**3GPP TSG-2 Meeting #164 *S2-240xxxx***

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

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| *CR-Form-v12.3* |
| **CHANGE REQUEST** |
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|  | **23.501** | **CR** | **X** | **rev** | **-** | **Current version:** | **19.0.0** |  |
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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:***  | Exposure enhancements for static UE IP address assignment and 5G VN group’s User Plane Security Policy  |
|  |  |
| ***Source to WG:*** | Ericsson, Nokia, Deutsche Telekom, Telefonica?, Siemens AG? |
| ***Source to TSG:*** | SA2 |
|  |  |
| ***Work item code:*** | TEI19\_IP-SP-EXP |  | ***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:*** | This CR addresses two aspects related to exposure for private networks:Issue #1:There is currently no method for an enterprise to provision static UE IP adresses via an APIIssue #2: TS 33.501 requires that all PDU Sessions of a 5G VN gorup should have the same User Plane Security Policy. Provisioning the security policy via the 5G VN API is however not supported currently.  |
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| ***Summary of change:*** | Enhance NEF Parameter provisioning service to support provisioning of user plane security policy and static UE IP addresses  |
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| ***Consequences if not approved:*** | Not possible to support key uses cases for enterprise deployments |
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| ***Clauses affected:*** | 5.8.2.2.1, 5.29.2 |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** | **X** |  |  Other core specifications  | TS 23.502 CR ??? |
| ***affected:*** |  | **X** |  Test specifications |  |
| ***(show related CRs)*** |  | **X** |  O&M Specifications |  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

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

#### 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.

The UE shall perform the association of the application to a new PDU Session described in clause 6.1.2.2.1 of TS 23.503 [45], with the following considerations:

- If there is a matching URSP rule, except the URSP rule with the "match all" Traffic descriptor, 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 Detailed operation is described in TS 24.526 [110].

- Otherwise, if a URSP Rule with the "match all" Traffic descriptor exists, the UE shall set the requested PDU Session Type to the PDU Session Type contained in the "match all" URSP Rule, if this PDU Session Type is supported by the UE's IP stack capabilities. Detailed operation is described in TS 24.526 [110].

- Otherwise, 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 8415 [182]) may also be supported. IPv6 Prefix Delegation using DHCPv6 may be supported for allocating additional IPv6 prefixes for a PDU Session. The details of Prefix Delegation are described in clause 5.8.2.2.4.

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. 5GC may also support the allocation of a static IPv4 address and/or a static IPv6 prefix based on NEF Parameter Provision service as described in TS 23.502 [3], clause 4.15.6.

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 the UE IP address/prefix was not already allocated and provided to PCF when SMF initiates the SM policy association, the SMF may receive a Subscribers 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 can e.g. be used to select between different IP pools, including between IP pools with overlapping private address range. To support deployments with overlapping private IPv4 address, the IP domain corresponding to IP index can also be provided from UDM to SMF as part of the subscription data and then provided to PCF.

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.

UPF may use NAT between the UE and the Data Network, and thus the 5GC allocated (private) UE IP address may not be visible on the N6 reference point.

\*\*\*\* Next Change \*\*\*\*

### 5.29.2 5G VN group management

5G System supports management of 5G VN Group identification and membership (i.e. definition of 5G VN group identifiers and membership) and 5G VN Group data (i.e. definition of 5G VN group data). The 5G VN Group management can be configured by a network administrator or can be managed dynamically by AF.

A 5G VN group is characterized by the following:

- 5G VN group identities: External Group ID and Internal Group ID are used to identify the 5G VN group.

- 5G VN group membership: The 5G VN group members are uniquely identified by GPSI. The group as described in clause 5.2.3.3.1 of TS 23.502 [3] is applicable to 5G LAN-type services.

- 5G VN group data. The 5G VN group data may include the following parameters: PDU session type, DNN, S-NSSAI and Application descriptor, the indication that the 5G VN group is associated with 5G VN group communication, Information related with secondary authentication / authorization (e.g. to enable IP address assignment by the DN-AAA), Maximum Group Data Rate, User Plane Security Policy.

 The Information related with secondary authentication / authorization corresponds to the procedures described in clause 5.6.6; it allows e.g. the AF to provide DN-AAA server addressing information and possibly to request the SMF to get the UE IP address from the DN-AAA server.

In order to support dynamic management of 5G VN Group identification and membership, the NEF exposes a set of services to manage (e.g. add/delete/modify) 5G VN groups and 5G VN members. The NEF also exposes services to dynamically manage 5G VN group data.

An AF can request provisioning of traffic characteristics, QoS parameters and monitoring of QoS parameters for a 5G VN group as described in clause 6.1.3.28 of TS 23.503 [45].

A 5G VN group is identified by the AF using External Group ID. The NEF provides the External Group ID to UDM. The UDM maps the External Group ID to Internal Group ID. For a newly created 5G VN Group, an Internal Group ID is determined by the UDM based on implementation specific means.

NOTE 1: The Internal Group ID determined by UDM has to comply with the format defined in TS 23.003 [19].

The NEF can retrieve the Internal Group ID from UDM via Nudm\_SDM\_Get service operation (External Group ID, Group Identifier translation).

An External Group ID for a 5G VN group corresponds to a unique set of 5G VN group data parameters.

The 5G VN group configuration is either provided by OA&M or provided by an AF to the NEF.

When configuration is provided by an AF, the procedures described in clause 4.15.6.2 of TS 23.502 [3] apply for storing the 5G VN group identifiers, group membership information and group data in the UDR, as follows:

- The NEF provides the External Group ID, 5G VN group membership information and 5G VN group data to the UDM.

- The UDM updates the Internal Group ID-list of the corresponding UE's subscription data in UDR, if needed.

- The UDM updates the Group Identifier translation in the Group Subscription data with the Internal Group ID, External Group ID and list of group members, if needed.

- The UDM stores/updates the 5G VN group data (PDU session type, DNN and S-NSSAI, Application descriptor, the indication that the 5G VN group is associated with 5G VN group communication, Information related with secondary authentication / authorization, Maximum Group Data Rate, User Plane Security Policy) in UDR.

NOTE 2: It is assumed that all members of a 5G VN group belong to the same UDM Group ID. The NEF can select a UDM instance supporting the UDM Group ID of any of the member GPSIs of the 5G VN group.

NOTE 3: Shared data mechanisms as defined in TS 29.503 [122] can be used to support large 5G VN groups.

An AF may also configure and update the service area, QoS for the 5G VN group as described in clause 5.20b as well as other parameters (e.g. Expected UE Behaviour parameters, Network Configuration parameters, ECS Address Configuration Information, etc.) for a 5G VN group as described in clause 4.15.6 of TS 23.502 [3].

If a UE is member of a 5G VN Group, UDM retrieves UE subscription data and corresponding 5G VN group data from UDR, and provides the AMF and SMF with UE subscription data with 5G VN group data included. If the 5G VN group data contains the indication that the 5G VN group is associated with 5G VN group communication, the SMF may apply the 5G VN group communication as defined in clauses 5.29.3 and 5.29.4 for the PDU Sessions accessing to the 5G VN group.

The PCF generates URSP rules based on 5G VN group data. The PCF retrieves 5G VN group data from UDR. The PCF(s) that have subscribed to modifications of 5G VN group data receive(s) a Nudr\_DM\_Notify notification of 5G VN group data change from the UDR as defined in TS 29.505 [145]. The PCF receives from the AMF at the UE Policy association establishment the Internal Group ID(s) corresponding to a UE, so that PCF identifies the 5G VN group data that needs to be used to generate URSP rules to the UE. If the PCF is made aware of a change of UE Internal Group Identifier(s) as defined in TS 29.525 [144] or change of 5G VN group membership as defined in TS 29.505 [145], or both, the PCF then may update the URSP rules for the impacted 5G VN group members.

NOTE 4: The proper way to obtain the 5G VN group membership changes of a specific UE, e.g. if the UE is added to a new 5G VN group, is via the notification of change of UE Internal Group Identifier(s) from the AMF as specified in TS 29.525 [144]. The subscription in the UDR is for being notified about changes in the 5G VN group data and in the 5G VN group membership of a specific 5G VN group.

If the PCF receives the Maximum Group Data Rate as part of the 5G VN group data, it performs the group related policy control as described in clauses 6.1.5 and 6.2.1.11 of TS 23.503 [45].

An AF may update the UE Identities of the 5G VN group at any time after the initial provisioning.

An AF may subscribe to notification of the group status changes for the 5G VN group as described in clause 5.20.

The DNN, S-NSSAI, User Plane Security Policy provided within 5G VN group data cannot be modified after the initial provisioning.

In this Release of the specification, the home network of the 5G VN group members is same.

In this Release of the specification, only a 1:1 mapping between (DNN, S-NSSAI) combination and 5G VN group is supported.

The PCF delivers 5G VN group configuration information (DNN, S-NSSAI, PDU session type) to the UE for each GPSI that belongs to a 5G VN group. The 5G VN group configuration information is delivered in the URSP from the PCF to the UE using the UE Configuration Update procedure for transparent UE Policy delivery as described in clause 4.2.4.3 of TS 23.502 [3] and clause 6.1.2.2 of TS 23.503 [45].

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