**3GPP TSG-WG SA2 Meeting #166S2-2411966**

**18th – 22nd November, 2024, Orlando, US (revision of S2-240xxxx)**

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| *CR-Form-v12.3* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **23.304** | **CR** | **0503** | **rev** | **-** | **Current version:** | **19.1.0** |  |
|  | | | | | | | | |
| *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 |  |

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|  | | | | | | | | | | |
| ***Title:*** | Update on Multihop U2N Relay with Model B Discovery | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Huawei, HiSilicon, KPN N.V., Samsung | | | | | | | | | |
| ***Source to TSG:*** | SA2 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | 5G\_ProSe\_Ph3 | | | | |  | ***Date:*** | | | 2024-11-08 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **F** |  | | | | | ***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:*** | | 1. The optional Intermediate U2N Relay(s) is missing in the figure of User plane protocol stack for Layer-3 UE-to-Network Relay without N3IWF. 2. Solve ENs in U2N Model B Discovery procedure:  * The U2N Relay may receive multiple Relay Discovery messages from different paths, it can choose to response one or more discovery messages based on number of hops, etc. But it is up to implementation to decide when to send the Relay Discovery Response message, e.g. based on the number of received Solicitation messages or a timer. * The Intermediate U2N Relay, when receiveing Relay Discovery Response message, could decide the next hop to unicast the Response message based on its own User Info ID and the path info contained in the Response message. There is only one its own User Info ID in the path info because the loop situation is avoided when sending the Solicitation message.  1. Terms alignment, changing 5G ProSe Intermediate Relay to 5G ProSe Intermediate UE-to-Network Relay. 2. For path selection during Discovery procedure, the wording “PC5 signal strength and … to the 5G ProSe UE-to-Network Relay” could be misleading. 3. The “multi-hop indicator per RSC” is provisioned in the Relay Discovery Parameters, but it is unclear whether the values of RSC for multi-hop and for single-hop are different or they could be the same. It is preferred to clarify that they are different so that SA3 could reuse legacy security methods defined in R17. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | 1. Adding optional Intermediate U2N Relay(s) into Figure 6.1.2.3.1-1. 2. Adding NOTEs in U2N Model B Discovery procedure to clarify that (1) how does U2N Relay decide to send Discovery Response is up to implementation; (2) Intermediate U2N Relay decides how to forward Discovery Response message based on path information. 3. Terms alignment. 4. Clarify that “the PC5 signal strength” is between the Remote UE and its neighbour Intermediate U2N Relay rather than with U2N Relay. 5. Clarify that the values of RSC for multi-hop and for single-hop are different, in Policy/Parameter provisioning for multi-hop UE-to-Network Relay. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | Incomplete and unclear description for U2N Model B Discovery related procedures. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 6.1.2.3.1, 6.3.2.5.3, 5.1.4.1a | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **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:*** | |  | | | | | | | | |

\* \* \* \* First change \* \* \* \*

##### 6.1.2.3.1 5G ProSe Layer-3 UE-to-Network Relay

PDU Layer

MAC

L1

RLC

PDCP

SDAP

Remote UE

PC5-U

Application

PDU\_Relay

MAC

L1

RLC

PDCP

SDAP

Intermediare U2N Relay(s)

MAC

L1

RLC

PDCP

SDAP

PDU\_Relay

MAC

L1

RLC

PDCP

SDAP

MAC

L1

RLC

PDCP

SDAP

UE-to-Network Relay

MAC

L1

RLC

PDCP

SDAP

L2

L1

UDP/IP

GTP-U

NG-RAN node

.

Relay

PC5-U

Uu

N3

L2

L1

UDP/IP

UPF

GTP-U

PDU Layer

N6

**Legend:**

- GPRS Tunnelling Protocol for the user plane (GTP‑U): This protocol tunnels user data between NG-RAN node and UPF as well as between the UPFs in the backbone network (not shown in the figure). GTP-U shall encapsulate all end user PDU packets.

- SMF controls the user plane tunnel establishment and establishes User Plane Bearers between NG-RAN node and UPF.

- UDP/IP: These are the backbone network protocols used for routing user data and control signalling.

- Uu: The NR Uu radio protocols of NG-RAN between the UE-to-Network Relay and the NG-RAN node are specified in TS 38.300 [12].

- PC5-U: The radio protocols between the UE and the UE-to-Network Relay are specified in clause 6.1.2.2.

Figure 6.1.2.3.1-1: User plane protocol stack for Layer-3 UE-to-Network Relay

PC5

PDU Layer

IP

PC5

IPSec

(tunnel mode)

Inner IP

GRE

IP

PC5

Remote UE

Intermediate U2N Relay(s)

PC5

U2N Relay

IP

Uu

Uu

RAN

N3 Stack

.

Relay

N3

stack

U2N Relay UPF

L2/L1

IP

PC5

PC5

Uu

N3

N6

Lower Layers

IP

N3IWF

IPSec

(tunnel mode)

Inner IP

GRE

N3

Stack

.

Relay

PDU Layer

N3

Stack

N9

Stack

.

Relay

N3

N9

N9

Stack

UPF(PSA)

**Legend:**

- IPSec, Inner IP and GRE between the UE and the N3IWF are defined in TS 23.501 [4] clause 8.3.2.

Figure 6.1.2.3.1-2: User plane protocol stacks for Layer-3 UE-to-Network Relay with N3IWF support

There may be zero, one or multiple 5G ProSe Intermediate UE-to-Network Relay(s) between the 5G ProSe Remote UE and the 5G ProSe UE-to-Network Relay. If there is no 5G ProSe Intermediate UE-to-Network Relay, the IP connection and the PC5 link is between the 5G ProSe Remote UE and the 5G ProSe UE-to-Network Relay.

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

##### 6.3.2.5.3 Procedure for Multi-hop 5G ProSe UE-to-Network Relay Discovery with Model B

intermediate Relay1

intermediate Relay3

intermediate Relay2

Remote UE1

**……**

U2N Relay

10. choose relay

PCF

0. ProSe Policy

1.decides max hop num

2a. U2N Relay Discovery Solicitation message

4a. U2N Relay Discovery Solicitation message

3a. decides to send Solicitation or Response

3b. decides to send Solicitation or Response

4b. Solicitation message

7a. Response

8a. Response

6. choose Relay

5b. Solicitation message

2b. U2N Relay Discovery Solicitation message

8b. Response

9. Response

7b. Response

Figure 6.3.2.5.3-1: General Procedures for 5G ProSe Multi-hop UE-to-Network Relay Discovery with Model B

1. The 5G ProSe Remote UE determines the multi-hop supported indication and Hop-Limit for discovery based on policy configuration (i.e. a mapping between multi-hop indicator and RSC, and a mapping between maximum number of hops and RSC) or QoS requirements.

If the multi-hop supported indication and Hop-Limit are determined based on configuration associated with the RSC, the 5G ProSe Remote UE does not include the multi-hop supported indication and Hop-Limit in the Solicitation message. Otherwise, the 5G ProSe Remote UE includes the multi-hop supported indication and Hop-Limit in the Solicitation message.

2a. The 5G ProSe Remote UE sends a 5G ProSe UE-to-Network Relay Discovery Solicitation message. The 5G ProSe UE-to-Network Relay Discovery Solicitation message additionally contains following IEs compared with that in clause 6.3.2.3.3: an indication that multi-hop relay is supported, hop count and Hop-Limit.

The Target Info may contain the User Info ID of the UE-to-Network Relay and Intermediate UE-to-Network Relay(s).

3a. If an indication that multi-hop relay is supported is contained in the received Solicitation message, the RSC contained in the Solicitation message matches any of the (pre)configured RSC(s), as specified in clause 5.1.4.1a, of a 5G ProSe Intermediate UE-to-Network Relay, and the Target Info matches the User Info ID of the 5G ProSe Intermediate UE-to-Network Relay (if any), the 5G ProSe Intermediate UE-to-Network Relay may decide to send a 5G ProSe UE-to-Network Relay Discovery Solicitation message.

The 5G ProSe Intermediate UE-to-Network Relay shall drop the received Solicitation message if the hop count (corresponding to the number of Relays included in the message) has reached the Hop-Limit of the received Solicitation message or the (pre)configured maximum number of hops associated with the RSC.

The 5G ProSe Intermediate UE-to-Network Relay may send a Response message when it has already found or established PC5 link with 5G ProSe UE-to-Network Relay(s), without sending Solicitation message. i.e., steps 4a-7a are skipped and step 8a is performed directly. The response message additionally contains the User Info ID of UE-to-Network Relay, path information to the UE-to-Network Relay which is an (ordered) list of User Info ID of intermediate UE-to-Network Relay(s).

If the same information on User Info IDs of Remote UE and UE-to-Network Relay is received from different ProSe UEs, the 5G ProSe Intermediate UE-to-Network Relay may select a Solicitation message to be sent to the next hop based on various criteria (e.g., hop count, delay, channel quality of received messages, etc.).

NOTE 2: If the 5G ProSe Remote UE does not receive any response after a pre-configured time, based on application requirement, it may increase the Hop-Limit and send the discovery message again.

4a. A 5G ProSe Intermediate UE-to-Network Relay sends a Solicitation message, it additionally includes its own User Info ID in the message. i.e., the message contains the path information which is an (ordered) list of User Info ID and Layer-2 ID of Relays in the path that has relayed the Solicitation message. The hop count is increased by 1. The solicitation message may include cumulative QoS for PC5 link.

The cumulative QoS for PC5 link, if present in the received solicitation message, will be updated to include the QoS of the PC5 link between the 5G ProSe Intermediate UE-to-Network Relay and its child UE (Intermediate UE-to-Network Relay or Remote UE) when the 5G ProSe Intermedidate UE-to-Network Relay can determine the QoS between 5G ProSe Intermedidate UE-to-Network Relay and the sender of the message, e.g. there exists a PC5 connection between them.

2b.-5b. The Solicitation message from the same Remote UE goes through a different ordered list of 5G ProSe Intermediate UE-to-Network Relays.

6-7. If the RSC contained in the solicitation message matches any of the (pre)configured RSC(s), as specified in clause 5.1.4.1, of the 5G ProSe UE-to-Network Relay, and the Target Info matches the User Info ID of the 5G ProSe UE-to-Network Relay (if any), then the 5G ProSe UE-to-Network Relay responds to the 5G ProSe Intermediate UE-to-Network Relay with a 5G ProSe UE-to-Network Relay Discovery Response message. The 5G ProSe UE-to- Network Relay Discovery Response message additionally contains the path information compared with that in clause 6.3.2.3.3. The response message may include the received cumulative QoS for PC5 link.

After verifying whether QoS related parameters of received Relay Discovery Solicitation message (e.g. number of hops, cumulative QoS for PC5 link) satisfies the policy configuration or QoS requirements per RSC, the 5G ProSe UE-to-Network Relay may decide to response Relay Discovery Response message.

The 5G ProSe UE-to-Network Relay may choose the path based on e.g., the PC5 signal strength of each message received, hops to the Remote UE, the path information, cumulative QoS for PC5 link, etc.

NOTE 3: It is up to implementation how the 5G ProSe UE-to-Network Relay decides when to send the Relay Discovery Response message. E.g., when receiving the first Solicitation message from a 5G ProSe Remote UE, the 5G ProSe UE-to-Network Relay can set a timer as the trigger for sending Relay Discovery Response message(s).

8-9. When a 5G ProSe UE-to-Network Relay Discovery Response message is received, if the User Info ID of the receiving 5G ProSe Intermediate UE-to-Network Relay is included in the path information, the 5G ProSe Intermediate UE-to-Network Relay forwards the 5G ProSe UE-to-Network Relay Discovery Response message. The Response message additionally contains the path information which is a list of User Info IDs of 5G ProSe Intermediate UE-to-Network Relay(s) and the remote UE in the order of position in the path. Based on the path information, the Relay Discovery Response message is forwarded along the path, where each 5G ProSe Intermediate UE-to-Network Relay determines the next hop information (e.g. User Info ID and Layer-2 ID) to forward the Relay Discovery Response message. The response message may include the received cumulative QoS for PC5 link.

The Source Layer-2 ID and Destination Layer-2 ID of 5G ProSe UE-to-Network Relay Discovery Response message are described in clause 5.8.3.

10. If the Remote UE receives multiple Discovery Response messages, it may perform relay path selection based on e.g., path information, the PC5 signal strength between Remote UE and its neighbour Intermediate UE-to-Network Relay, cumulative QoS for PC5 link, and the number of hops to the 5G ProSe UE-to-Network Relay.

NOTE: If the 5G ProSe Remote UE does not receive any response after a pre-configured time, based on application requirement, it may increase the Hop-Limit and send the discovery message again.

\* \* \* \* Third changes \* \* \* \*

#### 5.1.4.1a Policy/Parameter provisioning for 5G ProSe multi-hop UE-to-Network Relay

The following information is provisioned in the UE in support of the UE assuming the role of a 5G ProSe Layer-3 UE-to-Network Relay supporting 5G ProSe Layer-3 multi-hop UE-to-Network Relay:

1) Authorisation policy for acting as a 5G ProSe Layer-3 UE-to-Network Relay supporting 5G ProSe Layer-3 multi-hop UE-to-Network Relay when "served by NG-RAN":

- PLMNs in which the UE is authorized to relay traffic for 5G ProSe Layer-3 Remote UEs supporting 5G ProSe Layer-3 multi-hop UE-to-Network Relay.

The authorisation for a UE to act as a 5G ProSe Layer-3 UE-to-Network Relay supporting 5G ProSe Layer-3 multi-hop UE-to-Network Relay also authorizes the use of 5G ProSe Layer-3 multi-hop UE-to-Network Relay Discovery with Model A and Model B.

NOTE 1: It is up to UE and application implementation to select a discovery model or whether to perform both models simultaneously.

2) ProSe Relay Discovery policy/parameters for 5G ProSe Layer-3 UE-to-Network Relay supporting 5G ProSe Layer-3 multi-hop UE-to-Network Relay:

- Includes the parameters that enable the UE to perform 5G ProSe Layer-3 multi-hop UE-to-Network Relay Discovery when provided by PCF or provisioned in the ME or configured in the UICC:

- 5G ProSe Layer-3 multi-hop UE-to-Network Relay Discovery parameters (User Info ID, Relay Service Code(s), UE-to-Network Relay Layer Indicator per RSC, multi-hop indicator per RSC, maximum number of hops per RSC). The UE-to-Network Relay Layer Indicator indicates whether the associated RSC is offering 5G ProSe Layer-2 or Layer-3 UE-to-Network Relay service. RSC dedicated for emergency service may also be provisioned. The multi-hop indicator indicates whether the associated RSC can be supported for 5G ProSe multi-hop UE-to-Network Relay operation. The maximum number of hops per RSC indicates the maximum number of hops can be supported for the associated RSC.

NOTE x: The RSC used for multi-hop service is different from the RSC used for single-hop service.

- Default Destination Layer-2 ID(s) for sending Relay Discovery Announcement and Relay Discovery Additional Information messages and receiving Relay Discovery Solicitation messages;

- For 5G ProSe Layer-3 UE-to-Network Relay supporting 5G ProSe Layer-3 multi-hop UE-to-Network Relay, the PDU Session parameters (PDU Session type, DNN, SSC Mode, S-NSSAI, Access Type Preference) to be used for the relayed traffic for each ProSe Relay Service Code;

NOTE 2: 5G ProSe Relay Discovery policy/parameters can be provided from ProSe Application Server to the 5G ProSe UE-to-Network Relay supporting 5G ProSe Layer-3 multi-hop UE-to-Network Relay.

3) For 5G ProSe Layer-3 UE-to-Network Relay supporting 5G ProSe Layer-3 multi-hop UE-to-Network Relay to relay Ethernet or Unstructured traffic from 5G ProSe Layer-3 Remote UE supporting 5G ProSe Layer-3 multi-hop UE-to-Network Relay by using IP type PDU Session:

- Mapping of ProSe Service(s) to ProSe Application Server address information (consisting of IP address/FQDN and transport layer port number).

4) Validity time indicating the expiration time of the Policy/Parameter for 5G ProSe Layer-3 multi-hop UE-to-Network Relay discovery and communication.

The following information is provisioned in the UE in support of the UE assuming the role of a 5G ProSe Layer-3 Remote UE supporting 5G ProSe Layer-3 multi-hop UE-to-Network Relay and thereby enabling the use of a 5G ProSe Layer-3 UE-to-Network Relay supporting 5G ProSe Layer-3 multi-hop UE-to-Network Relay:

1) Authorisation policy for using a 5G ProSe Layer-3 UE-to-Network Relay supporting 5G ProSe Layer-3 multi-hop UE-to-Network Relay:

- For 5G ProSe Layer-3 Remote UE supporting 5G ProSe Layer-3 multi-hop UE-to-Network Relay, indicates whether the UE is authorised to use a 5G ProSe Layer-3 UE-to-Network Relay supporting 5G ProSe Layer-3 multi-hop UE-to-Network Relay.

The authorisation for a UE to act as a 5G ProSe Layer-3 Remote UE supporting 5G ProSe Layer-3 multi-hop UE-to-Network Relay also authorizes the use of 5G ProSe Layer-3 multi-hop UE-to-Network Relay discovery with Model A and Model B.

NOTE 3: It is up to UE and application implementation to select a discovery model or whether to perform both models simultaneously.

2) Policy/parameters for 5G ProSe Layer-3 Remote UE supporting 5G ProSe Layer-3 multi-hop UE-to-Network Relay:

- Includes the parameters for 5G ProSe Relay Discovery and for enabling the UE to connect to the 5G ProSe UE-to-Network Relay supporting 5G ProSe Layer-3 multi-hop UE-to-Network Relay after discovery when provided by PCF or provisioned in the ME or configured in the UICC:

- 5G ProSe Layer-3 multi-hop UE-to-Network Relay Discovery parameters (User Info ID, Relay Service Code(s), UE-to-Network Relay Layer indicator per RSC, multi-hop indicator per RSC, maximum number of hops per RSC). The UE-to-Network Relay Layer Indicator indicates whether the associated RSC is offering 5G ProSe Layer-2 or Layer-3 UE-to-Network Relay service. RSC(s) dedicated for emergency service may be provisioned to enable the support of emergency services for multi-hop UE-to-Network Relaying. The multi-hop indicator indicates whether the associated RSC can be supported for 5G ProSe multi-hop UE-to-Network Relay operation. The maximum number of hops per RSC indicates the maximum number of hops can be supported for the associated RSC.

NOTE x: The RSC used for multi-hop service is different from the RSC used for single-hop service.

- Default Destination Layer-2 ID(s) for sending Relay Discovery Solicitation messages and receiving Relay Discovery Announcement and Relay Discovery Additional Information messages;

- For 5G ProSe Layer-3 Remote UE supporting 5G ProSe Layer-3 multi-hop UE-to-Network Relay, the PDU Session parameters (PDU Session type, DNN, SSC Mode, S-NSSAI, Access Type Preference) to be used for the relayed traffic without using N3IWF access, or an indication of N3IWF access, for each ProSe Relay Service Code;

- For 5G ProSe Layer-3 Remote UE supporting 5G ProSe Layer-3 multi-hop UE-to-Network Relay, optionally the ProSe application Traffic Descriptor(s) (as defined in TS 23.503 [9]) to be used for the relayed traffic for each ProSe Relay Service Code;

3) Policy/parameters for N3IWF selection for 5G ProSe Layer-3 Remote UE supporting 5G ProSe Layer-3 multi-hop UE-to-Network Relay:

- N3IWF identifier configuration for 5G ProSe Layer-3 Remote UE supporting 5G ProSe Layer-3 multi-hop UE-to-Network Relay (either FQDN or IP address) in the HPLMN.

- 5G ProSe Layer-3 UE-to-Network Relay supporting 5G ProSe Layer-3 multi-hop UE-to-Network Relay access node selection information - a prioritized list of PLMNs for N3IWF selection. It also indicates if selection of an N3IWF in a PLMN should be based on Tracking Area Identity FQDN or on Operator Identifier FQDN.

NOTE 4: 5G ProSe Relay Discovery policy/parameters can be provided from ProSe Application Server to the 5G ProSe Layer-3 Remote UE supporting 5G ProSe Layer-3 multi-hop UE-to-Network Relay.

4) Validity time indicating the expiration time of the Policy/Parameter for 5G ProSe Layer-3 multi-hop UE-to-Network Relay discovery and communication.

The following information is provisioned in the UE in support of the UE assuming the role of a 5G ProSe Layer-3 Intermediate UE-to-Network Relay:

1) Authorisation policy for acting as a 5G ProSe Layer-3 Intermediate UE-to-Network Relay:

- For 5G ProSe Layer-3 Intermediate UE-to-Network Relay, indicates whether the UE is authorised to act as a 5G ProSe Layer-3 Intermediate UE-to-Network Relay.

The authorisation for a UE to act as a 5G ProSe Layer-3 Intermediate UE-to-Network Relay also authorizes the use of 5G ProSe Layer-3 multi-hop UE-to-Network Relay Discovery with Model A and Model B.

NOTE 5: It is up to UE and application implementation to select a discovery model or whether to perform both models simultaneously.

2) ProSe Relay Discovery policy/parameters for 5G ProSe Layer-3 Intermediate UE-to-Network Relay:

- Includes the parameters that enable the UE to perform 5G ProSe Layer-3 multi-hop UE-to-Network Relay Discovery when provided by PCF or provisioned in the ME or configured in the UICC:

- 5G ProSe Layer-3 multi-hop UE-to-Network Relay Discovery parameters (User Info ID, Relay Service Code(s), UE-to-Network Relay Layer Indicator per RSC, multi-hop indicator per RSC, maximum number of hops per RSC). The UE-to-Network Relay Layer Indicator indicates whether the associated RSC is offering 5G ProSe Layer-2 or Layer-3 UE-to-Network Relay service. RSC dedicated for emergency service may also be provisioned. The multi-hop indicator indicates whether the associated RSC can be supported for 5G ProSe multi-hop UE-to-Network Relay operation. The maximum number of hops per RSC indicates the maximum number of hops can be supported for the associated RSC.

NOTE x: The RSC used for multi-hop service is different from the RSC used for single-hop service.

- Default Destination Layer-2 ID(s) for sending Relay Discovery Announcement and Relay Discovery Additional Information messages and receiving Relay Discovery Solicitation messages;

- For 5G ProSe Layer-3 Intermediate UE-to-Network Relay, the traffic type (IP, Ethernet, Unstructured) to be used for the relayed traffic for each Relay Service Code;

NOTE 6: 5G ProSe Relay Discovery policy/parameters can be provided from ProSe Application Server to the 5G ProSe Layer-3 Intermediate UE-to-Network Relay.

3) Validity time indicating the expiration time of the Policy/Parameter for 5G ProSe Layer-3 Intermediate UE-to-Network Relay discovery and communication.

The following information is provisioned in the UE in support of the UE assuming the role of a 5G ProSe Layer-3 UE-to-Network Relay supporting 5G ProSe Layer-3 multi-hop UE-to-Network Relay, in the UE in support of the UE assuming the role of a 5G ProSe Layer-3 Remote UE supporting 5G ProSe Layer-3 multi-hop UE-to-Network Relay and thereby enabling the use of a 5G ProSe Layer-3 UE-to-Network Relay, and in the UE in support of the UE assuming the role of a 5G ProSe Layer-3 Intermediate UE-to-Network Relay:

1) Radio parameters for 5G ProSe Layer-3 multi-hop UE-to-Network Relay Discovery when the UE is not "served by NG-RAN":

- Includes the radio parameters NR PC5 with Geographical Area(s) and an indication of whether they are "operator managed" or "non-operator managed". The UE uses the radio parameters to perform 5G ProSe Direct Discovery over PC5 reference point when "not served by NG-RAN" only if the UE can reliably locate itself in the corresponding Geographical Area. Otherwise, the UE is not authorized to transmit.

- Default PC5 DRX configuration (see TS 38.331 [16]).

2) Radio parameters for 5G ProSe Layer-3 multi-hop UE-to-Network Relay communication when the UE is not "served by NG-RAN":

- Includes the radio parameters NR PC5 with Geographical Area(s) and an indication of whether they are "operator managed" or "non-operator managed". The UE uses the radio parameters to perform 5G ProSe Direct Communication over PC5 reference point when "not served by NG-RAN" only if the UE can reliably locate itself in the corresponding Geographical Area. Otherwise, the UE is not authorized to transmit.

NOTE 7: The validity time of these radio parameters is the same as the validity time of the Policy/Parameter listed above for 5G ProSe Layer-3 UE-to-Network Relay supporting 5G ProSe Layer-3 multi-hop UE-to-Network Relay or 5G ProSe Layer-3 Remote UE supporting 5G ProSe Layer-3 multi-hop UE-to-Network Relay or 5G ProSe Layer-3 Intermediate UE-to-Network Relay.

3) Policy/parameters related to privacy:

- A privacy timer value indicating the duration after which the UE shall change each source Layer-2 ID self-assigned by the UE when privacy is required.

\* \* \* \* Fourth changes \* \* \* \*

#### 5.8.3.1 Common identifiers for 5G ProSe UE-to-Network Relay

The following parameters are used for the 5G ProSe UE-to-Network Relay Discovery Announcement message (Model A), where Source Layer-2 ID and Destination Layer-2 ID are used for sending and receiving the message and Announcer Info and Relay Service Code are contained in the message:

- Source Layer-2 ID: the 5G ProSe UE-to-Network Relay self-selects a Source Layer-2 ID for 5G ProSe UE-to-Network Relay Discovery.

- Destination Layer-2 ID: the Destination Layer-2 ID for 5G ProSe UE-to-Network Relay Discovery is selected based on the configuration as described in clause 5.1.4.1.

- Announcer Info: provides information (i.e. User Info ID) about the announcing user.

- Relay Service Code: parameter identifying a connectivity service the 5G ProSe UE-to-Network Relay provides to a 5G ProSe Remote UE. The Relay Service Codes are configured in a 5G ProSe UE-to-Network Relay for advertisement. Additionally, the Relay Service Code may also identifies authorized users the 5G ProSe UE-to-Network Relay would offer service to and may be used to select the related security policies or information e.g. necessary for authentication and authorization between the 5G ProSe Remote UE and the 5G ProSe UE-to-Network Relay (e.g. a Relay Service Code for relays for police members only would be different than a Relay Service Code for relays for Fire Fighters only, even though potentially they provided connectivity to same DN e.g. to support Internet Access).

The 5G ProSe UE-to-Network Relay Discovery Announcement message (Model A) is extended and modified as follows when used for 5G ProSe multi-hop UE-to-Network Relay discovery:

- Hop-Count: This value reflects the number of PC5 hops for the 5G ProSe Remote UE to reach the network. It is set to 1 by the 5G ProSe UE-to-Network Relay and shall be incremented by 1 every time the 5G ProSe UE-to-Network Relay Discovery Announcement message is forwarded by a 5G ProSe Intermediate UE-to-Network Relay.

A 5G ProSe Intermediate UE-to-Network Relay shall only process the 5G ProSe UE-to-Network Relay Discovery Announcement if the Hop-Count is present and the value is less than the (pre-)configured maximum number of hops for the associated RSC and the optional Hop-Limit in the message.

- Source Layer-2 ID: the 5G ProSe UE-to-Network Relay or the 5G ProSe Intermediate UE-to-Network Relay self-selects a Source Layer-2 ID when sending the discovery message.

- Destination Layer-2 ID: the 5G ProSe Intermediate UE-to-Network Relay sets the Desination Layer-2 ID of the 5G ProSe UE-to-Network Relay Discovery Announcement message based on configuration described in clause 5.1.4.1.

- Announcer Info: identify information (i.e. User Info ID) of the announcing 5G ProSe UE-to-Network Relay or the 5G ProSe Intermediate UE-to-Network Relay.

- (optinal) Root Relay Info: this is the User Info ID of the 5G ProSe UE-to-Network Relay. A 5G ProSe Intermediate UE-to-Network Relay may stored it in the discovery entry and included it in the 5G ProSe UE-to-Network Relay Discovery Announcement message. This information can be used in the relay selection at the 5G ProSe Remote UE or other 5G ProSe Intermediate UE-to-Network Relays.

- (optional) Accumulated QoS for PC5 link: this reflects the QoS supported over all the PC5 links to the Root Relay, i.e. the 5G ProSe UE-to-Network Relay, for this RSC.

- (optional) Hop-Limit: this is the hop limit set by the announcing 5G ProSe UE-to-Network Relay to a value smaller than the configured maximum number of hops.

Editor's note: Whether the same 5G ProSe UE-to-Network Relay Discovery Announcement message is reused for multi-hop operation or a new message type is to be defined will be decided by Stage 3.

The following parameters are used for the 5G ProSe UE-to-Network Relay Discovery Solicitation message (Model B), where Source Layer-2 ID and Destination Layer-2 ID are used for sending and receiving the message and Discoverer Info and Relay Service Code are contained in the message:

- Source Layer-2 ID: the 5G ProSe Remote-UE self-selects a Source Layer-2 ID for 5G ProSe UE-to-Network Relay Discovery.

- Destination Layer-2 ID: the Destination Layer-2 ID for 5G ProSe UE-to-Network Relay Discovery is selected based on the configuration as described in clause 5.1.4.1.

- Discoverer Info: provides information (i.e. User Info ID) about the discoverer user.

- Target Info: provides information (i.e. User Info ID) about the targeted discoveree user.

- Relay Service Code: information about connectivity that the discoverer UE is interested in. The Relay Service Codes are configured in the 5G ProSe Remote UEs interested in related connectivity services.

To support Multi-hop 5G ProSe UE-to-Network Relay discovery the following parameters are added:

- (Optional) Hop count: indicates the number of hops that the message is already relayed. It is increased by 1 per hop.

- (Optional) Hop-Limit: a unmodified value that indicates the hop limit of the message. It is set, by the 5G ProSe Remote UE, to a value smaller than the (pre)configured maximum number of hops.

- Path information: an (ordered) list of User Info ID(s) of Intermediate UE-to-Network Relay(s) that indicates the transmitted path of the message.

- (optional) cumulative QoS for PC5 link: this reflects the QoS supported over all the PC5 links starting from the PC5 link between the Remote UE and a Intermediate UE-to-Network Relay in the path information for this RSC.

The following parameters are used in the 5G ProSe UE-to-Network Relay Discovery Response message (Model B), where Source Layer-2 ID and Destination Layer-2 ID are used for sending and receiving the message and Discoveree Info and Relay Service Code are contained in the message:

- Source Layer-2 ID: the 5G ProSe UE-to-Network Relay self-selects a Source Layer-2 ID for 5G ProSe UE-to-Network Relay Discovery.

- Destination Layer-2 ID: set to the Source Layer-2 ID of the received 5G ProSe UE-to-Network Relay Discovery Solicitation message.

- Relay Service Code: identifies the connectivity service the 5G ProSe UE-to-Network Relay provides to 5G ProSe Remote UEs that matches the Relay Service Code from the corresponding Discovery Solicitation message.

- Discoveree Info: provides information (i.e. User Info ID) about the discoveree.

To support Multi-hop 5G ProSe UE-to-Network Relay discovery the following parameters are added:

- (Optional) Hop count: indicates the number of hops between the 5G ProSe Remote UE and the 5G ProSe UE-to-Network Relay on the path selected by the 5G ProSe UE-to-Network Relay.

- (Optional) Path information: an (ordered) list of User Info ID(s) of Intermediate UE-to-Network Relay(s) on the path selected by the 5G ProSe UE-to-Network Relay.

- (optional) cumulative QoS for PC5 link: this reflects the QoS supported over all the PC5 links starting from the PC5 link between the Remote UE and a Intermediate UE-to-Network Relay in the path information for this RSC.

The following parameters may be used in the Relay Discovery Additional Information message (using Model A) based on the procedure defined in clause 6.5.1.3 for 5G ProSe UE-to-Network Relay and clause 6.3.2.5.4 for 5G ProSe multi-hop UE-to-Network Relay where Source Layer-2 ID and Destination Layer-2 ID are used for sending and receiving the message and the other parameters are contained in the message:

- Source Layer-2 ID: the 5G ProSe UE-to-Network Relay or the 5G ProSe Intermediate UE-to-Network Relay self-selects a Source Layer-2 ID to send the Relay Discovery Additional Information message.

- Destination Layer-2 ID: the Destination Layer-2 ID to send the Relay Discovery Additional Information message is selected based on the configuration as described in clause 5.1.4.1.

- Relay Service Code: the Relay Service Code associated with the message. The Relay Service Code is used to identify the security parameters needed by the receiving UE to process the discovery message.

- Announcer Info: provides information about the announcing user (i.e. User Info ID of the 5G ProSe UE-to-Network Relay).

- Hop-Count: This value reflects the number of PC5 hops for the 5G ProSe Remote UE to reach the network. It is set to 1 by the 5G ProSe UE-to-Network Relay and shall be incremented by 1 every time the Relay Discovery Additional Information message is forwarded by a 5G ProSe Intermediate UE-to-Network Relay.

A 5G ProSe Intermediate UE-to-Network Relay shall only process the Relay Discovery Additional Information message if the Hop-Count is present and the value is less than the (pre-)configured maximum number of hops for the associated RSC and the optional Hop-Limit in the message.

- Announcer Info of 5G ProSe Intermediate UE-to-Network Relay: identify information (i.e. User Info ID) of the 5G ProSe Intermediate UE-to-Network Relay connected to 5G ProSe UE-to-Network Relay. This parameter is only applicable to the additional parameter announcement procedure over 5G ProSe multi-hop UE-to-Network Relay specified in clause 6.3.2.5.4.

- (optional) Hop-Limit: this is the hop limit set by the announcing 5G ProSe UE-to-Network Relay to a value smaller than the configured maximum number of hops.

- Additional parameters: the additional parameters for 5G ProSe Layer-3 UE-to-Network Relay (when applicable) are defined in clause 5.8.3.2.

NOTE 1: The UE implementation needs to ensure that when the UE self-selects Source Layer-2 IDs, the self-selected Source Layer-2 IDs are different between 5G ProSe Direct Discovery (including 5G ProSe UE-to-Network Relay Discovery) in clause 6.3.2 and 5G ProSe Direct Communication (including 5G ProSe UE-to-Network Relay Communication) in clause 6.4 and are different from any other provisioned Destination Layer-2 IDs as described in clause 5.1 and any other self-selected Source Layer-2 IDs used in a simultaneous 5G ProSe Direct Discovery (including 5G ProSe UE-to-Network Relay Discovery) with a different discovery model.

NOTE 2: If a 5G ProSe UE-to-Network Relay and 5G ProSe Remote UE from different PLMNs discover each other, it means that the Relay Service Code is associated with the same connectivity service, and the same Relay Service Code is provisioned based on Service Level Agreement among PLMNs.

NOTE 3: The Hop count, Hop-Limit and Path information are used for multi-hop 5G ProSe UE-to-Network Relay Discovery with Model B. The multi-hop UE-to-Network Relay Discovery message has no impact on 5G ProSe UE-to-Network Relay or 5G ProSe Remote UE that only supports the single-hop UE-to-Network Relay. Single-hop and Multi-hop UE-to-Network Relays discoveries can be distinguished based on RSC.

\* \* \* \* Fifth changes \* \* \* \*

#### 6.4.3.9 Layer-2 link management over PC5 reference point for Multi-hop 5G ProSe UE-to-Network Relay (based on Model B Discovery)

The Layer-2 link procedures over PC5 reference point for unicast mode 5G ProSe Direct Communication as depicted from clause 6.4.3.6 is used for the PC5 reference point among the 5G ProSe Remote UE, the 5G ProSe Intermediate UE-to-Network Relay and the UE-to-Network Relay after Model B Discovery, with the following differences and clarifications:

For the UE oriented Layer-2 link establishment as described in the clause 6.4.3.1,

- The 5G ProSe Remote UE determines the destination Layer-2 ID for PC5 unicast link establishment based on the unicast source Layer-2 ID of the selected 5G ProSe Intermediate Relay (as specified in clause 5.8.3) during UE-to-Network Relay discovery as specified in clause 6.3.2.5.3.

- The 5G ProSe Intermediate Relay determines the destination Layer-2 ID for PC5 unicast link establishment based on the unicast source Layer-2 ID of the selected 5G ProSe Intermediate Relay or UE-to-Network Relay (as specified in clause 5.8.3) during UE-to-Network Relay discovery as specified in clause 6.3.2.5.3.

NOTE: How long the Intermediate UE-to-Network Relay keeps the Layer-2 ID information of other Relays obtained in the discovery procedures is based on implementation.

- 5G ProSe Remote UE sends a unicast Direct Communication Request message to the selected 5G ProSe Intermediate Relay. The Direct Communication Request message additionally includes:

- Path information: an (ordered) list of User Info ID of 5G ProSe Intermediate Relays and the UE-to-Network Relay selected by the 5G ProSe Remote UE based on the path information provided to the 5G ProSe Remote UE during 5G ProSe UE-to-Network Relay Discovery procedure.

- QoS Info: indicates the End to End QoS Info.

- 5G ProSe Intermediate Relay sends a unicast Direct Communication Request message to the next 5G ProSe Intermediate Relay or the UE-to-Network Relay according to the path information in the received Direct Communication Request message. The Direct Communication Request message additionally includes:

- Path information: an (ordered) list of User Info ID of 5G ProSe Intermediate Relays and the UE-to-Network Relay selected by the 5G ProSe Remote UE based on the path information provided to the 5G ProSe Remote UE during 5G ProSe UE-to-Network Relay Discovery procedure.

- QoS Info: End to End QoS Info and the remaining QoS Info of hops from the Intermediate Relay to the network.

- In step 4 and step 5, step 4a and step 5a are performed if the 5G ProSe Intermediate/UE-to-Network Relay's identity matches the Target Info (if any) and the Relay Service Code is one of the Relay Service Codes included during UE-to-Network Relay discovery as specified in clause 6.3.2.5.3.

Editor's note: Details of QoS info content is FFS.

For the Layer-2 link release as described in the clause 6.4.3.3,

- If the Layer-2 link release procedure is initiated by the 5G ProSe Intermediate Relay, the Disconnect Request message may indicate the 5G ProSe UE-to-Network Relay is temporarily not available as described in clause 5.12.

- If the service authorization for acting as a 5G ProSe Intermediate Relay is revoked, the 5G ProSe Intermediate Relay should initiate the release of the layer-2 link that the revoked authorization affects.

Each PC5 unicast link for 5G ProSe UE-to-Network Relay is associated with a Unicast Link Profile, which additionally includes:

- Path Information: which contains the User Info ID of Intermediate Relay at the next hop to the Remote UE.

Each PC5 unicast link for 5G ProSe Intermediate Relay is associated with a Unicast Link Profile, which additionally includes:

- Path Information: which contains the User Info ID of Intermediate Relay or UE-to-Network Relay at the adjancent hop.

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