**3GPP TSG SA WG2 Meeting #XX *S2-200xxxx***

**Elbonia, ???, 2020 *(Revision of S2-20xxxxx)***

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| *CR-Form-v12.0* |
| **CHANGE REQUEST** |
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|  | **23.501** | **CR** | **xxxx** | **rev** | **-** | **Current version:** | **16.6.0** |  |
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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:***  | IP index from UDM |
|  |  |
| ***Source to WG:*** | Ericsson, Verizon?, Nokia?, Oracle?, Cisco? |
| ***Source to TSG:*** | SA2 |
|  |  |
| ***Work item code:*** | TEI17\_IPU |  | ***Date:*** | 2020-02-18 |
|  |  |  |  |  |
| ***Category:*** | **C** |  | ***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-12 (Release 12)**Rel-13 (Release 13)Rel-14 (Release 14)Rel-15 (Release 15)Rel-16 (Release 16)* |
|  |  |
| ***Reason for change:*** | See DP S2-2002025 |
|  |  |
| ***Summary of change:*** | Add the possibility that SMF may receive IPindex from UDM |
|  |  |
| ***Consequences if not approved:*** | 1) No UE service possible when dynamic PCC is not deployed and IPindex is mandatory part of an operator service (e.g. enterprise ). 2) When dynamic PCC is deployed and provides IPindex today there is additional PCC signaling required from SMF to PCF to provide the SMF with the IPindex before the SMF can ensure an IP address is allocated to the UE– providing IPindex via UDM eliminates that extra PCC signaling |
|  |  |
| ***Clauses affected:*** | 5.6.1, 5.8.2.2.1 |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** | **X** |  |  Other core specifications  | TS 23.502 CRxxxxx.  |
| ***affected:*** |  | **X** |  Test specifications | TS/TR ... CR ...  |
| ***(show related CRs)*** |  | **X** |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* 1st changes \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

### 5.6.1 Overview

The 5GC supports a PDU Connectivity Service i.e. a service that provides exchange of PDUs between a UE and a data network identified by a DNN. The PDU Connectivity Service is supported via PDU Sessions that are established upon request from the UE.

The Subscription Information for each S-NSSAI may contain a Subscribed DNN list and one default DNN. When the UE does not provide a DNN in a NAS Message containing PDU Session Establishment Request for a given S-NSSAI, the serving AMF determines the DNN for the requested PDU Session by selecting the default DNN for this S-NSSAI if a default DNN is present in the UE's Subscription Information; otherwise the serving AMF selects a locally configured DNN for this S-NSSAI.

The expectation is that the URSP in the UE is always up to date using the procedure defined in TS 23.502 [3] clause 4.16.12.2 and therefore the UE requested DNN will be up to date.

In order to cover cases that UE operates using local configuration, but also other cases where operator policies can be used in order to replace an "up to date" UE requested DNN with another DNN used only internally in the network, during UE Registration procedure the PCF may indicate, to the AMF, the operator policies to be used at PDU Session Establishment for DNN replacement of a UE requested DNN. PCF may indicate a policy for DNN replacement of UE requested DNNs not supported by the network, and/or indicate a list of UE requested DNNs per S-NSSAI valid for the serving network, that are subject for replacement (details are described in TS 23.503 [45]).

If the DNN provided by the UE is not supported by the network and AMF cannot select an SMF by querying NRF, the AMF shall reject the NAS Message containing PDU Session Establishment Request from the UE with a cause indicating that the DNN is not supported unless the PCF provided the policy to perform a DNN replacement of unsupported DNNs.

If the DNN requested by the UE is indicated for replacement or the DNN provided by the UE is not supported by the network and the PCF provided the policy to perform DNN replacement of UE requested DNNs not supported by the network, the AMF shall interact with the PCF to perform a DNN replacement. During PDU Session Establishment procedure and as a result of DNN replacement, the PCF provides the selected DNN that is applicable for the S-NSSAI requested by the UE at the PDU Session Establishment. The AMF uses the selected DNN in the query towards the NRF for the SMF selection, as specified in clause 6.3.2, and provides both requested and selected DNN to the selected SMF. For PDU Session with Home-routed Roaming whether to perform DNN replacement is based on operator agreements.

NOTE 1: The selected DNN is determined based on operator preferences and can differ from subscribed DNNs. The matching of selected DNN to S-NSSAI is assumed to be based on network configuration.

Each PDU Session supports a single PDU Session type i.e. supports the exchange of a single type of PDU requested by the UE at the establishment of the PDU Session. The following PDU Session types are defined: IPv4, IPv6, IPv4v6, Ethernet, Unstructured.

PDU Sessions are established (upon UE request), modified (upon UE and 5GC request) and released (upon UE and 5GC request) using NAS SM signalling exchanged over N1 between the UE and the SMF. Upon request from an Application Server, the 5GC is able to trigger a specific application in the UE. When receiving that trigger message, the UE shall pass it to the identified application in the UE. The identified application in the UE may establish a PDU Session to a specific DNN, see clause 4.4.5.

SMF may support PDU Sessions for LADN where the access to a DN is only available in a specific LADN service area. This is further defined in clause 5.6.5.

SMF may support PDU Sessions for a 5G VN group which offers a virtual data network capable of supporting 5G LAN-type service over the 5G system. This is further defined in clause 5.8.2.13.

The SMF is responsible of checking whether the UE requests are compliant with the user subscription. For this purpose, it retrieves and requests to receive update notifications on SMF level subscription data from the UDM. Such data may indicate per DNN and per S-NSSAI of the HPLMN:

- The allowed PDU Session Types and the default PDU Session Type.

- The allowed SSC modes and the default SSC mode.

- QoS Information (refer to clause 5.7): the subscribed Session-AMBR, Default 5QI and Default ARP.

- The IP Index information.

- The static IP address/prefix.

- The subscribed User Plane Security Policy.

- the Charging Characteristics to be associated with the PDU Session. Whether this information is provided by the UDM to a SMF in another PLMN (for PDU Sessions in LBO mode) is defined by operator policies in the UDM/UDR.

NOTE 2: The content of the Charging Characteristics as well as the usage of the Charging Characteristics by the SMF are defined in TS 32.240 [41].

A PDU Session may support:

(a) a single-access PDU Connectivity Service, in which case the PDU Session is associated with a single access type at a given time, i.e. either 3GPP access or non-3GPP access; or

(b) a multi-access PDU Connectivity Service, in which case the PDU Session is simultaneously associated with both 3GPP access and non-3GPP access and simultaneously associated with two independent N3/N9 tunnels between the PSA and RAN/AN.

A PDU Session supporting a single-access PDU Connectivity Service is also referred to as single-access PDU Session, while a PDU Session supporting a multi-access PDU Connectivity Service is referred to as Multi-Access PDU (MA PDU) Session and it is used to support the ATSSS feature (see clause 5.32 for details).

A UE that is registered over multiple accesses chooses over which access to establish a PDU Session. As defined in TS 23.503 [45], the HPLMN may send policies to the UE to guide the UE selection of the access over which to establish a PDU Session.

NOTE 3: In this Release of the specification, at any given time, a PDU Session is routed over only a single access network, unless it is an MA PDU Session in which case it can be routed over one 3GPP access network and one Non 3GPP access network concurrently.

A UE may request to move a single-access PDU Session between 3GPP and Non 3GPP accesses. The decision to move single-access PDU Sessions between 3GPP access and Non 3GPP access is made on a per PDU Session basis, i.e. the UE may, at a given time, have some PDU Sessions using 3GPP access while other PDU Sessions are using Non 3GPP access.

If the UE is attempting to move a single-access PDU session from 3GPP access to non-3GPP access and the PDU session is associated with control plane only indication, then the AMF shall reject the PDU Session Establishment request as related CIoT 5GS optimisation features are not supported over non-3GPP access as described in clause 5.4.5.2.5 of TS 24.501 [47]. If the UE is attempting to move a single-access PDU session from non-3GPP access to NB-N1 mode of 3GPP access, the PDU Session Establishment request would also be rejected by AMF when the UP resources for the UE exceed the maximum number of supported UP resources as described in clause 5.4.5.2.4 of TS 24.501 [47].

In a PDU Session Establishment Request message sent to the network, the UE shall provide a PDU Session ID. The PDU Session ID is unique per UE and is the identifier used to uniquely identify one of a UE's PDU Sessions. The PDU Session ID shall be stored in the UDM to support handover between 3GPP and non-3GPP access when different PLMNs are used for the two accesses. The UE also provides as described in TS 24.501 [47]:

(a) PDU Session Type.

(b) S-NSSAI of the HPLMN that matches the application (that is triggering the PDU Session Request) within the NSSP in the URSP rules or within the UE Local Configuration as defined in clause 6.1.2.2.1 of TS 23.503 [45].

NOTE 4: If the UE cannot determine any S-NSSAI after performing the association of the application to a PDU Session, then it does not indicate any S-NSSAI in the PDU Session Establishment procedure as defined in clause 5.15.5.3.

(c) S-NSSAI of the Serving PLMN from the Allowed NSSAI, corresponding to the S-NSSAI of the HPLMN (b).

NOTE 5: Generally, in non-roaming scenario the mapping of the Allowed NSSAI to HPLMN S-NSSAIs is not provided to the UE (because the S-NSSAI of the Serving PLMN (c) has the same value of the S-NSSAI of the HPLMN (b)), therefore the UE provides in the PDU Session Request only the S-NSSAI of the Serving PLMN (c). However, if the UE is provided with the mapping of the Allowed NSSAI to HPLMN S-NSSAIs even in non-roaming scenario, then the UE provides in the PDU Session Request both the S-NSSAI of the HPLMN (b) and the S-NSSAI from the Allowed NSSAI (c) that maps to the S-NSSAI of the HPLMN.

NOTE 6: In roaming scenarios the UE provides in the PDU Session Request both the S-NSSAI of the HPLMN (b) and the S-NSSAI of the VPLMN from the Allowed NSSAI (c) that maps to the S-NSSAI of the HPLMN.

(d) DNN (Data Network Name).

(e) SSC mode (Service and Session Continuity mode defined in clause 5.6.9.2).

Additionally, if the UE supports ATSSS and wants to activate a MA PDU Session, the UE shall provide Request Type as "MA PDU Request" and shall indicate the supported ATSSS capabilities (see clause 5.32 for details).

Table 5.6.1-1: Attributes of a PDU Session

|  |  |  |
| --- | --- | --- |
| PDU Session attribute | May be modified later during the lifetime of the PDU Session | Notes |
| S-NSSAI of the HPLMN | No | (Note 1) (Note 2) |
| S-NSSAI of the Serving PLMN | Yes | (Note 1) (Note 2) (Note 4) |
| DNN (Data Network Name) | No | (Note 1) (Note 2) |
| PDU Session Type | No | (Note 1) |
| SSC mode | No | (Note 2)The semantics of Service and Session Continuity mode is defined in clause 5.6.9.2 |
| PDU Session Id | No |  |
| User Plane Security Enforcement information | No | (Note 3) |
| Multi-access PDU Connectivity Service | No | Indicates if the PDU Session provides multi-access PDU Connectivity Service or not. |
| NOTE 1: If it is not provided by the UE, the network determines the parameter based on default information received in user subscription. Subscription to different DNN(s) and S-NSSAI(s) may correspond to different default SSC modes and different default PDU Session TypesNOTE 2: S-NSSAI(s) and DNN are used by AMF to select the SMF(s) to handle a new session. Refer to clause 6.3.2.NOTE 3: User Plane Security Enforcement information is defined in clause 5.10.3.NOTE 4: The S-NSSAI value of the Serving PLMN associated to a PDU Session can change whenever the UE moves to a different PLMN, while keeping that PDU Session. |

Subscription Information may include a wildcard DNN per subscribed S-NSSAI: when a wildcard DNN is associated with a subscribed S-NSSAI, the subscription allows, for this S-NSSAI, the UE to establish a PDU Session using any DNN value.

NOTE 7: The SMF is made aware whether the DNN of a PDU Session being established corresponds to an explicitly subscribed DNN or corresponds to a wildcard DNN. Thus, the SMF can reject a PDU Session establishment if the DNN of the PDU Session is not part of explicitly subscribed DNN(s) and local policies in the SMF require UE to have a subscription to this DNN.

A UE may establish multiple PDU Sessions, to the same data network or to different data networks, via 3GPP and via and Non-3GPP access networks at the same time.

A UE may establish multiple PDU Sessions to the same Data Network and served by different UPF terminating N6.

A UE with multiple established PDU Sessions may be served by different SMF.

The SMF shall be registered and deregistered on a per PDU Session granularity in the UDM.

The user plane paths of different PDU Sessions (to the same or to different DNN) belonging to the same UE may be completely disjoint between the AN and the UPF interfacing with the DN.

When the SMF cannot control the UPF terminating the N3 interface used by a PDU Session and SSC mode 2/3 procedures are not applied to the PDU Session, an I-SMF is inserted between the SMF and the AMF and handling of PDU Session(s) is described in clause 5.34.

NOTE 8: User Plane resources for PDU Sessions of a UE, except for regulatory prioritized service like Emergency Services and MPS, can be deactivated by the SMF if the UE is only reachable for regulatory prioritized services.

The SMF serving a PDU session (i.e. Anchor) does not change during lifetime of the PDU session.

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* Next changes \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

#### 5.8.2.2 UE IP Address Management

##### 5.8.2.2.1 General

The UE IP address management includes allocation and release of the UE IP address as well as renewal of the allocated IP address, where applicable.

- If there is a matching URSP rule or a matching UE Local Configuration containing a PDU Session Type of "IPv4", "IPv6" or "IPv4v6", then the UE shall set the requested PDU Session Type to the PDU Session Type contained in the matching URSP rule or in the matching UE Local Configuration, if this PDU Session Type is supported by the UE's IP stack capabilities. If there is no PDU Session Type value in the matching URSP rule or in the matching UE Local Configuration, the UE shall not include the requested PDU Session Type in the PDU Session Establishment Request message.

- Otherwise, if there is no matching URSP rule and no matching UE Local Configuration, the UE shall set the requested PDU Session Type during the PDU Session Establishment procedure based on its IP stack capabilities as follows:

- A UE which supports IPv6 and IPv4 shall set the requested PDU Session Type "IPv4v6".

- A UE which supports only IPv4 shall request for PDU Session Type "IPv4".

- A UE which supports only IPv6 shall request for PDU Session Type "IPv6".

- When the IP version capability of the UE is unknown in the UE (as in the case when the MT and TE are separated and the capability of the TE is not known in the MT), the UE shall request for PDU Session Type "IPv4v6".

The SMF selects PDU Session Type of the PDU Session as follows:

- If the SMF receives a request with PDU Session Type set to "IPv4v6", the SMF selects either PDU Session Type "IPv4" or "IPv6" or "IPv4v6" based on DNN configuration, subscription data and operator policies.

- If the SMF receives a request for PDU Session Type "IPv4" or "IPv6" and the requested IP version is supported by the DNN the SMF selects the requested PDU Session type.

In its answer to the UE, the SMF may indicate the PDU Session Types not allowed for the combination of (DNN, S-NNSAI). In this case, the UE shall not request another PDU Session to the same (DNN, S-NNSAI) for PDU Session Types indicated as not allowed by the network. In the case that the initial PDU Session was established with a PDU Session Type and the UE needs another single IP version PDU Session Type, the UE may initiate another PDU Session Establishment procedure to this (DNN, S-NNSAI) in order to activate a second PDU session with that PDU Session Type.

An SMF shall ensure that the IP address management procedure is based on the selected PDU Session Type. If IPv4 PDU Session Type is selected, an IPv4 address is allocated to the UE. Similarly, if IPv6 PDU Session type is selected, an IPv6 prefix is allocated. If IPv4v6 PDU Session Type is selected, both an IPv4 address and an IPv6 prefix are allocated. For Roaming case, the SMF in this clause refers to the SMF controlling the UPF(s) acting as PDU Session Anchor. i.e. H-SMF in home routed case and V-SMF in local breakout case. For home routed case, V-SMF forwards the PDU Session Type requested by UE to H-SMF without interpreting it. V-SMF sends back to UE the PDU Session Type selected by H-SMF. The SMF shall process the UE IP address management related messages, maintain the corresponding state information and provide the response messages to the UE.

The 5GC and UE support the following mechanisms:

a. During PDU Session Establishment procedure, the SMF sends the IP address to the UE via SM NAS signalling. The IPv4 address allocation and/or IPv4 parameter configuration via DHCPv4 (according to RFC 2131 [9]) can also be used once PDU Session is established.

b. /64 IPv6 prefix allocation shall be supported via IPv6 Stateless Auto-configuration according to RFC 4862 [10], if IPv6 is supported. The details of Stateless IPv6 Address Autoconfiguration are described in clause 5.8.2.2.3. IPv6 parameter configuration via Stateless DHCPv6 (according to RFC 3736 [14]) may also be supported.

For scenarios with RG connecting to 5GC, additional features for IPv6 address allocation and IPv6 prefix delegation are supported, as described in TS 23.316 [84].

To allocate the IP address via DHCPv4, the UE may indicate to the network within the Protocol Configuration Options that the UE requests to obtain the IPv4 address with DHCPv4, or obtain the IP address during the PDU Session Establishment procedure. This implies the following behaviour both for static and dynamic address allocation:

- The UE may indicate that it requests to obtain an IPv4 address as part of the PDU Session Establishment procedure. In such a case, the UE relies on the 5GC network to provide IPv4 address to the UE as part of the PDU Session Establishment procedure.

- The UE may indicate that it requests to obtain the IPv4 address after the PDU Session Establishment procedure by DHCPv4. That is, when the 5GC network supports DHCPv4 and allows that, it does not provide the IPv4 address for the UE as part of the PDU Session Establishment procedure. The network may respond to the UE by setting the allocated IPv4 Address to 0.0.0.0. After the PDU Session Establishment procedure is completed, the UE uses the connectivity with the 5GC and initiates the IPv4 address allocation on its own using DHCPv4. However, if the 5GC network provides IPv4 address to the UE as part of the PDU Session Establishment procedure, the UE should accept the IPv4 address indicated in the PDU Session Establishment procedure.

- If the UE sends no IP Address Allocation request, the SMF determines whether DHCPv4 is used between the UE and the SMF or not, based on per DNN configuration.

If dynamic policy provisioning is deployed, and the PCF was not informed of the IPv4 address at PDU Session Establishment procedure, the SMF shall inform the PCF about an allocated IPv4 address. If the IPv4 address is released, the SMF shall inform the PCF about the de-allocation of an IPv4 address.

In order to support DHCP based IP address configuration, the SMF shall act as the DHCP server towards the UE. The PDU Session Anchor UPF does not have any related DHCP functionality. The SMF instructs the PDU Session Anchor UPF serving the PDU Session to forward DHCP packets between the UE and the SMF over the user plane.

When DHCP is used for external data network assigned addressing and parameter configuration, the SMF shall act as the DHCP client towards the external DHCP server. The UPF does not have any related DHCP functionality. In the case of DHCP server on the external data network, the SMF instructs a UPF with N6 connectivity to forward DHCP packets between the UE and the SMF and the external DHCP server over the user plane.

The 5GC may also support the allocation of a static IPv4 address and/or a static IPv6 prefix based on subscription information in the UDM or based on the configuration on a per-subscriber, per-DNN basis and per-S-NSSAI.

If the static IP address/prefix is stored in the UDM, during PDU Session Establishment procedure, the SMF retrieves this static IP address/prefix from the UDM. If the static IP address/prefix is not stored in the UDM subscription record, it may be configured on a per-subscriber, per-DNN and per-S-NSSAI basis in the DHCP/DN-AAA server and the SMF retrieves the IP address/prefix for the UE from the DHCP/DN-AAA server. This IP address/prefix is delivered to the UE in the same way as a dynamic IP address/prefix. It is transparent to the UE whether the PLMN or the external data network allocates the IP address and whether the IP address is static or dynamic.

For IPv4 or IPv6 or IPv4v6 PDU Session Type, during PDU Session Establishment procedure, the SMF may receive a Subscriber’s IP Index from the UDM. If UE IP address/prefix was not already allocated and provided to PCF when SMF initiates the SM policy association, the SMF may receive a Subscriber’s IP Index from the PCF. If the SMF received a Subscriber’s IP index from both UDM and PCF, the SMF shall apply the Subscriber’s IP Index received from the PCF. The SMF may use the Subscriber’s IP Index to assist in selecting how the IP address is to be allocated when multiple allocation methods, or multiple instances of the same method are supported. In the case of Home Routed roaming, the H-SMF may receive the IP index from the H-PCF.

NOTE: The IP Index may e.g. be used to select between different local IP pools in SMF.

When Static IP addresses for a PDU session are not used, the actual allocation of the IP Address(es) for a PDU Session may use any of the following mechanisms:

- The SMF allocates the IP address from a pool that corresponds to the PDU Session Anchor (UPF) that has been selected

- The UE IP address is obtained from the UPF. In that case the SMF shall interact with the UPF via N4 procedures to obtain a suitable IP address. The SMF provides the UPF with the necessary information allowing the UPF to derive the proper IP address (e.g. the network instance).

- In the case that the UE IP address is obtained from the external data network, additionally, the SMF shall also send the allocation, renewal and release related request messages to the external data network, i.e. DHCP/DN-AAA server, and maintain the corresponding state information. The IP address allocation request sent to DHCP/DN-AAA server may include the IP address pool ID to identify which range of IP address is to be allocated. In this case the SMF is provisioned with separate IP address pool ID(s), and the mapping between IP address pool ID and UPF Id, DNN, S-NSSAI, IP version. The provision is done by OAM or during the N4 Association Setup procedure.

A given IP address pool is controlled by a unique entity (either the SMF or the UPF or an external server). The IP address managed by the UPF can be partitioned into multiple IP address pool partition(s), i.e. associated with multiple IP address pool ID(s).

When the SMF is configured to obtain UE IP addresses from the UPF, the SMF may select a UPF based upon support of this feature. The SMF determines whether the UPF supports this feature via NRF or via N4 capability negotiation during N4 Association Setup. If no appropriate UPF support the feature, the SMF may allocate UE IP addresses, if configured to do so.

The IP address/prefix is released by the SMF (e.g. upon release of the PDU Session), likewise the UPF considers that any IP address it has allocated within a N4 session are released when this N4 session is released.

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