**3GPP TSG-SA WG2 Meeting #146E (e-meeting)S2-210xxxx**

**August 16 – 27, 2021, Elbonia (revision of S2-210xxxx)**

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| *CR-Form-v12.1* |
| **CHANGE REQUEST** |
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|  | **23.501** | **CR** | **xxxx** | **rev** | **-** | **Current version:** | **17.1.1** |  |
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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 | **x** | Radio Access Network |  | Core Network | **X** |

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|  |
| ***Title:***  | IP prefix delegation |
|  |  |
| ***Source to WG:*** | LG Electronics, Ericsson, OPPO |
| ***Source to TSG:*** | SA2 |
|  |  |
| ***Work item code:*** | 5G\_ProSe |  | ***Date:*** | 2021-07-28 |
|  |  |  |  |  |
| ***Category:*** | **B** |  | ***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-15 (Release 15)Rel-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)* |
|  |  |
| ***Reason for change:*** | In clause 5.5 "IP address allocation" of TS 23.304, the following text exists regarding Layer-3 UE-to-Network Relay operation.*b) When the 5G ProSe Remote UE uses IPv6 to access the external DN:**b1) IPv6 network prefix allocation via IPv6 Stateless Address auto-configuration. Router solicitation from the Remote UE is always sent subsequent to the establishment of the one-to-one ProSe Direct Communication between the 5G ProSe Remote UE and the 5G ProSe Layer-3 UE-to-Network Relay, see details for IPv6 prefix allocation in clause 5.4.4.2 of TS 23.303 [3] with the following differences:****- The 5G ProSe Layer-3 UE-to-Network Relay shall obtain the IPv6 prefix assigned to the Remote UE via prefix delegation function from the network as defined in TS 23.501 [4].****- PDN connection is replaced by PDU Session.*For IP prefix delegation in the above texts, TS 23.501 is referred, but the description on IP prefix delegation in TS 23.501 is intended for for 5G RG scenario where TS 23.316 is referenced, see below: *5.8.2.2 UE IP Address Management**5.8.2.2.1 General**…**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].*So, description on IP prefix delegation be added. |
|  |  |
| ***Summary of change:*** | Clause 5.8.2.2.1: move the text related to IPv6 prefix delegation to the new clause.Add a new clause about IP prefix delegation.The texts are based on clause 5.3.1.2.6 "IPv6 Prefix Delegation via DHCPv6" of TS 23.401. |
|  |  |
| ***Consequences if not approved:*** | No description on IP prefix delegation used for Layer-3 UE-to-Network Relay operation, implying that IP prefix delegation is not available for Layer-3 UE-to-Network Relay operation (but only available for RG connecting to 5GC). |
|  |  |
| ***Clauses affected:*** | 2, 5.8.2.2.1, 5.8.2.2.X (new) |
|  |  |
|  | **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:*** |  |

\* \* \* \* Start of 1st Change \* \* \* \*

# 2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non‑specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 22.261: "Service requirements for next generation new services and markets; Stage 1".

[3] 3GPP TS 23.502: "Procedures for the 5G System; Stage 2".

[4] 3GPP TS 23.203: "Policies and Charging control architecture; Stage 2".

[5] 3GPP TS 23.040: "Technical realization of the Short Message Service (SMS); Stage 2".

[6] 3GPP TS 24.011: "Point-to-Point (PP) Short Message Service (SMS) support on mobile radio interface: Stage 3".

[7] IETF RFC 7157: "IPv6 Multihoming without Network Address Translation".

[8] IETF RFC 4191: "Default Router Preferences and More-Specific Routes".

[9] IETF RFC 2131: "Dynamic Host Configuration Protocol".

[10] IETF RFC 4862: "IPv6 Stateless Address Autoconfiguration".

[11] ITU‑T Recommendation I.130: "Method for the characterization of telecommunication services supported by an ISDN and network capabilities of an ISDN".

[12] ITU‑T Recommendation Q.65: "The unified functional methodology for the characterization of services and network capabilities".

[13] 3GPP TS 24.301: "Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS): Stage 3".

[14] IETF RFC 3736: "Stateless DHCP Service for IPv6".

[15] 3GPP TS 23.228: "IP Multimedia Subsystem (IMS); Stage 2".

[16] 3GPP TS 22.173: "IMS Multimedia Telephony Service and supplementary services; Stage 1".

[17] 3GPP TS 23.122: "Non-Access-Stratum (NAS) functions related to Mobile Station in idle mode".

[18] 3GPP TS 23.167: "3rd Generation Partnership Project; Technical Specification Group Services and Systems Aspects; IP Multimedia Subsystem (IMS) emergency sessions".

[19] 3GPP TS 23.003: "Numbering, Addressing and Identification".

[20] IETF RFC 7542: "The Network Access Identifier".

[21] 3GPP TS 23.002: "Network Architecture".

[22] 3GPP TS 23.335: "User Data Convergence (UDC); Technical realization and information flows; Stage 2".

[23] 3GPP TS 23.221: "Architectural requirements".

[24] 3GPP TS 22.153: "Multimedia priority service".

[25] 3GPP TS 22.011: "Service Accessibility".

[26] 3GPP TS 23.401: "General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access".

[27] 3GPP TS 38.300: "NR; NR and NG-RAN Overall Description".

[28] 3GPP TS 38.331: "NR; Radio Resource Control (RRC); Protocol Specification".

[29] 3GPP TS 33.501: "Security architecture and procedures for 5G system".

[30] 3GPP TS 36.300: "Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Overall description; Stage 2".

[31] 3GPP TS 37.340: "Evolved Universal Terrestrial Radio Access (E-UTRA) and NR; Multi-connectivity; Stage 2".

[32] 3GPP TS 23.214: "Architecture enhancements for control and user plane separation of EPC nodes; Stage 2".

[33] 3GPP TS 22.101: "3rd Generation Partnership Project; Technical Specification Group Services and Systems Aspects; Service aspects; Service principles".

[34] 3GPP TS 38.413: "NG-RAN; NG Application Protocol (NGAP)".

[35] 3GPP TS 33.126: "Lawful Interception Requirements".

[36] 3GPP TS 23.682: "Architecture enhancements to facilitate communications with packet data networks and applications".

[37] 3GPP TS 22.280: "Mission Critical Services Common Requirements (MCCoRe); Stage 1".

[38] 3GPP TS 23.379: "Functional architecture and information flows to support Mission Critical Push To Talk (MCPTT); Stage 2".

[39] 3GPP TS 23.281: "Functional architecture and information flows to support Mission Critical Video (MCVideo); Stage 2".

[40] 3GPP TS 23.282: "Functional architecture and information flows to support Mission Critical Data (MCData); Stage 2".

[41] 3GPP TS 32.240: "Charging management; Charging architecture and principles".

[42] 3GPP TS 38.401: "NG-RAN Architecture description".

[43] 3GPP TS 23.402: "Architecture enhancements for non-3GPP accesses".

[44] IETF RFC 4960: "Stream Control Transmission Protocol".

[45] 3GPP TS 23.503: "Policy and Charging Control Framework for the 5G System".

[46] 3GPP TS 23.041: "Public Warning System".

[47] 3GPP TS 24.501: "Non-Access-Stratum (NAS) protocol for 5G System (5GS); Stage 3".

[48] 3GPP TS 24.502: "Access to the 5G System (5GS) via non-3GPP access networks; Stage 3".

[49] 3GPP TS 29.500: "5G System; Technical Realization of Service Based Architecture; Stage 3".

[50] 3GPP TS 38.304: "NR; User Equipment (UE) procedures in idle mode".

[51] 3GPP TS 36.331: "Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification".

[52] 3GPP TS 36.304: "Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) procedures in idle mode".

[53] Void.

[54] IETF RFC 4861: "Neighbor Discovery for IP version 6 (IPv6)".

[55] 3GPP TS 23.271: "Functional stage 2 description of Location Services (LCS)".

[56] 3GPP TS 23.060: "General Packet Radio Service (GPRS); Service description; Stage 2".

[57] IETF RFC 4555: "IKEv2 Mobility and Multihoming Protocol (MOBIKE)".

[58] 3GPP TS 29.510: "5G System: Network function repository services; Stage 3".

[59] 3GPP TS 29.502: "5G System: Session Management Services: Stage 3".

[60] IETF RFC 7296: "Internet Key Exchange Protocol Version 2 (IKEv2) ".

[61] 3GPP TS 23.380: "IMS Restoration Procedures".

[62] 3GPP TS 24.229: "IP multimedia call control protocol based on Session Initiation Protocol (SIP) and Session Description Protocol (SDP); Stage 3".

[63] 3GPP TS 23.292: "IP Multimedia Subsystem (IMS) centralized services; Stage 2".

[64] 3GPP TS 23.222: "Functional architecture and information flows to support Common API Framework for 3GPP Northbound APIs".

[65] 3GPP TS 29.244: "Interface between the Control Plane and the User Plane Nodes; Stage 3".

[66] 3GPP TS 32.421: "Telecommunication management; Subscriber and equipment trace; Trace concepts and requirements".

[67] 3GPP TS 32.290: "5G system; Services, operations and procedures of charging using Service Based Interface (SBI)".

[68] 3GPP TS 32.255: "5G Data connectivity domain charging; Stage 2".

[69] 3GPP TS 38.306: "NR; User Equipment -UE) radio access capabilities".

[70] 3GPP TS 36.306: "Evolved Universal Terrestrial Radio Access -E-UTRA); User Equipment -UE) radio access capabilities".

[71] 3GPP TS 29.518: "5G System; Access and Mobility Management Services; Stage 3".

[72] 3GPP TS 23.285: "Architecture enhancements for V2X services".

[73] IETF RFC 2865: "Remote Authentication Dial In User Service (RADIUS)".

[74] IETF RFC 3162: "RADIUS and IPv6".

[75] 3GPP TS 29.281: "General Packet Radio System (GPRS) Tunnelling Protocol User Plane (GTPv1-U)".

[76] 3GPP TS 26.238: "Uplink streaming".

[77] 3GPP TR 26.939: "Guidelines on the Framework for Live Uplink Streaming (FLUS)".

[78] International Telecommunication Union (ITU), Standardization Bureau (TSB): "Operational Bulletin No. 1156"; http://handle.itu.int/11.1002/pub/810cad63-en (retrieved October 5, 2018).

[79] 3GPP TS 28.533: "Management and orchestration; Architecture framework".

[80] 3GPP TS 24.250: "Protocol for Reliable Data Service; Stage 3".

[81] IETF RFC 8684: "TCP Extensions for Multipath Operation with Multiple Addresses".

[82] IETF RFC 8803: "0-RTT TCP Convert Protocol".

[83] IEEE Std 802.1CB-2017: "IEEE Standard for Local and metropolitan area networks-Frame Replication and Elimination for Reliability".

[84] 3GPP TS 23.316: "Wireless and wireline convergence access support for the 5G System (5GS)".

[85] WiFi Alliance Technical Committee, Hotspot 2.0 Technical Task Group: "Hotspot 2.0 (Release 2) Technical Specification".

[86] 3GPP TS 23.288: "Architecture enhancements for 5G System (5GS) to support network data analytics services".

[87] 3GPP TS 23.273: "5G System (5GS) Location Services (LCS); Stage 2".

[88] 3GPP TS 23.216: "Single Radio Voice Call Continuity (SRVCC); Stage 2".

[89] CableLabs DOCSIS MULPI: "Data-Over-Cable Service Interface Specifications DOCSIS 3.1, MAC and Upper Layer Protocols Interface Specification".

[90] BBF TR-124 issue 5: "Functional Requirements for Broadband Residential Gateway Devices".

[91] BBF TR-101 issue 2: "Migration to Ethernet-Based Broadband Aggregation".

[92] BBF TR-178 issue 1: "Multi-service Broadband Network Architecture and Nodal Requirements".

[93] BBF TR-456 issue 1: "AGF Functional Requirements".

[94] BBF WT-457: "FMIF Functional Requirements".

Editor's note: The reference to BBF WT-457 will be revised when finalized by BBF.

[95] IEEE Std 802.1Qcc-2018: "IEEE Standard for Local and metropolitan area networks - Bridges and Bridged Networks - Amendment: Stream Reservation Protocol (SRP) Enhancements and Performance Improvements".

[96] Void.

[97] IEEE Std 802.1AB-2016: "IEEE Standard for Local and metropolitan area networks -- Station and Media Access Control Connectivity Discovery".

[98] IEEE Std 802.1Q-2018: "IEEE Standard for Local and metropolitan area networks--Bridges and Bridged Networks".

[99] 3GPP TS 38.423: "NG-RAN; Xn Application Protocol (XnAP)".

[100] 3GPP TS 36.413: "Evolved Universal Terrestrial Radio Access Network (E-UTRAN); S1 Application Protocol (S1AP)".

[101] 3GPP TS 29.274: "Evolved General Packet Radio Service (GPRS) Tunnelling Protocol for Control plane (GTPv2-C); Stage 3".

[102] 3GPP TS 23.632: "User Data Interworking, Coexistence and Migration; stage 2".

[103] 3GPP TS 29.563: "5G System (5GS); HSS services for interworking with UDM; Stage 3".

[104] IEEE Std 802.1AS-2020: "IEEE Standard for Local and metropolitan area networks--Timing and Synchronization for Time-Sensitive Applications".

[105] 3GPP TS 22.104: "Service requirements for cyber-physical control applications in vertical domains".

[106] IEEE Std 802.11-2012: "IEEE Standard for Information technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements - Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications".

[107] IEEE Std 1588-2008: "IEEE Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems".

[108] 3GPP TS 28.552: "Management and orchestration; 5G performance measurements".

[109] 3GPP TS 24.193: "Access Traffic Steering, Switching and Splitting; Stage 3".

[110] 3GPP TS 24.526: "User Equipment (UE) policies for 5G System (5GS); Stage 3".

[111] 3GPP TS 22.186: "Enhancement of 3GPP support for V2X scenarios; Stage 1".

[112] 3GPP TR 38.824: "Study on physical layer enhancements for NR ultra-reliable and low latency case (URLLC)".

[113] IEEE: "Guidelines for Use of Extended Unique Identifier (EUI), Organizationally Unique Identifier (OUI), and Company ID (CID)", https://standards.ieee.org/content/dam/ieee-standards/standards/web/documents/tutorials/eui.pdf.

[114] 3GPP TS 32.256: "Charging Management; 5G connection and mobility domain charging; Stage 2".

[115] 3GPP TS 33.210: "Network Domain Security (NDS); IP network layer security".

[116] 3GPP TS 38.415: "PDU Session User Plane Protocol".

[117] 3GPP TS 24.535: "Device-side Time-Sensitive Networking (TSN) Translator (DS-TT) to network-side TSN Translator (NW-TT) protocol aspects; Stage 3".

[118] 3GPP TS 32.274: "Charging Management; Short Message Service (SMS) charging".

[119] 3GPP TS 23.008: "Organization of subscriber data".

[120] 3GPP TS 38.314: "NR; Layer 2 measurements".

[121] 3GPP TS 23.287: "Architecture enhancements for 5G System (5GS) to support Vehicle-to-Everything (V2X) services".

[122] 3GPP TS 29.503: "5G System; Unified Data Management Services; Stage 3".

[123] 3GPP TS 32.254: "Charging management; Exposure function Northbound Application Program Interfaces (APIs) charging".

[124] 3GPP TS 33.535: "Authentication and Key Management for Applications based on 3GPP credentials in the 5G System (5GS)".

[125] 3GPP TS 38.410: "NG-RAN; NG general aspects and principles".

[126] IEEE Std 1588: "IEEE Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems".

[127] ST 2059-2:2015: "SMPTE Standard - SMPTE Profile for Use of IEEE-1588 Precision Time Protocol in Professional Broadcast Applications".

[128] 3GPP TS 23.304: "Proximity based Services (ProSe) in the 5G System (5GS)".

[129] 3GPP TS 23.247: "Architectural enhancements for 5G multicast-broadcast services".

[130] 3GPP TS 23.548 "5G System Enhancements for Edge Computing; Stage 2".

[131] IEEE Std 802.3: "Ethernet".

[132] 3GPP TS 29.561: "5G System; Interworking between 5G Network and external Data Networks; Stage 3".

[133] 3GPP TS 29.513: "Policy and Charging Control signalling flows and QoS parameter mapping; Stage 3".

[134] 3GPP TS 23.558: "Architecture for enabling Edge Applications (EA)".

[135] 3GPP TS 26.501: "5G Media Streaming (5GMS); General description and architecture".

[136] 3GPP TS 23.256 "Support of Uncrewed Aerial Systems (UAS) connectivity, identification and tracking; Stage 2".

[137] GSMA NG.116: "Generic Network Slice Template".

[x1] IETF RFC 6603: "Prefix Exclude Option for DHCPv6-based Prefix Delegation".

[x2] IETF RFC 8415: "Dynamic Host Configuration Protocol for IPv6 (DHCPv6)".

\* \* \* \* Start of 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.

- 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. 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.X.

For scenarios with RG connecting to 5GC, additional features for IPv6 address allocation 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 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.

\* \* \* \* Next Changes \* \* \* \*

##### 5.8.2.2.X IPv6 Prefix Delegation via DHCPv6

Optionally a single network prefix shorter than the default /64 prefix may be assigned to a PDU Session. In this case, the /64 default prefix used for IPv6 stateless autoconfiguration will be allocated from this network prefix; the remaining address space from the network prefix can be delegated to the PDU Session using prefix delegation after the PDU Session establishment and IPv6 prefix allocation via IPv6 stateless address autoconfiguration as defined in clause 5.8.2.2.3. When PLMN based parameter configuration is used, the SMF provides the requested IPv6 prefix from a locally provisioned pool. When external DN based IPv6 prefix allocation is used, the SMF obtains the prefix from the external DN.

NOTE: Allocation of IPv6 prefixes with flexible prefix length can leverage e.g. local configuration on the SMF or interaction with the AAA server.

The address space provided is maintained as an IPv6 address space pool available to the PDU Session for DHCPv6 IPv6 prefix requests with the exclusion of the IPv6 prefix that is allocated to the PDU Session during PDU Session establishment as defined in clause 5.8.2.2.3. The total IPv6 address space available for the PDU Session (UE PDU Session prefix and UE PDU Session IPv6 address space pool) shall be possible to aggregate into one IPv6 prefix that will represent all IPv6 addresses that the UE may use. If the UE had indicated that it supports prefix exclusion and the prefix to be delegated to the UE includes the /64 prefix that was allocated to the PDU Session, the SMF shall utilise the prefix exclusion feature as specified for DHCPv6 Prefix Delegation in RFC 6603 [x1].

The UE uses DHCPv6 to request additional IPv6 prefixes (i.e. prefixes in addition to the default prefix) from the SMF after completing stateless IPv6 address autoconfiguration procedures. The UE acts as a "Requesting Router" as described in RFC 8415 [x2] and inserts one or more IA\_PD option(s) into a DHCPv6 Solicit message sent from the UE to the SMF. The SMF acts as the DHCP server and fulfils the role of a "Delegating Router" according to RFC 8415 [x2]. The UE optionally includes the RAPID\_COMMIT option in the DHCPv6 Solicit message to trigger two-message DHCPv6 procedure instead of the four-message DHCPv6 procedure. The UE shall include OPTION\_PD\_EXCLUDE option code in an OPTION\_ORO option to indicate support for prefix exclusion. In response to the DHCPv6 Solicit message, the UE receives a DHCPv6 Reply message with one or more IA\_PD prefix(es) for every IA\_PD option that it sent in the DHCPv6 Solicit message. The SMF delegates a prefix excluding the default prefix with help of OPTION\_PD\_EXCLUDE. Prefix exclusion procedures shall follow RFC 6603 [x1].

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

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