**3GPP TSG- Meeting # *r02***

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| **CHANGE REQUEST** |
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| ***Proposed change affects:*** | UICC apps |  | ME | **X** | Radio Access Network |  | Core Network |  |

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|  |
| ***Title:***  | Scope, terms, reference architecture, and functional entities for 5G ProSe Multi-hop  |
|  |  |
| ***Source to WG:*** | KPN N.V., LG Electronics, Qualcomm Incorporated (?), AT&T (?), Ericsson (?), FirstNet (?), Intel, Huawei (?), HiSilicon (?), NIST  |
| ***Source to TSG:*** | SA2 |
|  |  |
| ***Work item code:*** |  |  | ***Date:*** |  |
|  |  |  |  |  |
| ***Category:*** |  |  | ***Release:*** |  |
|  | *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)* |
|  |  |
| ***Reason for change:*** | This paper covers the required updates and additions for the scope, terms, reference architecture, and functional entities to support 5G ProSe Multi-hop Relay based on the agreed conclusions of the TR 23.700-03. |
|  |  |
| ***Summary of change:*** | §1: Add description of the new multi-hop functionality for 5G ProSe.§3.1: Add new term "5G ProSe Intermediate UE-to-Network Relay" and modify existing terms "5G ProSe Remote UE" and "5G ProSe End UE".§4.2.7.1A: Add reference architecture for 5G ProSe Multi-hop Layer-3 UE-to-Network Relay.§4.2.8A: Add reference architecture for 5G ProSe Multi-hop UE-to-UE Relay.§4.3.1: Add UE functions to support 5G ProSe Multi-hop Relay.§4.3.9.2: Add functionality description to support 5G ProSe Multi-hop UE-to-Network Relay§4.3.12: Add functionality description to support 5G ProSe Multi-hop UE-to-UE Relay§4.3.13: Add the new 5G ProSe Intermediate UE-to-Network Relay functional entity. |
|  |  |
| ***Consequences if not approved:*** | Missing reference architecture and functional entities for supporting 5G ProSe Multi-hop Relay |
|  |  |
| ***Clauses affected:*** | 1, 2, 3.1, 4.2.7.1A (new), 4.2.8A (new), 4.3.1, 4.3.9.2, 4.3.12.2, 4.3.13 (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 Changes \* \* \* \*

# 1 Scope

The present document specifies the Stage 2 of the Proximity based Services (ProSe) features in 5GS. 5G ProSe features consist of: 5G ProSe Direct Discovery, 5G ProSe Direct Communication, 5G ProSe UE-to-Network Relay and 5G ProSe UE-to-UE Relay.

5G ProSe Direct Discovery identifies that 5G ProSe-enabled UEs are in proximity using NR.

5G ProSe Direct Communication enables establishment of communication paths between two or more 5G ProSe-enabled UEs that are in direct communication range using NR.

5G ProSe UE-to-Network Relay enables indirect communication between the 5G network and UEs (e.g. for UEs that are out of coverage of the network). Both Layer-2 and Layer-3 single- and multi-hop is supported.

5G ProSe UE-to-UE Relay enables indirect Layer-2 and Layer-3 single.hop communication and Layer-3 multi-hop communication between two 5G ProSe End UEs.

Security aspects of ProSe in 5GS are defined in TS 33.503 [29].

\* \* \* \* Next 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 23.287: "Architecture enhancements for 5G System (5GS) to support Vehicle-to-Everything (V2X) services".

[3] 3GPP TS 23.303: "Proximity-based services (ProSe); Stage 2".

[4] 3GPP TS 23.501: "System Architecture for the 5G System; Stage 2".

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

[6] 3GPP TS 22.261: "Service requirements for next generation new services and markets; Stage 1".

[7] 3GPP TS 22.278: "Service requirements for the Evolved Packet System (EPS)".

[8] 3GPP TS 23.288: "Architecture enhancements for 5G System (5GS) to support network data analytics services".

[9] 3GPP TS 23.503: "Policy and Charging Control Framework for the 5G System".

[10] Void.

[11] 3GPP TS 36.300: "Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Overall description; Stage 2".

[12] 3GPP TS 38.300: "NR; NR and NG-RAN Overall Description; Stage 2".

[13] 3GPP TS 38.304: "NR; User Equipment (UE) procedures in idle mode".

[14] 3GPP TS 23.122: "Non-Access-Stratum (NAS) functions related to Mobile Station in idle mode".

[15] 3GPP TS 36.331: "Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification".

[16] 3GPP TS 38.331: "NR; Radio Resource Control (RRC); Protocol Specification".

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

[18] IETF RFC 3927: "Dynamic Configuration of IPv4 Link-Local Addresses".

[19] IETF RFC 826: "An Ethernet Address Resolution Protocol".

[20] Void.

[21] 3GPP TR 23.752: "Study on system enhancement for Proximity based Services (ProSe) in the 5G System (5GS)".

[22] 3GPP TS 32.277: "Proximity-based Services (ProSe) charging".

[23] 3GPP TS 24.554: "Proximity-services (ProSe) in 5G System (5GS) protocol aspects; Stage 3".

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

[25] IETF RFC 4039: "Rapid Commit Option for the Dynamic Host Configuration Protocol version 4 (DHCPv4)".

[26] Void.

[27] Void.

[28] 3GPP TS 38.351: "NR; Sidelink Adaptation Layer Protocol".

[29] 3GPP TS 33.503: "Security Aspects of Proximity based Services (ProSe) in the 5G System (5GS)".

[30] 3GPP TS 29.500: "5G System; Technical Realization of Service Based Architecture; Stage 3".

[31] 3GPP TS 23.167: "3rd Generation Partnership Project; Technical Specification Group Services and Systems Aspects; IP Multimedia Subsystem (IMS) emergency sessions".

[32] 3GPP TS 23.041: "Technical realization of Cell Broadcast Service (CBS)".

[33] 3GPP TS 22.268: "Public Warning System (PWS) requirements".

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

[xx] IETF RFC 7181: "The Optimized Link State Routing Protocol Version 2".

[yy] IETF RFC 6130: "Mobile Ad Hoc Network (MANET) Neighborhood Discovery Protocol (NHDP)".

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

## 3.1 Terms

For the purposes of the present document, the terms given in TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [1].

**5G ProSe-enabled UE:** A UE that supports 5G ProSe requirements and associated procedures.

**5G ProSe Direct Discovery:** A procedure employed by a 5G ProSe-enabled UE to discover other 5G ProSe-enabled UEs in its vicinity based on direct radio transmissions between the two UEs with NR technology.

**5G ProSe Direct Communication:** A communication between two or more UEs in proximity that are 5G ProSe-enabled, by means of user plane transmission using NR technology via a path not traversing any network node.

**5G ProSe UE-to-Network Relay:** A 5G ProSe-enabled UE that provides functionality to support connectivity to the network for 5G ProSe Remote UE(s).

**5G ProSe Intermediate UE-to-Network Relay:** A 5G ProSe-enabled UE that provides functionality to support connectivity to the network for 5G ProSe Remote UE(s) by using the PC5 reference point with other 5G ProSe-enabled UEs. The 5G ProSe Intermediate UE-to-Network Relay is located on the path between 5G ProSe Remote UE and 5G ProSe UE-to-Network Relay.

Editor's Note: Aspects on Multi-hop Layer-2 UE-to-Network relaying (e.g. terms, functionalities, etc.) will be aligned with RAN WGs' progress/decision.

**5G ProSe Remote UE:** A 5G ProSe-enabled UE that communicates with a DN via zero or more 5G ProSe Intermediate UE-to-Network Relay(s) and a 5G ProSe UE-to-Network Relay.

**5G ProSe UE-to-UE Relay:** A 5G ProSe-enabled UE that provides functionality to support connectivity between 5G ProSe End UEs.

**5G ProSe End UE:** A 5G ProSe-enabled UE that connects with another 5G ProSe-enabled UE(s) via one or more 5G ProSe UE-to-UE Relay(s).

**Application Layer ID:** An identifier identifying a 5G ProSe-enabled UE within the context of a specific application. The format of this identifier is outside the scope of 3GPP.

**Direct Network Communication:** One mode of network communication, where there is no 5G ProSe UE-to-Network Relay between a UE and the 5G network.

**Indirect Network Communication:** One mode of network communication, where there is a 5G ProSe UE-to-Network Relay between a UE and the 5G network.

**Member ID:** An identifier uniquely identifying a member in the Application Layer managed group and that is managed by the ProSe application layer.

**Mode of communication:** Mode of communication to be used by the 5G ProSe-enabled UE over PC5 reference point, i.e. broadcast mode, groupcast mode or unicast mode.

**Open ProSe Discovery**: ProSe Direct Discovery without explicit permission from the 5G ProSe-enabled UE being discovered, according to TS 22.278 [7].

**ProSe identifier:** A globally unique identifier used to identify the ProSe Application associated with the ProSe operation in 5G ProSe Direct Discovery and 5G ProSe Direct Communication. In this Release, the "Application ID" defined in TS 23.303 [3] can be used as the ProSe identifier in 5G ProSe Direct Discovery and in a consequent 5G ProSe Direct Communication.

**Restricted ProSe Discovery**:ProSe Direct Discovery that only takes place with explicit permission from the 5G ProSe-enabled UE being discovered, according to TS 22.278 [7].

**Relay Service Code:** A Relay Service Code is used for the case of UE-to-Network Relay as well as for the case of UE-to-UE Relay. The definition for the case of UE-to-Network Relay is in TS 23.303 [3]. For the case of UE-to-UE Relay, the Relay Service Code is used to identify a connectivity service the 5G ProSe UE-to-UE Relay provides and the authorized users the 5G ProSe UE-to-UE Relay would offer service to. The definition of values of Relay Service Code for the case of UE-to-UE Relay is out of scope of this specification.

**User Info ID:** The User Info ID is configured for Model A or Model B Group Member Discovery, 5G ProSe UE-to-Network Relay Discovery and 5G ProSe UE-to-UE Relay Discovery, either for public safety or commercial applications based on the policy of the HPLMN or via the ProSe application server that allocates it. The definition of values of User Info ID is out of scope of this specification.

For the purposes of the present document, the following term and definition given in TS 23.303 [3] apply:

**Application Layer Group ID**

**Destination Layer-2 ID**

**Discovery Entry ID**

**Discovery Filter**

**Discovery Query Filter**

**Discovery Response Filter**

**Geographical Area**

**Local PLMN**

**Model A**

**Model B**

**Metadata Index Mask**

**ProSe Application ID**

**ProSe Application Code**

**ProSe Application Mask**

**ProSe Query Code**

**ProSe Response Code**

**ProSe Restricted Code**

**ProSe Restricted Code Prefix**

**ProSe Restricted Code Suffix**

**ProSe Discovery UE ID**

**ProSe Layer-2 Group ID**

**Restricted ProSe Application User ID**

**Source Layer-2 ID**

For the purposes of the present document, the following term and definition given in TS 23.287 [2] apply:

**NR Tx Profile**

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

#### 4.2.7.1A 5G ProSe Multi-hop Layer-3 UE-to-Network Relay reference architecture

Figure 4.2.7.1A-1 shows the high level reference architecture for 5G ProSe multi-hop Layer-3 UE-to-Network Relay. There may be one or multiple 5G ProSe Intermediate UE-to-Network Relays between the 5G Prose Remote UE and the 5G ProSe UE-to-Network Relay. In this figure, the 5G ProSe Layer-3 UE-to-Network Relay may be in the HPLMN or a VPLMN.

5G ProSe

Remote UE

5G ProSe Intermediate

UE-to-Network Relay(s)

NG

-

RAN

PC5

5G ProSe UE

-

to

-

Network Relay

PC5

Uu

5GC

Data

Network

N6

A1

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

#### 4.2.8A 5G ProSe Multi-hop UE-to-UE Relay reference architecture

Figure 4.2.8A-1 shows the Layer-3 5G ProSe UE-to-UE Relay reference architecture. The 5G ProSe End UEs communicate with each other via a set of interconnected 5G ProSe Multi-hop UE-to-UE Relays.



Figure 4.2.8A-1: Reference architecture for Layer-3 5G ProSe Multi-hop UE-to-UE Relay

Based on capability and configuration the 5G ProSe UE can act as a 5G ProSe End UE, a 5G ProSe Multi-hop UE-to-UE Relay or both.

* For IP PDU type, the 5G ProSe Multi-hop UE-to-UE Relays form a MANET network as defined in IETF RFC 7181 [xx]. A 5G ProSe UE acting as 5G ProSe UE-to-UE Relay shall support the protocols defined in IETF RFC 7181 [xx] and IETF RFC 6130 [yy] on the PC5 interfaces towards other 5G ProSe Multi-hop UE-to-UE Relays. In addition, the 5G ProSe UE-to-UE Relay shall support a dedicated MANET message (i.e. [MANET] Discovery Info message defined in [FFS]) on the PC5 interfaces towards other 5G ProSe Multi-hop UE-to-UE Relays for propagation of DNS information, as described in clause 5.14.x.2.

Editor's note: It is up to CT1 WG to determine where and how to specify the [MANET] Discovery Info message.

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

4.3.1 UE

Any 5G ProSe-enabled UE may support the following functions:

- Exchange of information for 5G ProSe Direct Discovery between 5G ProSe-enabled UE and the 5G DDNMF over PC3a reference point.

- Procedures for 5G ProSe Direct Discovery of other 5G ProSe-enabled UEs over PC5 reference point.

- Procedures for 5G ProSe Direct Communication over PC5 reference point, including Broadcast, Groupcast and Unicast mode 5G ProSe Direct Communication.

- Procedures to act as a 5G ProSe Layer-2 UE-to-Network Relay.

- Procedures to act as a 5G ProSe Layer-3 UE-to-Network Relay.

- Procedures to act as a 5G ProSe Intermediate UE-to-Network Relay.

- Procedures to act as a 5G ProSe Layer-2 Remote UE.

- Procedures to act as a 5G ProSe Layer-3 Remote UE.

- Procedures to act as a 5G ProSe Layer-2 UE-to-UE Relay.

- Procedures to act as a 5G ProSe Layer-3 UE-to-UE Relay.

- Procedures to act as a 5G ProSe Layer-2 End UE.

- Procedures to act as a 5G ProSe Layer-3 End UE.

- Procedures for communication path switching between PC5 and Uu reference points.

- Procedures for Multi-path communication via Uu and via 5G ProSe UE-to-Network Relay.

- Indicating UE Policy Provisioning Request in UE Policy Container for UE triggered 5G ProSe Policy provisioning, which requests one or multiple types of policies/parameters as listed below:

- Policy/parameters for 5G ProSe Direct Discovery;

- Policy/parameters for 5G ProSe Direct Communication;

- Policy/parameters for 5G ProSe Layer-2 Remote UE;

- Policy/parameters for 5G ProSe Layer-3 Remote UE;

- Policy/parameters for 5G ProSe Layer-2 UE-to-Network Relay;

- Policy/parameters for 5G ProSe Layer-3 UE-to-Network Relay;

- Policy/parameters for 5G ProSe Intermediate Layer-3 UE-to-Network Relay;

- Policy/parameters for 5G ProSe Layer-2 End UE;

- Policy/parameters for 5G ProSe Layer-3 End UE;

- Policy/parameters for 5G ProSe Layer-2 UE-to-UE Relay;

- Policy/parameters for 5G ProSe Layer-3 UE-to-UE Relay.

- Policy/parameters for 5G ProSe Multi-hop UE-to-Network Relay Discovery;

- Policy/parameters for 5G ProSe Multi-hop UE-to-UE Relay Discovery;

- Policy/parameters for 5G ProSe Communication via Multi-hop UE-to-Network Relay;

- Policy/parameters for 5G ProSe Communication via Multi-hop UE-to-UE Relay;

- Receiving the 5G ProSe Policy from 5GC over N1 reference point.

- Configuration of parameters for 5G ProSe Direct Discovery, 5G ProSe Direct Communication, 5G ProSe Single-hop UE-to-Network Relay (e.g. including IP addresses, ProSe Layer-2 Group IDs, see clause 5.1), 5G ProSe Multi-hop UE-to-Network Relay, 5G ProSe Single-hop UE-to-UE Relay, and 5G ProSe Multi-hop UE-to-UE Relay. These parameters can be pre-configured in the UE, or, if in coverage, provisioned or updated by signalling over the N1 reference point from the PCF in the HPLMN or over PC1 reference point from the ProSe Application Server.

- Reporting the following capabilities to 5GC over the N1 reference point:

- 5G ProSe Capability.

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

#### 4.3.12.1 General

Both 5G ProSe Layer-2 and Layer-3 UE-to-UE Relay provides the relaying functionality to support connectivity between 5G ProSe End UEs. 5G ProSe UE-to-UE Relay can be used for both public safety services and commercial services (e.g. interactive service).

Both 5G ProSe Layer-2 and Layer-3 UE-to-UE Relay supports the following functions to enable connectivity between 5G ProSe End UEs:

- 5G ProSe UE-to-UE Relay Discovery service as defined in clause 6.3.2.4, to allow discovery by the 5G ProSe End UE;

- 5G ProSe Discovery integrated into PC5 unicast link establishment as specified in clause 6.7.3;

- Access 5GS as a UE as defined in TS 23.501 [4] with the enhancements as specified in clauses 6.2;

- Relay unicast traffic between the 5G ProSe End UEs directly in case of 5G ProSe Single-hop UE-to UE Relay, or via one or more Layer-3 UE-to-UE Relay in case of 5G ProSe Multi-hop UE-to-UE Relay, supporting IP, Ethernet or Unstructured traffic type.

NOTE: Relaying groupcast and broadcast traffic to a 5G ProSe End UE by a 5G ProSe UE-to-UE Relay is not supported in this release of the specification.

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

4.3.9.2 5G ProSe Layer-3 UE-to-Network Relay

In addition to the common 5G ProSe UE-to-Network Relay functions defined in clause 4.3.9.1, 5G ProSe Layer-3 UE-to-Network Relay supports the following functions to enable connectivity to the network:

- 5G ProSe Direct Communication via 5G ProSe Layer-3 UE-to-Network Relay as specified in clause 6.5.1, for the communication with the 5G ProSe Layer-3 Remote UEs for the relay operations;

- end-to-end QoS treatment for the 5G ProSe Layer-3 Remote UE's traffic without N3IWF as defined in clause 5.6.2.1 and when accessing via an N3IWF as defined in clause 5.6.2.2;

- IP address management for the 5G ProSe Layer-3 Remote UE as defined in clause 5.5.1.3 in case the 5G ProSe Layer-3 Remote UE uses IP traffic type.

- Emergency PDU Session establishment for 5G ProSe Layer-3 Remote UE via 5G ProSe Layer-3 UE-to-Network Relay without N3IWF support.

NOTE: For emergency service via N3IWF, see clause 5.4.4.3.

In case 5G ProSe Multi-hop UE-to-Network Relay is supported, a 5G ProSe Layer-3 UE-to-Network Relay supports the following functions:

- 5G ProSe Multi-hop UE-to-Network Relay Discovery;

- 5G ProSe Communication via Multi-hop UE-to-Network Relay as defined in clause 6.5.1.

- Relay unicast traffic originating from the 5G ProSe Remote UE and received from a 5G ProSe Intermediate UE-to-Network Relay to the network supporting IP, Ethernet or Unstructured traffic type.

- QoS handling and end-to-end QoS treatment for the 5G ProSe Layer-3 End UE's traffic as defined in clause 5.6.2.X;

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

#### 4.3.12.2 5G ProSe Layer-3 UE-to-UE Relay

In addition to the common 5G ProSe UE-to-UE Relay functionality defined in clause 4.3.12.1, a 5G ProSe Layer-3 UE-to-UE Relay supports the following functions:

- 5G ProSe Direct Communication via 5G ProSe Layer-3 UE-to-UE Relay as specified in clause 6.7.1, for the communication between 5G ProSe Layer-3 End UEs for relay operations;

- QoS handling and end-to-end QoS treatment for the 5G ProSe Layer-3 End UE's traffic as defined in clause 5.6.3.1;

- IP address management for the 5G ProSe Layer-3 End UE as defined in clause 5.5.1.4 when the 5G ProSe Layer-3 End UE uses IP traffic type;

- 5G ProSe UE-to-UE Relay reselection as specified in clause 6.7.4.3.

In case 5G ProSe Multi-hop UE-to-UE Relay is supported, a 5G ProSe Layer-3 UE-to-UE Relay supports the following functions:

- 5G ProSe Multi-hop UE-to-UE Relay Discovery service;

- 5G ProSe Communication via Multi-hop UE-to-UE Relay as defined in clause XXX.

- Relay unicast traffic between the 5G ProSe End UEs via one or more Layer-3 UE-to-UE Relays, supporting IP, Ethernet or Unstructured traffic type.

- QoS handling and end-to-end QoS treatment for the 5G ProSe Layer-3 End UE's traffic as defined in clause XXX;

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

#### 4.3.13 5G ProSe Intermediate UE-to-Network Relay

The 5G ProSe Intermediate UE-to-Network Relay entity provides the relaying functionality to support multi-hop connectivity between the 5G ProSe Remote UEs and the 5G ProSe UE-to-Network Relay. It can be used for both public safety services and commercial services (e.g. interactive service). There can be more than one 5G ProSe Intermediate UE-to-Network Relay connecting the 5G ProSe Remote UEs and the 5G ProSe UE-to-Network Relay.

The 5G ProSe Intermediate UE-to-Network Relay supports the following functions to enable connectivity between the 5G ProSe Remote UEs and the 5G ProSe UE-to-Network Relay:

- 5G ProSe Multi-hop UE-to-Network Relay Discovery service to allow discovery by the 5G ProSe Remote UE as defined in clause 6.3.2.X;

- access the 5GS as a UE as defined in TS 23.501 [4];

- relays unicast traffic (uplink and downlink) between the 5G ProSe Remote UE and the 5G ProSe UE-to-Network Relay directly or via other 5G ProSe Intermediate UE-to-Network Relay(s), supporting IP, Ethernet or Unstructured traffic type.

- 5G ProSe Multi-hop Communication via 5G ProSe Layer-3 UE-to-Network Relay as specified in clause 6.5.1;

- end-to-end QoS treatment for the 5G ProSe Layer-3 Remote UE's traffic with and without N3IWF as defined in clause 5.6.2.X;

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