**3GPP TSG-WG2 Meeting #165 *Updated-S2-2409992***

**Hyderabad, India, Oct 14 – 18, 2024**

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| *CR-Form-v12.3* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
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|  | **23.316** | **CR** |  | **rev** | **3** | **Current version:** | **18.6.0** |  |
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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 | **X** | Radio Access Network |  | Core Network | **x** |

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| ***Title:*** | Identifying devices behind 5G-RG via DHCPv6 | | | | | | | | | |
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| ***Source to WG:*** | Ericsson | | | | | | | | | |
| ***Source to TSG:*** |  | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | UIA\_ARC | | | | |  | ***Date:*** | | | 2024-10-04 |
|  |  | | | |  | |  | | |  |
| ***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 can be 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)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | Conclusions for work item FS\_UIA\_ARC Rel 19 has been made in 3GPP meeting#163 and. This CR is part of normative work to include agreed features regarding 5G-RG and DHCPv6 in the specifications as per TR conclusion:  *“For non-3GPP devices requiring QoS differentiation, UE/5G-RG may also send the Device Identifier of the non-3GPP device to the SMF in DHCPv6 message to associate the Device Identifier with the user plane address.”*  The user plane address is defined in the conclusion as:  *“When using an IP PDU Session Type, the user plane address is the UE IP Address(es) / Port Number(s) that carry the non-3GPP device's traffic.”* | | | | | | | | |
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| ***Summary of change:*** | | The following changes have been made :   * general overview is provided in a new section 4.10x * Complementry explanation is added to the IP address allocation section   - the procedure is clarified in a new section 7.3.8.x  Compare to the previous version of the CR, procedures for device disconnection and more details on prefix deligation are provided. | | | | | | | | |
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| ***Consequences if not approved:*** | | Incomplete specifications not aligned with study conclusions | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 2, 4.6.2.2, 4.6.2.3, 4.10x (new), 7.3.8.x (new) | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | | **X** |  | Other core specifications | | | | TS 23.501 CR 5503  TS 23.503 CR 1344 | | |
| ***affected:*** | |  | **X** | Test specifications | | | | TS/TR ... CR ... | | |
| ***(show related CRs)*** | |  | **X** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | | The referenced clause 5.x of 23.501 being added by 23.501 CR#5503  The referenced clause 6.1.3.x of TS 23.503 being added by 23.503 CR#1344. The referenced clause 6.1.x of TS 23.503 being added by 23.503 CR#1383. | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | | Changes compared to CR S2-2408972: - 5G-RG is used instead of RG - more detailed description for address allocation and prefix delegation - including device disconnection in the procedure | | | | | | | | |

\* \* \* \* First 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 23.501: "System Architecture for the 5G System; Stage 2".

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

[4] 3GPP TS 23.503: "Policy and Charging Control Framework for the 5G System".

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

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

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

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

[9] BBF TR-456 issue 2: "AGF Functional Requirements".

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

NOTE: Technical Report of BBF WT-457 will be TR-457 which will be available when finalized by BBF.

[11] 3GPP TS 33.501: "Security architecture and procedures for 5G System".

[12] BBF TR-177 Issue 1 Corrigendum 1: "IPv6 in the context of TR-101".

[13] IETF RFC 6788: "The Line-Identification Option".

[14] 3GPP TS 23.003: "Numbering, Addressing and Identification".

[15] Void.

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

[17] Void.

[18] BBF TR-069: "CPE WAN Management Protocol".

[19] BBF TR-369: "User Services Platform (USP)".

[20] IETF RFC 3046: "DHCP Relay Agent Information Option".

[21] IETF RFC 4604: "Using Internet Group Management Protocol Version 3 (IGMPv3) and Multicast Listener Discovery Protocol Version 2 (MLDv2) for Source-Specific Multicast".

[22] 3GPP TR 24.501: "Non-Access-Stratum (NAS) protocol for 5G System (5GS); Stage 3".

[23] 3GPP TS 38.413: "NG RAN; NG Application Protocol (NGAP)".

[24] 3GPP TS 23.401: "General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access".

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

[26] 3GPP TS 23.122: "Non-Access-Stratum (NAS) functions related to Mobile Station (MS) in idle mode".

[27] CableLabs WR-TR-5WWC-ARCH: "5G Wireless Wireline Converged Core Architecture".

[28] IETF RFC 3376: "Internet Group Management Protocol, Version 3".

[29] 3GPP TS 23.273: "5G System (5GS) Location Services (LCS)".

[30] BBF TR-198: "DQS:DQM systems functional architecture and requirements".

[31] 3GPP TS 23.203: "Policy and charging control architecture".

[32] 3GPP TS 33.126: "Lawful Interception Requirements".

[33] IETF RFC 2236: "Internet Group Management Protocol, Version 2".

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

[35] IETF RFC 1112: "Internet Group Management Protocol".

[36] IETF RFC 2710: "Multicast Listener Discovery Version for IPv6".

[37] IETF RFC 2010: "Operational Criteria for Root Name Servers".

[38] BBF TR-470: "5G FMC architecture".

[39] 3GPP TS 29.519: "Policy Data, Application Data and Structured Data for exposure".

[40] 3GPP TS 23.041: "Public Warning System".

[41] IEEE Publication (2017): "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.

[42] 3GPP TS 29.413: "Application of the NG Application Protocol (NGAP) to non-3GPP access".

[43] Void.

[44] 3GPP TS 24.502: "Access to the 3GPP 5G Core Network (5GCN) via non-3GPP access networks".

[45] 3GPP TS 23.402: " Architecture enhancements for non-3GPP accesses".

[46] BBF TR-181: "Device Data Model for TR-069".

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

[XX] IETF RFC 4649: "Dynamic Host Configuration Protocol for IPv6 (DHCPv6) Relay Agent Remote-ID Option".

\* \* \* \* Second change \* \* \* \*

### 4.6.2 IP address allocation

#### 4.6.2.1 General

IP address allocation is performed as described in TS 23.501 [2] clause 5.8.2.2, with the differences and additions described in this clause.

Stateless IPv6 Address Autoconfiguration applies with the differences described in clause 4.6.2.4.

In addition to the IP address management features described in TS 23.501 [2] clause 5.8.2.2 the 5GC network functions and RG support the following mechanisms:

a. IPv6 address allocation using DHCPv6 may be supported for allocating individual /128 IPv6 address(es) for a PDU Session. The details of IPv6 address allocation using DHCPv6 are described in clause 4.6.2.2.

b. 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 4.6.2.3.

The mechanisms in a. and b. above are only applicable for IPv6 and IPv4v6 PDU Session types.

The requested IPv6 address or set of IPv6 Prefixes may be (as defined in TS 23.501 [2] clause 5.8.2.2.1):

- allocated from a local pool in the SMF or

- obtained from the UPF. In that case the SMF shall interact with the UPF via N4 procedures to obtain a suitable IP address/Prefix, or

- obtained from an external server.

When obtaining the IP address from the UPF, the SMF provides the UPF with the necessary information allowing the UPF to derive the proper IP address (e.g. the network instance, IP version, size of the IP address or Prefix the UPF is to allocate).

The SMF may also provide IP configuration parameters (e.g. MTU value) to the 5G-RG, as described in clause 5.6.10 of TS 23.501 [2].

NOTE: In order to provide an IP MTU value that is specifically suitable for W-5GAN without considering N3 in case of combined W-AGF/UPF, the SMF can e.g. be configured with such MTU for a given DNN and/or for a given slice whether the DNN and/or the slice only serves wireline access and a UPF combined with the W-AGF has been selected for the PDU Session.

In this clause, unless specified otherwise, the RG may correspond either to a 5G RG or to a FN RG.

#### 4.6.2.2 IPv6 Address Allocation using DHCPv6

Optionally, and instead of using Stateless IPv6 Address Autoconfiguration, individual 128-bit IPv6 address(es) may be assigned to a PDU Session.

In this case, after PDU Session Establishment, the SMF sends a Router Advertisement message (solicited or unsolicited) towards the RG. The SMF shall set the Managed Address Configuration Flag (M-flag) in the Router Advertisement messages to indicate towards the RG that IPv6 Address allocation using DHCPv6 is available, as described in RFC 4861 [34]. In that case the IPv6 address of the RG is allocated using DHCPv6 Identity Association for Non-temporary Addresses (IA\_NA) and mechanisms defined in RFC 8415 [47].

The SMF may receive a Router Solicitation message, soliciting a Router Advertisement message.

When using DHCPv6 address allocation, a prefix (e.g. /64) may be allocated for the PDU Session at PDU Session Establishment from which the /128 addresses are selected. The SMF determines the size of the prefix for a PDU Session to a specific DNN and S-NSSAI based on subscription data and local configuration. The individual /128 address(es) allocated to the RG as part of DHCP IA\_NA procedure are then selected from the prefix allocated to the PDU Session. For statically assigned prefix, the subscription data in UDM for a DNN and S-NSSAI includes the prefix. Alternatively, individual 128-bit address(es) are allocated for the PDU Session without allocating a prefix to the PDU Session and provided to the RG as part of DHCP IA\_NA procedure.

When a prefix is allocated to the PDU Session, the SMF provides the prefix to the PCF instead of each /128 address. When individual /128 address(es) are allocated without allocating a prefix to the PDU Session, the SMF provides the /128 bits address(es) to PCF. Whether the SMF allocates a prefix for the PDU Session or individual 128-bit addresses is transparent to the RG and W-5GAN.

If Prefix Delegation (as described in clause 4.6.2.3) is also supported, a SMF may receive both DHCP options for IA\_NA and IA\_PD together in a single DHCPv6 message. An SMF may provide a reply to both IA\_NA and IA\_PD in the same message or alternatively process the DHCPv6 IA\_NA before the DHCPv6 IA\_PD.

The SMF may receive multiple different IA\_NA related DHCP requests within the same PDU Session.

NOTE 1: This is applicable if the RG acts as a DHCP relay for devices behind the RG.

To allocate an IPv6 address to a non-3GPP device behind 5G-RG and enable identification of the device in 5GC, the 5G-RG can act as a DHCPv6 relay agent and relay IA\_NA related DHCPv6 solicitation messages, created by the device or by the 5G-RG itself on behalf of the device (e.g. if other mechanism than DHCPv6 is used between the 5G-RG and the device for IP address/prefix allocation). The solicitation message may contain IA Address options encapsulated within IA\_NAto request a preferred address for the device. The 5G-RG includes the Device ID in the relayed DHCPv6 messages as described in clause 4.10x.

NOTE 2: Even though the 5G-RG may request for a certain address allocation, the SMF can override this as per DHCPv6 specification RFC 8415 [47]

When IPv6 Address Allocation using DHCPv6 is used, 5GC does not support IPv6 multi-homing for enabling SSC mode 3 and PDU Sessions with multiple PDU Session Anchors.

#### 4.6.2.3 IPv6 Prefix Delegation via DHCPv6

In addition to what is the specified in clause 5.8.2.2.4 of TS 23.501 [2], there is following difference:

- UE is replaced by 5G-RG and FN-RG.

- For IPv6 stateless IPv6 address autoconfiguration or IPv6 address allocation using DHCPv6, the SMF determines the maximum size of the prefix that may be allocated for the PDU Session based on subscription data and local configuration.

- If IPv6 address allocation using DHCPv6 is used, the DHCPv6 message may include a request for a delegated prefix (IA\_PD) together with a request for an IPv6 address (IA\_NA). Alternatively, a delegated prefix may be requested after an IPv6 address has been assigned using IA\_NA.

- If the DHCPv6 request indicates support for prefix exclusion via the OPTION\_PD\_EXCLUDE option code in an OPTION\_ORO option and if the SMF accepts this option, the SMF delegates a prefix excluding the default prefix with help of OPTION\_PD\_EXCLUDE. Prefix exclusion procedures shall follow IETF RFC 6603 [16].

- To provide IPv6 prefixes for non-3GPP devices behind a 5G-RG, a single network prefix shorter than /64 (e.g., /48) can be assigned to the PDU session as describe in clause 5.8.2.2.4 of TS 23.501 [2]. To request an IPv6 prefix for a device behind 5G-RG and enable identification of the non-3GPP device in 5GC, the 5G-RG can act as a DHCPv6 relay agent and relay IA\_PD related solicitation DHCPv6 messages, created by the Non-3GPP device or by the 5G-RG on behalf of the device (e.g. if other mechanism than DHCPv6 is used between the 5G-RG and the device for IP address/prefix allocation). The solicitation message may contain IA Prefix options encapsulated within IA\_PD to request a preferred prefix for the device. The 5G-RG includes the Device ID in the relayed DHCPv6 messages as described in clause 4.10x. The SMF delegates the IPv6 prefix for the device according to the clause 5.8.2.2.4 of TS 23.501 [2].

NOTE 2: Even though the 5G-RG may request for a certain prefix allocation, the SMF can override this as per DHCPv6 specification RFC 8415 [47]

#### 4.6.2.4 The procedure of Stateless IPv6 Address Autoconfiguration

Stateless IPv6 Address Autoconfiguration applies as described in clause 5.8.2.2.3 of TS 23.501 [2] with the differences described below.

When the W-AGF is serving an FN-RG, the W-AGF may include in the PDU Session Establishment Request an interface identifier of the FN-RG IPv6 link-local address associated with the PDU Session. If the SMF receives an interface identifier in the PDU Session Establishment Request message, the SMF provides this interface identifier value as the UE interface identifier in the PDU Session Establishment Accept message. To ensure that the link-local address used by the FN-RG does not collide with the link-local address of the SMF in this case, the SMF selectes a different link-local address for use as the SMF link local address for the PDU Session. If the PDU Session Establishment Request message does not contain an interface identifier, the SMF selects interface identifier for the UE, and SMF link-local address, as described in clause 5.8.2.2.3 of TS 23.501 [2].

NOTE 1: An FN-RGs is configuring its IPv6 link local address based on its MAC address and is not able to use an interface identifier selected by SMF as described in clause 5.8.2.2.3 of TS 23.501 [2].

In case of wireline access, independent of whether SMF received an interface identifier in the PDU Session Establishment Request message or not, the SMF includes the SMF link local address in the PDU Session Establishment Accept message.

NOTE 2: The SMF link local address is needed by the W-AGF to support procedures towards the FN-RG defined in BBF TR-456 [9].

\* \* \* \* Third change \* \* \* \*

## 4.10x Identification of Non-3GPP Devices Behind 5G-RG using DHCPv6

To identify a non-3GPP devices behind the 5G-RG in the 5GC, the 5G-RG may (create and) relay a DHCPv6 solicitation message and include the Device ID (see clause 5.x of TS 23.501 [2]) in the DHCPv6 message via the INTERFACE-ID option as described in RFC 8415 [47] or REMOTE\_ID option as described in RFC 4649 [XX].

Upon receiving the DHCPv6 solicitation message with the Device ID, the SMF may allocate the device IPv6 address/prefix based on the DHCPv6 message as described in clause 4.6.2. The SMF may consider the IA Address or IA Prefix values for allocation of IPv6 address or prefix for the device, if they are included in the IA\_NA or IA\_PD options. SMF forwards the Non-3GPP Device Information including Non-3GPP Device address, the Non-3GPP Device ID, and indication of device connectivity status to PCF. The PCF may use this to create/update PCC rules for the device as described in clause 6.1.3.x of TS 23.503 [4]. The procedure for identifying non-3GPP devices behind the 5G-RG is described in clause 7.3.8.x.

If a non-3GPP device is disconnected or the 5G-RG wants to terminate the device identification, the 5G-RG sends a DHCPv6 release message to the SMF and includes the Device ID in relayed message as described above.

NOTE: In addition to 5G-RG, this clause also applies to UEs that support DHCPv6 relaying option.

\* \* \* \* Fourth change \* \* \* \*

#### 7.3.8.x IPv6 Session Management Procedures for Identifying Non-3GPP Devices Behind 5G-RG using DHCPv6

This clause describes the procedure to enable 5GC to identify the non-3GPP devices behind a 5G-RG using DHCPv6 messaging, where both device connection and disconnection is considered.



Figure 7.3.8-1: Identifying device behind RG.

0. The Non-3GPP Device-Specific Information is provided in the UDR by an AF as described in clause 5.x of TS 23.501 [2].

NOTE: By implementation, any data in UDR can also be managed by OAM.1a. [device connection] A Non-3GPP device connects to the 5G-RG. The 5G-RG determines if it is required that the device’s traffic is identified in the 5GC or not based on local configuration. Only if this is required, the rest of the steps are performed.

1b. [device disconnection] Either the device gets disconnected from 5G-RG or the 5G-RG decides that device identification is no longer needed for the device.

2. [device connection] The 5G-RG either establishes a new IPv6 PDU session or use an existing one. The RG decides on this either based on configuration or the URSP rules related to the Device ID.

3. The non-3GPP device or the 5G-RG on behalf of the device may create a DHCPv6 solicitation message to obtain IPv6 Address or IPv6 Prefix or a release message if the device needs to be disconnected.

NOTE: The SMF may consider the IA Address or IA Prefix values for allocation of IPv6 address or prefix for the device, if they are included in the IA\_NA or IA\_PD options in the DHCPv6 solicitation message.

4. The 5G-RG acts as a DHCPv6 relay agent and creates a DHCPv6 relayed message and includes the Device ID via INTERFACE-ID option as described in RFC 8415 [47] or REMOTE\_ID option as described in RFC 4649 [XX].

5. The 5G-RG sends the DHCPv6 message to SMF via UP as per current specifications.

6. The SMF obtains the Non-3GPP Device ID from the DHCPv6 request. If the device is connected, the SMF allocates the IPv6 Address or IPv6 Prefix.

7. The SMF initiates SM policy association modification request and includes Non-3GPP Device Information containing the Non-3GPP Device ID, the IPv6 Address/Prefix allocated to the Non-3GPP Device, and indication of the device connection. The PCF obtains the Non-3GPP Device-Specific Information associated with the Device ID stored in the UDR. The PCF may enforce that that the number of identifiable devices that are simultaneously connected to the 5G-RG is less than the Maximum number of identifiable non-3GPP device IDs as described in clause 6.1.x of TS 23.503 [4]. The PCF may update the PCC rules for the 5G-RG based on the Non-3GPP Device associated data in UDR. For further information, see TS 23.503 [4] clause 6.1.3.x

Editor’s Note: depending on how max number of identifiable devices are enforced, the text in step 7 may need to be updated.

8. The SMF sends the DHCPv6 reply message to 5G-RG.

9. If PCC rules were updated in step 5, the SMF may need to initiate a PDU session modification procedure.

10. [device connection] Traffic to and from the device is identified and associated with the Device ID and depending on PCC rule, it may be QoS differentiated.

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