**3GPP TSG-WG SA2 Meeting #164 S2-2407625**

**Maastricht, Netherlands, 19 August – 23 August, 2024**

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| *CR-Form-v12.2* |
| **CHANGE REQUEST** |
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|  | **23.501** | **CR** | **5431** | **rev** | **----** | **Current version:** | **17.13.0** |  |
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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:***  | Align H-PCF selection with H-SMF selection in 23.501 R17 |
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| ***Source to WG:*** | Oracle, Verizon UK Ltd., Ericsson |
| ***Source to TSG:*** | SA2 |
|  |  |
| ***Work item code:*** | 5GS\_Ph1, 5G\_eSBA, TEI17? |  | ***Date:*** | 2024-08-19 |
|  |  |  |  |  |
| ***Category:*** | **F** |  | ***Release:*** | Rel-17 |
|  | *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)* |
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| ***Reason for change:*** | 1. Currently during PDU session establishment procedure for HR roaming scenario, the AMF discovers both vSMF and hSMF. According 23.502 5.2.8.2.5 or/and according 29.502 table 6.1.6.2.2-1, it optionally provides both hSMF ID and hSMF URI (e.g FQDN/IP-address) to vSMF. This may obviate the need for vSMF to re-discover hSMF.2. Similarly to (1), Currently during UE registration procedure for a roaming UE, the AMF discovers both vPCF and hPCF. However, based on 23.501 6.3.7, it provides only hPCF ID to vPCF (it does not provide hPCF URI). This requires vPCF to discover the FQDN/IP-addr/port of the hPCF by querying the NRF. In addition, it creates a misalignment, between the above two discoveries (i.e. H-SMF discovery vs H-PCF discovery), which was not the original intention.3. For (1) providing hSMF ID and hSMF URI to vSMF by AMF is currently described only for delegated discovery (aka SCP model D). However, this should be applicable also for the non-delegated discovery model.NOTE 1: URI Structure is defined in 29.501 4.4.NOTE 2: This CR attempts to address inconsistency/inaccuracies only in the roaming scenario (e.g it stays away from updating anything related to I-SMF). |
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| ***Summary of change:*** | This CR proposes to* Update 23.501 6.3.7 – Allow AMF to provide to V-PCF also URI (e.g FQDN/IP-address) of the hPCF.
* Update 23.501 6.3.2 – Adjust the text to such that it is clear that hSMF ID and hSMF URI can be provided to vSMF by AMF regardless of the discovery model that is used.
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| ***Consequences if not approved:*** | 1. Misalignment between H-SMF discovery and H-PCF discovery. 2. Unnecessarily, limiting the use of H-SMF ID and H-SMF URI to delegated discovery model only. |
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| ***Clauses affected:*** | 6.3.2, 6.3.7.1 |
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|  | **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 ...  |
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| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

\*\*\* 1st Change \*\*\*

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

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

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.

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.

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].

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.

- The AMF should provide to the V-SMF an H-SMF ID and/optionally the address of the Nsmf\_PDUSession service of selected H-SMF instance in the Nsmf\_PDUSession\_CreateSMContext Request.

- 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 should include H-SMF ID and optionally the endpoint of the Nsmf\_PDUSession service(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 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.

\*\*\* 2nd Change \*\*\*

#### 6.3.7.1 PCF discovery and selection for a UE or a PDU Session

PCF discovery and selection functionality is implemented in AMF, SMF and SCP, and follows the principles in clause 6.3.1. The AMF uses the PCF services for a UE and the SMF uses the PCF services for a PDU Session.

When the NF service consumer performs discovery and selection for a UE, the following applies:

- The AMF may utilize the NRF to discover the candidate PCF instance(s) for a UE. In addition, PCF information may also be locally configured in the AMF. The AMF selects a PCF instance based on the available PCF instances obtained from the NRF or locally configured information in the AMF, depending on operator's policies.

In the non roaming case, the AMF selects a PCF instance for AM policy association and selects the same PCF instance for UE policy association. In the roaming case, the AMF selects a V-PCF instance for AM policy association and selects the same V-PCF instance for UE policy association. The following factors may be considered at PCF discovery and selection for Access and Mobility policies and UE policies:

- SUPI; the AMF selects a PCF instance based on the SUPI range the UE's SUPI belongs to or based on the results of a discovery procedure with NRF using the UE's SUPI as input for PCF discovery.

- S-NSSAI(s). In the roaming case, the AMF selects the V-PCF instance based on the S-NSSAI(s) of the VPLMN and selects the H-PCF instance based on the S-NSSAI(s) of the HPLMN.

- PCF Set ID.

- PCF Group ID of the UE's SUPI.

NOTE 1: The AMF can infer the PCF Group ID the UE's SUPI belongs to, based on the results of PCF discovery procedures with NRF. The AMF provides the PCF Group ID the SUPI belongs to to other PCF NF consumers as described in TS 23.502 [3].

- DNN replacement capability of the PCF.

- PCF Selection Assistance Info and PCF ID(s) serving the established PDU Sessions/PDN Connections received from UDM. In case PCF Selection Assistance Info and PCF ID(s) are received from the UDM, the AMF selects the same PCF instance serving the combination of DNN and S-NSSAI as indicated by the PCF Selection Assistance Info, if multiple DNN, S-NSSAI combinations are provided, the AMF selects the DNN,S-NSSAI using local configuration. In case PCF ID(s) are not received, e.g. EPS interworking is not supported, the AMF selects the PCF instance by considering other above factors.

When the NF service consumer performs discovery and selection for a PDU Session, the following applies:

- The SMF may utilize the NRF to discover the candidate PCF instance(s) for a PDU Session. In addition, PCF information may also be locally configured in the SMF. The SMF selects a PCF instance based on the available PCF instances obtained from the NRF or locally configured information in the SMF, depending on operator's policies.

 The following factors may be considered at PCF discovery and selection for a PDU session:

a) Local operator policies.

b) Selected Data Network Name (DNN).

c) S-NSSAI of the PDU Session. In the LBO roaming case, the SMF selects the PCF instance based on the S-NSSAI of the VPLMN. In the home routed roaming case, the H-SMF selects the H-PCF instance based on the S-NSSAI of the HPLMN.

d) SUPI; the SMF selects a PCF instance based on the SUPI range the UE's SUPI belongs to or based on the results of a discovery procedure with NRF using the UE's SUPI as input for PCF discovery.

e) PCF selected by the AMF for the UE.

f) MA PDU Session capability of the PCF, for an MA PDU session.

g) The PCF Group ID provided by the AMF to the SMF.

h) PCF Set ID.

i) Same PCF Selection Indication.

In the case of delegated discovery and selection in SCP, the SMF includes the factors b) - h), if available, in the first request.

The selected PCF instance for serving the UE and the selected PCF instance for serving a PDU session of this UE may be the same or may be different.

In the following scenarios, information about the PCF instance that has been selected (i.e. the PCF ID, PCF Set Id and, if PCF Set Id is not available, the PCF Group ID (if available)) may be forwarded to another NF. If the NF service consumer performs discovery and selection, this NF may use this PCF instance. If the NF service consumer performs delegated discovery and selection, this NF may include PCF ID, PCF Set Id and, if PCF Set Id is not available, the PCF Group ID (if available) in the request and the SCP may use this information to select the PCF instance (discovery may still be needed depending on what level of information is sent by the AMF, e.g. the endpoint address(es) of the PCF/PCF serviceinstanc(es) may not be present):

When NF service consumer performs discovery and selection, the following applies:

- During AMF relocation, the target AMF may receive a PCF ID, PCF Set Id and, if PCF Set Id is not available, the PCF Group ID (if available) from the source AMF to enable the usage of the same PCF by the target AMF, and the target AMF may decide based on operator policy either to use the same PCF or select a new PCF.

- The AMF may, based on operator policies, forward the selected PCF to SMF instance(s) during the PDU Session Establishment procedure(s) to enable the usage of the same PCF for the AMF and the SMF instance(s). The SMF may decide based on operator policy either to use the same PCF or select a new PCF. If combination of the DNN and S-NSSAI of the PDU session matches one of the combination of the DNN and S-NSSAI included in the PCF Selection Assistance info received from UDM, the AMF shall forward Same PCF Selection Indication together with the selected PCF to SMF instance during the PDU Session Establishment procedure. In case that the Same PCF Selection Indication is received together with the PCF ID, the SMF shall select the same PCF instance for SM Policy Control.

- In the roaming case, the AMF may, based on operator policies, e.g. roaming agreement, select the H-PCF in addition to the V-PCF for a UE by performing the PCF discovery and selection as described above. The AMF should send the H-PCF ID and optionally the endpoint address of the Npcf\_UEPolicyControl service of the selected H-PCF instance to the V-PCF during the policy association establishment procedure.

When the SMF receives a redirection indication with PCF ID from the PCF for the PDU session, the SMF shall terminate the current SM Policy Control association and reselects a PCF based on the received PCF ID. The SMF shall then establish an SM Policy Control association with the reselected PCF.

In the case of delegated discovery and selection in the SCP, the following applies:

- The selected PCF instance may include the PCF Id, PCF Set Id and, if PCF Set Id is not available, the PCF Group ID (if available) in the response to the AMF.

NOTE 2: The selected (V-)PCF instance can include the binding indication, including the (V-)PCF ID and possibly PCF Set ID in the response to the AMF as described in clause 6.3.1.0.

- The AMF first establishes an AM policy association; when forwarding the related request message the SCP discovers and selects a PCF instance. Unless binding information is provided in the response to that request the SCP adds the NF function producer ID it selected, i.e. PCF ID, into the response and the AMF uses the received PCF ID and available binding information as discovery and selection parameters for the request to establish the UE policy association towards the SCP. The SCP selects the (V-)PCF instance for UE policy association based on the received discovery and selection parameters.

- During AMF relocation, the AMF may receive a PCF ID, PCF Set Id and, if PCF Set Id is not available, the PCF Group ID (if available) from the source AMF to enable the usage of the same PCF instance by the AMF. The AMF may decide based on operator policy either to use the old PCF instance or select another PCF instance. If the AMF decides to use the old PCF, the AMF includes the PCF ID PCF Set Id, and if PCF Set Id is not available, the PCF Group ID (if available) as received from the source AMF in the AM policy update request to the SCP.

- The AMF may, based on operator policies, forward the selected PCF ID, PCF Set Id and, if PCF Set Id is not available, the PCF Group ID (if available) to the SMF during the PDU Session Establishment procedure to enable the usage of the same PCF for the AMF and the SMF. The SMF may include that information in the request in discovery and selection parameters to the SCP. The SCP may decide based on operator policy either to use the indicated PCF instance or select another PCF instance.

- In the roaming case, the AMF performs discovery and selection of the H-PCF from NRF as described in this clause. The AMF may indicate the maximum number of H-PCF instances to be returned from NRF, i.e. H-PCF selection at NRF. The AMF uses the received V-PCF nd available binding information received during the AM policy association procedure to send the UE policy association establishment request, which should also include the H-PCF ID and optionally the Npcf\_UEPolicyControl service of the selected H-PCF, to the SCP. The SCP discovers and selects the V-PCF. The V-PCF sends an UE policy association establishment request towards the HPLMN, which should include the H-PCF ID and optionally the endpoint address of the Npcf\_UEPolicyControl service of selected H-PCF as a discovery and selection parameter to SCP.

\*\*\* End of Change \*\*\*