**3GPP TSG-CT WG1 Meeting #141eC1-232516**

**Electronic, 17 – 21 April 2023**

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| *CR-Form-v12.2* |
| **CHANGE REQUEST** |
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|  | **24.554** | **CR** | **0311** | **rev** | **-** | **Current version:** | **18.0.0** |  |
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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 to 5G ProSe direct link establishment procedure for U2U relay |
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| ***Source to WG:*** | CATT |
| ***Source to TSG:*** | C1 |
|  |  |
| ***Work item code:*** | 5G\_ProSe\_Ph2 |  | ***Date:*** | 2023-04-10 |
|  |  |  |  |  |
| ***Category:*** | B |  | ***Release:*** | Rel-18 |
|  | *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-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)Rel-19 (Release 19)* |
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| ***Reason for change:*** | In clause 6.7.1.1 of TS 23.304, it describes:"In the case of one source 5G ProSe Layer-3 End UE communicates with multiple target 5G ProSe Layer-3 End UEs, the PC5 link between the source 5G ProSe Layer-3 End UE and the 5G ProSe Layer-3 UE-to-UE Relay can be shared for multiple target 5G ProSe Layer-3 End UEs per RSC while the PC5 links may be established individually between the 5G ProSe Layer-3 UE-to-UE Relay and target 5G ProSe Layer-3 End UEs per RSC. For the shared PC5 link, the Layer-2 link modification procedure shall be used.In the case of multiple source 5G ProSe Layer-3 End UEs communicate with one target 5G ProSe Layer-3 End UE, the PC5 link between the 5G ProSe Layer-3 UE-to-UE Relay and the target 5G ProSe Layer-3 End UE can be shared per RSC while the PC5 links may be established individually between the source 5G ProSe Layer-3 End UEs and the 5G ProSe Layer-3 UE-to-UE Relay per RSC. For the shared PC5 link, the Layer-2 link modification procedure shall be used."So if the 5G ProSe layer-3 end UE initiates 5G ProSe direct link modification procedure to establish 5G ProSe UE-to-UE relay communication with additional 5G ProSe layer-3 end UE(s), the 5G ProSe layer-3 UE-to-UE relay UE shall perform the 5G ProSe direct link establishment procedure towards the target 5G ProSe layer-3 end UE. |
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| ***Summary of change:*** | Add 5G ProSe direct link establishment procedure triggered by 5G ProSe direct link modification by the source 5G ProSe layer-3 end UE for establishing 5G ProSe UE-to-UE relay communication with additional target 5G ProSe layer-3 end UE(s). |
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| ***Consequences if not approved:*** | It is not supported that the source 5G ProSe layer-3 end UE establishes 5G ProSe UE-to-UE relay communication with additional target 5G ProSe layer-3 end UE(s) using 5G ProSe direct link modification procedures. |
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| ***Clauses affected:*** | 7.2.2.2, 7.2.2.4 |
|  |  |
|  | **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 Change \* \* \* \*

#### 7.2.2.2 5G ProSe direct link establishment procedure initiation by initiating UE

The initiating UE shall meet the following pre-conditions before initiating this procedure:

a) a request from upper layers to transmit the packet for ProSe application over PC5 or a request from lower layers to trigger ProSe direct link establishment;

b) the communication mode is unicast mode (e.g., pre-configured as specified in clause 5.2.4 or indicated by upper layers);

c) the link layer identifier for the initiating UE (i.e., layer-2 ID used for unicast communication) is available (e.g., pre-configured or self-assigned) and is not being used by other existing 5G ProSe direct links within the initiating UE;

d) the link layer identifier for the destination UE (i.e., the unicast layer-2 ID of the target UE or the broadcast layer-2 ID) is available to the initiating UE (e.g., pre-configured, obtained as specified in clause 5.2, known via prior ProSe direct communication or indicated by lower layers);

NOTE 1: In the case where different ProSe applications are mapped to distinct default destination layer-2 IDs, when the initiating UE intends to establish a single unicast link that can be used for more than one ProSe identifiers, the UE can select any of the default destination layer-2 ID for unicast initial signalling.

e) the initiating UE is either authorised for 5G ProSe direct communication over PC5 in NR-PC5 in the serving PLMN, has a valid authorization for 5G ProSe direct communication over PC5 in NR-PC5 when not served by NG-RAN, is authorized to use a 5G ProSe UE-to-network relay UE, is authorized to use a 5G ProSe UE-to-UE relay UE or is authorized to act as a 5G ProSe UE-to-UE relay UE. The UE considers that it is not served by NG-RAN if the following conditions are met:

1) not served by NG-RAN for ProSe direct communication over PC5;

2) in limited service state as specified in 3GPP TS 23.122 [14], if the reason for the UE being in limited service state is one of the following;

i) the UE is unable to find a suitable cell in the selected PLMN as specified in 3GPP TS 38.304 [15];

ii) the UE received a REGISTRATION REJECT message or a SERVICE REJECT message with the 5GMM cause #11 "PLMN not allowed" as specified in 3GPP TS 24.501 [11]; or

iii) the UE received a REGISTRATION REJECT message or a SERVICE REJECT message with the 5GMM cause #7 "5GS services not allowed" as specified in 3GPP TS 24.501 [11]; or

3) in limited service state as specified in 3GPP TS 23.122 [14] for reasons other than i), ii) or iii) above and located in a geographical area for which the UE is provisioned with "non-operator managed" radio parameters as specified in clause 5.2;

f) there is no existing 5G ProSe direct link for the pair of peer application layer IDs, or there is an existing 5G ProSe direct link for the pair of peer application layer IDs and:

1) the network layer protocol of the existing 5G ProSe direct link is not identical to the network layer protocol required by the upper layer in the initiating UE for this ProSe application;

2) the security policy (either signalling security policy or user plane security policy) corresponding to the ProSe identifier is not compatible with the security policy of the existing 5G ProSe direct link; or

3) in case of the 5G ProSe direct link establishment procedure is for direct communication between the 5G ProSe layer-3 remote UE and the 5G ProSe layer-3 UE-to-network relay UE, the existing 5G ProSe direct link for the peer UE is established with a different RSC or established not for direct communication between the 5G ProSe layer-3 remote UE and the 5G ProSe layer-3 UE-to-network relay UE;

4) in case of the 5G ProSe direct link establishment procedure is for direct communication between the 5G ProSe layer-2 remote UE and the 5G ProSe layer-2 UE-to-network relay UE, the existing 5G ProSe direct link for the peer UE is established not for direct communication between the 5G ProSe layer-2 remote UE and the 5G ProSe layer-2 UE-to-network relay UE; or

5) in case of the 5G ProSe direct link establishment procedure is for direct communication between the 5G ProSe layer-3 end UE and the 5G ProSe layer-3 UE-to-UE relay UE, the existing 5G ProSe direct link for the peer UE is established with a different RSC or established not for direct communication between the 5G ProSe layer-3 end UE and the 5G ProSe layer-3 UE-to-UE relay UE;

g) the number of established 5G ProSe direct links is less than the implementation-specific maximum number of established 5G ProSe direct links allowed in the UE at a time;

h) timer T5088 is not associated with the link layer identifier for the destination UE or timer T5088 associated with the link layer identifier for the destination UE has already expired or stopped; and

x) a PROSE DIRECT LINK MODIFICATION REQUEST message is received from the 5G ProSe layer-3 end UE to establish 5G ProSe UE-to-UE relay communication with additional 5G ProSe layer-3 end UE(s) as specified in clause 7.2.3.2, in case that the UE acts as a 5G ProSe layer-3 UE-to-UE relay UE, the 5G ProSe direct link modification procedure is initiated over an existing 5G ProSe direct link for direct communication between the 5G ProSe layer-3 end UE and the 5G ProSe layer-3 UE-to-UE relay UE, and there is no existing 5G ProSe direct link between the 5G ProSe layer-3 UE-to-UE relay UE and the additional target 5G ProSe layer-3 end UE.

After receiving the service data or request from the upper layers, the initiating UE shall derive the PC5 QoS parameters and assign the PQFI(s) for the PC5 QoS flows(s) to be established as specified in clause 7.2.7.

If the 5G ProSe direct link establishment procedure is for direct communication between the 5G ProSe remote UE and the 5G ProSe UE-to-network relay UE, then the UE shall apply the DUCK or DUSK with the associated encrypted bitmask used for UE-to-network relay discovery along with the UTC-based counter for encrypting:

a) the relay service code; and

b) the UP-PRUK ID or CP-PRUK ID, if available,

as specified in clause 6.3.5.2 of 3GPP TS 33.503 [34], and the UE shall use the security protected relay service code and the security protected UP-PRUK ID or security protected CP-PRUK ID for creating a PROSE DIRECT LINK ESTABLISHMENT REQUEST message.

NOTE 2: If the UE is neither configured with DUCK nor DUSK, the relay service code and the UP-PRUK ID or CP-PRUK ID are not encrypted.

If the 5G ProSe direct link establishment procedure is for direct communication between the 5G ProSe UE-to-UE relay UE and the target 5G ProSe end UE, upon successful completion of the 5G ProSe direct link security mode control procedure with the source 5G ProSe end UE, the initiating UE acting as the 5G ProSe UE-to-UE relay UE initiates the 5G ProSe direct link establishment procedure to the target 5G ProSe end UE.

Editor’s note: When the direct link modification procedure can be used between the 5G ProSe UE-to-UE relay UE and the target 5G ProSe end UE is FFS.

In order to initiate the 5G ProSe direct link establishment procedure, the initiating UE shall create a PROSE DIRECT LINK ESTABLISHMENT REQUEST message. The initiating UE:

a) shall include the source user info set to the initiating UE's application layer ID received from upper layers, or set to the user info ID of the source 5G ProSe end UE if the 5G ProSe direct link establishment procedure is for 5G ProSe direct communication between the 5G ProSe end UE and the 5G ProSe UE-to-UE relay UE;

b) shall include the ProSe identifier(s) received from upper layer if the 5G ProSe direct link establishment procedure is not for 5G ProSe direct communication between the 5G ProSe remote UE and the 5G ProSe UE-to-network relay UE;

c) shall include the target user info set to the target UE's application layer ID if received from upper layers or if known based on the unicast layer-2 ID of target UE (i.e. destination layer-2 ID) as described in clause 5.8.2.4 of 3GPP TS 23.304 [3], to the user info ID of the 5G ProSe UE-to-network relay UE obtained during the 5G ProSe UE-to-network relay discovery procedure, or to the user info ID of the target 5G ProSe end UE:

1) if the initiating UE is acting as the source 5G ProSe end UE and the user info ID of the target 5G ProSe end UE is obtained during the 5G ProSe UE-to-UE relay discovery procedure; or

2) if the initiating UE is acting as the 5G ProSe UE-to-UE relay UE and the user info ID of the target 5G ProSe end UE is obtained in the PROSE DIRECT LINK ESTABLISHMENT REQUEST message or PROSE DIRECT LINK MODIFICATION REQUEST message from the source 5G ProSe end UE;

ca) shall include the UE-to-UE relay UE user info set to the user info ID of the 5G ProSe UE-to-UE relay UE:

1) if obtained during the 5G ProSe UE-to-UE relay discovery procedure and the 5G ProSe direct link establishment procedure is for 5G ProSe direct communication between the source 5G ProSe end UE and the 5G ProSe UE-to-UE relay UE; or

2) if the initiating UE is acting as the 5G ProSe UE-to-UE relay UE;

cb) shall include the target end UE layer-2 ID set to the layer-2 ID of the target 5G ProSe end UE, if the initiating UE is acting as the source 5G ProSe end UE and the layer-2 ID of the target 5G ProSe end UE is available in the source 5G ProSe end UE via the previous direct communication;

d) if the 5G ProSe direct link is not for direct communication between the 5G ProSe remote UE and the 5G ProSe UE-to-network relay UE:

1) shall include the key establishment information container if the UE PC5 unicast signalling integrity protection policy is set to "Signalling integrity protection required" or "Signalling integrity protection preferred" and may include the key establishment information container if the UE PC5 unicast signalling integrity protection policy is set to "Signalling integrity protection not needed";

NOTE 3: The key establishment information container is provided by upper layers.

e) shall include:

1) a Nonce\_1, if the direct communication is not between the 5G ProSe remote UE and the 5G ProSe UE-to-network relay UE, or if the direct communication is between the 5G ProSe remote UE and the 5G ProSe UE-to-network relay UE and the security procedure over control plane is used as specified in 3GPP TS 33.503 [34]; or

2) a KNRP freshness parameter 1, if the direct communication is between the 5G ProSe remote UE and the 5G ProSe UE-to-network relay UE and the security procedure over user plane is used as specified in 3GPP TS 33.503 [34];

 set to the 128-bit nonce value generated by the initiating UE for the purpose of session key establishment over this 5G ProSe direct link if the UE PC5 unicast signalling integrity protection policy is set to "Signalling integrity protection required" or "Signalling integrity protection preferred";

NOTE 4: The Nonce\_1 IE in the PROSE DIRECT LINK ESTABLISHMENT REQUEST message is used to hold the value of Nonce\_1 or KNRP freshness parameter 1.

f) shall include its UE security capabilities indicating the list of algorithms that the initiating UE supports for the security establishment of this 5G ProSe direct link;

g) shall include the MSB of KNRP-sess ID chosen by the initiating UE as specified in 3GPP TS 33.503 [34] if the UE PC5 unicast signalling integrity protection policy is set to "Signalling integrity protection required" or "Signalling integrity protection preferred";

NOTE 5: If the direct communication is not between the 5G ProSe remote UE and the 5G ProSe UE-to-network relay UE, the KNRP-sess ID holds the ID that corresponds to KNRP-sess. If the direct communication is between the 5G ProSe remote UE and the 5G ProSe UE-to-network relay UE, the KNRP-sess ID holds the ID that corresponds to KNRP-sess (if security procedure over user plane is used) or Krelay-sess (if security procedure over control plane is used).

h) may include a KNRP ID if the initiating UE has an existing KNRP for the target UE and the direct communication is not between the 5G ProSe remote UE and the 5G ProSe UE-to-network relay UE;

i) shall include its UE PC5 unicast signalling security policy. In the case where the different ProSe applications are mapped to the different PC5 unicast signalling security policies, when the initiating UE intends to establish a single unicast link that can be used for more than one ProSe application, each of the signalling security polices of those ProSe applications shall be compatible, e.g., "Signalling integrity protection not needed" and "Signalling integrity protection required" are not compatible. In case the 5G ProSe direct link establishment procedure is for direct communication between 5G ProSe remote UE and 5G ProSe UE-to-network relay UE, the Signalling integrity protection policy shall be set to "Signalling integrity protection required";

j) shall include the Relay service code IE set to the relay service code of the target relay UE if the 5G ProSe direct link establishment procedure is for direct communication between the 5G ProSe remote UE and the 5G ProSe UE-to-network relay UE, or to the relay service code indicating the connectivity service requested by the source 5G ProSe end UE if the 5G ProSe direct link establishment procedure is for direct communication between the (source or target) 5G ProSe end UE and the 5G ProSe UE-to-UE relay UE;

k) shall include the UTC-based counter LSB set to the four least significant bits of the UTC-based counter if the 5G ProSe direct link establishment procedure is for direct communication between the 5G ProSe remote UE and the 5G ProSe UE-to-network relay UE;

l) shall include the UE identity IE set to the SUCI of the initiating UE if:

1) the 5G ProSe direct link establishment procedure is for direct communication between the 5G ProSe remote UE and the 5G ProSe UE-to-network relay UE; and

2) the security for 5G ProSe UE-to-network relay uses the security procedure over control plane and the initiating UE does not have a valid CP-PRUK as specified in 3GPP TS 33.503 [34], or, the security for 5G ProSe UE-to-network relay uses the security procedure over user plane and the initiating UE does not have a valid UP-PRUK as specified in 3GPP TS 33.503 [34];

m) shall include the User security key ID IE set to:

1) UP-PRUK ID of the initiating UE if:

i) the 5G ProSe direct link establishment procedure is for direct communication between the 5G ProSe remote UE and the 5G ProSe UE-to-network relay UE;

ii) the initiating UE has a valid UP-PRUK; and

iii) the security for 5G ProSe UE-to-network relay uses the security procedure over user plane as specified in 3GPP TS 33.503 [34]; or

2) CP-PRUK ID of the initiating UE that is associated with the relay service code of the target UE if:

i) the 5G ProSe direct link establishment procedure is for direct communication between the 5G ProSe remote UE and the 5G ProSe UE-to-network relay UE;

ii) the initiating UE has a valid CP-PRUK is associated with the relay service code of the target UE; and

iii) the security for 5G ProSe UE-to-network relay uses the security procedure over control plane as specified in 3GPP TS 33.503 [34];

n) shall include the HPLMN ID of the initiating UE, if the UP-PRUK ID of the initiating UE is included and is not in NAI format (see 3GPP TS 33.503 [34]); and

o) shall include the MIC IE set to the calculated MIC value as specified in clause 6.3.5.3 of 3GPP TS 33.503 [34] if the 5G ProSe direct link establishment procedure is for direct communication between the 5G ProSe remote UE and the 5G ProSe UE-to-network relay UE and the UE has the DUIK.

Editor’s note: The security parameters for 5G ProSe UE-to-UE relay and the parameters for 5G ProSe layer-2 UE-to-UE relay are FFS.

After the PROSE DIRECT LINK ESTABLISHMENT REQUEST message is generated, the initiating UE shall pass this message to the lower layers for transmission along with the source layer-2 ID and destination layer-2 ID as follows:

a) if the 5G ProSe direct communication is in a consequence of 5G ProSe direct discovery as defined in clause 6.2.14, clause 6.2.15, clause 8.2.1, and clause 8a.2.1:

 self-assign a source layer-2 ID, and

1) the destination layer-2 ID set to the received target end UE layer-2 ID in the PROSE DIRECT LINK ESTABLISHMENT REQUEST message or PROSE DIRECT LINK MODIFICATION REQUEST message from the source 5G ProSe end UE if the initiating UE is acting as the 5G ProSe UE-to-UE relay UE;

2) otherwise, the destination layer-2 ID set to the source layer-2 ID in the received PROSE PC5 DISCOVERY message for discovery procedure; or

b) otherwise:

 self-assign a source layer-2 ID, and the destination layer-2 ID set to the destination layer-2 ID used for unicast initial signalling as specified in clause 5.2.4,

NOTE 6: The UE implementation ensures that any value of the self-assigned source layer-2 ID in a) and b) is different from any other self-assigned source layer-2 ID(s) in use for 5G ProSe direct discovery as specified in clause 6.2.14, clause 6.2.15 and clause 8.2.1, and is different from any other provisioned destination layer-2 ID(s) as specified in clause 5.2.

NOTE 7: It is possible for the initiating UE to reuse the initiating UE's layer-2 ID used in previous 5G ProSe direct link with the same peer UE.

and start timer T5080.

NOTE 8: A default PC5 DRX configuration is used for transmitting the PROSE DIRECT LINK ESTABLISHMENT REQUEST message as specified in 3GPP TS 38.300 [21].

The UE shall not send a new PROSE DIRECT LINK ESTABLISHMENT REQUEST message to the same target UE identified by the same application layer ID while timer T5080 is running. If the target user info IE is not included in the PROSE DIRECT LINK ESTABLISHMENT REQUEST message (i.e., ProSe application oriented 5G ProSe direct link establishment procedure), the initiating UE shall handle multiple PROSE DIRECT LINK ESTABLISHMENT ACCEPT messages, if any, received from different target UEs for the establishment of multiple 5G ProSe direct links before the expiry of timer T5080.

NOTE 9: In order to ensure successful 5G ProSe direct link establishment, T5080 should be set to a value larger than the sum of T5089 and T5092.



Figure 7.2.2.2.1: UE oriented 5G ProSe direct link establishment procedure



Figure 7.2.2.2.2: ProSe service oriented 5G ProSe direct link establishment procedure

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

#### 7.2.2.4 5G ProSe direct link establishment procedure completion by the initiating UE

If the Target user info IE is included in the PROSE DIRECT LINK ESTABLISHMENT REQUEST message, upon receipt of the PROSE DIRECT LINK ESTABLISHMENT ACCEPT message, the initiating UE shall stop timer T5080. If the Target user info IE is not included in the PROSE DIRECT LINK ESTABLISHMENT REQUEST message the initiating UE may keep the timer T5080 running and continue to handle multiple response messages (i.e., the PROSE DIRECT LINK ESTABLISHMENT ACCEPT message) from multiple target UEs.

For each of the PROSE DIRECT LINK ESTABLISHMENT ACCEPT message received, the initiating UE shall uniquely assign a PC5 link identifier and create a 5G ProSe direct link context for each of the 5G ProSe direct link(s). Then the initiating UE shall store the source layer-2 ID and the destination layer-2 ID used in the transport of this message provided by the lower layers in the 5G ProSe direct link context(s) to complete the establishment of the 5G ProSe direct link with the target UE(s). From this time onward the initiating UE shall use the established link(s) for ProSe direct communication over PC5 and additional PC5 signalling messages to the target UE(s).

After receiving the PROSE DIRECT LINK ESTABLISHMENT ACCEPT message, the initiating UE shall provide the following information along with the layer-2 IDs to the lower layer, which enables the lower layer to handle the coming PC5 signalling or traffic data:

a) the PC5 link identifier self-assigned for this 5G ProSe direct link;

b) PQFI(s) and its corresponding PC5 QoS parameters, if available; and

c) an indication of activation of the PC5 unicast user plane security protection for the 5G ProSe direct link, if applicable.

The initiating UE shall start timer T5090 if:

a) at least one of ProSe identifiers for the 5G ProSe direct links satisfies the privacy requirements as specified in clause 5.2.4; or

b) T5090 is configured as specified in clause 5.2.5.

In addition, the initiating UE may perform the PC5 QoS flow establishment over 5G ProSe direct link as specified in clause 7.2.7.

Upon expiry of the timer T5080, if the PROSE DIRECT LINK ESTABLISHMENT REQUEST message did not include the Target user info IE and the initiating UE received at least one PROSE DIRECT LINK ESTABLISHMENT ACCEPT message, it is up to the UE implementation to consider the 5G ProSe direct link establishment procedure as complete or to restart the timer T5080.

If the 5G ProSe direct link establishment procedure is triggered by a PROSE DIRECT LINK MODIFICATION REQUEST message from the source 5G ProSe layer-3 end UE as specified in clause 7.2.3.2, upon receipt of the PROSE DIRECT LINK ESTABLISHMENT ACCEPT message, the initiating UE shall send a PROSE DIRECT LINK MODIFICATION ACCEPT message to the source 5G ProSe layer-3 end UE as specified in clause 7.2.3.3, if the initiating UE acts as the 5G ProSe layer-3 UE-to-UE relay UE.

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