) associated with 5G VN group: Service Area (LADN service area) for the 5G VN group. In the case of SMF selection for a PDU Session targeting 5G VN group, the AMF may prefer candidate SMF(s) that have an intersection with the LADN service area of the 5G VN group.

- per (S-NSSAI, subscribed DNN): Additional Parameters for SMF selection in target PLMN as defined in TS 23.502 [3] and may include the target network identifier (i.e. PLMN ID preferred by the operator).

NOTE 3: When AMF formulates the NRF query for SMF selection, the target network identifier (i.e. PLMN ID) in subscription data can be used as the Operator Identifier of the DNN parameter and as part of the Target PLMN List parameter.

g) Void.

h) Local operator policies.

NOTE 3: These policies can take into account whether the SMF to be selected is an I-SMF or a V-SMF or a SMF.

i) Load conditions of the candidate SMFs.

j) Analytics (i.e. statistics or predictions) for candidate SMFs' load as received from NWDAF (see TS 23.288 [86]), if NWDAF is deployed.

k) UE location (i.e. TA).

l) Service Area of the candidate SMFs or serving scope/preferred locality (which may be formulated by AMF, as specified in TS 29.510 [58], based on UE location) of the candidate SMFs.

m) Capability of the SMF to support a MA PDU Session.

n) If interworking with EPS is required.

o) Preference of V-SMF support. This is applicable only for V-SMF selection in the case of home routed roaming.

p) Target DNAI.

q) Capability of the SMF to support User Plane Remote Provisioning (see clause 5.30.2.10.4.3).

r) Supported DNAI list.

s) HR-SBO support (according to clause 6.7 of TS 23.548 [130]).

t) Capability of the SMF (V-SMF and H-SMF) to support non-3GPP access path switching.

To support the allocation of a static IPv4 address and/or a static IPv6 prefix as specified in clause 5.8.2.2.1, a dedicated SMF may be deployed for the indicated combination of DNN and S-NSSAI and registered to the NRF, or provided by the UDM as part of the subscription data.

In the case of delegated discovery, the AMF, shall send all the available factors a)-d), k) and n) to the SCP.

In addition, the AMF may indicate to the SCP which NRF to use (in the case of NRF dedicated to the target slice).

If there is an existing PDU Session and the UE requests to establish another PDU Session to the same DNN and S-NSSAI of the HPLMN, and the UE subscription data indicates the support for interworking with EPS for this DNN and S-NSSAI of the HPLMN or UE subscription data indicates the same SMF shall be selected for all PDU sessions to the same S-NSSAI, DNN, the same SMF in non roaming and LBO case or the same H-SMF in home routed roaming case, shall be selected. In addition, if the UE Context in the AMF provides a SMF ID for an existing PDU session to the same DNN, S-NSSAI, the AMF uses the stored SMF ID for the additional PDU Session. In any such a case where the AMF can determine which SMF should be selected, if delegated discovery is used, the AMF shall indicate a desired NF Instance ID so that the SCP is able to route the message to the relevant SMF. Otherwise, if UE subscription data does not indicate the support for interworking with EPS for this DNN and S-NSSAI, a different SMF in non roaming and LBO case or a different H-SMF in home routed roaming case, may be selected. For example, to support a SMF load balancing or to support a graceful SMF shutdown (e.g. a SMF starts to no more take new PDU Sessions).

In the home-routed roaming case, the SMF selection functionality selects an SMF in VPLMN based on the S-NSSAI of the VPLMN, as well as an SMF in HPLMN based on the S-NSSAI of the HPLMN. This is specified in clause 4.3.2.2.3.3 of TS 23.502 [3].

In the case of Indirect Network Sharing, the SMF selection of the anchor SMF in the participating operator's network reuses the procedure of H-SMF selection for home-routed roaming but may furthermore take into account the location information based on current UE location.

If the HR-SBO roaming is allowed for the PDU Session, the DNN is also considered for V-SMF selection.

When the UE requests to establish a PDU Session to a DNN and an S-NSSAI of the HPLMN, if the UE MM Core Network Capability indicates the UE supports EPC NAS and optionally, if the UE subscription indicates the support for interworking with EPS for this DNN and S-NSSAI of the HPLMN, the selection functionality (in AMF or SCP) selects a combined SMF+PGW-C. Otherwise, a standalone SMF may be selected.

If the UDM provides a subscription context that allows for handling the PDU Session in the VPLMN (i.e. using LBO) for this DNN and S-NSSAI of the HPLMN and, optionally, the AMF is configured to know that the VPLMN has a suitable roaming agreement with the HPLMN of the UE, the following applies:

- If the AMF does discovery, the SMF selection functionality in AMF selects an SMF from the VPLMN.

- If delegated discovery is used, the SCP selects an SMF from the VPLMN.

If an SMF in the VPLMN cannot be derived for the DNN and S-NSSAI of the VPLMN, or if the subscription does not allow for handling the PDU Session in the VPLMN using LBO, then the following applies:

- If the AMF does discovery, both an SMF in VPLMN and an SMF in HPLMN are selected, and the DNN and S-NSSAI of the HPLMN is used to derive an SMF identifier from the HPLMN.

- If delegated discovery is used:

- The AMF performs discovery and selection of H-SMF from NRF. The AMF may indicate the maximum number of H-SMF instances to be returned from NRF, i.e. SMF selection at NRF.

- The AMF sends Nsmf\_PDUSession\_CreateSMContext Request to SCP, which includes the endpoint (e.g. URI) of the selected H-SMF, and the discovery and selection parameters as defined in this clause, i.e. parameter for V-SMF selection. The SCP performs discovery and selection of the V-SMF and forwards the request to the selected V-SMF.

- The V-SMF sends the Nsmf\_PDUSession\_Create Request towards the H-SMF via the SCP; the V-SMF uses the received endpoint (e.g. URI) of the selected H-SMF to construct the target destination to be addressed. The SCP forwards the request to the H-SMF.

- Upon reception of a response from V-SMF, based on the received V-SMF ID the AMF obtains the Service Area of the V-SMF from NRF. The AMF uses the Service Area of the V-SMF to determine the need for V-SMF relocation upon subsequent UE mobility.

If the initially selected SMF in VPLMN (for roaming with LBO) detects it does not understand information in the UE request, it may reject the N11 message (related with a PDU Session Establishment Request message) with a proper N11 cause triggering the AMF to select both a new SMF in the VPLMN and a SMF in the HPLMN (for home routed roaming).

The AMF selects SMF(s) considering support for CIoT 5GS optimisations (e.g. Control Plane CIoT 5GS Optimisation).

In the case of onboarding of UEs for SNPNs, when the UE is registered for SNPN onboarding the AMF selects SMF(s) of Onboarding Network considering the Capability of SMF to support User Plane Remote Provisioning.

Additional details of AMF selection of an I-SMF, including the case that local offloading management is allowed while the UE is within the service area of the SMF, are described in clause 5.34.

In the case of home routed scenario, the AMF selects a new V-SMF if it determines that the current V-SMF cannot serve the UE location. The selection/relocation is same as an I-SMF selection/relocation as described in clause 5.34.

Fifth CHANGES

### 6.3.23 EASDF discovery and selection

Multiple instances of EASDF may be deployed in a network. NF consumers mentioned in this clause are SMF(s) or I-SMF in case I-SMF based local offloading management applies.

NOTE: In case I-SMF based local offloading management applies, EASDF discovery and selection is only performed by the selected I-SMF.

The NF consumers shall utilize the NRF to discover EASDF instance(s) unless EASDF information is available by other means, e.g. locally configured on the NF consumer. The EASDF selection function in NF consumers or SCP selects an EASDF instance based on the available EASDF instances.

The following factors may be considered by the NF consumer or SCP for EASDF selection:

- S-NSSAI.

- DNN.

- the N6 IP address of the EASDF.

NOTE: The IP address of the EASDF is not used for EASDF discovery. It can be used is to select an EASDF that is "IP near" to the PSA of the PDU Session.

- The N6 IP address of the PSA UPF.

- Location as per NF profile.

- DNAI (if exist).

- Supported DNS security protocols (if existing).

End of CHANGES