**3GPP TSG-WG SA2 Meeting #164S2-2407650**

**Maastricht, NL, 19th Aug – 23rd Aug, 2024 (revision of S2-240xxxx)**

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| *CR-Form-v12.3* |
| **CHANGE REQUEST** |
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|  | **23.304** | **CR** | **0450** | **rev** |  | **Current version:** | **19.0.0** |  |
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| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* |
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| ***Proposed change affects:*** | UICC apps |  | ME | **X** | Radio Access Network |  | Core Network |  |

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| ***Title:***  | Update on ProSe U2U Multihop Relay for non-IP PDU |
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| ***Source to WG:*** | Huawei, HiSilicon, China Telecom, Samsung, Interdigital, CATT, KPN N.V |
| ***Source to TSG:*** | SA2 |
|  |  |
| ***Work item code:*** | 5G ProSe\_Ph3 |  | ***Date:*** | 2024-08-09 |
|  |  |  |  |  |
| ***Category:*** | **B** |  | ***Release:*** | Rel-19 |
|  | *Use one of the following categories:****F*** *(correction)****A*** *(mirror corresponding to a change in an earlier release)****B*** *(addition of feature),* ***C*** *(functional modification of feature)****D*** *(editorial modification)*Detailed explanations of the above categories canbe found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | *Use one of the following releases:Rel-8 (Release 8)Rel-9 (Release 9)Rel-10 (Release 10)Rel-11 (Release 11)…Rel-17 (Release 17)Rel-18 (Release 18)Rel-19 (Release 19) Rel-20 (Release 20)* |
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| ***Reason for change:*** | Addition of features to support multi-hop Layer-3 UE-to-UE Relay for PDU type Ethernet and Unstructured based on the conclusions for KI#2 in TR 23.700-03. |
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| ***Summary of change:*** | 1. Update the Policy/Parameter provisioning of maximum number of hops for 5G ProSe UE-to-UE Relay and End UE.
2. Update QoS handling for 5G ProSe Layer-3 UE-to-UE Relay in terms of multi-hop.
3. Update the identifiers for multi-hop U2U Discovery.
4. New clause for multi-hop UE-to-UE Relay discovery with Model A.
5. New clause for multi-hop UE-to-UE Relay discovery with Model B.
6. New clause for Layer-2 link management over PC5 reference point for multi-hop Layer-3 UE-to-UE Relay.
7. New clause for 5G ProSe Communication via Multi-hop 5G ProSe Layer-3 UE-to-UE Relay.
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| ***Consequences if not approved:*** | Multi-hop Layer-3 UE-to-UE Relay will not be fully supported. |
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| ***Clauses affected:*** | 5.1.5.1, 5.6.3.1, 5.8.4.2, 6.3.2.4.1, 6.3.2.4.2a (new), 6.3.2.4.3a (new), 6.4.3.7.3a (new), 6.7.1a (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:*** |  |

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

##### 6.3.2.X.3 Procedure for 5G ProSe Multi-hop UE-to-UE Relay discovery of non-IP PDU type

6.3.2.X.3.1 Procedure for Multi-hop 5G ProSe UE-to-UE Relay Discovery of non-IP PDU type with Model A

Depicted in Figure 6.3.2.X.3.1-1 is the procedure for Multi-hop 5G ProSe UE-to-UE Relay Discovery of non-IP PDU type with Model A.

UE-to-UERelay1

Relay1

UE-to-UE

Relay2

End UE1

1. obtains Direct Discovery set(s)

2. 5G ProSe UE-to-UE Relay Discovery Announcement message

4. 5G ProSe UE-to-UE Relay Discovery Announcement message

3. decides to relay Direct Discovery set(s)

Figure 6.3.2.x.3.1-1: 5G ProSe multi-hop UE-to-UE Relay Discovery of non-IP PDU type with Model A

1. The 5G ProSe UE-to-UE Relay has discovered End UEs in proximity and obtains the Direct discovery set from End UEs in proximity per RSC. (e.g. via a previous 5G ProSe UE-to-UE Relay Discovery or via secure PC5 connection between 5G ProSe U2U Relay and 5G ProSe End UE (refer to TS 33.503 [29])). 5G ProSe UE-to-UE Relay may also get the maximum number of hops from End UEs.

2. The 5G ProSe UE-to-UE Relay sends a UE-to-UE Relay Discovery Announcement message. The UE-to-UE Relay Discovery Announcement message contains the User Info ID of itself, Direct Discovery set including list of protected user info of End UEs, a list of paths indicated by an (ordered) list of User Info ID of Relays (initially it only contains the User Info ID of UE-to-UE Relay1 in the figure), hop count (which is set to 1 initially) corresponding to each user info in the Direct Discovery set and optionally maximum number of hops corresponding to each user info in the Direct Discovery set. Each path corresponds to a user info in the Direct Discovery set.

The UE-to-UE Relay Discovery Announcement message is sent using the Source Layer-2 ID and Destination Layer-2 ID as described in clause 5.8.4.

3. After receiving UE-to-UE Relay Discovery Announcement message(s) from another 5G ProSe UE-to-UE relay, a 5G ProSe UE-to-UE Relay checks the received Direct Discovery set. For each protected user info in the received Direct Discovery set, if the path does not include the User Info ID of the 5G ProSe UE-to-UE Relay and the hop count is less than the corresponding maximum number of hops, the relay will add the protected user info into its own Direct Discovery set (if it is not added before) and add its own User Info ID into the path of the corresponding protected user info and increase the hop count by 1. If the relay already has the protected user info in its own Direct Discovery set with less hop count than the received one, then the relay may not add the protected user info again.

NOTE: Based on implementation, Relay UEs can determine if two protected user info are identical, e.g., by comparing the protected user info bit by bit if it is encrypted.

4. A 5G ProSe End UE or a 5G ProSe UE-to-UE Relay monitors Announcement message from a 5G ProSe UE-to-UE Relay. The 5G ProSe End UEs and 5G ProSe UE-to-UE Relays determine the Destination Layer-2 ID for signalling reception as specified in clause 5.1.

6.3.2.X.3.2 Procedure for Multi-hop 5G ProSe UE-to-UE Relay Discovery of non-IP PDU type with Model B

Depicted in Figure 6.3.2.X.3.2-1 is the procedure for Multi-hop 5G ProSe UE-to-UE Relay Discovery of non-IP PDU type with Model B.



Figure 6.3.2.X.3.2-1: Multi-hop 5G ProSe UE-to-UE Relay Discovery of non-IP PDU type with Model B1. The Source End UE decides the maximum number of hops for discovery based on policy configuration (i.e. a mapping between maximum number of hops and RSC) or QoS parameters.

If the maximum number of hops is determined based on RSC, the Source End UE may not include the maximum number of hops in the Solicitation message. Otherwise, the Source End UE includes the maximum number of hops in the Solicitation message.

2a. The Source End UE sends a 5G ProSe UE-to-UE Relay Discovery Solicitation message. The 5G ProSe UE-to-UE Relay Discovery Solicitation message additionally contains following information compared with that defined in clause 6.3.2.4.3: hop count which will be increased by 1 per hop, a const value of maximum number of hops.

3a. If the RSC contained in the solicitation message matches any of the (pre)configured RSC(s) of a 5G ProSe UE-to-UE Relay, the 5G ProSe UE-to-UE Relay may decide to send a 5G ProSe UE-to-UE Relay Discovery Solicitation message.

The 5G ProSe UE-to-UE Relay should drop the received Solicitation message when its own User Info ID is contained in the received Solicitation message, or if the hop count (i.e., the number of Relays included in the message) has reached the maximum number of hops of the received Solicitation message. The maximum number of hops may be obtained from the Solicitation message or may be decided based on RSC if it is not obtained from the message.

If the same Direct Discovery Set is received from different 5G ProSe-enabled UEs, the 5G ProSe UE-to-UE 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 1: If the Source End UE does not receive any response after a timeout, based on application requirement, it may increase the maximum number of hops and send the discovery message again.

NOTE 2: Based on implementation, Relay UEs can decide to send the discovery message with the same direct discovery set at most once in order to control the total number of discovery messages transferred among Relays. To determine the identical direct discovery set, the Relay UE can compare the direct discovery set bit by bit if it is encrypted, or check the source End UE and target End UE User info if the direct discovery set is not encrypted.

4a. A 5G ProSe UE-to-UE 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 of Relays in the path that has sent the Solicitation message. The hop count is increased by 1.

 The 5G ProSe UE-to-UE Relay may assign unique Layer-2 ID for sending Solicitation message as described in clause 6.3.2.4.3.

2b.-6b. Another transmission path of the Solicitation message.

7-8. If the RSC contained in the solicitation message matches any of the (pre)configured RSC(s) of the Target 5G ProSe End UE, and the Target 5G ProSe End UE matches the user info (i.e. Application Layer ID) of the discoveree 5G ProSe End UE contained in the solicitation message, then the Target 5G ProSe End UE responds to the 5G ProSe UE-to-UE Relay with a 5G ProSe UE-to-UE Relay Discovery Response message. The 5G ProSe UE-to-UE Relay Discovery Response message additionally contains the path information compared with that defined in clause 6.3.2.4.3.

 The Target 5G ProSe End UE may choose a path and sends Response message to 5G ProSe UE-to-UE Relay(s) based on e.g., the PC5 signal strength of each message received, hops to the Source End UE, the path information, etc.

9-10. A 5G ProSe UE-to-UE Relay sends a 5G ProSe UE-to-UE Relay Discovery Response message. A 5G ProSe UE-to-UE Relay may associate the User Info ID and Layer-2 ID of neighbour UE-to-UE Relays according to the Response message. The association can be used in the subsequent Link Management procedures.

11. The Source End UE may perform the UE-to-UE Relay(s)/path selection for subsequent Link Management procedures based on e.g., the PC5 signal strength of the received Response messages, the number of hops to Target 5G ProSe End UE.

\* \* \* \* Next change \* \* \* \*

##### 6.4.3.X.2 Layer-2 link establishement and management over PC5 reference point for non-IP PDU type

For the 5G ProSe Communication via Multi-hop 5G ProSe Layer-3 UE-to-UE Relay as described in clause 6.7.1a, the description in clause 6.4.3.7.1 applies with following differences and clarifications:

The Direct Communication Request message over the PC5 reference point between source End UE and the first hop UE-to-UE Relay additionally includes:- Path Information: an (ordered) list of User Info ID of 5G ProSe UE-to-UE Relays selected by the source 5G ProSe End UE based on the path information provided to the source 5G ProSe End UE during 5G ProSe UE-to-UE Relay Discovery procedure.

- QoS Info: indicates the End to End QoS Info from the source End UE to the target End UE.

The Direct Communication Request message over the PC5 reference point between two UE-to-UE Relays includes:

- User Info of source 5G ProSe End UE.

- User Info of target 5G ProSe End UE.

- Path information.

- ProSe Service Info: the information about the ProSe identifier(s).

- RSC: the connectivity service provided by the 5G ProSe UE-to-UE Relay as requested by the source 5G ProSe End UE.

- Security Information: the information for the establishment of security for the PC5 link establishment between two UE-to-UE Relays or between target End UE and UE-to-UE Relay (see TS 33.503 [29]).

- QoS Info: indicates the rest QoS Info from the UE-to-UE Relay to the target End UE.

- The Direct Communication Request message over the PC5 reference point between between the target End UE and UE-to-UE Relay additionally includes:

- Path information.

- QoS Info: indicates the rest QoS Info from the UE-to-UE Relay to the target End UE.

- The Direct Communication Accept message over the PC5 reference point between target End UE and UE-to-UE Relay additionally includes:

- QoS Info which is the accepted QoS Info of the hop between target End UE and the last UE-to-UE Relay.

- The Direct Communication Accept message over the PC5 reference point between two UE-to-UE Relays includes:

- User Info of target 5G ProSe End UE.

- Path information.

- QoS Info which is the accepted QoS Info of the hop between two UE-to-UE Relays and the accumulated QoS Info of hops from the receiver UE-to-UE Relay to the target End UE.

- The Direct Communication Accept message over the PC5 reference point between the source End UE and UE-to-UE Relay additionally includes:

- Path information.

- QoS Info which is the accepted QoS Info of the hop between two UE-to-UE Relays and the accumulated QoS Info of hops from the source End UE to the target End UE.

- The Link Modification Request message over the PC5 reference point between source End UE and the first hop UE-to-UE Relay additionally includes:

- Path Information: an (ordered) list of User Info ID of 5G ProSe UE-to-UE Relays provided to the source 5G ProSe End UE during 5G ProSe UE-to-UE Relay Discovery procedure.

 - QoS Info: indicates the End-to-End QoS Info from the source End UE to the target End UE.

- The Link Modification Request message over the PC5 reference point between two UE-to-UE Relays includes:

- User Info of source 5G ProSe End UE.

- Path Information.

- User Info of target 5G ProSe End UE.

- QoS Info: indicates the rest QoS Info from the UE-to-UE Relay to the target End UE.

- The Link Modification Request message over the PC5 reference point between the target End UE and UE-to-UE Relay additionally includes:

- Path Information.

- QoS Info: indicates the rest QoS Info from the UE-to-UE Relay to the target End UE.

- The Link Modification Accept message over the PC5 reference point between the target End UE and UE-to-UE Relay additionally includes:

- Path information.

- QoS Info which is the accepted QoS Info of the hop between target End UE and UE-to-UE Relay.

- The Link Modification Accept message over the PC5 reference point between two UE-to-UE Relays includes:

- Path information.

- QoS Info which is the accepted QoS Info of the hop between two UE-to-UE Relays and the accumulated QoS Info of hops from the UE-to-UE Relay to the target End UE.

- The Link Modification Accept message over the PC5 reference point between source End UE and the first UE-to-UE Relay additionally includes:

- Path information.

 - QoS Info which is the accepted QoS Info of the hop between source End UE and the first UE-to-UE Relay and the accumulated QoS Info of hops from the UE-to-UE Relay to the target End UE.

NOTE: The path information in DCR/LMR/DCA/LMA message is used for multi-hop 5G ProSe UE-to-UE Relay Discovery only. A 5G ProSe UE-to-UE Relay Discovery that only supports single-hop UE-to-UE Relay will ignore the messages that contains path information.

- In the Security Procedure of the PC5 reference point between source End UE and UE-to-UE Relay, the source 5G ProSe Layer-3 End UE provides the QoS Info of the end-to-end QoS to the 5G ProSe Layer-3 UE-to-UE Relay. If the PC5 link is used for transferring Ethernet traffic, the source 5G ProSe Layer-3 End UE provides its Ethernet MAC address. The 5G ProSe Layer-3 UE-to-UE Relay may provide the Ethernet MAC address of the target 5G ProSe Layer-3 End UE in the DCA/LMA message.

- In the Security Procedure of the PC5 reference point between two UE-to-UE Relays, a 5G ProSe Layer-3 UE-to-UE Relay provides the QoS Info from itself to the target 5G ProSe Layer-3 UE-to-UE Relay. If the PC5 link is used for transferring Ethernet traffic, the 5G ProSe Layer-3 UE-to-UE Relay provides the Ethernet MAC address of the source 5G ProSe Layer-3 End UE. The 5G ProSe Layer-3 UE-to-UE Relay may provide the Ethernet MAC address of the target 5G ProSe Layer-3 End UE in the DCA/LMA message

- In the Security Procedure of the PC5 reference point between target End UE and a UE-to-UE Relay, the 5G ProSe Layer-3 UE-to-UE Relay provides the QoS Info of the last hop QoS to the target 5G ProSe End UE. If the PC5 link is used for transferring Ethernet traffic, the 5G ProSe Layer-3 UE-to-UE Relay provides the Ethernet MAC address of the source 5G ProSe Layer-3 End UE. The target 5G End UE may provide its Ethernet MAC address in the DCA/LMA message

- The 5G ProSe Layer-3 UE-to-UE Relay decides the QoS Info of the next hop to source End UE with considering the accumulated QoS Info of the hop(s) to the target End UE which is received in the Direct Communication Accept message.

- For adding new end-to-end QoS flow or modifying existing end-to-end QoS flow, the Link Modification Accept message over each PC5 reference point additionally includes QoS Info of that hop. If the PC5 link is used for transferring Ethernet traffic, the target 5G ProSe Layer-3 End UE may provide its Ethernet MAC address.For a path between a specific pair of End UEs, if at least one of the PC5 link is released, the 5G ProSe Layer-3 UE-to-UE Relay(s) in the path may release other PC5 link(s) in the path.

\* \* \* \* Next change \* \* \* \*

#### 6.7.X.3 5G ProSe Communication via Multi-hop 5G ProSe Layer-3 UE-to-UE Relay for Non-IP Type PDU

1a. Authorization and Provisioning

2. Discovery Procedure

3. DCR or LMR

5. DCR or LMR

7. DCR or LMR

4. Security Establishment

6. Security Establishment

8. Security Establishment

9. DCA or LMA

10. DCA or LMA

11. DCA or LMA

U2U Relay1

U2U Relay2

Source End UE1

Target End UE2

1a. Authorization and Provisioning

1b. Authorization and Provisioning

Figure 6.7.X.3-1: Layer-2 link establishment via 5G ProSe Layer-3 UE-to-UE Relay for Non-IP Type PDU

1. 5G ProSe Layer-3 End UE1 and 5G ProSe Layer-3 End UE2 are authorized for multi-hop UE-to-UE Relay service as End UE and are provisioned with parameters for discovery and connection setup with other UEs via multi-hop UE-to-UE Relay services.

5G ProSe Layer-3 UE-to-UE Relays are authorized for multi-hop UE-to-UE Relay service as Relay UE and are provisioned with parameters for discovery and connection setup with other UEs and relay UEs via multi-hop UE-to-UE Relay services (as described in clause 5.1.5.1). The provisioned parameter may include parameters such as RSC (Relay service Code)(s), list of PLMN, user info of UE for application which are allowed at multi-hop relay connection.

2. It is assumed that the source 5G ProSe Layer-3 End UE1 selectes a relay path to the Target End UE2 from the discovery procedure which is captured in clause 6.3.2.4.

3. The source 5G ProSe Layer-3 End UE1 initiates the unicast Layer-2 link establishment procedure with the 5G ProSe Layer-3 UE-to-UE Relays by sending a Direct Communication Request message to the UE-to-UE Relay. The parameters included in the Direct Communication Request message are described in clause 6.4.3.X.2.

If there is already a PC5 link with the same RSC been established between the End UE and the UE-to-UE Relay or between UE-to-UE Relays, a Link Modification Request message is sent instead of Direct Communication Request message. The parameters included in the LMR message are described in clause 6.4.3.X.2.

4. (Optional) When the security protection is enabled, the source 5G ProSe Layer-3 End UE sends the parameters as described in clause 6.4.3.X.2 to the 5G ProSe Layer-3 UE-to-UE Relay.

5. A UE-to-UE Relay sends a Direct Communication Request or Link Modification Request message to the next UE-to-UE Relay according to the path information in the received Direct Communication Request or Link Modification Request message.

The Source Layer-2 ID of the Direct Communication Request message is self-assigned by the UE-to-UE Relay and the Destination Layer-2 ID is the unicast Layer-2 ID associated with the User Info ID of the next hop UE-to-UE Relay.

7. A UE-to-UE Relay may know it is the last Relay in the path (e.g., according to the User Info ID of Relays in the received Direct Communication Request/Link Modification Request message). The UE-to-UE Relay sends a Direct Communication Request/Link Modification Request message to the target 5G ProSe Layer-3 End UE.

The Destination Layer-2 ID is the unicast Layer-2 ID of target End UE or a broadcast Layer-2 ID. Unicast Layer-2 ID is used if the Layer-2 ID of the Target End UE is known to the UE-to-UE Relay.

9. The target End UE sends a Direct Communication Accept message to the UE-to-UE Relay it has successfully established security with. The DCA message may include the path information.

10-11. After receiving a DCA message, the UE-to-UE Relay (e.g. Relay2) sends a DCA message to the next UE-to-UE Relay (e.g. Relay1) or Source End UE it has successfully established security with. The UE-to-UE Relay may decide the next UE-to-UE Relay (e.g. Relay1) according to the received DCA message or from which it previously received a corresponding DCR message.

For Ethernet communication, the 5G ProSe Layer-3 UE-to-UE Relay maintains the association between PC5 links and Ethernet MAC addresses received from the 5G ProSe Layer-3 End UE.

For Unstructured traffic communication, for each pair of source and target 5G ProSe Layer-3 End UEs, the 5G ProSe Layer-3 UE-to-UE Relay maintains the 1:1 mapping between two PC5 links to the (next hop to) source 5G ProSe Layer-3 End UE and the (next hop to) target 5G ProSe Layer-3 End UE.

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