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Contents

Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

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In the present document, modal verbs have the following meanings:

shall indicates a mandatory requirement to do something

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will indicates that something is certain or expected to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

will not indicates that something is certain or expected not to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

might indicates a likelihood that something will happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

might not indicates a likelihood that something will not happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

In addition:

is (or any other verb in the indicative mood) indicates a statement of fact

is not (or any other negative verb in the indicative mood) indicates a statement of fact

The constructions "is" and "is not" do not indicate requirements.

1 Scope

The present document specifies the protocols for Proximity-based Services (ProSe) in 5G system as specified in 3GPP TS 23.304 [2] for:

a) 5G ProSe direct discovery;

b) 5G ProSe communication over the PC5 interface; and

c) 5G ProSe-enabled UE-to-network relay.

The present document defines the associated procedures for 5G ProSe service authorisation, 5G ProSe direct discovery (e.g. the procedures between 5G ProSe-enabled UE and 5G Direct Discovery Name Management Function (DDNMF) over the PC3a interface, the procedures over the PC5 interface), 5G ProSe UE-to-network relay discovery, and 5G ProSe direct communication.

The present document also defines the message format, message contents, error handling and system parameters applied by the protocols for ProSe in 5GS.

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 23.304: "Proximity based Services (ProSe) in the 5G System (5GS); Stage 2".

[3] IETF RFC 7230: "Hypertext Transfer Protocol (HTTP/1.1): Message Syntax and Routing".

[4] IETF RFC 7231: "Hypertext Transfer Protocol (HTTP/1.1): Semantics and Content".

[5] 3GPP TS 24.526: "UE policies for 5G System (5GS); Stage 3".

[6] OMA-WAP-TS-PushOTA-V2_1-20110405-A: "Push Over the Air".

[7] OMA-AD-Push-V2_2-20110809-A: "Push Architecture".

[8] WAP-168-ServiceLoad-20010731-a: "Service Loading".

[9] 3GPP TS 29.555: "Inter-5G Direct Discovery Name Management Function (DDNMF) signalling aspects; Stage 3".

[10] 3GPP TS 29.503: "5G System; Unified Data Management Services; Stage 3".

[11] 3GPP TS 24.501: "Non-Access-Stratum (NAS) protocol for 5G System (5GS); Stage 3".

[12] 3GPP TS 23.003: "Numbering, addressing and identification".

[13] 3GPP TS 38.331: "NR; Radio Resource Control (RRC); Protocol Specification".

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

[15] 3GPP TS 38.304: "User Equipment (UE) procedures in Idle mode and RRC Inactive state".

[16] 3GPP TS 38.323: "NR; Packet Data Convergence Protocol (PDCP) specification".

[17] 3GPP TS 24.555: "Proximity-services (ProSe) in 5G System (5GS); User Equipment (UE) policies; Stage 3".

[18] 3GPP TS 24.587: "Vehicle-to-Everything (V2X) services in 5G System (5GS); Protocol aspects; Stage 3".

[19] 3GPP TS 29.557: "5G System; Application Function ProSe Service; Stage 3".

[20] 3GPP TS 24.007: "Mobile radio interface signalling layer-3; General aspects".

[21] 3GPP TS 38.300: "NR; NR and NG-RAN Overall Description; Stage 2".

[22] 3GPP TS 23.501: "System Architecture for the 5G System; Stage 2".

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

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

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

[26] 3GPP TS 24.502: "Access to the 5G System (5GS) via non-3GPP access networks; Stage 3".

[27] ITU-T Recommendation E.212: "The international identification plan for mobile terminals and mobile users".

[28] ISO/IEC 10118-3:2018: "IT Security techniques – Hash-functions – Part 3: Dedicated hash-functions".

[29] W3C REC-xmlschema-2-20041028: "XML Schema Part 2: Datatypes".

[30] IETF RFC 4122: "A Universally Unique IDentifier (UUID) URN Namespace".

[31] 3GPP TS 24.008: "Mobile Radio Interface Layer 3 specification; Core Network Protocols; Stage 3".

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

[33] 3GPP TS 23.503: "Policy and Charging Control Framework for the 5G System; Stage 2".

[34] 3GPP TS 33.503: "Security Aspects of Proximity based Services (ProSe) in the 5G System (5GS)".

[35] 3GPP TS 23.303: "Proximity-based services (ProSe); Stage 2".

[36] 3GPP TS 33.303: "Proximity-based Services (ProSe); Security aspects".

[37] 3GPP TS 33.536: "Security aspects of 3GPP support for advanced Vehicle-to-Everything (V2X) services".

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

3 Definitions of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the terms given in 3GPP 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 3GPP TR 21.905 [1].

5G ProSe Direct Communication: A function that supports the communications 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 Direct Discovery: A function 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 UE-to-network relay: A function employed by a 5G ProSe-enabled UE to support the communications between a 5G ProSe UE-to-network remote UE and DN.

5G ProSe layer-2 UE-to-network relay: A function employed by a 5G ProSe-enabled UE to support the communications between a 5G ProSe layer-2 UE-to-network remote UE and DN.

5G ProSe layer-3 UE-to-network relay: A function that supports the communications between a 5G ProSe layer-3 UE-to-network remote UE and DN.

5G ProSe UE-to-network relay UE: A 5G ProSe-enabled UE that provides functionality to support connectivity to the network for 5G ProSe remote UE(s).

5G ProSe layer-2 UE-to-network relay UE: A 5G ProSe-enabled UE that provides functionality to support connectivity to the network for 5G ProSe layer-2 remote UE(s) via layer-2 protocol.

5G ProSe layer-3 UE-to-network relay UE: A 5G ProSe-enabled UE that provides functionality to support connectivity to the network for 5G ProSe layer-3 remote UE(s) via layer-3 protocol.

5G ProSe layer-2 remote UE: A 5G ProSe-enabled UE that communicates with a DN via a 5G ProSe layer-2 UE-to-network relay UE.

5G ProSe layer-3 remote UE: A 5G ProSe-enabled UE that communicates with a DN via a 5G ProSe layer-3 UE-to-network relay UE.

Open 5G ProSe direct discovery: A 5G ProSe direct discovery that takes place without explicit permission from the 5G ProSe-enabled UE being discovered**.**

Restricted 5G ProSe direct discovery: A 5G ProSe direct discovery that only takes place with explicit permission from the 5G ProSe-enabled UE being discovered.

For the purposes of the present document, the following term and definition given in TS 23.304 [2] apply:

5G ProSe-enabled UE
5G ProSe remote UE
Application layer ID
Application layer group ID
Destination layer-2 ID
Discovery entry ID
Discovery filter
Discovery query filter
Discovery response filter
Geographical area
Local PLMN
Member ID
Metadata index
Metadata index mask
Model A
Model B
Mode of communication
ProSe application code
ProSe application mask
ProSe application ID
ProSe application user ID
ProSe discovery UE ID
ProSe identifier
ProSe layer-2 group ID
ProSe query code
ProSe response code
ProSe restricted code
ProSe restricted code prefix
ProSe restricted code suffix

Relay service code
Restricted ProSe application user ID
User info ID
Source layer-2 ID

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in 3GPP TR 21.905 [1].

5G DDNMF	5G Direct Discovery Name Management Function
5G ProSe	5G Proximity-based Services
DN	Data Network
DUCK	Discovery User Confidentility Key
DUIK	Discovery User Integrity Key
DUSK	Discovery User Scrambling Key
GFBR	Guaranteed Flow Bit Rate
LSB	Least Significant 8 Bits
MSB	Most Significant 8 Bits
MFBR	Maximum Flow Bit Rate
MIC	Message Integrity Check
NCGI	NG-RAN Cell Global ID
PC5 LINK-AMBR	PC5 Link Aggregated Bit Rate
PDUID	ProSe Discovery UE ID
PKMF	ProSe Key Management Function
PQI	PC5 5QI
ProSeP	5G ProSe Policy
PSDK	Public Safety Discovery Key
RQI	Reflective QoS Indication
RPAUID	Restricted ProSe Application User ID
RSC	Relay Service Code
TTL	Time-To-Live

4 General

4.1 Overview

5G Proximity-based Services (ProSe) are services that can be provided by the 3GPP system based on UEs being in proximity to each other. In this release of the document, the 3GPP system enablers for 5G ProSe include the following functions:

a) 5G ProSe direct discovery;

b) 5G ProSe direct communication; and

c) 5G ProSe UE-to-network relay.

The above functions are applicable for both public safety UE and commercial UEs.

The security aspects for 5G ProSe features are specified in 3GPP TS 33.503 [34].

5 Provisioning of configuration information for 5G ProSe

5.1 Overview

5G ProSe configuration parameters are configured by the related procedures which allow configuration of necessary 5G ProSe configuration parameters to UE.

5.2 Configuration and precedence of 5G ProSe configuration information

5.2.1 General

UE's usage of 5G ProSe service is controlled by 5G ProSe configration information.

The 5G ProSe configuration information consist of the configuration parameters for 5G ProSe direct discovery, 5G ProSe direct communication, 5G ProSe UE-to-network relay and 5G ProSe usage reporting configuration and rules.

5.2.2 Precedence of 5G ProSe configuration information

The 5G ProSe configuration information for 5G ProSe direct discovery, 5G ProSe direct communication, 5G ProSe UE-to-network relay and 5G ProSe usage reporting configuration and rules can be:

a) pre-configured in the ME;

b) configured in the UICC;

c) provided as a ProSeP by PCF;

d) provided by a ProSe application server via PC1 reference point except:

   1) the authorization policy for 5G ProSe direct discovery and restricted ProSe discovery UE ID for restricted direct discovery in parameters for 5G ProSe direct discovery;

   2) the authorization policy in parameters for 5G ProSe direct communication;

   3) the following parameters for the role of a 5G ProSe UE-to-network relay UE:

      i) authorization policy for acting as a 5G ProSe layer-3 and/or layer-2 UE-to-network relay when "served by NG-RAN";

      ii) QoS mapping rules for 5G ProSe layer-3 ProSe UE-to-network relay; and

      iii) a mapping of ProSe identifier(s) to ProSe application server address information for 5G ProSe layer-3 UE-to-network relay to relay Ethernet or Unstructured traffic from Remote UE by using IP type PDU session;

   4) the following parameters for the role of a remote UE:

      i) authorization policy for using a 5G ProSe layer-3 and/or layer-2 UE-to-network relay; and

   5) the following parameters for the role of a 5G ProSe UE-to-network relay as well as for the role of a 5G ProSe remote UE:

      i) radio parameters for 5G ProSe relay discovery when the UE is not "served by NG-RAN "; and

      ii) radio parameters for 5G ProSe relay communication when the UE is not "served by NG-RAN"; or

e) a combination of case a), b), c) or d) above.

The UE should not request or accept any 5G ProSe configuration information from PCF when the UE is working as a remote UE using a 5G ProSe layer-3 ProSe UE-to-network relay without involving N3IWF.

The UE shall use the 5G ProSe configuration information in the following order of decreasing precedence:

a) the 5G ProSe configuration information provided as a ProSeP by PCF;

b) the 5G ProSe configuration information provided by a ProSe application server via PC1 reference point;

c) the 5G ProSe configuration information configured in the UICC; and

d) the 5G ProSe configuration information pre-configured in the ME.

5.2.3 Configuration parameters for 5G ProSe direct discovery

The configuration parameters for 5G ProSe direct discovery over PC5 reference point consist of:

a) a validity timer for the validity of the configuration parameter for 5G ProSe direct discovery over PC5 interface;

b) a list of PLMNs in which the UE is authorised to perform open 5G ProSe direct discovery Model A monitoring when the UE is served by NG-RAN;

c) a list of PLMNs in which the UE is authorized to perform open 5G ProSe direct discovery Model A announcing when the UE is served by NG-RAN and an authorised discovery range for announcing per PLMN;

d) a list of PLMNs in which the UE is authorised to perform restricted 5G ProSe direct discovery Model A monitoring when the UE is served by NG-RAN;

e) a list of PLMNs in which the UE is authorized to perform restricted 5G ProSe direct discovery Model A announcing when the UE is served by NG-RAN and an authorised discovery range for announcing per PLMN;

f) a list of PLMNs in which the UE is authorized to perform restricted Model B discoverer operation when the UE is served by NG-RAN and an authorised discovery range for announcing per PLMN;

g) a list of PLMNs in which the UE is authorized to perform restricted Model B discoveree operation when the UE is served by NG-RAN and an authorised discovery range for announcing per PLMN;

h) an indication of whether the UE is authorized to perform 5G ProSe direct discovery for Model A or Model B when "not served by NG-RAN";

i) radio parameters for ProSe direct discover per NR PC5 applicable per geographical area(s) with an indication of whether these radio parameters are "operator managed" or "non-operator managed" when "not served by NG-RAN";

NOTE 1: Whether a frequency band is "operator managed" or "non-operator managed" in a given geographical area is defined by local regulations.

j) a 5G ProSe direct discovery UE ID for restricted direct discovery;

k) a list of group member discovery parameters that enable the group member discovery. For each group the list consists of, one application layer group ID, layer-2 group ID, and User info ID;

NOTE 2: User info ID is expected to be assigned uniquely to a user within the discovery group.

l) a list of ProSe identifiers to be used for direct discovery over PC5 interface;

m) a list of security parameters used for direct discovery over PC5; and

n) a list of ProSe identifiers to default destination layer-2 ID for initial discovery signalling mapping rule. Each mapping rule contains one or more ProSe identifiers and the default destination layer-2 ID for the initial signalling of direct discovery.

Editor's note: Whether the security parameters can be provided by the PCF and details of security parameters will be determined by SA3 WG.

5.2.4 Configuration parameters for 5G ProSe direct communication over PC5 interface

The configuration parameters for 5G ProSe direct communication over PC5 interface consist of:

a) a validity timer for the validity of the configuration parameters for 5G ProSe direct communication over PC5 interface;

b) a list of PLMNs in which the UE is authorized to use 5G ProSe direct communication over PC5 interface when the UE is served by NG-RAN. Each entry of the list contains a PLMN ID in which the UE is authorized to use 5G ProSe direct communication over PC5 interface;

c) an indication of whether the UE is authorized to use 5G ProSe direct communication over PC5 interface when the UE is not served by NG-RAN;

d) the radio parameters of the 5G ProSe direct communication over PC5 interface applicable per geographical area with an indication of whether these radio parameters are "operator managed" or "non-operator managed" when the UE is not served by NG-RAN;

e) configuration parameters for groupcast mode 5G ProSe direct communication for each application layer group, consisting of:

   1) application layer group ID;

   2) ProSe layer-2 group identifier;

   3) ProSe group IP multicast address;

   4) an indication of whether the UE is authorized to use IPv4 or IPv6; and

   5) optionally, an IPv4 address to be used by the UE as a source address for a specific group if the UE is authorized to use IPv4;

f) configuration parameters for privacy support, consisting of:

   1) a list of ProSe applications requiring privacy. Each entry of the list contains one or more ProSe identifiers and one or more geographical areas where the privacy is required; and

   2) a privacy timer value as specified in 3GPP TS 24.555 [17];

g) optionally, a list of ProSe identifier to ProSe NR frequency mapping rules. Each mapping rule contains one or more ProSe identifiers and the ProSe NR frequencies with associated geographical areas;

h) a list of ProSe identifier to destination layer-2 ID for broadcast mapping rules. Each mapping rule contains one or more ProSe identifiers and the destination layer-2 ID for broadcast;

i) optionally, a default destination layer-2 ID for broadcast;

j) a list of ProSe identifier to default destination layer-2 ID for unicast initial signalling mapping rules. Each mapping rule contains one or more ProSe identifiers and the default destination layer-2 ID for initial signalling to establish unicast connection;

k) a list of ProSe identifier to PC5 QoS parameters mapping rules. The PC5 QoS parameters are specified in clause 5.7 of 3GPP TS 23.304 [2];

l) an AS configuration, including a list of SLRB mapping rules applicable when the UE is not served by NG-RAN. Each SLRB mapping rule contains a PC5 QoS profile and an SLRB. The PC5 QoS profile contains the following parameters:

   1) the PC5 QoS profile containing a PQI;

   2) if the PQI of the PC5 QoS profile identifies a GBR QoS, the PC5 QoS profile containing a PC5 flow bit rates consisting of a guaranteed flow bit rate (GFBR) and a maximum flow bit rate (MFBR);

   3) if the PQI of the PC5 QoS profile identifies a non-GBR QoS, the PC5 QoS profile containing the PC5 link aggregated bit rate consisting of a per link aggregate maximum bit rate (PC5 LINK-AMBR);

NOTE 1: PC5 link aggregated bit rate is only used for unicast mode communications over PC5 interface.

4) the PC5 QoS profile containing a range, which is only used for groupcast mode communications over PC5 interface; and

5) the PC5 QoS profile optionally containing the priority level, the averaging window, and the maximum data burst volume. If one or more of the priority levels, the averaging window or the maximum data burst volume are not contained in the PC5 QoS profile, their default values apply;

m) a list of 5G ProSe direct security policies. Each entry in the list contains a 5G ProSe direct security policy composed of:

1) one or more ProSe identifiers;

2) the signalling integrity protection policy for the ProSe identifier(s);

3) the signalling ciphering policy for the ProSe identifier(s);

4) the user plane integrity protection policy for the ProSe identifier(s);

5) the user plane ciphering policy for the ProSe identifier(s); and

6) one or more geographical areas where the 5G ProSe direct security policy applies;

n) a list of ProSe identifiers to default mode of communication mapping rules. Each mapping rule contains one or more ProSe identifiers and the default mode of communication (one of unicast, groupcast or broadcast); and

o) a list of ProSe application to path preference mapping rules (i.e., PC5 preferred, Uu preferred, or no preference) as defined in clause 5.4 in 3GPP TS 24.555 [17]. The list of ProSe application to path preference mapping rules are in prioritized order according to the local configuration of the network.

NOTE 2: In this release of specification, the application ID defined in 3GPP TS 23.303 [35] can be used as the ProSe identifier in 5G ProSe direct discovery and in a consequent 5G ProSe direct communication.

5.2.5 Configuration parameters for 5G ProSe UE-to-network relay

The configuration parameters for the role of a ProSe UE-to-network relay UE over PC5 reference point consist of:

a) a validity timer for the validity of the configuration parameter for 5G ProSe UE-to-network relay over PC5 interface;

b) a list of PLMNs in which the UE is authorised to relay traffic for 5G ProSe layer-3 remote UEs when the UE is served by NG-RAN, and in each PLMN;

c) a list of PLMNs in which the UE is authorised to relay traffic for 5G ProSe layer-2 remote UEs when the UE is served by NG-RAN, and in each PLMN;

d) the default destination layer-2 ID(s) for sending the discovery signalling for announcement and additional information, and for receiving the discovery signalling for solicitation;

NOTE 1: Which default destination layer-2 ID is selected is up to UE implementation when there are more than one default destination layer-2 ID.

e) a User info ID for the UE-to-network relay discovery;

f) one or more relay service code(s) for the UE-to-network relay discovery, and for each relay service code:

1) security related content for 5G ProSe relay discovery;

2) an indication of whether the relay service code is offering 5G ProSe layer-2 or layer-3 UE-to-network relay service; and

3) for 5G ProSe layer-3 UE-to-network relay UE, a set of PDU session parameters:

i) PDU Session type;

ii) optionally, DNN;

iii) optionally, SSC Mode;

iv) optionally, S-NSSAI; and

v) optionally, access type preference;

4) for 5G ProSe layer-3 UE-to-network relay UE, security policies for UE-to-network relay direct communication:

i) the signalling integrity protection policy;

ii) the signalling ciphering policy;

iii) the user plane integrity protection policy; and

iv) the user plane ciphering policy;

g) for 5G ProSe layer-3 UE-to-network relay UE, QoS mapping rules including:

1) a mapping between a 5QI value and a 5G ProSe PQI value over PC5 for traffic relayed over the PC5 interface;

2) a PDB adjustment factor of the standardized PDB identified by the PQI; and

3) optionally, the relay service code(s) associated with the QoS mapping rule;

h) the radio parameters of the 5G ProSe UE-to-network relay discovery applicable per geographical area with an indication of whether these radio parameters are "operator managed" or "non-operator managed" when the UE is not served by NG-RAN;

i) for 5G ProSe layer-3 UE-to-network relay UE, for Ethernet and Unstructured traffic using IP type PDU session, a list of ProSe identifier(s) to ProSe application server address mapping rule. Each mapping rule contains one or more ProSe identifier(s) and IP address/FQDN and transport layer port number; and

j) the radio parameters of the 5G ProSe direct communication applicable per geographical area with an indication of whether these radio parameters are "operator managed" or "non-operator managed" when the UE is not served by NG-RAN; and

k) optionally, the ProSe key management function (PKMF) address.

The configuration parameters for the role of a 5G ProSe remote UE consist of:

a) a validity timer for the validity of the configuration parameters for 5G ProSe remote UE;

b) an indication whether the UE is authorized to use a 5G ProSe layer-3 UE-to-network relay UE;

c) a list of PLMNs in which the UE is authorized to use a 5G ProSe layer-2 UE-to-network relay UE;

d) default destination layer-2 ID(s) for sending the discovery signalling for solicitation, and for receiving the discovery signalling for announcement and additional information;

NOTE 2: Which default destination layer-2 ID is selected is up to UE implementation when there are more than one default destination layer-2 ID.

e) a User info ID for the UE-to-network relay discovery;

f) one or more relay service code(s) for the UE-to-network relay discovery, and for each relay service code:

1) security related content for 5G ProSe relay discovery;

2) an indication of whether the relay service code is offering 5G ProSe layer-2 or layer-3 UE-to-network relay service; and

3) for 5G ProSe remote UE using 5G ProSe layer-3 UE-to-network relays, one of the following:

i) a set of PDU session parameters for the relayed traffic without using N3IWF access:

A) PDU Session type;

B) optionally, DNN;

C) optionally, SSC Mode;

D) optionally, S-NSSAI; and

E) optionally, access type preference; or

ii) an indication of using N3IWF access for the relayed traffic;

4) for 5G ProSe remote UE using 5G ProSe layer-3 UE-to-network relays, security policies for UE-to-network relay direct communication:

i) the signalling integrity protection policy;

ii) the signalling ciphering policy;

iii) the user plane integrity protection policy; and

iv) the user plane ciphering policy;

g) the radio parameters of the 5G ProSe Relay Discovery applicable per geographical area with an indication of whether these radio parameters are "operator managed" or "non-operator managed" when the UE is not served by NG-RAN;

h) the radio parameters of the 5G ProSe direct communication applicable per geographical area with an indication of whether these radio parameters are "operator managed" or "non-operator managed" when the UE is not served by NG-RAN;

NOTE 3: Whether a frequency band is "operator managed" or "non-operator managed" in a given Geographical Area is defined by local regulations.

i) the N3IWF selection information for 5G ProSe layer-3 remote UE:

1) N3IWF identifier configuration (either FQDN or IP address); and

2) 5G ProSe layer-3 UE-to-network relays, access node selection information consists of a prioritized list of PLMNs for N3IWF selection and an indication that the selection of an N3IWF in a PLMN should be based on Tracking Area Identity FQDN or on Operator Identifier FQDN; and

j) optionally, the PKMF address.

5.3 Procedures

5.3.1 General

The procedure for provisioning of parameters for 5G ProSe allows the UE to obtain 5G ProSe policy (ProSeP).

5.3.2 UE-requested ProSeP provisioning procedure

5.3.2.1 General

The UE-requested ProSeP policy provisioning procedure enables the UE to request ProSeP from the PCF in the following cases:

a) if the T5051 for a UE policies for 5G ProSe direct discovery expires;

b) if the T5052 for a UE policies for 5G ProSe direct communications expires;

c) if the T5053 for a UE policies for 5G ProSe UE-to-network relay UE expires;

d) if the T5054 for UE policies for 5G ProSe remote UE expires; and

e) if there are no valid configuration parameters, e.g., for the current area, or due to abnormal situation.

The UE shall follow the principles of PTI handling for UE policy delivery service procedures defined in 3GPP TS 24.501 [11] clause D.1.2.

5.3.2.2 UE-requested ProSeP policy provisioning procedure initiation

In order to initiate the UE-requested ProSeP policy provisioning procedure, the UE shall create a UE POLICY PROVISIONING REQUEST message (see example in figure 5.3.2.2.1). The UE:

a) shall allocate a PTI value currently not used and set the PTI IE to the allocated PTI value;

b) shall include the Requested UE policies IE indicating whether the UE policies for 5G ProSe direct discovery, the UE policies for 5G ProSe direct communications, the UE policies for 5G ProSe UE-to-network relay or any combination of them are requested;

c) shall transport the UE POLICY PROVISIONING REQUEST message using the NAS transport procedure as specified in 3GPP TS 24.501 [11] clause 5.4.5; and

d) shall start timer T5040.

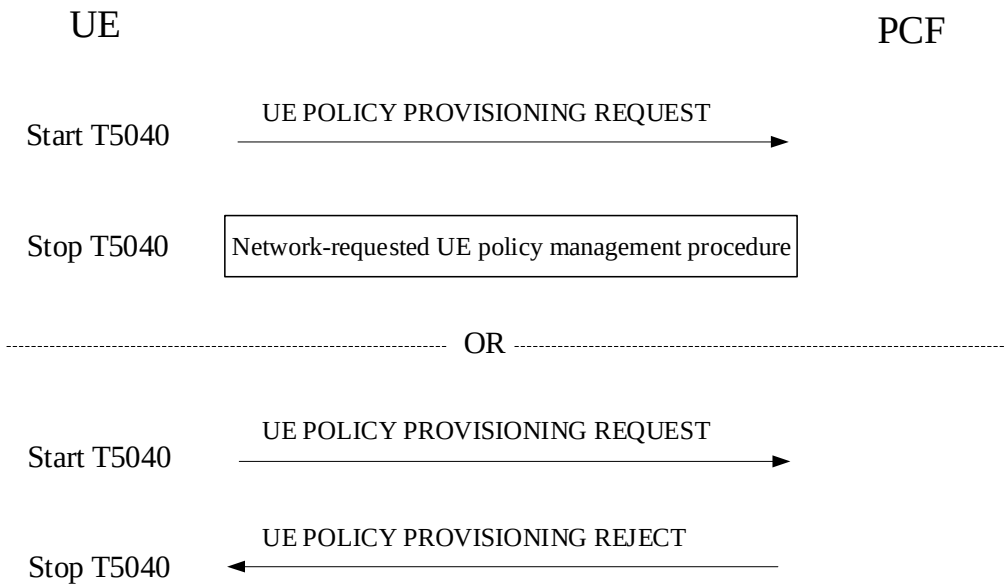

Figure 5.3.2.2.1: UE-requested ProSeP policy provisioning procedure

5.3.2.3 UE-requested ProSeP policy provisioning procedure accepted by the network

Handling in 3GPP TS 24.587 [18] clause 5.3.2.3 shall apply.

If new UE policies for 5G ProSe direct discovery are included in the MANAGE UE POLICY COMMAND message, the UE shall stop timer T5051 if it is running and start timer T5051 with the value included in the UE policies for 5G ProSe direct discovery, and start using the new UE policies for 5G ProSe direct discovery included in the MANAGE UE POLICY COMMAND message.

If new UE policies for 5G ProSe direct communications are included in the MANAGE UE POLICY COMMAND message, the UE shall stop timer T5052 if it is running and start timer T5052 with the value included in the UE policies for 5G ProSe direct communications, and start using the new UE policies for 5G ProSe direct communications included in the MANAGE UE POLICY COMMAND message.

If new UE policies for 5G ProSe UE-to-network relay UE are included in the MANAGE UE POLICY COMMAND message, the UE shall stop timer T5053 if it is running and start timer T5053 with the value included in the UE policies

for 5G ProSe UE-to-network relay UE, and start using the new UE policies for 5G ProSe UE-to-network relay UE included in the MANAGE UE POLICY COMMAND message.

If new UE policies for 5G ProSe remote UE are included in the MANAGE UE POLICY COMMAND message, the UE shall stop timer T5054 if it is running and start timer T5054 with the value included in the UE policies for 5G ProSe remote UE, and start using the new UE policies for 5G ProSe remote UE included in the MANAGE UE POLICY COMMAND message.

5.3.2.4 UE-requested ProSeP policy provisioning procedure not accepted by the network

Handling in 3GPP TS 24.587 [18] clause 5.3.2.4 shall apply.

5.3.2.5 Abnormal cases on the network side

Handling in 3GPP TS 24.587 [18] clause 5.3.2.5 shall apply.

5.3.2.6 Abnormal cases on the UE

Handling in 3GPP TS 24.587 [18] clause 5.3.2.6 shall apply.

6 5G ProSe direct discovery

6.1 Overview

6.1.1 Transport protocol for PC3a control protocol messages for 5G ProSe direct discovery

The UE and 5G DDNMF shall use HTTP 1.1 as specified in IETF RFC 7230 [3] and IETF RFC 7231 [4] as the transport protocol for 5G ProSe messages over the PC3a interface. The 5G ProSe messages described here shall be included in the body of either an HTTP request message or an HTTP response message.

6.1.2 Handling of UE-initiated procedures

6.1.2.1 General

The following rules apply for UE-initiated procedures:

a) the UE initiates 5G ProSe transactions with an HTTP request message containing the PC3a request(s);

b) the 5G DDNMF responds to the requests with an HTTP response message containing the PC3a response(s) for the PC3a request(s); and

c) HTTP POST methods are used for PC3a direct discovery procedures.

The UE may use UE local configuration or URSP, as defined in 3GPP TS 24.526 [5], to establish a PDU session for reaching the HPLMN 5G DDNMF:

a) if a PDU session for reaching the HPLMN 5G DDNMF is not established yet, the UE shall establish the PDU session for reaching the HPLMN 5G DDNMF and shall send the HTTP request message via the PDU session for reaching the HPLMN 5G DDNMF; and

b) if a PDU session for reaching the HPLMN 5G DDNMF is already established (e.g., either due to other 5G ProSe feature or due to other application), the UE shall send the HTTP request message via the PDU session for reaching the HPLMN 5G DDNMF.

6.1.2.2 5G DDNMF discovery

The IP address of the 5G DDNMF in the HPLMN may be pre-configured in the UE. The UE may use the pre-configured IP address or the FQDN of the 5G DDNMF in the HPLMN to discover the 5G DDNMF.

6.1.3 Handling of 5G DDNMF-initiated procedures

6.1.3.1 General

The 5G DDNMF-initiated messages for 5G ProSe direct discovery over the PC3a interface shall be contained in an HTTP response message. Either HTTP long polling, or OMA Push, can be used to trigger the HTTP request corresponding to this HTTP response message. The UE and the 5G DDNMF shall support OMA Push for network initiated procedures. The UE and 5G DDNMF should support long polling as well for network initiated procedures.

If the UE supports the HTTP long polling, the UE shall include a Network-Initiated Transaction Method set to "HTTP long polling" in the DISCOVERY_REQUEST message to the 5G DDNMF.

Upon receiving a DISCOVERY_REQUEST message containing a Network-Initiated Transaction Method set to "HTTP long polling", if the 5G DDNMF supports the HTTP long polling, the 5G DDNMF shall include a Network-Initiated Transaction Method set to "HTTP long polling" in the DISCOVERY_RESPONSE message.

If the UE receives a DISCOVERY_RESPONSE message including a Network-Initiated Transaction Method set to "HTTP long polling", the UE shall use the HTTP long polling for network initiated procedures. Otherwise, the UE shall assume that the 5G DDNMF uses OMA Push for network initiated procedures.

6.1.3.2 HTTP long polling

The HTTP long polling method is described by the following steps:

a) the UE sends an empty HTTP request message as a polling request when it expects network initiated message(s) over the PC3a interface;

b) the 5G DDNMF defers its response to the UE's request until;

   1) one or more network-initiated PC3a message(s) for the UE are available. The 5G DDNMF encloses the message(s) in an HTTP response message and send it to the UE; or

   2) a particular timeout for HTTP polling has occurred. The 5G DDNMF then sends an empty HTTP response message as the polling response to the UE; and

c) after receiving the response from the 5G DDNMF, the UE may keep polling after some waiting period if:

   1) the UE receives an empty polling response; or

   2) the UE receives 5G DDNMF-initiated message(s) from the 5G DDNMF but still expects additional network-initiated message(s).

NOTE: The implementation of the HTTP polling process can be coordinated with the SUPL (Secure User Plane Location) procedures to synchronize the SUPL location report procedures and the HTTP polling procedure so as to reduce unnecessary wait time of polling.

If the UE is trigged to send a PC3a message to the 5G DDNMF while it has a pending HTTP polling request, the UE shall open another HTTP connection to the 5G DDNMF to send this new request. Alternately the UE may always use a separate dedicated HTTP connection for polling.

6.1.3.3 OMA Push

The OMA Push method is described by the following steps:

a) if one or more network-initiated PC3a message(s) for the UE are available, the 5G DDNMF sends a push message containing a particular URL to the UE via the OMA-Push Architecture as defined in OMA-AD-Push-V2_2-20110809-A [6]. The URL is linked to the PC3a message(s) to be sent to the UE. The 5G DDNMF (performing OMA Push Proxy Gateway functionality) generates a Push Message as specified in OMA-WAP-TS-

PushOTA-V2_1-20110405-A [7] with the PDU set according to WAP-168-ServiceLoad-20010731-a [8]. The URL information shall be included in the PDU payload;

b) after receiving the push message, the UE retrieves the URL from the payload of the message and sends an HTTP GET request to the 5G DDNMF with this URL; and

c) the 5G DDNMF sends an HTTP response message containing the PC3a message(s) to the UE.

6.2 Procedures

6.2.1 Types of 5G ProSe direct discovery procedures

The following PC3a control protocol procedures are defined:

a) announce request;

b) monitor request;

c) discoveree request;

d) discoverer request;

e) match report;

f) network initiated direct discovery update; and

g) announcing alert request.

In the following descriptions of PC3a control protocol procedures, the terms "request" and "response" refer to the corresponding PC3a control protocol messages, not to the HTTP request or response. The following procedure descriptions use a single PC3a control protocol message for illustration purposes.

The PC3a control protocol procedures for 5G ProSe direct discovery shall be integrity protected and confidentiality protected using the security procedures defined in clause 5.2.3 in 3GPP TS 33.503 [34].

NOTE 1: A single HTTP request message can contain multiple PC3a control protocol requests and a single HTTP response message can contain multiple PC3a control protocol responses.

NOTE 2: The privacy of the UE identity included in the PC3a control protocol procedures for 5G ProSe direct discovery is ensured by the confidentiality protection of those procedures.

6.2.2 Announce request procedure for open 5G ProSe direct discovery

6.2.2.1 General

The purpose of the announce request procedure for open 5G ProSe direct discovery is for the UE:

a) to obtain one or more ProSe application code(s) to be announced over the PC5 interface, upon a request for announcing from upper layers as defined in 3GPP TS 23.304 [2];

b) to inform the 5G DDNMF that the UE wants to stop announcing a ProSe application code as defined in 3GPP TS 23.304 [2]; or

c) to upload metadata associated with a ProSe application ID to the 5G DDNMF as defined in 3GPP TS 23.304 [2].

The UE shall be authorized for open 5G ProSe direct discovery announcing in the registered PLMN or the local PLMN based on the service authorization procedure as specified in clause 5, before initiating the announce request procedure.

The UE includes one of the ProSe application code(s) obtained as a result of a successful announce request procedure per PROSE PC5 DISCOVERY message and passes the PROSE PC5 DISCOVERY messages to the lower layers for transmission over the PC5 interface.

6.2.2.2 Announce request procedure initiation

Before initiating the announce request procedure for open 5G ProSe direct discovery, the UE is configured with the data structure of the ProSe application IDs appropriate for its HPLMN. This step is performed using mechanisms out of scope of 3GPP.

If the UE is authorized to perform open 5G ProSe direct discovery announcing in the PLMN operating the radio resources signalled from the serving PLMN, it shall initiate an announce request procedure:

a) when the UE is triggered by an upper layer application to announce a ProSe application ID and the UE has no valid corresponding ProSe application code for that upper layer application;

b) when the validity timer T5060 assigned by the 5G DDNMF to a ProSe application code has expired and the request from upper layers to announce the ProSe application ID corresponding to that ProSe application code is still in place;

c) when the UE selects a new PLMN while announcing a ProSe application code and intends to announce in the new PLMN, and the UE is authorized for open 5G ProSe direct discovery announcing in the new PLMN;

d) when, while announcing a ProSe application ID, the UE intends to switch the announcing PLMN to a different PLMN without performing PLMN selection, and the UE does not have a valid allocated ProSe application code for this new PLMN yet;

e) when the UE needs to inform the 5G DDNMF that the UE wants to stop announcing a ProSe application code; or

f) when the UE needs to update metadata associated with a ProSe application ID to the 5G DDNMF.

When the UE selects a new PLMN while announcing a ProSe application code and the UE is not yet authorized for open 5G ProSe direct discovery announcing in the new PLMN, the UE shall initiate an announce request procedure only after the UE is authorized for open 5G ProSe direct discovery announcing in the new PLMN.

NOTE 1: To ensure service continuity if the UE needs to keep announcing a ProSe application code corresponding to the same ProSe application ID, the UE can initiate the announce request procedure before the validity timer T5060 assigned by the 5G DDNMF for a Prose application code expires.

The UE shall initiate the announce request procedure for open 5G ProSe direct discovery by sending a DISCOVERY_REQUEST message with:

a) a new transaction ID;

b) the ProSe application ID set to the ProSe application ID received from upper layers;

c) the command set to "metadata_update" if the UE has a valid ProSe application code corresponding to the ProSe application ID and intends to update metadata associated with the ProSe application ID to the 5G DDNMF, otherwise set to "announce";

d) the UE identity set to the UE's SUPI;

e) the application identity set to the application identity of the upper layer application that requested the announcing;

f) the discovery entry ID set to 0 when this is a new request or set to the discovery entry ID received from the 5G DDNMF if the announce request is to update a previously sent announce request;

g) the ACE enabled indicator set to "application-controlled extension enabled" if application-controlled extension is required by the upper layers or "normal" if application-controlled extension is not used;

h) optionally the requested timer set to the length of validity timer associated with the ProSe application code that the UE expects to receive from the 5G DDNMF;

i) optionally the Metadata set to the metadata received from upper layers associated with the ProSe application ID; and

j) optionally the announcing PLMN ID set to the PLMN ID of the local PLMN operating the radio resources that the UE intends to use for announcing this ProSe application ID.

If open 5G ProSe direct discovery with application-controlled extension is requested by upper layers, the DISCOVERY_REQUEST message shall also include the application level container, which contains application-level data transparent to the 3GPP network, to be used by the ProSe application server e.g., to assign ProSe application code suffix(es).

When the UE initiates the announce request procedure to inform the 5G DDNMF that the UE wants to stop announcing a ProSe application code before the associated valid timer expires, the UE shall set the requested timer to 0.

NOTE 2: A UE can include one or multiple transactions in one DISCOVERY_REQUEST message for different ProSe application IDs, and receive corresponding <response-announce> element or <response-reject> element in a DISCOVERY_RESPONSE message for each respective transaction. In the following description of the announce request procedure, only one transaction is included.

Figure 6.2.2.2.1 illustrates the interaction of the UE and the 5G DDNMF in the announce request procedure.

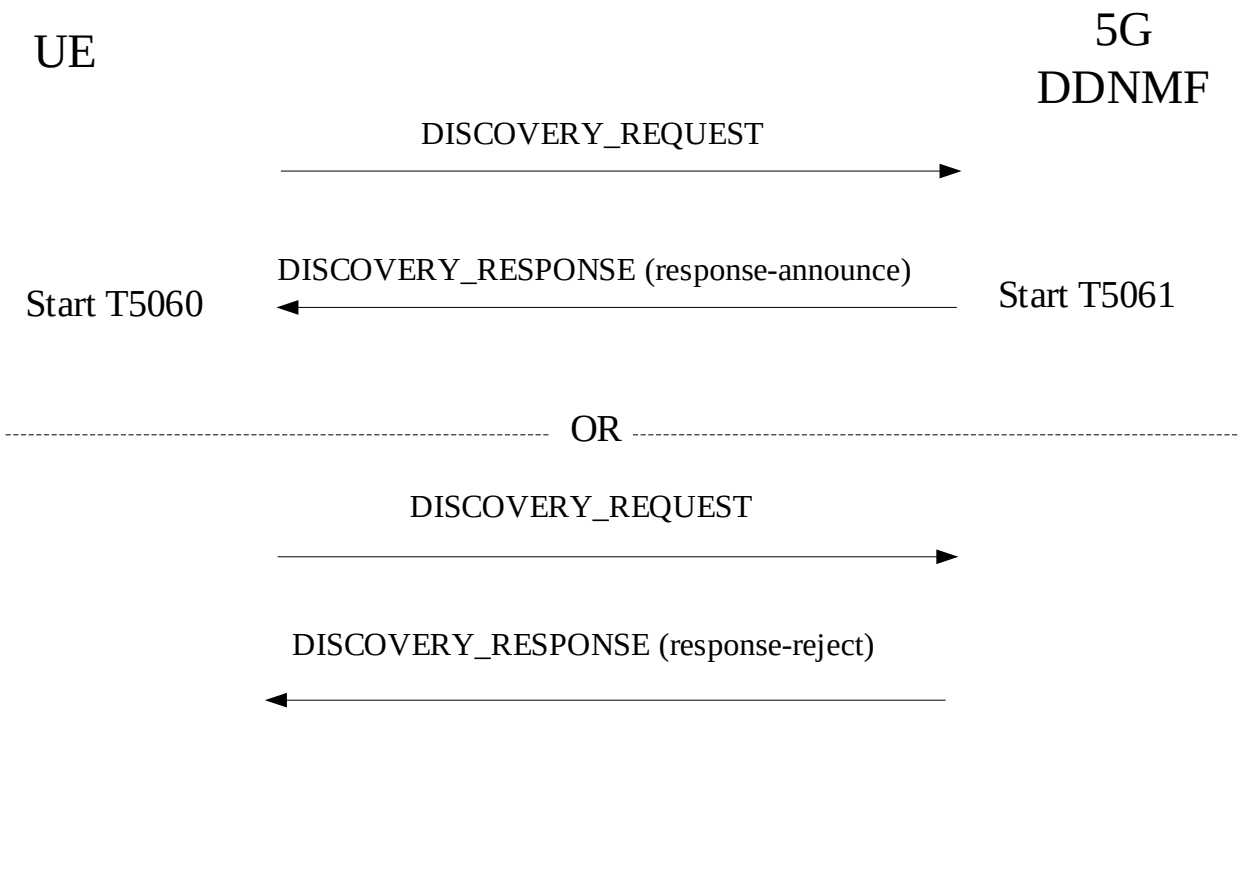

Figure 6.2.2.2.1: Announce request procedure

6.2.2.3 Announce request procedure accepted by the 5G DDNMF

Upon receiving a DISCOVERY_REQUEST message with the command set to "announce", if the requested timer is included in the DISCOVERY_REQUEST message and the requested timer is set to 0, the 5G DDNMF shall check whether there is an existing UE context containing the discovery entry identified by the discovery entry ID included in the DISCOVERY_REQUEST message. If the discovery entry exists in the UE context, the 5G DDNMF shall inform the 5G DDNMF in the announcing PLMN to remove the corresponding discovery entry as specified in 3GPP TS 29.555 [9] when the announcing PLMN is not the same as that of the PLMN to which the 5G DDNMF belongs and remove the discovery entry identified by the discovery entry ID from the UE's context. Then the 5G DDNMF shall send a DISCOVERY_RESPONSE message containing a <response-announce> element with:

a) the transaction ID set to the value of the transaction ID received in the DISCOVERY_REQUEST message; and

b) the discovery entry ID set to the identifier associated with the corresponding discovery entry.

Upon receiving a DISCOVERY_REQUEST message with the command set to "announce", if the requested timer is not included in the DISCOVERY_REQUEST message or the requested timer included in the DISCOVERY_REQUEST message is not set to 0, the 5G DDNMF shall perform the following procedure.

The 5G DDNMF shall check that the application corresponding to the application identity contained in the DISCOVERY_REQUEST message is authorized for open 5G ProSe direct discovery announcing. If the application is authorized for open 5G ProSe direct discovery announcing, the 5G DDNMF may also check whether the ProSe application ID contained in the DISCOVERY_REQUEST message is known. If the ProSe application ID is known or the 5G DDNMF skips the check of the ProSe application ID, the 5G DDNMF shall check whether there is an existing context for the UE associated with the requested ProSe application ID.

If there is no associated UE context, the 5G DDNMF checks with the UDM whether the UE is authorized for open 5G ProSe direct discovery announcing as described in 3GPP TS 29.503 [10]. If the check indicates that the UE is authorized then:

a) the 5G DDNMF shall check whether the UE is authorized to announce the ProSe application ID contained in the DISCOVERY_REQUEST message;

b) if the UE is authorized to announce the ProSe application ID, the ACE enabled indicator is included and set to "application-controlled extension enabled", the application level container is included in the DISCOVERY_REQUEST message and the requested application uses application-controlled extension, the 5G DDNMF shall check whether the UE is authorized to use ACE. If the UE is authorized for ACE, the 5G DDNMF shall invoke the procedure described in 3GPP TS 29.557 [19] to check whether the UE is authorized to announce the requested ProSe application ID with application-defined suffix(es), and obtain suffix-related information from the ProSe application server. The 5G DDNMF shall then allocate one ProSe application code prefix and a value for validity timer T5060 to be used with the ProSe application code suffix(es) obtained from the ProSe application server for the given ProSe application ID as specified in 3GPP TS 29.557 [19]. The 5G DDNMF may take into account the requested timer if contained in the DISCOVERY_REQUEST message;

c) if the UE is authorized to announce the ProSe application ID, the ACE enabled indicator is included and set to "normal" in the DISCOVERY_REQUEST message and the requested application does not use application-controlled extension, the 5G DDNMF shall allocate the corresponding ProSe application code(s) and a value for validity timer T5060. The 5G DDNMF may take into account the requested timer if contained in the DISCOVERY_REQUEST message;

d) if the UE is authorized to announce the ProSe application ID, the ACE enabled indicator is set included and to "normal" in the DISCOVERY_REQUEST message, the application level container is included in the DISCOVERY_REQUEST and the requested application only uses application-controlled extension, the 5G DDNMF shall check whether the UE is authorized to use ACE. If the UE is authorized for ACE, 5G DDNMF shall invoke the procedure described in 3GPP TS 29.557 [19] to check whether the UE is authorized to announce the requested ProSe application ID with application-defined suffix(es), and obtain suffix-related information from the ProSe application server. The 5G DDNMF shall then allocate one ProSe application code prefix and a value for validity timer T5060 to be used with the ProSe application code suffix(es) obtained from the ProSe application server for the given ProSe application ID as specified in 3GPP TS 29.557 [19]. The 5G DDNMF may take into account the requested timer if contained in the DISCOVERY_REQUEST message;

e) if the UE is authorized to announce the ProSe application ID, the ACE enabled indicator is included and set to "application-controlled-extension enabled" and the application level container is included in the DISCOVERY_REQUEST message but the requested application does not use application-controlled extension, the 5G DDNMF shall allocate the corresponding ProSe application code(s) and a value for validity timer T5060. The 5G DDNMF may consider the requested timer if contained in the DISCOVERY_REQUEST message; and

f) if the UE is authorized to announce the ProSe application ID and the ACE enabled indicator is not included in the DISCOVERY_REQUEST message, the 5G DDNMF shall allocate the corresponding ProSe application code(s) and a value for validity timer T5060. The 5G DDNMF may consider the requested timer if contained in the DISCOVERY_REQUEST message.

NOTE: The 5G DDNMF can allocate multiple ProSe application codes for a given ProSe application ID for instance in the case when one or more labels in the ProSe application ID name are wild carded as described in clause 24.2.2 of 3GPP TS 23.003 [12].

If the requested ProSe application ID is country-specific or global as described in clause 24.2 of 3GPP TS 23.003 [12], the 5G DDNMF shall allocate the corresponding ProSe application code(s) or ProSe application code prefix according to clause 24.3 of 3GPP TS 23.003 [12]. The temporary identity part of each ProSe application code or ProSe application

code prefix is taken from the data structure corresponding to the country-specific or global ProSe application ID namespace according to clause 24.3 of 3GPP TS 23.003 [12]. The 5G DDNMF shall use the MCC and MNC of the PLMN ID of this 5G DDNMF for the PLMN ID part of the ProSe application code or ProSe application code prefix.

After the ProSe application code(s) or ProSe application code prefix allocation, the 5G DDNMF then associates the ProSe application code(s) or ProSe application code prefix with a new discovery entry identified by a non-zero value discovery entry ID in the new context for the UE that contains the UE's subscription parameters obtained from the UDM, and starts timer T5061. The UDM also provides to the 5G DDNMF the PLMN ID of the PLMN in which the UE is currently registered. For a given set of ProSe application codes or the allocated ProSe application code prefix, timer T5061 shall be longer than timer T5060. By default, the value of timer T5061 is 4 minutes greater than the value of timer T5060.

If there is an existing context for the UE that contains the UE's subscription parameters obtained from the UDM, but no discovery entry identified by the discovery entry ID contained in the DISCOVERY_REQUEST message, the 5G DDNMF shall behave as if the discovery entry ID included in the DISCOVERY_REQUEST message was set to 0, and the 5G DDNMF shall allocate a new non-zero discovery entry ID for this entry.

If the metadata is included in the DISCOVERY_REQUEST message, the 5G DDNMF shall allocate the ProSe application code or ProSe application code prefix including a metadata index to indicate the current version of the metadata, and store the received metadata in the UE context.

Moreover, if the command is set to "metadata_update" in the DISCOVERY_REQUEST message and there is an existing UE context stored in the 5G DDNMF, the 5G DDNMF shall update the metadata in the UE context by using the received metadata in the DISCOVERY_REQUEST message, and update the ProSe application code or ProSe application code prefix in the UE context by changing the metadata index portion and keeping the rest unchanged.

After the ProSe application code(s) allocation, the 5G DDNMF then associates the ProSe application code(s) with a new discovery entry identified by a non-zero value discovery entry ID in the UE context, and starts timer T5061.

If there is an existing context for the UE and a discovery entry identified by the discovery entry ID contained in the DISCOVERY_REQUEST message associated with the requested ProSe application ID, the 5G DDNMF shall either update the discovery entry with a new validity timer T5060, or allocate new ProSe application code(s) or ProSe application code prefix for the requested ProSe application ID with a new validity timer T5060, and restart timer T5061. The 5G DDNMF may consider the requested timer if contained in the DISCOVERY_REQUEST message.

If a new discovery entry was created or an existing discovery entry was updated and the UE is currently roaming or the Announcing PLMN ID is included in the DISCOVERY_REQUEST message, the 5G DDNMF checks with the 5G DDNMF of the VPLMN or in case of open 5G ProSe direct discovery the local PLMN identified by the Announcing PLMN ID whether the UE is authorized for open 5G ProSe direct discovery announcing as described in 3GPP TS 29.555 [9].

If the check indicates that the UE is authorized, then the 5G DDNMF shall send a DISCOVERY_RESPONSE message containing a <response-announce> element with:

a) the transaction ID set to the value of the transaction ID received in the DISCOVERY_REQUEST message from the UE;

b) either the ProSe application code(s) set to the ProSe application code(s) allocated by the 5G DDNMF, or the ProSe application code ACE parameter set to include the ProSe-application code- prefix allocated by the 5G DDNMF, and one or more ProSe application code suffix Ranges which contain the suffix(es) for the ProSe application ID received in the DISCOVERY_REQUEST message from the UE;

c) validity timer T5060 set to the T5060 timer value assigned by the 5G DDNMF to the ProSe application code(s):

d) if the ACE enabled indicator was included by the UE in the DISCOVERY_REQUEST message, the ACE enabled indicator set to:

   1) "application-controlled extension enabled" if application-controlled extension is used; or

   2) "normal" if application-controlled extension is not used;

e) the discovery entry ID set to the identifier associated with the corresponding discovery entry;

f) the discovery key set to a value provided by the 5G DDNMF; and

g) the current time set to the current UTC-based time at the 5G DDNMF and the max offset.

If timer T5061 expires, the 5G DDNMF shall remove the discovery entry identified by the discovery entry ID from the UE's context.

6.2.2.4 Announce request procedure completion by the UE

Upon receipt of the DISCOVERY_RESPONSE message, if only the transaction ID and the discovery entry ID are contained in the <response-announce> element and the transaction ID and the discovery entry ID match the corresponding values sent by the UE in a DISCOVERY_REQUEST message, the UE shall:

a) stop the validity timer T5060 corresponding to the ProSe application code(s) or ProSe application code prefix in the discovery entry identified by the discovery entry ID;

b) remove the discovery entry identified by the discovery entry ID included; and

c) instruct the lower layers to stop announcing.

Upon receipt of the DISCOVERY_RESPONSE message, if the transaction ID contained in the <response-announce> element matches the value sent by the UE in a DISCOVERY_REQUEST message with the command set to "announce", the UE shall create a new discovery entry or update an existing discovery entry with the received ProSe application code(s) and the PLMN ID of the intended announcing PLMN. For this discovery entry, the UE shall stop the validity timer T5060 if running and start the validity timer T5060 with the received value. Otherwise, the UE shall discard the DISCOVERY_RESPONSE message and shall not perform the procedures below. The UE shall set a ProSe clock (see 3GPP TS 33.503 [34]) to the value of the received current time parameter and store the received max offset parameter.

For any one of the received ProSe application codes or ProSe application code prefix in this discovery entry, the UE may perform open 5G ProSe direct discovery announcing as described in clause 6.2.14.2.1.1.

6.2.2.5 Announce request procedure not accepted by the 5G DDNMF

If the DISCOVERY_REQUEST message cannot be accepted by the 5G DDNMF, the 5G DDNMF sends a DISCOVERY_RESPONSE message containing a <response-reject> element to the UE including an appropriate PC3a control protocol cause value.

If the application corresponding to the application identity contained in the DISCOVERY_REQUEST message is not authorized for open 5G ProSe direct discovery announcing, the 5G DDNMF shall send the DISCOVERY_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value #1 "Invalid application".

If the ProSe application ID contained in the DISCOVERY_REQUEST message is unknown to the 5G DDNMF, the 5G DDNMF shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value #2 "Unknown ProSe application ID".

If the UE is not authorized for open 5G ProSe direct discovery announcing, the 5G DDNMF shall send the DISCOVERY_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value #3 "UE authorization failure".

If the UE is not authorized to use the ProSe application ID contained in the DISCOVERY_REQUEST message, the 5G DDNMF shall send the DISCOVERY_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value #3 "UE authorization failure".

If the UE requests a country-specific ProSe application ID for a country that does not correspond to the country of its HPLMN, and the 5G DDNMF has not authorized the UE to announce in that country, the 5G DDNMF shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value #8 "Scope violation in Prose application ID".

If the UE requests a country-specific ProSe application ID for a country that does not correspond to the country of its HPLMN, and the 5G DDNMF has no agreement to access the country-wide ProSe application ID database of that country, the 5G DDNMF shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value #8 "Scope violation in Prose application ID".

If the discovery entry ID contained in the DISCOVERY_REQUEST message is unknown to the 5G DDNMF and the requested timer is set to zero, the 5G DDNMF shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value # 10 "Unknown or invalid discovery entry ID".

If the UE is not authorized to use ACE, but the DISCOVERY_REQUEST message contains the ACE enabled indicator set to "application-controlled extension enabled", the 5G DDNMF shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value #12 "UE unauthorized for discovery with application-controlled extension".

If the DISCOVERY_REQUEST message contains the ACE enabled indicator set to "application-controlled extension enabled", but does not contain the application level container parameter, the 5G DDNMF shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value #14 "Missing application level container".

If the ProSe application server indicates to the 5G DDNMF that the application level container in the DISCOVERY_REQUEST message contains invalid information, the 5G DDNMF shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value #15 "Invalid data in application level container".

If the DISCOVERY_REQUEST message does not contain the ACE enabled indicator and the requested application only uses application-controlled extension, the 5G DDNMF shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value #1 "Invalid application".

6.2.2.6 Abnormal cases

6.2.2.6.1 Abnormal cases in the UE

The following abnormal cases can be identified:

a) Indication from the transport layer of transmission failure of DISCOVERY_REQUEST message (e.g., after TCP retransmission timeout)

   The UE shall close the existing secure connection to the 5G DDNMF, establish a new secure connection and then restart the announce request procedure.

b) No response from the 5G DDNMF after the DISCOVERY_REQUEST message has been successfully delivered (e.g., TCP ACK has been received for the DISCOVERY_REQUEST message)

   The UE shall retransmit the DISCOVERY_REQUEST message.

NOTE: The timer to trigger retransmission and the maximum number of allowed retransmissions are UE implementation specific.

c) Indication from upper layers that the request to announce the ProSe application ID is no longer in place after sending the DISCOVERY_REQUEST message, but before the announce request procedure is completed

   The UE shall acknowledge the DISCOVERY_RESPONSE message received from the 5G DDNMF but discard its contents and then abort the procedure.

d) Change of PLMN

   If a PLMN change occurs before the announce request procedure is completed, the procedure shall be aborted. If the UE is authorized to announce in the new PLMN, the procedure shall be restarted once the UE is registered on the new PLMN.

e) Absence of discovery entry ID parameter in a DISCOVERY_RESPONSE message received in response to a DISCOVERY_REQUEST message which contained a discovery entry ID parameter

   If the DISCOVERY_REQUEST message:

   1) included a requested timer which is set to 0; or

   2) included an Announcing PLMN ID;

the UE shall acknowledge the DISCOVERY_RESPONSE message received from the 5G DDNMF but discard its content and then abort the procedure.

6.2.2.6.2 Abnormal cases in the 5G DDNMF

The following abnormal cases can be identified:

a) Indication from the lower layer of transmission failure of DISCOVERY_RESPONSE message

After receiving an indication from lower layer that the DISCOVERY_RESPONSE message has not been successfully acknowledged (e.g., TCP ACK is not received), the 5G DDNMF shall abort the procedure, and stop any associated timer(s) T5061, if running.

6.2.3 Announce request procedure for restricted 5G ProSe direct discovery model A

6.2.3.1 General

The purpose of the announce request procedure for restricted 5G ProSe direct discovery model A is for the UE:

a) to obtain a ProSe restricted code corresponding to the RPAUID to be announced over the PC5 interface, upon a request for announcing from upper layers (e.g., application client) as defined in 3GPP TS 23.304 [2]; or

b) to inform the 5G DDNMF that the UE wants to stop announcing a ProSe restricted code as defined in 3GPP TS 23.304 [2].

Before initiating the announce request procedure, the UE shall be authorized for restricted 5G ProSe direct discovery model A announcing in the registered PLMN or local PLMN based on the service authorization procedure as specified in clause 5.

The UE includes the ProSe restricted code obtained from a successful announce request procedure in a PROSE PC5 DISCOVERY message and passes the PROSE PC5 DISCOVERY message to the lower layers for transmission over the PC5 interface.

6.2.3.2 Announce request procedure initiation

Before initiating the announce request procedure, the user sets the permissions for the restricted discovery using application layer mechanisms. The application client in the UE retrieves the PDUID provisioned to the UE as part of the service authorization procedure as specified in clause 5 and obtains an RPAUID associated with the UE's PDUID from the ProSe application server. The UE may provide metadata to be associated with the RPAUID, and the ProSe application server stores the metadata. This step is performed using mechanisms that are out of scope of the present specification.

If the UE is authorized to perform restricted 5G ProSe direct discovery model A announcing in the PLMN operating the radio resources signalled from the serving PLMN, it shall initiate an announce request procedure:

a) when the UE is triggered by an upper layer application to announce an RPAUID and the UE has no valid corresponding ProSe restricted code for that RPAUID of the upper layer application;

b) when the validity timer T5062 assigned by the 5G DDNMF to a ProSe restricted code has expired and the request from upper layers to announce the RPAUID corresponding to that ProSe restricted code is still in place;

c) when the UE selects a new PLMN while announcing a ProSe restricted code and intends to announce in the new PLMN, and the UE is authorized for restricted 5G ProSe direct discovery model A announcing in the new PLMN;

d) when, while announcing a RPAUID, the UE intends to switch the announcing PLMN to a different PLMN without performing PLMN selection, and the UE does not have a valid allocated ProSe restricted code for this new PLMN yet; or

e) when the UE needs to update a previously sent restricted 5G ProSe direct discovery model A announcing request.

When the UE selects a new PLMN while announcing a ProSe restricted code and the UE is not yet authorized for restricted 5G ProSe direct discovery model A announcing in the new PLMN, the UE shall initiate an announce request procedure only after the UE is authorized for restricted 5G ProSe direct discovery model A announcing in the new PLMN.

NOTE 1: To ensure service continuity if the UE needs to keep announcing a ProSe restricted code corresponding to the same RPAUID, the UE can initiate the announce request procedure before the validity timer T5062 assigned by the 5G DDNMF for a ProSe restricted code expires.

The UE shall initiate the announce request procedure by sending a DISCOVERY_REQUEST message with:

a) a new transaction ID not used in any other direct discovery procedures in PC3a interface;

b) the RPAUID set to the RPAUID received from upper layers;

c) the command set to "announce";

d) the UE identity set to the UE's SUPI;

e) the application identity set to the application identity of the upper layer application that requested the announcing;

f) the discovery type set to "Restricted discovery";

g) the ACE enabled indicator set to "application-controlled extension enabled" if application-controlled extension is required by the upper layers or "normal" if application-controlled extension is not used;

h) the announcing type set to "on demand" if on demand announcing is requested by upper layers and "normal" if on demand announcing is not requested by upper layers;

i) optionally the requested timer set to the length of validity timer associated with the ProSe restricted code that the UE expects to receive from the 5G DDNMF;

j) the discovery entry ID set to a 0 if the announcing request is a new request, and set to the discovery entry ID received from the 5G DDNMF if the announcing request is to update a previously sent announcing request; and

k) optionally the announcing PLMN ID set to the PLMN ID of the local PLMN operating the radio resources that the UE intends to use for announcing the RPAUID.

If restricted 5G ProSe direct discovery model A with application-controlled extension is requested by upper layers, the DISCOVERY_REQUEST message shall also include the application level container, which contains application-level data transparent to the 3GPP network, to be used by the ProSe application server e.g., to assign ProSe restricted code suffix(es).

When the UE initiates the announce request procedure to inform the 5G DDNMF that the UE wants to stop announcing a ProSe restricted code before the associated valid timer expires, the UE shall set the requested timer to 0.

NOTE 2: A UE can include one or multiple transactions in one DISCOVERY_REQUEST message for different RPAUIDs, and receive corresponding <restricted-announce-response> element or <response-reject> element in a DISCOVERY_RESPONSE message for each respective transaction. In the following description of the announce request procedure, only one transaction is included.

Figure 6.2.3.2.1 illustrates the interaction of the UE and the 5G DDNMF in the announce request procedure.

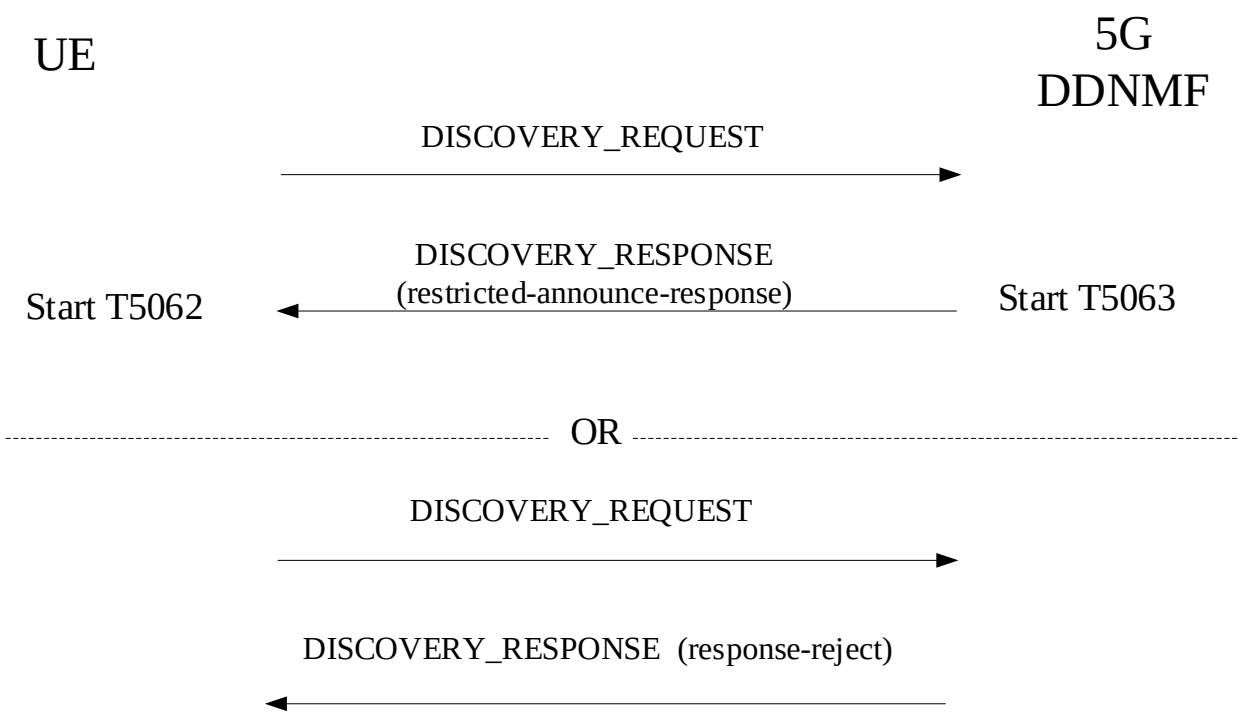

Figure 6.2.3.2.1: Announce request procedure for restricted 5G ProSe direct discovery model A

6.2.3.3 Announce request procedure accepted by the 5G DDNMF

Upon receiving a DISCOVERY_REQUEST message with the command set to "announce" and the discovery type set to "Restricted discovery", if the requested timer is included in the DISCOVERY_REQUEST message and the requested timer is set to 0, the 5G DDNMF shall check whether there is an existing UE context containing the discovery entry identified by the discovery entry ID included in the DISCOVERY_REQUEST message. If the discovery entry exists in the UE context, the 5G DDNMF shall inform the 5G DDNMF in the announcing PLMN to remove the corresponding discovery entry as specified in 3GPP TS 29.555 [9] when the announcing PLMN is not the same as that of the PLMN to which the 5G DDNMF belongs and remove the discovery entry identified by the discovery entry ID from the UE's context.

Upon receiving a DISCOVERY_REQUEST message with the command set to "announce" and the discovery type set to "Restricted discovery", if the requested timer is not included in the DISCOVERY_REQUEST message or the requested timer included in the DISCOVERY_REQUEST message is not set to 0, the 5G DDNMF shall perform the following procedure.

The 5G DDNMF shall check that the application corresponding to the application identity contained in the DISCOVERY_REQUEST message is authorized for restricted 5G ProSe direct discovery model A announcing. If the application is authorized for restricted 5G ProSe direct discovery model A announcing, the 5G DDNMF shall check whether there is an existing context for the UE.

If there is no associated UE context, the 5G DDNMF checks with the UDM whether the UE is authorized for restricted 5G ProSe direct discovery model A announcing as described in 3GPP TS 29.503 [10]. If the check indicates that the UE is authorized, the 5G DDNMF creates a UE context that contains the UE's subscription parameters obtained from the UDM. The UDM also provides to the 5G DDNMF the PLMN ID of the PLMN in which the UE is currently registered. If the UE context exists, the 5G DDNMF shall then check whether the UE is authorized for restricted 5G ProSe direct discovery model A announcing in the currently registered PLMN or in the local PLMN identified by the Announcing PLMN ID included in the DISCOVERY_REQUEST message.

If the UE is authorized and the discovery entry ID included in the DISCOVERY_REQUEST message is set to 0 then:

a) the 5G DDNMF shall check whether the UE is authorized to announce the RPAUID contained in the DISCOVERY_REQUEST message. Optionally this can include checking with the ProSe application server as described in 3GPP TS 29.557 [19] to obtain the binding between the RPAUID and PDUID, and then verifying that the PDUID belongs to the requesting UE;

b) if the UE is authorized to announce the RPAUID, the ACE enabled indicator is set to "application-controlled extension enabled", the application level container is included in the DISCOVERY_REQUEST message and the requested application uses application-controlled extension, the 5G DDNMF shall check whether the UE is authorized to use ACE. If the UE is authorized for ACE, the 5G DDNMF shall invoke the procedure described in 3GPP TS 29.557 [19] to check whether the UE is authorized to announce the requested RPAUID with application-defined suffix(es), and obtain suffix-related information from the ProSe application server. The 5G DDNMF shall then allocate a ProSe restricted code prefix and a value for validity timer T5062 to be used with the ProSe restricted code suffix(es) obtained from the ProSe application server for the given RPAUID as specified in 3GPP TS 29.557 [19]. The 5G DDNMF may take into account the requested timer if contained in the DISCOVERY_REQUEST message when allocating validity timer T5062;

c) if the UE is authorized to announce the RPAUID, the ACE enabled indicator is set to "normal" in the DISCOVERY_REQUEST message and the requested application does not use application-controlled extension, the 5G DDNMF shall allocate the corresponding ProSe restricted code and a value for validity timer T5062. The 5G DDNMF may take into account the requested timer if contained in the DISCOVERY_REQUEST message when allocating validity timer T5062;

d) if the UE is authorized to announce the RPAUID, the ACE enabled indicator is set to "normal" in the DISCOVERY_REQUEST message, the application level container is included in the DISCOVERY_REQUEST and the requested application only uses application-controlled extension, the 5G DDNMF shall check whether the UE is authorized to use ACE. If the UE is authorized for ACE, the 5G DDNMF shall invoke the procedure described in 3GPP TS 29.557 [19] to check whether the UE is authorized to announce the requested RPAUID with application-defined suffix(es), and obtain suffix-related information from the ProSe application server. The 5G DDNMF shall then allocate a ProSe restricted code prefix and a value for validity timer T5062 to be used with the ProSe restricted code suffix(es) obtained from the ProSe application server for the given RPAUID as specified in 3GPP TS 29.557 [19] The 5G DDNMF may consider the requested timer if contained in the DISCOVERY_REQUEST message when allocating validity timer T5062;

e) if the UE is authorized to announce the RPAUID, the ACE enabled indicator is set to "application-controlled-extension enabled" and the application level container is included in the DISCOVERY_REQUEST message but the requested application does not use application-controlled extension, the 5G DDNMF shall allocate the corresponding ProSe restricted code and a value for validity timer T5062. The 5G DDNMF may consider the requested timer if contained in the DISCOVERY_REQUEST message when allocating validity timer T5062; and

f) the 5G DDNMF associates the allocated ProSe restricted code or ProSe restricted code prefix with a new discovery entry in the UE's context, and starts timer T5063. The UDM also provides to the 5G DDNMF the PLMN ID of the PLMN in which the UE is currently registered. For a given ProSe restricted code, timer T5063 shall be longer than timer T5062. By default, the value of timer T5063 is 4 minutes greater than the value of timer T5062.

If the discovery entry ID included in the DISCOVERY_REQUEST message is not set to 0 and if there is an existing discovery entry for this discovery entry ID value in the UE's context, the 5G DDNMF shall either update the discovery entry with a new validity timer T5062, or allocate a new ProSe restricted code or ProSe restricted code prefix for the requested RPAUID with a new validity timer T5062, restart timer T5063, and clear any existing on demand announcing enabled indicator. The 5G DDNMF may consider the requested timer if contained in the DISCOVERY_REQUEST message when allocating validity timer T5062.

If the discovery entry ID contained in the DISCOVERY_REQUEST message is not found in the UE context or there is no UE context in the 5G DDNMF, the 5G DDNMF shall behave as if the discovery entry ID included in the DISCOVERY_REQUEST message was set to 0, and the 5G DDNMF shall allocate a new non-zero discovery entry ID for this entry.

If the announcing type is set to "on demand" in the DISCOVERY_REQUEST message, the 5G DDNMF shall check if "on demand" announcing is authorized and enabled based on the application identity and the operator's policy. If "on demand" announcing is authorized and enabled, and there is no ongoing monitoring request for this RPAUID, then the 5G DDNMF shall set the on demand announcing enabled indicator to 1 for the corresponding discovery entry in the UE's context.

If a new UE context was created or an existing UE context was updated, and the UE is currently roaming or the announcing PLMN ID is included in the DISCOVERY_REQUEST message, and the on demand announcing enabled indicator is not set to 1 for this discovery entry in the UE's context, the 5G DDNMF checks with the 5G DDNMF of the VPLMN or the local PLMN represented by the Announcing PLMN ID whether the UE is authorized for restricted 5G ProSe direct discovery model A announcing as described in 3GPP TS 29.555 [9].

The 5G DDNMF shall then send a DISCOVERY_RESPONSE message containing a <restricted-announce-response> element with:

a) the transaction ID set to the value of the transaction ID received in the DISCOVERY_REQUEST message from the UE;

b) if the on demand announcing enabled indicator is not set to 1 in the UE's context for this discovery entry, either the ProSe restricted code set to the ProSe restricted code or the ProSe restricted code prefix allocated by the 5G DDNMF, and optionally one or more ProSe restricted code suffix Ranges which contain the suffix(es) for the RPAUID received in the DISCOVERY_REQUEST message;

c) a validity timer T5062 set to the T5062 timer value assigned by the 5G DDNMF to the ProSe restricted code;

d) the ACE enabled indicator set to "application-controlled extension enabled" if application-controlled extension is used, or "normal" if application-controlled extension is not used;

e) the code-sending security parameter containing the security-related information for the UE to protect the transmission of the ProSe restricted code;

f) the on demand announcing enabled indicator indicating whether the on demand announcing is enabled or not for this discovery entry if the announcing type is set to "on demand" in the DISCOVERY_REQUEST message;

g) the discovery entry ID set to the ID of the discovery entry associated with this announce request in the UE's context;

h) the current time set to the current UTC-based time at the 5G DDNMF and the max offset; and

i) optionally, the PC5 security policies used for 5G ProSe direct link establishment procedure.

If timer T5063 expires, the 5G DDNMF shall remove the discovery entry associated with the corresponding RPAUID from the UE's context.

6.2.3.4 Announce request procedure completion by the UE

Upon receipt of the DISCOVERY_RESPONSE message, if only the transaction ID and the discovery entry ID are contained in the <restricted-announce-response> element and the transaction ID and the discovery entry ID match the corresponding values sent by the UE in a DISCOVERY_REQUEST message, the UE shall:

a) stop the validity timer T5062 for the discovery entry corresponding to the discovery entry ID received in the DISCOVERY_RESPONSE message;

b) remove the discovery entry identified by the discovery entry ID included; and

c) instruct the lower layers to stop announcing.

Upon receipt of the DISCOVERY_RESPONSE message, if the transaction ID contained in the <restricted-announce-response> element matches the value sent by the UE in a DISCOVERY_REQUEST message with the command set to "announce", the UE shall create a new discovery entry or update an existing discovery entry with the received ProSe restricted code or ProSe restricted code prefix and the PLMN ID of the intended announcing PLMN. For this discovery entry, the UE shall stop the validity timer T5062, if running, for the discovery entry corresponding to the discovery entry ID received in the DISCOVERY_RESPONSE message, and start the validity timer T5062 for this discovery entry with the received value in the DISCOVERY_RESPONSE message. Otherwise, the UE shall discard the DISCOVERY_RESPONSE message and shall not perform the procedures below. The UE shall set a ProSe clock (see 3GPP TS 33.503 [34]) to the value of the received current time parameter and store the received max offset parameter.

If the DISCOVERY_RESPONSE message includes new ProSe restricted code or ProSe restricted code prefix to replace the existing ProSe restricted code being announced, the UE shall notify lower layer to stop announcing the old ProSe restricted code in PC5 interface.

If the DISCOVERY_RESPONSE message contains an on demand announcing enabled indicator set to 1, the UE shall wait for an announcing alert Request message from the 5G DDNMF of the HPLMN before starting to perform restricted 5G ProSe direct discovery model A announcing. Otherwise, the UE may perform restricted 5G ProSe direct discovery model A announcing as described in clause 6.2.14.2.1.

6.2.3.5 Announce request procedure not accepted by the 5G DDNMF

If the DISCOVERY_REQUEST message cannot be accepted by the 5G DDNMF, the 5G DDNMF sends a DISCOVERY_RESPONSE message containing a <response-reject> element to the UE including an appropriate PC3a control protocol cause value.

If the application corresponding to the application identity contained in the DISCOVERY_REQUEST message is not authorized for ProSe direct discovery announcing, the 5G DDNMF shall send the DISCOVERY_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value #1 "Invalid application".

If the RPAUID contained in the DISCOVERY_REQUEST message is unknown to the 5G DDNMF or ProSe application server, the 5G DDNMF shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value #9 "Unknown RPAUID".

If the RPAUID contained in the DISCOVERY_REQUEST message does not match the stored RPAUID for the requested discovery entry ID, the 5G DDNMF shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value #10 "Unknown or invalid discovery entry ID".

If the UE is not authorized for restricted 5G ProSe direct discovery model A announcing, the 5G DDNMF shall send the DISCOVERY_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value #3 "UE authorization failure".

If the UE is not authorized for restricted "on demand" restricted 5G ProSe direct discovery model A announcing, the 5G DDNMF shall send the DISCOVERY_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value #13 "UE unauthorized for on-demand announcing".

If the RPAUID contained in the DISCOVERY_REQUEST message is not associated with the PDUID belonging to the requesting UE, the 5G DDNMF shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value #3 "UE authorization Failure".

If the UE is not authorized to use ACE, but the DISCOVERY_REQUEST message contains the ACE enabled indicator set to "application-controlled extension enabled", the 5G DDNMF shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value #12 "UE unauthorized for discovery with application-controlled extension".

If the DISCOVERY_REQUEST message contains the ACE enabled indicator set to "application-controlled extension enabled", but does not contain the application level container parameter, the 5G DDNMF shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value #14 "Missing application level container".

If the ProSe application server indicates to the 5G DDNMF that the application level container in the DISCOVERY_REQUEST message contains invalid information, the 5G DDNMF shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value #15 "Invalid data in application level container".

If the discovery entry ID contained in the DISCOVERY_REQUEST message is unknown to the 5G DDNMF and the requested timer is set to zero, the 5G DDNMF shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value # 10 "Unknown or invalid discovery entry ID".

6.2.3.6 Abnormal cases

6.2.3.6.1 Abnormal cases in the UE

The following abnormal cases can be identified:

a) Indication from the transport layer of transmission failure of DISCOVERY_REQUEST message (e.g., after TCP retransmission timeout)

The UE shall close the existing secure connection to the 5G DDNMF, establish a new secure connection and then restart the announce request procedure.

b) No response from the 5G DDNMF after the DISCOVERY_REQUEST message has been successfully delivered (e.g., TCP ACK has been received for the DISCOVERY_REQUEST message)

The UE shall retransmit the DISCOVERY_REQUEST message.

NOTE: The timer to trigger retransmission and the maximum number of allowed retransmissions are UE implementation specific.

c) Indication from upper layers that the request to announce the RPAUID is no longer in place after sending the DISCOVERY_REQUEST message, but before the announce request procedure is completed

The UE shall acknowledge the DISCOVERY_RESPONSE message received from the 5G DDNMF but discard its contents and then abort the procedure.

d) Change of PLMN

If a PLMN change occurs before the announce request procedure is completed, the procedure shall be aborted. If the UE is authorized to announce in the new PLMN, the procedure shall be restarted once the UE is registered on the new PLMN.

6.2.3.6.2 Abnormal cases in the 5G DDNMF

The following abnormal cases can be identified:

a) Indication from the lower layer of transmission failure of DISCOVERY_RESPONSE message

After receiving an indication from lower layer that the DISCOVERY_RESPONSE message has not been successfully acknowledged (e.g. TCP ACK is not received), the 5G DDNMF shall abort the procedure, and stop any associated timer(s) T5063, if running.

6.2.4 Monitor request procedure for open 5G ProSe direct discovery

6.2.4.1 General

The purpose of the monitor request procedure for open 5G ProSe direct discovery is to allow a UE:

a) to receive and process PROSE PC5 DISCOVERY messages upon a request for monitoring from upper layers as defined in 3GPP TS 23.304 [2]; or

b) to inform the 5G DDNMF that the UE wants to stop using discovery filters for direct discovery monitoring as defined in 3GPP TS 23.304 [2].

The UE shall only initiate the monitor request procedure if it has been authorized for open 5G ProSe direct discovery monitoring at least in one PLMN based on the service authorization procedure.

As a result of the monitor request procedure completing successfully, the UE obtains one or more discovery filters, along with a TTL (Time-To-Live) timer T5064 for each discovery filter indicating the time during which the filter is valid.

6.2.4.2 Monitor request procedure Initiation

Before initiating the monitor request procedure, the UE is configured with the data structure of the ProSe application IDs it wants to monitor. This step is performed using mechanisms that are out of scope of 3GPP.

If the UE is authorized to perform open 5G ProSe direct discovery monitoring in at least one PLMN, it shall initiate a monitor request procedure:

a) when the UE is triggered by an upper layer application to perform open 5G ProSe direct discovery monitoring corresponding to a ProSe application ID and the UE has no valid discovery filters corresponding to the requested ProSe application ID for that upper layer application;

b) when the TTL timer T5064 assigned by the 5G DDNMF to a discovery filter has expired and the request from upper layers to monitor that ProSe application ID is still in place; or

c) when the UE needs to inform the 5G DDNMF that the UE wants to stop using discovery filters for direct discovery monitoring.

NOTE 1: To ensure service continuity if the UE needs to keep monitoring the same discovery filter, the UE can initiate the monitor request procedure before the TTL timer T5064 assigned by the 5G DDNMF for a discovery filter expires.

The UE shall initiate the monitor request procedure for open 5G ProSe direct discovery by sending a DISCOVERY_REQUEST message with:

a) a new transaction ID;

b) the ProSe application ID set to the ProSe application ID received from upper layers;

c) the command set to "monitor"

d) the UE identity set to the UE's SUPI;

e) the application identity set to the application identity of the upper layer application that requested the monitoring;

f) the ACE enabled indicator set to "application-controlled extension enabled" if application-controlled extension is required by the upper layers, or "normal" if application-controlled extension is not used;

g) the discovery entry ID set to 0 if this is a new request or set to the discovery entry ID received from the 5G DDNMF if the monitor request is to update a previously sent monitor request; and

h) optionally, the requested timer set to 0 only when the UE wants to stop using discovery filters for direct discovery monitoring.

If open 5G ProSe direct discovery with application-controlled extension is requested by upper layers, the DISCOVERY_REQUEST message shall also include the application level container, which contains information corresponding to the ProSe application code suffix, e.g., group or user-specific information.

NOTE 2: A UE can include one or multiple transactions in one DISCOVERY_REQUEST message for one or more ProSe application IDs, and receive corresponding <response-monitor> element or <response-reject> element in the DISCOVERY_RESPONSE message for each respective transaction. In the following description of the monitor request procedure, only one transaction is included.

Figure 6.2.4.2.1 illustrates the interaction between the UE and the 5G DDNMF in the monitor request procedure.

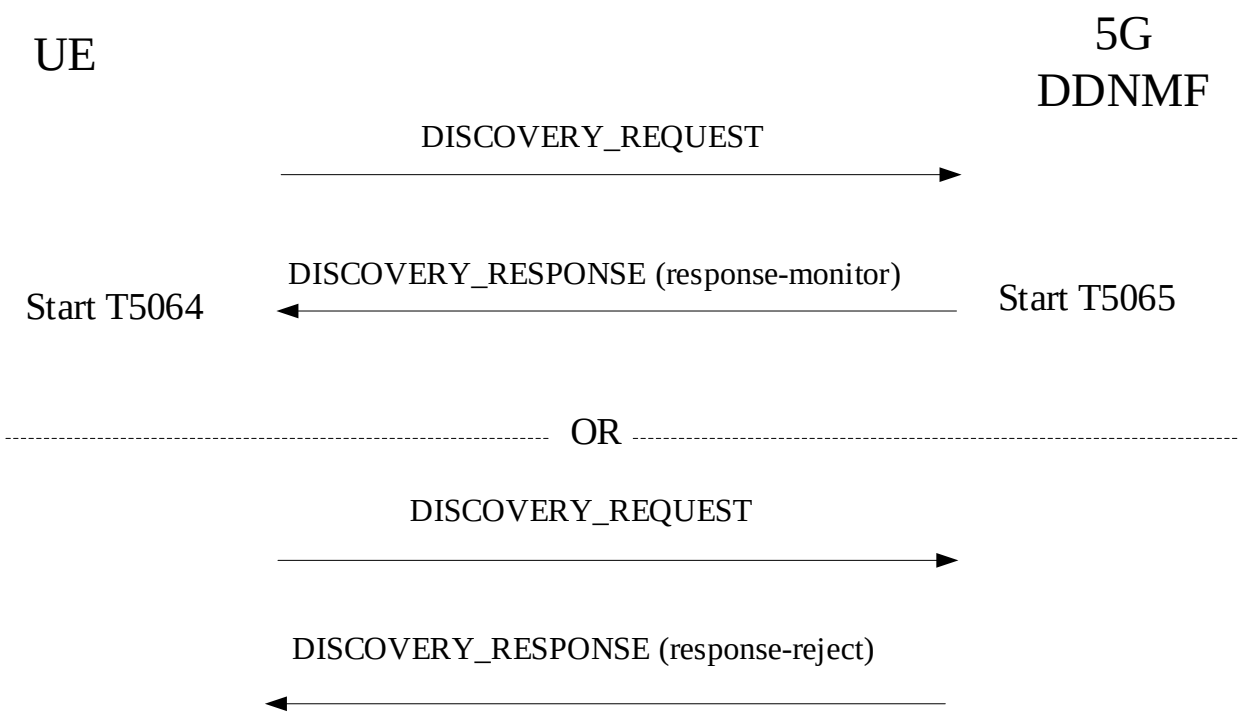

Figure 6.2.4.2.1: Monitor request procedure

6.2.4.3 Monitor request procedure accepted by the 5G DDNMF

Upon receiving a DISCOVERY_REQUEST message with the command set to "monitor", if the requested timer is included in the DISCOVERY_REQUEST message and the requested timer is set to 0, the 5G DDNMF shall check whether there is an existing UE context containing the discovery entry identified by the discovery entry ID included in the DISCOVERY_REQUEST message. If the discovery entry exists in the UE context, the 5G DDNMF shall remove the discovery entry identified by the discovery entry ID from the UE's context. When the associated ProSe application ID is PLMN-specific and that PLMN ID indicated by the ProSe application ID is not the same as that of the PLMN to which the 5G DDNMF belongs, the 5G DDNMF shall inform the 5G DDNMF in the PLMN indicated by the ProSe application ID to remove the corresponding discovery entry as specified in 3GPP TS 29.555 [9]. Then the 5G DDNMF shall send a DISCOVERY_RESPONSE message containing a <response-monitor> element with:

a) the transaction ID set to the value of the transaction ID received in the DISCOVERY_REQUEST message; and

b) the discovery entry ID set to the value of the discovery entry ID received in the DISCOVERY_REQUEST message.

Upon receiving a DISCOVERY_REQUEST message with the command set to "monitor", if the requested timer is not included in the DISCOVERY_REQUEST message, the 5G DDNMF shall perform the following procedure.

The 5G DDNMF shall check that the application corresponding to the application identity contained in the DISCOVERY_REQUEST message is authorized for open 5G ProSe direct discovery monitoring. If the application is authorized for open 5G ProSe direct discovery monitoring, the 5G DDNMF checks whether there is an existing context for the UE associated with the requested ProSe application ID.

If there is no associated UE context, the 5G DDNMF checks with the UDM whether the UE is authorized for open 5G ProSe direct discovery monitoring as described in 3GPP TS 29.503 [10]. The UDM provides to the 5G DDNMF the PLMN ID of the PLMN in which the UE is currently registered. If the subscription check indicates that the UE is authorized, the 5G DDNMF creates a new context for the UE and a new discovery entry identified by a non-zero value discovery entry ID which is associated with the requested ProSe application ID.

If the ACE enabled indicator in the DISCOVERY_REQUEST message is included and set to "application-controlled extension enabled" and the requested application uses application-controlled extension, the 5G DDNMF shall check whether the UE is authorized to use ACE. If the UE is authorized for ACE, the 5G DDNMF shall also use the procedure described in 3GPP TS 29.557 [19] to obtain the mask(s) for monitoring the ProSe application code suffix (es) corresponding to the requested ProSe application ID.

If the PLMN ID indicated in the ProSe application ID is PLMN-Specific and that PLMN ID is not the same as that of the PLMN to which the 5G DDNMF belongs, then the 5G DDNMF executes the procedures defined in 3GPP TS 29.555 [9] to obtain the discovery filter(s) for the ProSe application ID. Otherwise, the 5G DDNMF shall allocate one or more discovery filters for the requested ProSe application ID if it is known to the 5G DDNMF, and at least one corresponding valid ProSe application code or ProSe application code prefix is available in the 5G DDNMF. Each discovery filter consists of a ProSe application code, one or more ProSe application masks, and a TTL timer T5064. If application-controlled extension is used, the allocated Discovery Filter shall be applicable to match both prefix and suffix portions of the ProSe application code.

If the requested ProSe application ID is country-specific or global or PLMN-specific as defined respectively in clause 24.2 of 3GPP TS 23.003 [12], the 5G DDNMF shall allocate the discovery filter which contains ProSe application code and ProSe application mask(s) in the corresponding scope. If the ProSe application ID is country-specific or global, the ProSe application mask(s) enclosed in the discovery filter hides the PLMN ID part correspondingly and the temporary identity part is taken from the data structure corresponding to the global or country-wide ProSe application ID namespace, as specified in clause 24.3 of 3GPP TS 23.003 [12]. If the requested ProSe application ID is PLMN-specific, the 5G DDNMF shall allocate one or more PLMN-specific discovery filters. Each of these discovery filters shall contain a PLMN-specific Prose application code and the ProSe application mask(s) whose PLMN ID portion shall be set such that when the mask is applied to the ProSe application code, the outcome matches the full PLMN ID of that specific PLMN.

After the discovery filter(s) are allocated, the 5G DDNMF then associates the discovery filters with the new discovery entry in the UE context and starts timer T5065 assigned for each discovery filter. For a given discovery filter timer T5065 shall be longer than timer T5064. By default, the value of timer T5065 is 4 minutes greater than the value of timer T5064.

If there is an existing context for the UE that contains the UE's subscription parameters obtained from the UDM, but no discovery entry identified by the discovery entry ID contained in the DISCOVERY_REQUEST message, the 5G DDNMF shall check whether the UE is authorized for ProSe direct discovery monitoring. If the UE is authorized, the 5G DDNMF shall allocate the discovery filter as specified above.

After the discovery filter is allocated, the 5G DDNMF then associates the discovery filter with a new discovery entry identified by a non-zero value discovery entry ID in the UE context, and starts timer T5065 assigned for each discovery filter.

Similarly, if there is an existing context and a discovery entry identified by the discovery entry ID contained in the DISCOVERY_REQUEST message for the UE associated with the requested ProSe application ID, the 5G DDNMF updates the content of discovery filter(s), associate the discovery entry with the updated discovery filter(s) and restart timer T5065 for each filter. The update of a discovery filter content includes setting new TTL timer(s) and if necessary, assigning new ProSe application code or ProSe application code prefix and ProSe application mask(s).

Then the 5G DDNMF shall send a DISCOVERY_RESPONSE message containing a <response-monitor> element with:

a) the transaction ID set to the value of the transaction ID received in the DISCOVERY_REQUEST message from the UE;

b) the discovery entry ID set to the identifier associated with the discovery entry;

c) if the ACE enabled indicator was included by the UE in the DISCOVERY_REQUEST message, the ACE enabled indicator set to:

   1) "application-controlled extension enabled" if application-controlled extension is used; or

   2) "normal" if application-controlled extension is not used;

d) one or more discovery filters allocated by the 5G DDNMF(s) for the ProSe application ID received in the DISCOVERY_REQUEST message from the UE; and

e) the current time set to the current UTC-based time at the 5G DDNMF and the max offset.

If timer T5065 expires, the 5G DDNMF shall remove the UE's association with the corresponding discovery filter. Furthermore, the 5G DDNMF shall remove the discovery entry from the UE's context if there is no discovery filter corresponding to the ProSe application ID.

6.2.4.4 Monitor request procedure completion by the UE

Upon receipt of the DISCOVERY_RESPONSE message, if only the transaction ID and the discovery entry ID are contained in the <response-monitor> element and the transaction ID and the discovery entry ID match the corresponding values sent by the UE in a DISCOVERY_REQUEST message, the UE shall:

a) stop TTL timer T5064 for each discovery filter in the discovery entry identified by the discovery entry ID;

b) remove the discovery entry identified by the discovery entry ID; and

c) instruct the lower layers to stop monitoring.

Upon receipt of the DISCOVERY_RESPONSE message, if the transaction ID contained in the <response-monitor> element matches the value sent by the UE in a DISCOVERY_REQUEST message with the command set to "monitor", the UE shall, for each discovery filter assigned by the 5G DDNMF, stop TTL timer T5064 if running and start TTL timer T5064 with the received value. Otherwise, the UE shall discard the DISCOVERY_RESPONSE message and shall not perform the procedures below. The UE shall set a ProSe clock (see 3GPP TS 33.503 [34]) to the value of the received current time parameter and store the received max offset parameter.

The UE may perform open 5G ProSe direct discovery monitoring for discovery messages received over the PC5 interface as described in clause 6.2.14.2.1.3.

6.2.4.5 Monitor request procedure not accepted by the 5G DDNMF

If the DISCOVERY_REQUEST message is not accepted by the 5G DDNMF, the 5G DDNMF shall send a DISCOVERY_RESPONSE message containing a <response-reject> element to the UE including an appropriate PC3a control protocol cause value.

If the application corresponding to the application identity contained in the DISCOVERY_REQUEST message is not authorized for open 5G ProSe direct discovery monitoring, the 5G DDNMF shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value #1 "Invalid application".

If the ProSe application ID contained in the DISCOVERY_REQUEST message is unknown to the 5G DDNMF, the 5G DDNMF shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value #2 "Unknown ProSe application ID".

If the UE is not authorized for open 5G ProSe direct discovery monitoring, the 5G DDNMF shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value #3 "UE authorization failure".

If the UE requests a country-specific ProSe application ID for a country that does not correspond to the country of its HPLMN, and the 5G DDNMF has not authorized the UE to monitor in that country, it shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value #8 "Scope violation in Prose application ID".

If the UE requests a country-specific ProSe application ID for a country that does not correspond to the country of its HPLMN, and the 5G DDNMF has no agreement to access the country-specific ProSe application ID database of that country, the 5G DDNMF shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value #8 "Scope violation in Prose application ID".

If the discovery entry ID contained in the DISCOVERY_REQUEST message is unknown to the 5G DDNMF and the requested timer is set to 0, the 5G DDNMF shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value #10 "Unknown or invalid discovery entry ID ".

If the 5G DDNMF cannot retrieve a valid ProSe application code corresponding to the ProSe application ID contained in the DISCOVERY_REQUEST message, the 5G DDNMF shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value #17 "No valid ProSe application code".

If the UE is not authorized to use ACE, but the DISCOVERY_REQUEST message contains the ACE enabled indicator set to "application-controlled extension enabled", the 5G DDNMF shall send a DISCOVERY_RESPONSE message

containing a <response-reject> element with PC3a control protocol cause value #12 "UE unauthorized for discovery with application-controlled extension".

If the DISCOVERY_REQUEST message does not contain the ACE enabled indicator and the requested application only uses application-controlled extension, the 5G DDNMF shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value #1 "Invalid application".

6.2.4.6 Abnormal cases

6.2.4.6.1 Abnormal cases in the UE

The following abnormal cases can be identified:

a) Indication from the transport layer of transmission failure of DISCOVERY_REQUEST message (e.g., after TCP retransmission timeout)

The UE shall close the existing secure connection to the 5G DDNMF, establish a new secure connection and then restart the monitor request procedure.

b) No response from the 5G DDNMF after the DISCOVERY_REQUEST message has been successfully delivered (e.g., TCP ACK has been received for the DISCOVERY_REQUEST message)

The UE shall retransmit the DISCOVERY_REQUEST message.

NOTE: The timer to trigger retransmission and the maximum number of allowed retransmissions are UE implementation specific.

c) Indication from upper layers that the request to monitor the ProSe application ID is no longer in place after sending the DISCOVERY_REQUEST message, but before the monitor request procedure is completed

The UE shall acknowledge the DISCOVERY_RESPONSE message received from the 5G DDNMF but discard its contents and then abort the procedure.

d) Change of PLMN

If a PLMN change occurs before the monitor request procedure is completed, the procedure shall be aborted. If the UE is authorized to monitor in the new PLMN, the procedures shall be restarted once the UE is registered on the new PLMN.

6.2.4.6.2 Abnormal cases in the 5G DDNMF

The following abnormal cases can be identified:

a) Indication from the lower layer of transmission failure of DISCOVERY_RESPONSE message

After receiving an indication from lower layer that the DISCOVEY_RESPONSE message has not been successfully acknowledged, the 5G DDNMF shall abort the procedure, and stop any associated timer(s) T5065, if running.

6.2.5 Monitor request procedure for restricted 5G ProSe direct discovery model A

6.2.5.1 General

The purpose of the monitor request procedure for restricted 5G ProSe direct discovery model A is:

a) to allow a UE participating in restricted 5G ProSe direct discovery model A to receive and process PROSE PC5 DISCOVERY messages upon a request for monitoring from upper layers as defined in 3GPP TS 23.304 [2]; or

b) to inform the 5G DDNMF that the UE wants to stop using restricted discovery filter(s) for direct discovery monitoring as defined in 3GPP TS 23.304 [2].

The UE shall only initiate the restricted 5G ProSe direct discovery model A monitor request procedure if it has been authorized for restricted 5G ProSe direct discovery model A monitoring in at least in one PLMN based on the service authorization procedure.

As a result of the monitor request procedure completing successfully, the UE obtains one or more restricted discovery filters, along with a TTL (Time-To-Live) timer T5066 for each restricted discovery filter indicating the time during which the filter is valid.

6.2.5.2 Monitor request procedure Initiation

Before initiating the monitor request procedure, the user sets the permissions for the restricted discovery using application layer mechanisms. The application client in the UE retrieves the PDUID provisioned to the UE as part of the service authorization procedure as specified in clause 5, and obtains an RPAUID associated with the UE's PDUID and the target RPAUID(s) to be monitored from the ProSe application server. This step is performed using mechanisms that are out of scope of the present specification.

If the UE is authorized to perform ProSe direct discovery model A monitoring in at least one PLMN, it shall initiate a monitor request procedure:

a) when the UE is triggered by an upper layer application to perform restricted 5G ProSe direct discovery model A monitoring corresponding to at least one RPAUID, and the UE has no valid restricted discovery filters corresponding to the requested RPAUID for that upper layer application; or

b) when the TTL timer T5066 assigned by the 5G DDNMF to a Restricted discovery filter has expired and the request from upper layers to monitor that RPAUID is still in place; or

NOTE 1: To ensure service continuity if the UE needs to keep monitoring the same restricted discovery filter, the UE can initiate the monitor request procedure before the TTL timer T5066 assigned by the 5G DDNMF for a Restricted discovery filter expires.

c) when the UE needs to update a previously sent restricted 5G ProSe direct discovery model A monitoring request.

The UE shall initiate the monitor request procedure by sending a DISCOVERY_REQUEST message with:

a) a new transaction ID;

b) the RPAUID set to the RPAUID received from upper layers;

c) the command set to "monitor";

d) the discovery type set to "Restricted discovery"

e) the UE identity set to the UE's SUPI;

f) the application identity set to the application identity of the upper layer application that requested the monitoring;

g) the ACE enabled indicator set to "application-controlled extension enabled" if application-controlled extension is required by the upper layers, or "normal" if application-controlled extension is not used;

h) the application level container set to the target RPAUIDs to monitor;

i) the discovery entry ID set to 0 if the monitoring request is a new request, and set to the discovery entry ID received from the 5G DDNMF if the monitoring request is to update a previously sent monitoring request; and

j) optionally, the requested timer set to 0 only when the UE wants to stop using restricted discovery filter(s) for direct discovery monitoring.

If restricted direct discovery model A with application-controlled extension is requested by upper layers, the application level container included in the DISCOVERY_REQUEST also contains information corresponding to the ProSe restricted code suffix, e.g., group or user-specific information.

NOTE 2: A UE can include one or multiple transactions in one DISCOVERY_REQUEST message for one or more different monitoring targets, and receive corresponding <response-monitor> element or <response-reject> element in the DISCOVERY_RESPONSE message for each respective transaction. In the following description of the monitor request procedure, only one transaction is included.

Figure 6.2.5.2.1 illustrates the interaction between the UE and the 5G DDNMF in the monitor request procedure.

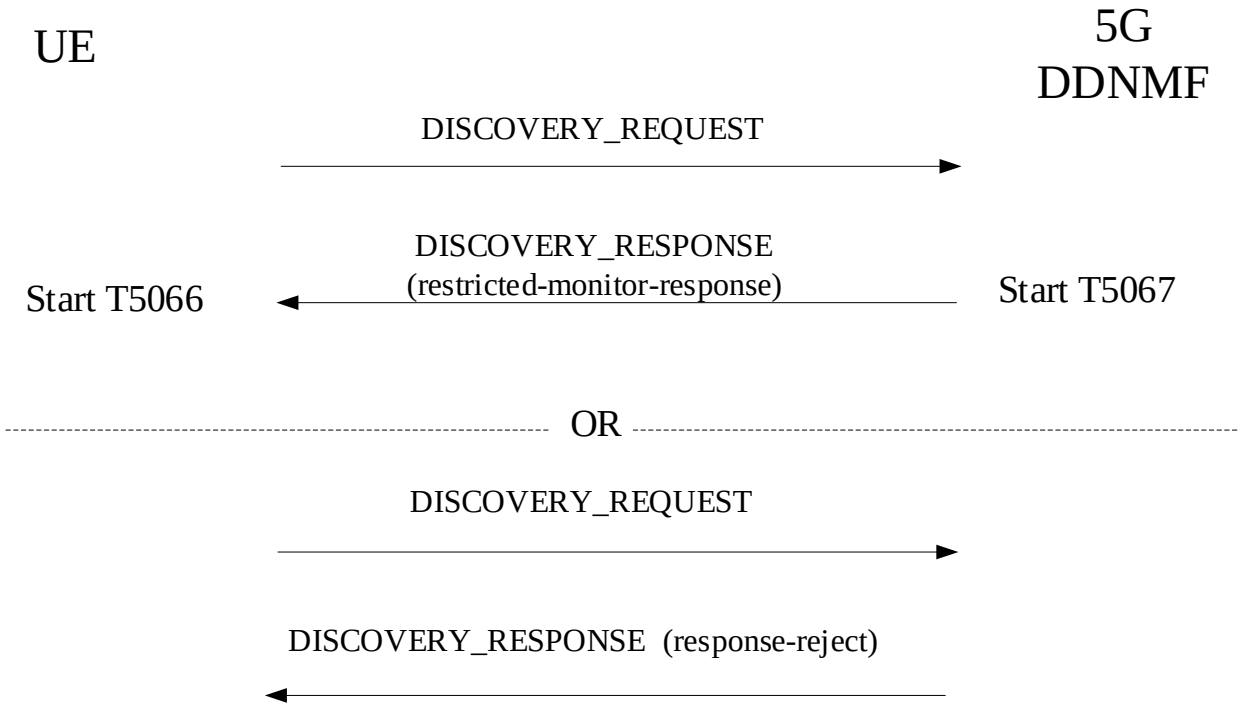

Figure 6.2.5.2.1: Monitor request procedure for restricted 5G ProSe direct discovery model A

6.2.5.3 Monitor request procedure accepted by the 5G DDNMF

Upon receiving a DISCOVERY_REQUEST message with the command set to "monitor" and the discovery type set to "Restricted discovery", if the requested timer is included in the DISCOVERY_REQUEST message and the requested timer is set to 0, the 5G DDNMF shall check whether there is an existing UE context containing the discovery entry identified by the discovery entry ID included in the DISCOVERY_REQUEST message. If the discovery entry exists in the UE context, the 5G DDNMF shall remove the discovery entry identified by the discovery entry ID from the UE's context. For each of the PDUIDs corresponding to the target RPAUIDs contained the restricted discovery filters in the discovery entry, if the PDUID is PLMN-specific and that PLMN ID indicated by the PDUID is not the same as that of the PLMN to which the 5G DDNMF belongs, the 5G DDNMF shall inform the 5G DDNMF in the PLMN indicated by the PDUID to remove the corresponding discovery entry as specified in 3GPP TS 29.555 [9].

Upon receiving a DISCOVERY_REQUEST message with the command set to "monitor" and the discovery type set to "Restricted discovery", if the requested timer is not included in the DISCOVERY_REQUEST message, the 5G DDNMF shall perform the following procedure.

The 5G DDNMF shall check that the application corresponding to the application identity contained in the DISCOVERY_REQUEST message is authorized for ProSe direct discovery model A monitoring. If the application is authorized for restricted 5G ProSe direct discovery model A monitoring, the 5G DDNMF shall check whether there is an existing UE context.

If there is no associated UE context, the 5G DDNMF checks with the UDM whether the UE is authorized for restricted 5G ProSe direct discovery model A monitoring as described in 3GPP TS 29.503 [10]. The UDM provides to the 5G

DDNMF the PLMN ID of the PLMN in which the UE is currently registered. If the subscription check indicates that the UE is authorized, the 5G DDNMF creates a new UE context containing the UE's subscription parameters obtained from the UDM.

If the discovery entry ID included in the DISCOVERY_REQUEST is set to 0 then:

a) the 5G DDNMF shall use the procedure described in 3GPP TS 29.557 [19] to pass the application level container included in the DISCOVERY_REQUEST message to the ProSe application server and obtain a list of PDUID(s) , an application level container and optionally Metadata Indicator(s) corresponding to the authorized target RPAUID(s) from the ProSe application server;

b) if the ACE enabled indicator in the DISCOVERY_REQUEST message is set to "application-controlled extension enabled" and the requested application uses application-controlled extension, the 5G DDNMF shall check whether the UE is authorized to use ACE. If the UE is authorized for ACE, the 5G DDNMF shall also use the procedure described in 3GPP TS 29.557 [19] to obtain the mask(s) for monitoring a ProSe restricted suffix pool corresponding to each of the Target RPAUIDs.

NOTE 1: The ProSe application server can reject the request for some of the target RPAUIDs included in the application level container in the DISCOVERY_REQUEST message because they are ineligible to be monitored by the requesting UE. Depending on the operator policy and application layer permissions, it is possible that only a subset of valid RPAUIDs is authorized by the ProSe application server.

c) for each of the PDUIDs corresponding to an authorized target RPAUID, if the PLMN ID of the PDUID is not the same as that of the PLMN to which the 5G DDNMF belongs, then the 5G DDNMF executes the procedures defined in 3GPP TS 29.555 [9] to obtain the ProSe restricted code or ProSe restricted code prefix for the target RPAUID and creates restricted discovery filter(s). Otherwise, for each target RPAUID, the 5G DDNMF shall allocate one or more restricted discovery filter(s). If the ACE enabled indicator in the DISCOVERY_REQUEST message does not match the ACE configuration in the 5G DDNMF or ProSe application server for this application, the ACE configuration in the 5G DDNMF or ProSe application server shall be used to create Restricted discovery filter(s). Each Restricted discovery filter consists of a ProSe restricted code, one or more masks, a TTL timer T5066, optionally the target RPAUID, optionally a metadata indicator and optionally metadata associated with this RPAUID;

d) the 5G DDNMF associates the restricted discovery filters with a new discovery entry in the UE's context; and

e) the 5G DDNMF starts timer T5067 assigned for each Restricted discovery filter. For a given restricted discovery filter, timer T5067 shall be longer than timer T5066. By default, the value of timer T5067 is 4 minutes greater than the value of timer T5066.

NOTE 2: For each target RPAUID, the 5G DDNMF either allocates one restricted discovery filter for full-matching the ProSe restricted code assigned to this RPAUID, or allocates one or more restricted discovery filter(s) for matching the ProSe restricted code prefix and suffix pool assigned to this RPAUID.

If the discovery entry ID included in the DISCOVERY_REQUEST message is not set to 0 and if there is an existing discovery entry for this discovery entry ID in the UE's context, the 5G DDNMF shall check whether the UE is authorized for restricted 5G ProSe direct discovery model A monitoring. If the UE is authorized, the 5G DDNMF shall process the request as above-mentioned and update this discovery entry with the contents of the restricted discovery filter(s) associated with this discovery entry and restart timer T5067(s) for each filter. The update of a restricted discovery filter content includes setting new TTL timer(s) and if necessary, obtaining new ProSe restricted code and ProSe restricted mask(s) via the procedure defined in 3GPP TS 29.555 [9].

If the discovery entry ID contained in the DISCOVERY_REQUEST message is not found in the UE context or there is no UE context in the 5G DDNMF, the 5G DDNMF shall behave as if the discovery entry ID included in the DISCOVERY_REQUEST message was set to 0, and the 5G DDNMF shall allocate a new non-zero discovery entry ID for this entry.

Then the 5G DDNMF shall send a DISCOVERY_RESPONSE message containing a <restricted-monitor-response> element with:

a) the transaction ID set to the value of the transaction ID received in the DISCOVERY_REQUEST message from the UE;

b) one or more restricted discovery filter(s) allocated by the 5G DDNMF(s) for the authorized target RPAUID(s);

c) the ACE enabled indicator set to "application-controlled extension enabled" if application-controlled extension is used, or "normal" if application-controlled extension is not used;

d) the discovery entry ID set to the ID of the discovery entry associated with this monitor request;

e) the application level container set to the application-level data received from the ProSe application server;

f) the coding-receiving security parameter containing the security-related information needed by the UE to undo the protection applied by the announcing UE;

g) the current time set to the current UTC-based time at the 5G DDNMF and the max offset; and

h) optionally, the PC5 security policies used for 5G ProSe direct link establishment procedure.

If T5067 expires, the 5G DDNMF shall remove the corresponding restricted discovery filter from the discovery entry in the UE's context. Furthermore, if there are no valid restricted discovery filters associated with the discovery entry (e.g., all restricted discovery filters have expired), the 5G DDNMF shall delete the discovery entry from the UE's context.

6.2.5.4 Monitor request procedure completion by the UE

Upon receipt of the DISCOVERY_RESPONSE message, if only the transaction ID and the discovery entry ID are contained in <restricted-monitor-response> element and the transaction ID and the discovery entry ID match the corresponding values sent by the UE in a DISCOVERY_REQUEST message with the command set to "monitor", the UE shall:

a) stop TTL timer T5066 for each Restricted discovery filter in the discovery entry identified by the discovery entry ID;

b) remove the discovery entry identified by the discovery entry ID; and

c) instruct the lower layers to stop monitoring.

Upon receipt of the DISCOVERY_RESPONSE message, if the transaction ID contained in the <restricted-monitor-response> element matches the value sent by the UE in a DISCOVERY_REQUEST message with the command set to "monitor" and, the UE shall process as follow:

a) if the DISCOVERY_RESPONSE creates a new discovery entry, start the TTL timer T5066 with the received value for each restricted discovery filter information element received in the DISCOVERY_RESPONSE message; or

b) if the DISCOVERY_RESPONSE updates an existing discovery entry, the UE shall

   1) stop the T5066 timer(s) of any restricted discovery filter in this discovery entry which are no longer authorized by the 5G DDNMF, ask lower layers to stop using those filters in monitoring operation, and remove the corresponding restricted discovery filter from the discovery entry;

   2) restart the T5066 timer(s) for those remain eligible; and

   3) start the T5066 timer(s) for any new restricted discovery filter(s) included in the DISCOVERY_RESPONSE message.

Otherwise, the UE shall discard the DISCOVERY_RESPONSE message and shall not perform the procedures below. The UE shall set a ProSe clock (see 3GPP TS 33.503 [34]) to the value of the received current time parameter and store the received max offset parameter.

The UE may perform monitoring for discovery messages received over the PC5 interface as described in clause 6.2.14.2.1.3.

6.2.5.5 Monitor request procedure not accepted by the 5G DDNMF

If the DISCOVERY_REQUEST message is not accepted by the 5G DDNMF, the 5G DDNMF shall send a DISCOVERY_RESPONSE message containing a <response-reject> element to the UE including an appropriate PC3a control protocol cause value.

If the application corresponding to the application identity contained in the DISCOVERY_REQUEST message is not authorized for ProSe direct discovery monitoring, the 5G DDNMF shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value #1 "Invalid application".

If the RPAUID contained in the DISCOVERY_REQUEST message is unknown to the ProSe application server, the 5G DDNMF shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value #9 "Unknown RPAUID".

If none of the RPAUID(s) contained in the application level container in the DISCOVERY_REQUEST message is eligible to be discovered by the requesting RPAUID, the 5G DDNMF shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value #11 "Invalid discovery target".

If the RPAUID contained in the DISCOVERY_REQUEST message does not match the stored RPAUID for the requested discovery entry ID, the 5G DDNMF shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value #10 "Unknown or invalid discovery entry ID".

If the UE is not authorized for restricted 5G ProSe direct discovery monitoring, the 5G DDNMF shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value #3 "UE authorization failure".

If the RPAUID contained in the DISCOVERY_REQUEST message is not associated with a PDUID belonging to the requesting UE, the 5G DDNMF shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value #3 "UE authorization failure".

If the UE is not authorized to use ACE, but the DISCOVERY_REQUEST message contains the ACE enabled indicator set to "application-controlled extension enabled", the 5G DDNMF shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value #12 "UE unauthorized for discovery with application-controlled extension".

If the discovery entry ID contained in the DISCOVERY_REQUEST message is unknown to the 5G DDNMF and the requested timer is set to 0, the 5G DDNMF shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value #10 "Unknown or invalid discovery entry ID".

6.2.5.6 Abnormal cases

6.2.5.6.1 Abnormal cases in the UE

The following abnormal cases can be identified:

a) Indication from the transport layer of transmission failure of DISCOVERY_REQUEST message (e.g., after TCP retransmission timeout)

   The UE shall close the existing secure connection to the 5G DDNMF, establish a new secure connection and then restart the monitor request procedure.

b) No response from the 5G DDNMF after the DISCOVERY_REQUEST message has been successfully delivered (e.g., TCP ACK has been received for the DISCOVERY_REQUEST message)

   The UE shall retransmit the DISCOVERY_REQUEST message.

NOTE: The timer to trigger retransmission and the maximum number of allowed retransmissions are UE implementation specific.

c) Indication from upper layers that the request to monitor the targets contained in application level container is no longer in place after sending the DISCOVERY_REQUEST message, but before the monitor request procedure is completed

   The UE shall acknowledge the DISCOVERY_RESPONSE message received from the 5G DDNMF but discard its contents and then abort the procedure.

d) Change of PLMN

If a PLMN change occurs before the monitor request procedure is completed, the procedure shall be aborted. If the UE is authorized to monitor in the new PLMN, the procedures shall be restarted once the UE is registered on the new PLMN.

6.2.5.6.2 Abnormal cases in the 5G DDNMF

The following abnormal cases can be identified:

a) Indication from the lower layer of transmission failure of DISCOVERY_RESPONSE message

After receiving an indication from lower layer that the DISCOVERY_RESPONSE message has not been successfully acknowledged, the 5G DDNMF shall abort the procedure, and stop any associated timer(s) T5067, if running.

6.2.6 Discoveree request procedure for restricted 5G ProSe direct discovery model B

6.2.6.1 General

The purpose of the discoveree request procedure for restricted 5G ProSe direct discovery model B is for the UE to obtain discovery query filter(s) to be used for monitoring a model B query for a RPAUID over the PC5 interface, and a ProSe response code to be announced over the PC5 interface as a response to a model B query, as defined in 3GPP TS 23.304 [2].

Before initiating the discoveree request procedure, the UE shall be authorised for restricted 5G ProSe direct discovery model B discoveree operation in the registered PLMN or the local PLMN based on the service authorisation procedure as specified in clause 5.

As the result of successful completion of this procedure, the UE obtains one or more discovery query filters and applies them to the monitoring operation in PC5 interface. The UE shall also include the ProSe response code in a PROSE PC5 DISCOVERY message and passes the message to the lower layers for transmission over the PC5 interface when there is a match of the discovery query filter(s).

6.2.6.2 Discoveree request procedure initiation

Before initiating the discoveree request procedure, the user sets the permissions for the restricted discovery using application layer mechanisms. The application client in the UE retrieves the PDUID provisioned to the UE as part of the service authorisation procedure as specified in clause 5 and obtains an RPAUID associated with the UE's PDUID from the ProSe application server. The UE can provide metadata to be associated with the RPAUID, and the ProSe application server stores the metadata. This step is performed using mechanisms that are out of scope of the present specification.

If the UE is authorised to perform restricted 5G ProSe direct discovery model B discoveree operation in the PLMN operating the radio resources signalled from the serving PLMN, it shall initiate a discoveree request procedure:

a) when the UE is triggered by an upper layer application to announce an RPAUID in Model B and the UE has no valid corresponding ProSe response code and discovery query filter(s) for that RPAUID of the upper layer application;

b) when the validity timer T5068 assigned by the 5G DDNMF to a ProSe response code and the corresponding discovery query filter(s) has expired and the request from upper layers to announce the RPAUID corresponding to that ProSe response code is still in place;

c) when the UE selects a new PLMN while announcing or waiting for announcing a ProSe response code and intends to announce in the new PLMN, and the UE is authorised for restricted 5G ProSe direct discovery model B discoveree operation in the new PLMN;

d) when, while announcing or waiting for announcing a ProSe response code, the UE intends to switch the announcing PLMN to a different PLMN without performing PLMN selection, and the UE does not have a valid allocated ProSe response code for this new PLMN yet; or

e) when the UE needs to update a previously sent restricted 5G ProSe direct discovery model B discoveree request.

When the UE selects a new PLMN while announcing or waiting for announcing a ProSe response code and the UE is not yet authorised for restricted 5G ProSe direct discovery model B discoveree operation in the new PLMN, the UE shall initiate a discoveree request procedure only after the UE is authorised for restricted 5G ProSe direct discovery model B discoveree operation in the new PLMN.

NOTE 1: To ensure service continuity if the UE needs to keep announcing in Model B a ProSe response code corresponding to the same RPAUID, the UE can initiate the discoveree request procedure before the validity timer T5068 assigned by the 5G DDNMF for a ProSe response code expires.

The UE shall initiate the discoveree request procedure by sending a DISCOVERY_REQUEST message with:

a) a new transaction ID not used in any other direct discovery procedures in PC3a interface;

b) the RPAUID set to the RPAUID received from upper layers;

c) the command set to "response";

d) the UE identity set to the UE's SUPI;

e) the application identity set to the application identity of the upper layer application that requested the announcing;

f) the discovery type set to "Restricted discovery";

g) the discovery model set to "Model B";

h) the discovery entry ID set to a 0 if the discoveree request is a new request, and set to the discovery entry ID received from the 5G DDNMF if the discoveree request is to update a previously sent discoveree request; and

i) optionally the announcing PLMN ID set to the PLMN ID of the local PLMN operating the radio resources that the UE intends to use for announcing the RPAUID.

NOTE 2: A UE can include one or multiple transactions in one DISCOVERY_REQUEST message for different RPAUIDs (e.g., for different applications), and receive corresponding <restricted-discoveree-response> element or <response-reject> element in a DISCOVERY_RESPONSE message for each respective transaction. In the following description of the discoveree request procedure, only one transaction is included.

Figure 6.2.6.2.1 illustrates the interaction of the UE and the 5G DDNMF in the discoveree request procedure.

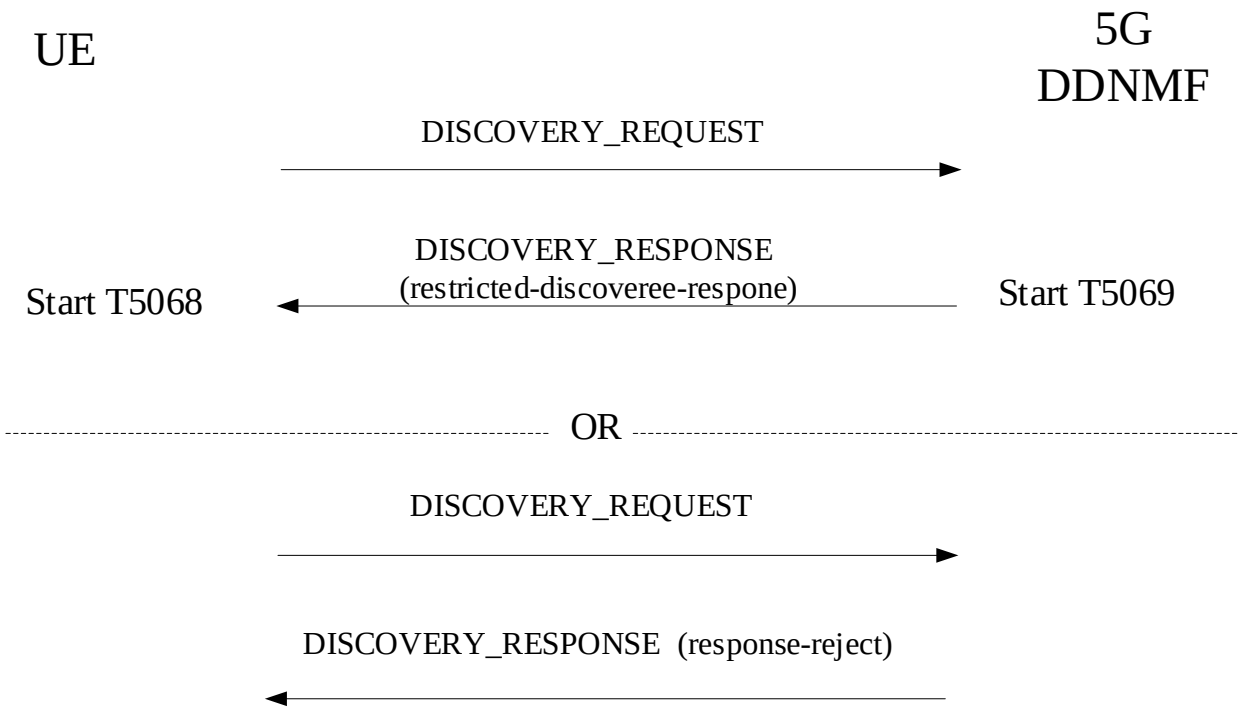

Figure 6.2.6.2.1: Discoveree request procedure for restricted 5G ProSe direct discovery model B

6.2.6.3 Discoveree request procedure accepted by the 5G DDNMF

Upon receiving a DISCOVERY_REQUEST message, the 5G DDNMF shall check that the application corresponding to the application identity contained in the DISCOVERY_REQUEST message is authorised for restricted 5G ProSe direct discovery model B discoveree operation. If the application is authorised for restricted 5G ProSe direct discovery model B discoveree operation, the 5G DDNMF shall check whether there is an existing context for the UE.

If there is no associated UE context, the 5G DDNMF checks with the UDM whether the UE is authorised for restricted 5G ProSe direct discovery model B discoveree operation as described in 3GPP TS 29.503 [10]. If the check indicates that the UE is authorised, the 5G DDNMF creates a UE context that contains the UE's subscription parameters obtained from the UDM. The UDM also provides to the 5G DDNMF the PLMN ID of the PLMN in which the UE is currently registered.

If the UE context exists, the 5G DDNMF shall check whether the UE is authorized for restricted 5G ProSe direct discovery model B discoveree operation in the currently registered PLMN or the local PLMN identified by the Announcing PLMN ID included in the DISCOVERY_REQUEST message.

If the UE is authorized and the discovery entry ID included in the DISCOVERY_REQUEST message is set to 0 then:

a) the 5G DDNMF shall check whether the UE is authorised to announce the RPAUID contained in the DISCOVERY_REQUEST message. Optionally this can include checking with the ProSe application server as described in 3GPP TS 29.557 [19] to obtain the binding between the RPAUID and PDUID, and then verifying that the PDUID belongs to the requesting UE;

b) if the UE is authorised to announce the RPAUID, the 5G DDNMF shall allocate the corresponding ProSe response code and ProSe query code for the RPAUID. It shall also allocate discovery query filter(s) based on the allocated ProSe query code. Then it shall assign a value for validity timer T5068, which is associated with the ProSe response code, ProSe query code and discovery query filter(s); and

c) the 5G DDNMF associates the allocated ProSe response code, ProSe query code, and discovery query filter with a new discovery entry ID in the UE context, and starts timer T5069. For a given ProSe response code, timer T5069 shall be longer than timer T5068. By default, the value of timer T5069 is 4 minutes greater than the value of timer T5068.

If the discovery entry ID included in the DISCOVERY_REQUEST message is not set to 0 and if there is an existing discovery entry for this discovery entry ID value in the UE context, the 5G DDNMF shall either update the discovery entry with a new validity timer T5068, or allocate a new ProSe response code, ProSe query code and the discovery query filter(s) for the requested RPAUID with a new validity timer T5068, restart timer T5069.

If the discovery entry ID contained in the DISCOVERY_REQUEST message is not found in the UE context or there is no UE context in the 5G DDNMF, the 5G DDNMF shall behave as if the discovery entry ID included in the DISCOVERY_REQUEST message was set to 0, and the 5G DDNMF shall allocate a new non-zero discovery entry ID for this entry.

If a new UE context was created or an existing UE context was updated, and the UE is currently roaming or the Announcing PLMN ID is included in the DISCOVERY_REQUEST message, the 5G DDNMF checks with the 5G DDNMF of the VPLMN or the local PLMN identified by the Announcing PLMN ID whether the UE is authorised for restricted 5G ProSe direct discovery model B discoveree operation as described in 3GPP TS 29.555 [9].

The 5G DDNMF shall then send a DISCOVERY_RESPONSE message containing a <restricted-discoveree-response> element with:

a) the transaction ID set to the value of the transaction ID received in the DISCOVERY_REQUEST message from the UE;

b) the ProSe response code set to the ProSe response code allocated for the RPAUID received in the DISCOVERY_REQUEST message;

c) one or more discovery query filters set to the ProSe query filter(s) used to match a query for the RPAUID received in the DISCOVERY_REQUEST message;

d) a validity timer T5068 set to the T5068 timer value assigned by the 5G DDNMF to the ProSe response code and the discovery query filter(s);

e) the code-sending security parameter containing the security-related information for the discoveree UE to protect the transmission of the ProSe response code;

f) the code-receiving security parameter containing the security-related information needed by the discoveree UE to undo the protection applied by the discoverer UE;

g) the discovery entry ID set to the ID of the discovery entry associated with this discoveree request in the UE context;

h) the current time set to the current UTC-based time at the 5G DDNMF and the max offset; and

i) optionally, the PC5 security policies used for 5G ProSe direct link establishment procedure.

If timer T5069 expires, the 5G DDNMF shall remove the discovery entry associated with the corresponding RPAUID from the UE's context.

6.2.6.4 Discoveree request procedure completion by the UE

Upon receipt of the DISCOVERY_RESPONSE message, if the transaction ID contained in the <restricted-discoveree-response> element matches the value sent by the UE in a DISCOVERY_REQUEST message with the command set to "response", the UE shall create a new discovery entry or update an existing discovery entry with the ProSe response code and discovery query filter(s) received in the DISCOVERY_RESPONSE message and the PLMN ID of the intended announcing PLMN. For this discovery entry, the UE shall stop the validity timer T5068 if running and start the validity timer T5068 with the received value. The UE shall also use the received ProSe response code and discovery query filter(s) to replace the old counterparts if they are currently used. This may involve notifying the lower layers to stop announcing the old ProSe response code or to stop monitoring with the old discovery query filter(s). Otherwise, the UE shall discard the DISCOVERY_RESPONSE message and shall not perform the procedures described in clause 6.2.14.2.2.3. The UE shall set a ProSe clock (see 3GPP TS 33.503 [34]) to the value of the received current time parameter and store the received max offset parameter.

6.2.6.5 Discoveree request procedure not accepted by the 5G DDNMF

If the DISCOVERY_REQUEST message cannot be accepted by the 5G DDNMF, the 5G DDNMF sends a DISCOVERY_RESPONSE message containing a <response-reject> element to the UE including an appropriate PC3a control protocol cause value.

If the application corresponding to the application identity contained in the DISCOVERY_REQUEST message is not authorised for ProSe direct discovery Model B discoveree operation, the 5G DDNMF shall send the DISCOVERY_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value #1 "Invalid application".

If the RPAUID contained in the DISCOVERY_REQUEST message is unknown to the 5G DDNMF or ProSe application server, the 5G DDNMF shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value #9 "Unknown RPAUID".

If the RPAUID contained in the DISCOVERY_REQUEST message does not match the stored RPAUID for the requested discovery entry ID, the 5G DDNMF shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value #10 "Unknown or invalid discovery entry ID".

If the UE is not authorised for restricted 5G ProSe direct discovery model B discoveree operation, the 5G DDNMF shall send the DISCOVERY_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value #3 "UE authorisation failure".

If the RPAUID contained in the DISCOVERY_REQUEST message is not associated with a PDUID belonging to the requesting UE, the 5G DDNMF shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value #3 "UE authorisation failure".

6.2.6.6 Abnormal cases

6.2.6.6.1 Abnormal cases in the UE

The following abnormal cases can be identified:

a) Indication from the transport layer of transmission failure of DISCOVERY_REQUEST message (e.g., after TCP retransmission timeout)

   The UE shall close the existing secure connection to the 5G DDNMF, establish a new secure connection and then restart the discoveree request procedure.

b) No response from the 5G DDNMF after the DISCOVERY_REQUEST message has been successfully delivered (e.g., TCP ACK has been received for the DISCOVERY_REQUEST message)

   The UE shall retransmit the DISCOVERY_REQUEST message.

NOTE: The timer to trigger retransmission and the maximum number of allowed retransmissions are UE implementation specific.

c) Indication from upper layers that the request to announce the RPAUID in model B is no longer in place after sending the DISCOVERY_REQUEST message, but before the discoveree request procedure is completed

   The UE shall acknowledge the DISCOVERY_RESPONSE message received from the 5G DDNMF but discard its contents and then abort the procedure.

d) Change of PLMN

   If a PLMN change occurs before the discoveree request procedure is completed, the procedure shall be aborted. If the UE is authorized to perform restricted 5G ProSe direct discovery model B discoveree operation in the new PLMN, the procedure shall be restarted once the UE is registered on the new PLMN.

6.2.6.6.2 Abnormal cases in the 5G DDNMF

The following abnormal cases can be identified:

a) Indication from the lower layer of transmission failure of DISCOVERY_RESPONSE message

After receiving an indication from lower layer that the DISCOVERY_RESPONSE message has not been successfully acknowledged (e.g. TCP ACK is not received), the 5G DDNMF shall abort the procedure, and stop any associated timer(s) T5069, if running.

6.2.7 Discoverer request procedure for restricted 5G ProSe direct discovery model B

6.2.7.1 General

The purpose of the discoverer request procedure for restricted 5G ProSe direct discovery model B is for the UE to obtain ProSe query code(s) and discovery response filter(s) to be used for sending query and monitoring responses over the PC5 interface based on the information provided by the upper layer application, as defined in 3GPP TS 23.304 [2].

Before initiating the discoverer request procedure, the UE shall be authorised for restricted 5G ProSe direct discovery model B discoverer operation in the registered PLMN or the local PLMN based on the service authorisation procedure as specified in clause 5.

As the result of successful completion of this procedure, the UE obtains one or more ProSe query code(s) which can be included in a PROSE PC5 DISCOVERY message and passes the PROSE PC5 DISCOVERY message to the lower layers for transmission over the PC5 interface. The UE also obtains discovery response filter(s) and apply it to the monitoring operation in PC5 interface to match potential responses for the sent query request for the target RPAUID.

6.2.7.2 Discoverer request procedure initiation

Before initiating the discoverer request procedure, the user sets the permissions for the restricted discovery using application layer mechanisms. The application client in the UE retrieves the PDUID provisioned to the UE as part of the service authorisation procedure as specified in clause 5 and obtains an RPAUID associated with the UE's PDUID from the ProSe application server. The UE can also obtain the target RPAUID(s) from the ProSe application server. This step is performed using mechanisms that are out of scope of the present specification.

If the UE is authorised to perform restricted 5G ProSe direct discovery model B discoverer operation in the PLMN operating the radio resources signalled from the serving PLMN, it shall initiate a discoverer request procedure:

a) when the UE is triggered by an upper layer application to perform the query for one or more target RPAUIDs in Model B and the UE has no valid corresponding ProSe query code and Discovery Response Filter for those target RPAUIDs of the upper layer application;

b) when the validity timer T5070 assigned by the 5G DDNMF to a ProSe query codes and the corresponding Discovery Response Filter has expired and the request from upper layers to announce the RPAUID corresponding to that ProSe response code is still in place;

c) when the UE selects a new PLMN while announcing a ProSe query code or waiting for a ProSe response code and intends to announce the ProSe query code in the new PLMN, and the UE is authorised for restricted 5G ProSe direct discovery model B discoverer operation in the new PLMN;

d) when, while querying for target RPAUID(s), the UE intends to switch the announcing PLMN to a different PLMN without performing PLMN selection, and the UE does not have a valid allocated ProSe query code for this new PLMN yet; or

e) when the UE needs to update a previously sent restricted 5G ProSe direct discovery model B discoverer request.

When the UE selects a new PLMN while announcing a ProSe query code or waiting for a ProSe response code and the UE is not yet authorised for restricted 5G ProSe direct discovery model B discoverer operation in the new PLMN, the UE shall initiate a discoverer request procedure only after the UE is authorised for restricted 5G ProSe direct discovery model B discoverer operation in the new PLMN.

NOTE 1: To ensure service continuity if the UE needs to keep announcing in Model B a ProSe query code corresponding to the same RPAUID, the UE can initiate the discoverer request procedure before the validity timer T5070 assigned by the 5G DDNMF for a ProSe query code expires.

The UE shall initiate the discoverer request procedure by sending a DISCOVERY_REQUEST message with:

a) a new transaction ID not used in any other direct discovery procedures in PC3a interface;

b) the RPAUID set to the RPAUID received from upper layers;

c) the application level container set to contain the application-layer information, e.g., target RPAUID(s) to discover;

d) the command set to "query";

e) the UE identity set to the UE's SUPI;

f) the application identity set to the application identity of the upper layer application that requested the announcing;

g) the discovery type set to "Restricted discovery";

h) the discovery model set to "Model B";

i) the discovery entry ID set to a 0 if the discoverer request is a new request, and set to the discovery entry ID received from the 5G DDNMF if the discoverer request is to update a previously sent discoverer request; and

j) optionally the Announcing PLMN ID set to the PLMN ID of the local PLMN operating the radio resources that the UE intends to use for transmitting the query for the target RPAUID(s).

NOTE 2: A UE can include one or multiple transactions in one DISCOVERY_REQUEST message for different discovering requests (e.g., for different applications), and receive corresponding <restricted-discoverer-response> element or <response-reject> element in a DISCOVERY_RESPONSE message for each respective transaction. In the following description of the discoverer request procedure, only one transaction is included.

Figure 6.2.7.2.1 illustrates the interaction of the UE and the 5G DDNMF in the discoverer request procedure.

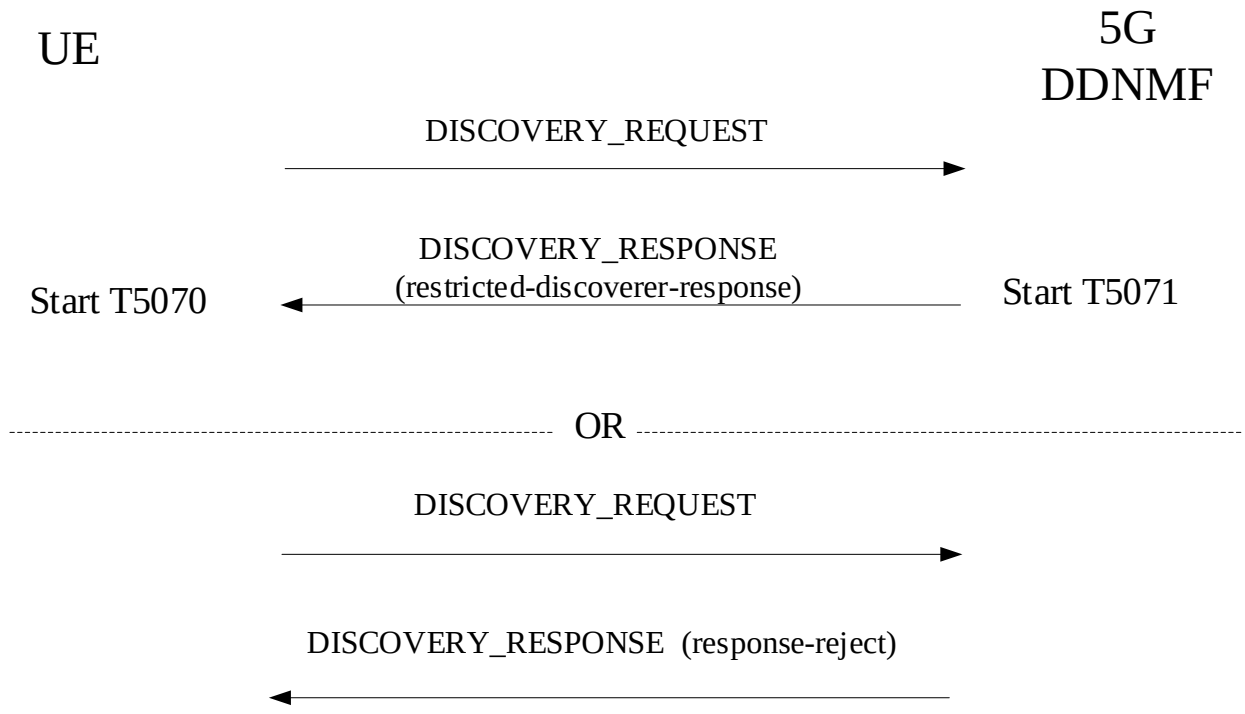

Figure 6.2.7.2.1: Discoverer request procedure for restricted 5G ProSe direct discovery model B

6.2.7.3 Discoverer request procedure accepted by the 5G DDNMF

Upon receiving a DISCOVERY_REQUEST message, the 5G DDNMF shall check that the application corresponding to the application identity contained in the DISCOVERY_REQUEST message is authorised for restricted 5G ProSe direct discovery model B discoverer operation. If the application is authorised for restricted 5G ProSe direct discovery model B discoverer operation, the 5G DDNMF shall check whether there is an existing context for the UE.

If there is no associated UE context, the 5G DDNMF checks with the UDM whether the UE is authorised for restricted 5G ProSe direct discovery model B discoverer operation as described in 3GPP TS 29.503 [10]. If the check indicates that the UE is authorised, the 5G DDNMF creates a UE context that contains the UE's subscription parameters obtained from the UDM. The UDM also provides to the 5G DDNMF the PLMN ID of the PLMN in which the UE is currently registered.

If the UE context exists, the 5G DDNMF shall check whether the UE is authorized for restricted 5G ProSe direct discovery model B discoveree operation in the currently registered PLMN or the local PLMN identified by the Announcing PLMN ID included in the DISCOVERY_REQUEST message.

If the UE is authorized and the discovery entry ID included in the DISCOVERY_REQUEST message is set to 0 then:

a) the 5G DDNMF uses the procedure described in 3GPP TS 29.557 [19] to pass the application level container included in the DISCOVERY_REQUEST message to the ProSe application server and obtain a list of PDUID(s) corresponding to the authorised target RPAUID(s) from the ProSe application server;

b) for each of the PDUIDs corresponding to an authorised target RPAUID:

   1) if the PLMN ID of the PDUID is not the same as that of the PLMN to which the 5G DDNMF belongs, then the 5G DDNMF executes the procedures defined in 3GPP TS 29.555 [9] to obtain the ProSe query code, the ProSe response code, the associated validity timer T5070, and optionally metadata associated with this target RPAUID. Otherwise, the 5G DDNMF shall locate the discoveree UE context and retrieve the corresponding ProSe query code and ProSe response code and the validity timer T5070, and optionally metadata associated with this RPAUID. Then, the 5G DDNMF in the HPLMN builds one or more discovery response filter(s) based on the respective ProSe response code, and associate the discovery response filter(s) and ProSe query code with a new validity timer T5071 based on the remaining value of T5071.

NOTE 1: If the 5G DDNMF cannot retrieve the corresponding discoveree UE context for a target RPAUID, e.g., the target RPAUID has not yet been requested to be discovered by Model B in a discoveree request procedure, or the discoveree UE context expires, the 5G DDNMF can skip the processing of this target RPAUID.

NOTE 2: The 5G DDNMF can choose the value of T5070 to be longer than the remaining value of T5069, so that the discoverer UE sends a new discoverer request for renewing the query-related information no earlier than the discoveree UE renewing its own ProSe response code with the 5G DDNMF.

   2) the 5G DDNMF associates the ProSe query code and corresponding discovery response filter(s), target RPAUID, and optionally metadata associated with the target RPAUID with a new discovery entry in the discoverer UE's context; and

c) the 5G DDNMF starts timer T5071 assigned for each ProSe query code and discovery response filter(s) (of each target RPAUID) under this discovery entry of the discoverer UE context. For a given ProSe query code and the corresponding discovery response filter(s), timer T5071 shall be longer than timer T5070. By default, the value of timer T5071 is 4 minutes greater than the value of timer T5070.

If the discovery entry ID included in the DISCOVERY_REQUEST message is not set to 0 and if there is an existing discovery entry for this discovery entry ID value in the UE's context, the 5G DDNMF shall still process the above steps, but update the discovery entry instead of creating a new discovery entry.

If the discovery entry ID contained in the DISCOVERY_REQUEST message is not found in the UE context or there is no UE context in the 5G DDNMF, the 5G DDNMF shall behave as if the discovery entry ID included in the DISCOVERY_REQUEST message was set to 0, and the 5G DDNMF shall allocate a new non-zero discovery entry ID for this entry.

If a new UE context was created or an existing UE context was updated, the UE is currently roaming or the announcing PLMN ID is included in the DISCOVERY_REQUEST message, the 5G DDNMF checks with the 5G DDNMF of the

VPLMN or the local PLMN indicated by the announcing PLMN ID whether the UE is authorised for restricted 5G ProSe direct discovery model B discoverer operation as described in 3GPP TS 29.555 [9].

The 5G DDNMF shall then send a DISCOVERY_RESPONSE message containing a <restricted-discoverer-response> element with:

a) the transaction ID set to the value of the transaction ID received in the DISCOVERY_REQUEST message from the UE;

b) one or more Subquery Result information elements, each of which includes:

   1) a target RPAUID;

   2) the ProSe query code set to the ProSe query code for the target RPAUID;

   3) one or more discovery response filters which are set to the discovery response filter(s) used to match a potential ProSe response code responding to the ProSe query code;

   4) a validity timer T5070 set to the T5070 timer value assigned by the 5G DDNMF to the ProSe query code and the discovery response filter(s);

   5) optionally, the metadata associated with the target RPAUID;

   6) the code-sending security parameter containing the security-related information needed by the discoverer UE to protect the transmission of ProSe query code; and

   7) the code-receiving security parameter containing the security-related information needed by the discoverer UE to undo the protection applied by the discoveree UE;

c) the discovery entry ID set to the ID of the discovery entry associated with this announce request in the UE context;

d) the current time set to the current UTC-based time at the 5G DDNMF and the max offset; and

e) optionally, the PC5 security policies used for 5G ProSe direct link establishment procedure.

If T5071 expires, the 5G DDNMF shall remove the corresponding ProSe query code and ProSe response filter(s) from the discovery entry associated with the discoverer UE's context.

6.2.7.4 Discoverer request procedure completion by the UE

Upon receipt of the DISCOVERY_RESPONSE message, if the transaction ID contained in the <restricted-discoverer-response> element matches the value sent by the UE in a DISCOVERY_REQUEST message with the command set to "query" and the discovery model set to "Model B", the UE shall, process as follow:

a) If the DISCOVERY_RESPONSE creates a new discovery entry, start the validity timer T5070 with the received value for the ProSe query code and the corresponding Discovery Response Filter(s) included for each SubQuery-Result information element received in the DISCOVERY_RESPONSE message and the PLMN ID of the intended announcing PLMN if included in the DISCOVERY_REQUEST message;

b) If the DISCOVERY_RESPONSE updates an existing discovery entry, the UE shall:

   1) stop the timer T5070 of any ProSe query code(s) and discovery response filter(s) in this discovery entry which are no longer authorized by the 5G DDNMF, ask lower layers to stop announcing the ProSe query code(s) and monitoring ProSe response filter(s), and remove the ProSe query code(s) and discovery response filter(s) from the existing discovery entry;

   2) restart the T5070 timer(s) for those remain eligible;

   3) start the T5070 timer(s) for any new ProSe query codes and their corresponding discovery response filter(s); and

   4) update the PLMN ID of the intended announcing PLMN for this discovery entry if included in the DISCOVERY_REQUEST message.

Otherwise, the UE shall discard the DISCOVERY_RESPONSE message and shall not perform the discoverer UE procedure for 5G ProSe direct discovery as described in clause 6.2.14.2.2.2. The UE shall set a ProSe clock (see 3GPP TS 33.503 [34]) to the value of the received current time parameter and store the received max offset parameter.

For each ProSe query code in this discovery entry, the UE performs the discoverer UE procedure for 5G ProSe direct discovery to announce the ProSe query code in the PC5 interface, as described in clause 6.2.14.2.2.2.

6.2.7.5 Discoverer request procedure not accepted by the 5G DDNMF

If the DISCOVERY_REQUEST message cannot be accepted by the 5G DDNMF, the 5G DDNMF sends a DISCOVERY_RESPONSE message containing a <response-reject> element to the UE including an appropriate PC3a control protocol cause value.

If the application corresponding to the application identity contained in the DISCOVERY_REQUEST message is not authorised for restricted 5G ProSe direct discovery Model B discoverer operation, the 5G DDNMF shall send the DISCOVERY_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value #1 "Invalid application".

If the RPAUID contained in the DISCOVERY_REQUEST message is unknown to the 5G DDNMF or ProSe application server, the 5G DDNMF shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value #9 "Unknown RPAUID".

If the RPAUID contained in the DISCOVERY_REQUEST message does not match the stored RPAUID for the requested discovery entry ID, the 5G DDNMF shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value #10 "Unknown or invalid discovery entry ID".

If the UE is not authorised for restricted 5G ProSe direct discovery model B discoverer operation, the 5G DDNMF shall send the DISCOVERY_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value #3 "UE authorisation failure".

If the RPAUID contained in the DISCOVERY_REQUEST message is not associated with a PDUID belonging to the requesting UE, the 5G DDNMF shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value #3 "UE authorisation failure".

If the 5G DDNMF fails to retrieve any valid target PDUIDs from ProSe application server based on the application level container contained in the DISCOVERY_REQUEST message, the 5G DDNMF shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value #11 "Invalid discovery target".

If the 5G DDNMF fails to retrieve any valid discoveree UE contexts for the valid target RPAUIDs contained in the application level container contained in the DISCOVERY_REQUEST message, the 5G DDNMF shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value #11 "Invalid discovery target".

6.2.7.6 Abnormal cases

6.2.7.6.1 Abnormal cases in the UE

The following abnormal cases can be identified:

a) Indication from the transport layer of transmission failure of DISCOVERY_REQUEST message (e.g., after TCP retransmission timeout)

   The UE shall close the existing secure connection to the 5G DDNMF, establish a new secure connection and then restart the discoverer request procedure.

b) No response from the 5G DDNMF after the DISCOVERY_REQUEST message has been successfully delivered (e.g., TCP ACK has been received for the DISCOVERY_REQUEST message)

   The UE shall retransmit the DISCOVERY_REQUEST message.

NOTE: The timer to trigger retransmission and the maximum number of allowed retransmissions are UE implementation specific.

c) Indication from upper layers that the request to discover the target RPAUID(s) is no longer in place after sending the DISCOVERY_REQUEST message, but before the discoverer request procedure is completed

The UE shall acknowledge the DISCOVERY_RESPONSE message received from the 5G DDNMF but discard its contents and then abort the procedure.

d) Change of PLMN

If a PLMN change occurs before the discoverer request procedure is completed, the procedure shall be aborted. If the UE is authorized to perform restricted 5G ProSe direct discovery discoverer operation Model B in the new PLMN, the procedure shall be restarted once the UE is registered on the new PLMN.

6.2.7.6.2 Abnormal cases in the 5G DDNMF

The following abnormal cases can be identified:

a) Indication from the lower layer of transmission failure of DISCOVERY_RESPONSE message

After receiving an indication from lower layer that the DISCOVERY_RESPONSE message has not been successfully acknowledged (e.g., TCP ACK is not received), the 5G DDNMF shall abort the procedure, and stop any associated timer(s) T5071, if running.

6.2.8 Match report procedure for open 5G ProSe direct discovery

6.2.8.1 General

The purpose of the match report procedure for open 5G ProSe direct discovery is to allow a UE to send a ProSe application code that was matched during the monitoring operation and receive the corresponding ProSe application ID or the updated metadata, if there is no such a mapping stored locally or the metadata index in the ProSe application code indicates the metadata is updated.

The UE shall only initiate the match report procedure if it has been authorized for open 5G ProSe direct discovery monitoring in the monitored PLMN based on the service authorization procedure.

As a result of the match report procedure completing successfully, the UE obtains a ProSe application ID and potentially other information, which the UE may store locally and pass to the upper layers.

6.2.8.2 Match report procedure initiation

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

a) a request from upper layers to monitor for the ProSe application ID, which resulted in the matched ProSe application code, is still in place;

b) the lower layers have provided a "Monitored PLMN ID" value, and UTC time information, along with the discovery message containing a ProSe application code; and

c) the TTL timer T5064 associated with the discovery filter, which resulted in a match event of the ProSe application code, has not expired.

If the UE is authorized to perform open 5G ProSe direct discovery monitoring in the monitored PLMN, it should initiate a match report procedure:

a) when there is a match event of one of the ProSe application codes received from the lower layers, and the UE does not have a corresponding ProSe application ID already locally stored;

b) when the UE has a locally stored mapping for the ProSe application code that resulted in a match event, but the validity timer T5072 of the ProSe application ID has expired;

c) when the UE has a locally stored mapping for the ProSe application code that resulted in a match event, but the match report refresh timer T5074 of the ProSe application filter has expired;

d) when there is a match event of one of the ProSe application codes received from the lower layers, and the UE has a locally stored ProSe application code excluding the metadata index portion located by the locally stored metadata index mask; or

e) when there is a match event of one of the ProSe application codes received from the lower layer, and the UE has not checked the MIC for the discovered ProSe application code previously.

The UE initiates the match report procedure for open 5G ProSe direct discovery by sending a MATCH_REPORT message with a new transaction ID and shall set the message contents as follows:

a) the UE shall set the ProSe application code to the ProSe application code for which there was a match event;

b) the UE shall set the UE identity to the UE's SUPI;

c) the UE shall set the UTC-based counter as follows:

1) the UE shall generate two UTC-based counters with:

i) the first counter composed of:

A) the 27 most significant bits of the UTC-based counter set to the 27 most significant bits of the UTC time provided by the lower layers for the PROSE PC5 DISCOVERY message that contained the ProSe application code for which there was a match event encoded as specified in clause 11.2.2.18;

B) the 28th most significant bit of the UTC-based counter set to '0'; and

C) the 4 least significant bits of the UTC-based counter shall be set to the 4 least significant bits of the UTC-based counter contained in the PROSE PC5 DISCOVERY message that contained the ProSe application code for which there was a match event, as specified in 3GPP TS 33.503 [34]; and

ii) the second counter composed of:

A) the 27 most significant bits of the UTC-based counter set to the 27 most significant bits of the UTC time provided by the lower layers for the PROSE PC5 DISCOVERY message that contained the ProSe application code for which there was a match event encoded as specified in clause 11.2.2.18;

B) the 28th most significant bit of the UTC-based counter set to '1'; and

C) the 4 least significant bits of the UTC-based counter set to the 4 least significant bits of the UTC-based counter contained in the PROSE PC5 DISCOVERY message that contained the ProSe application code for which there was a match event, as specified in 3GPP TS 33.503 [34]; and

2) then the UE shall select, among the two counters described above, the counter that is nearest to the UTC time provided by the lower layers for the PROSE PC5 DISCOVERY message that contained the ProSe application code for which there was a match event encoded as specified in clause 11.2.2.18, and set the UTC-based counter in the MATCH_REPORT message to that counter;

d) the UE shall set the MIC to the MIC of the PROSE PC5 DISCOVERY message that contained the ProSe application code for which there was a match event;

e) the UE shall set the message type to the value of message type field of the PROSE PC5 DISCOVERY message that contained the ProSe application code for which there was a match event;

f) the UE shall set the monitored PLMN ID to the PLMN ID of the PLMN where the PROSE PC5 DISCOVERY message was received, as provided by the lower layers;

g) if the UE was roaming when the match event occurred, the UE shall set the VPLMN ID to the PLMN ID of the PLMN in which the UE was registered when the match event occurred; and

h) the UE shall set the metadata flag to indicate whether or not it wishes to receive metadata information associated with the ProSe application ID in the MATCH_REPORT_ACK message from the 5G DDNMF.

NOTE 1: A UE can include one or multiple transactions in one MATCH_REPORT message for different ProSe application codes, and receive corresponding <match-ack> element or <match-reject> element in the MATCH_REPORT_ACK message for each respective transaction. In the following description of match report procedure, only one transaction is included.

NOTE 2: The value of the metadata flag is determined through an indication from upper layers in the original request to monitor for a ProSe application ID.

Figure 6.2.8.2.1 illustrates the interaction between the UE and the 5G DDNMF in the match report procedure.

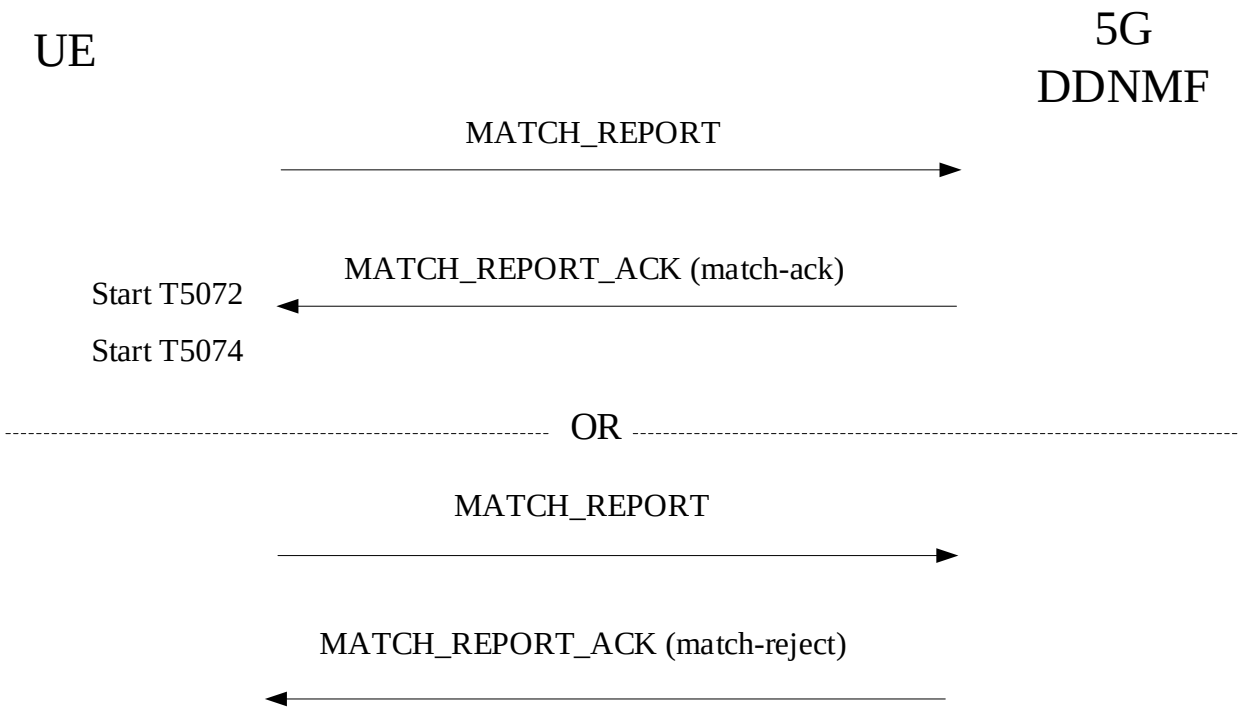

Figure 6.2.8.2.1: Match report procedure

6.2.8.3 Match report procedure accepted by the 5G DDNMF

Upon receiving a MATCH_REPORT message, the 5G DDNMF shall check whether there is an existing context for the UE identified by its SUPI. If there is no associated UE context, the 5G DDNMF checks with the UDM whether the UE is authorized for open 5G ProSe direct discovery monitoring as described in 3GPP TS 29.503 [10].

The 5G DDNMF shall also check the PLMN ID in the ProSe application code received from the UE. If the PLMN ID in the ProSe application code is not the same of that of the PLMN to which the 5G DDNMF belongs, the 5G DDNMF shall execute the procedures defined in 3GPP TS 29.555 [9]. Otherwise, the 5G DDNMF shall check whether the received ProSe application code is authorized to be transmitted on the monitored PLMN indicated in the Monitored PLMN ID in the received message.

If the ProSe application code is PLMN-specific, the 5G DDNMF shall verify if the PLMN ID in the ProSe application code is the same as the PLMN of the 5G DDNMF. If so, the 5G DDNMF shall map the ProSe application code to the corresponding ProSe application ID from the PLMN-specific database. If the ProSe application code is country-specific, as specified in clause 24.3 of 3GPP TS 23.003 [4], the 5G DDNMF shall check whether the MCC of the PLMN ID part of the ProSe application code corresponds to the country of the 5G DDNMF. If so, the 5G DDNMF shall map the ProSe application code to the corresponding ProSe application ID from the country-specific database. If the ProSe application code is global as specified in clause 24.3 of 3GPP TS 23.003 [4], the 5G DDNMF shall map the ProSe application code to the corresponding ProSe application ID from the global database. If the ProSe application code contains a ProSe application code prefix, the 5G DDNMF maps the ProSe application code prefix to the corresponding ProSe application ID.

The 5G DDNMF shall analyze the ProSe application code received from the UE and determine the validity of the ProSe application code.

NOTE: This might require the 5G DDNMF to execute procedures defined in 3GPP TS 29.555 [9].

The 5G DDNMF shall check if the MIC value and its corresponding UTC-based counter are valid, as defined in 3GPP TS 33.503 [34].

If the VPLMN ID is included in the MATCH_REPORT message, the 5G DDNMF uses it for charging purposes as specified in 3GPP TS 32.277 [r32277].

Editor's Note: Charging aspect will be updated upon stage-2 normative requirement is available.

If the outcome of above processing is successful, the 5G DDNMF shall send a MATCH_REPORT_ACK message containing a <match-ack> element with:

a) the transaction ID set to the value of the transaction ID received in the MATCH_REPORT message from the UE;

b) the ProSe application ID set to the ProSe application ID provided by the 5G DDNMF and corresponding to the ProSe application code contained in the MATCH_REPORT message;

c) the validity timer T5072 set to indicate for how long this ProSe application ID is valid;

d) the match report refresh timer T5074 set to indicate for how long the UE will wait before sending a new match report for this ProSe application code; and

e) optionally, the metadata set to the metadata information associated with the ProSe application code received in the MATCH_REPORT message and set the metadata index mask to the metadata index mask allocated by the 5G DDNMF for the ProSe application code received in the MATCH_REPORT message, if the UE has set the metadata flag to indicate that it wishes to receive metadata information associated with the ProSe application ID.

6.2.8.4 Match report procedure completion by the UE

Upon receipt of the MATCH_REPORT_ACK message, if the transaction ID contained in the <match-ack> element matches the value sent by the UE in a MATCH_REPORT message, the UE shall store the mapping between the ProSe application code and ProSe application ID locally, start timers T5072 and T5074, and may inform the upper layers of this match of the ProSe application ID. If the metadata index mask is contained in the MATCH_REPORT_ACK message, the UE shall also store the metadata index mask with the ProSe application code and the ProSe application ID locally. If there is a locally stored mapping between the ProSe application ID and a ProSe application code, the UE shall delete the old mapping. Otherwise, the UE shall discard the MATCH_REPORT_ACK message.

Upon receipt of the MATCH_REPORT_ACK message, if the transaction ID contained in the <match-reject> element matches the value sent by the UE in a MATCH_REPORT message and if the received PC3a control protocol cause value is #5 "Invalid MIC", as specified in clause 6.2.8.5, the UE shall stop timer T5072 if it is running.

NOTE 1: It is an implementation specific choice whether the UE informs the upper layers every time a ProSe application ID triggers a match event, or only the first time this match occurs.

NOTE 2: The UE can also inform the upper layers if a ProSe application ID is no longer matched, because the validity timer T5072 of the corresponding ProSe application code expires.

NOTE 3: The UE can also inform the upper layers if a ProSe application ID is no longer matched, because the validity timer T5072 of the corresponding ProSe application code is stopped upon receiving MATCH_REPORT_ACK message with a <match-reject> element with PC3a control protocol cause value #5 "Invalid MIC".

6.2.8.5 Match report procedure not accepted by the 5G DDNMF

If the MATCH_REPORT message is not accepted by the 5G DDNMF, the 5G DDNMF sends a MATCH_REPORT_ACK message with a <match-reject> element to the UE including an appropriate PC3a control protocol cause value.

If the ProSe application code contained in the MATCH_REPORT message is unknown by the 5G DDNMF, the 5G DDNMF shall send the MATCH_REPORT_ACK message with a <match-reject> element with PC3a control protocol cause value #4 "Unknown ProSe application code".

If the check of the MIC contained in the MATCH_REPORT message fails, the 5G DDNMF shall send the MATCH_REPORT_ACK message with a <match-reject> element with PC3a control protocol cause value #5 "Invalid MIC".

If the check of the UTC-based counter contained in the MATCH_REPORT message fails, the 5G DDNMF shall send the MATCH_REPORT_ACK message with a <match-reject> element with PC3a control protocol cause value #6 "Invalid UTC-based counter".

If the UE is not authorized for open 5G ProSe direct discovery monitoring in the monitored PLMN contained in the MATCH_REPORT message, the 5G DDNMF shall send the MATCH_REPORT_ACK message with a <match-reject> element with PC3a control protocol cause value #3 "UE authorization failure".

6.2.8.6 Abnormal cases

6.2.8.6.1 Abnormal cases in the UE

The following abnormal cases can be identified:

a) Indication from the transport layer of transmission failure of MATCH_REPORT message (e.g., after TCP retransmission timeout)

   The UE shall close the existing secure connection to the 5G DDNMF, establish a new secure connection and then restart the match report procedure.

b) No response from the 5G DDNMF after the MATCH_REPORT message has been successfully delivered (e.g., TCP ACK has been received for the MATCH_REPORT message)

   If the TTL timer T5064 associated with the discovery filter which resulted in a match event has not expired, the UE shall retransmit the MATCH_REPORT message.

NOTE: The timer to trigger retransmission and the maximum number of allowed retransmissions are UE implementation specific.

c) Change of PLMN

   If a PLMN change occurs before the match report procedure is completed, the procedure shall be aborted.

6.2.9 Match report procedure for restricted 5G ProSe direct discovery model A

6.2.9.1 General

The purpose of the match report procedure is to allow a UE to send a ProSe restricted code that was matched during the monitoring operation and receive the corresponding RPAUID, if there is no such a mapping stored locally.

The UE shall only initiate the match report procedure if it has been authorized for restricted 5G ProSe direct discovery monitoring model A in the monitored PLMN based on the service authorization procedure.

As a result of the match report procedure completing successfully, the UE obtains a RPAUID and potentially other information, which the UE may store locally and pass to the upper layers.

6.2.9.2 Match report procedure initiation

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

a) a request from upper layers to monitor for the target RPAUID, which resulted in the matched ProSe restricted code, is still in place;

b) the lower layers have provided UTC time information, along with the discovery message containing the ProSe restricted code; and

c) the TTL timer T5066 associated with the Restricted discovery filter, whose use resulted in a match event of the ProSe restricted code, has not expired.

If the UE is authorized to perform restricted 5G ProSe direct discovery monitoring model A in the monitored PLMN, it should initiate a match report procedure:

a) when there is a match event after applying one of the Restricted discovery filter(s) to a ProSe restricted code received from the lower layers, and the UE does not have a corresponding RPAUID already locally stored;

b) when the UE has a locally stored mapping for the ProSe restricted code that resulted in a match event, but the validity timer T5076 of the ProSe restricted code has expired;

c) when the UE has a locally stored mapping for the ProSe restricted code that resulted in a match event, but the match report refresh timer T5077 of the ProSe restricted code has expired;

d) when the UE desires to obtain the metadata associated with the discovered ProSe restricted code; or

e) when the UE has a locally stored mapping for the ProSe restricted code that resulted in a match event, but the UE does not have a running match report refresh timer T5077 for this ProSe restricted code and the UE is directed by the 5G DDNMF to perform the required MIC check via the match report procedure.

NOTE 1: The 5G DDNMF directs the UE to use the match report procedure to perform the MIC check by including the MIC Check Indicator parameter in the DISCOVERY_RESPONSE message.

The UE initiates the match report procedure by sending a MATCH_REPORT message with a new transaction ID and shall set the message contents as follows:

a) the RPAUID set to the UE's RPAUID which has requested the corresponding monitoring operation that resulted this match event;

b) the ProSe restricted code set to the ProSe restricted code for which there was a match event;

c) the UE identity set to the UE's SUPI;

d) the discovery type set to "Restricted discovery";

e) the application identity set to the application identity of the upper layer application that triggered the monitoring operation;

f) optionally, the UTC-based counter set as follows if the MIC is checked via the match report procedure:

   1) the UE shall generate two UTC-based counters with:

      i) the first counter composed of:

         A) the 23 most significant bits of the UTC-based counter set to the 23 most significant bits of the UTC time provided by the lower layers for the PROSE PC5 DISCOVERY message that contained the ProSe restricted code for which there was a match event encoded as specified in clause 11.2.2.18;

         B) the 24th most significant bit of the UTC-based counter set to '0'; and

         C) the 8 least significant bits of the UTC-based counter set to the 8 least significant bits of the UTC-based counter contained in the PROSE PC5 DISCOVERY message that contained the ProSe restricted code for which there was a match event, as specified in 3GPP TS 33.503 [34]; and

      ii) the second counter composed of:

         A) the 23 most significant bits of the UTC-based counter set to the 23 most significant bits of the UTC time provided by the lower layers for the PROSE PC5 DISCOVERY message that contained the ProSe restricted code for which there was a match event encoded as specified in clause 11.2.2.18;

         B) the 24th most significant bit of the UTC-based counter set to '1'; and

         C) the 8 least significant bits of the UTC-based counter set to the 8 least significant bits of the UTC-based counter contained in the PROSE PC5 DISCOVERY message that contained the ProSe restricted code for which there was a match event, as specified in 3GPP TS 33.503 [34]; and

Editor's Note: Security aspect will be updated upon SA3 normative requirement is available.

2) then the UE shall select, among the two counters described above, the counter that is nearest to the UTC time provided by the lower layers for the PROSE PC5 DISCOVERY message that contained the ProSe restricted code for which there was a match event encoded as specified in clause 11.2.2.18, and set the UTC-based counter in the MATCH_REPORT message to that counter;

g) optionally, the message type set to the value of message type field of the PROSE PC5 DISCOVERY message that contained the ProSe restricted code for which there was a match event, if the MIC is checked via the match report procedure;

h) optionally, the MIC set to the MIC of the PROSE PC5 DISCOVERY message that contained the ProSe restricted code for which there was a match event if the MIC is checked via the match report procedure; and

i) the metadata flag set to indicate whether or not the UE wishes to receive the latest metadata information associated with the RPAUID in the MATCH_REPORT_ACK message from the 5G DDNMF.

NOTE 2: A UE can include one or multiple transactions in one MATCH_REPORT message for different ProSe restricted codes, and receive a corresponding <restricted-match-ack> element or <match-reject> element in the MATCH_REPORT_ACK message for each respective transaction. In the following description of match report procedure, only one transaction is included.

Figure 6.2.9.2.1 illustrates the interaction between the UE and the 5G DDNMF in the match report procedure.

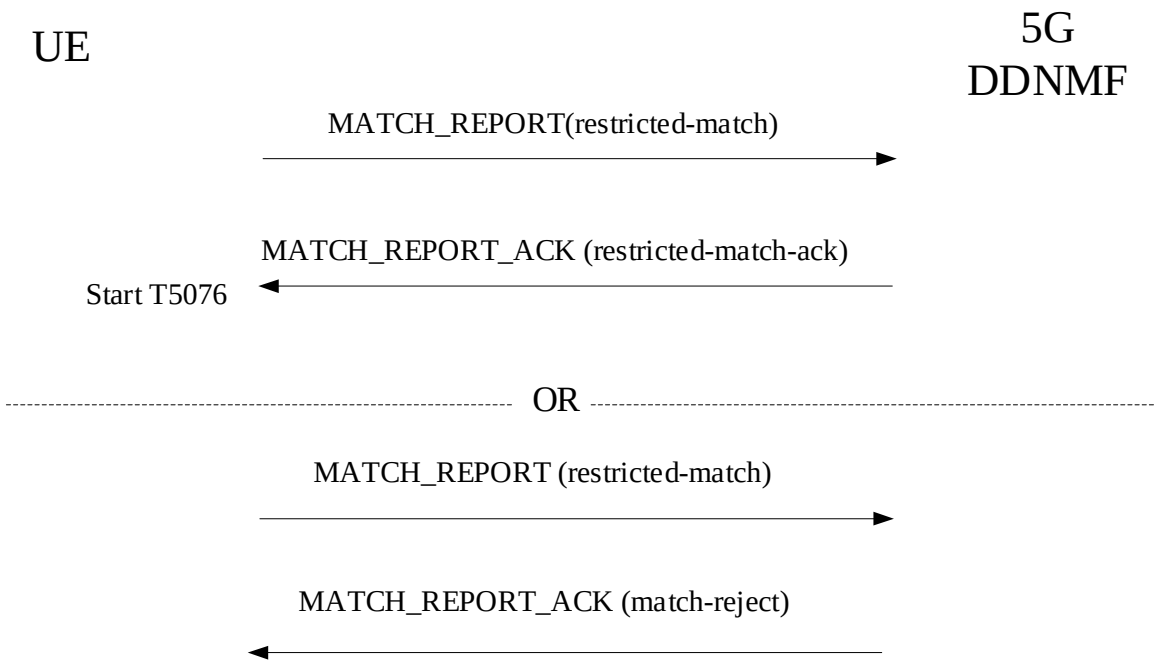

Figure 6.2.9.2.1: Match report procedure for restricted discovery model A

6.2.9.3 Match report procedure accepted by the 5G DDNMF

Upon receiving a MATCH_REPORT message, the 5G DDNMF shall check whether there is an existing context for the UE identified by its SUPI.

The 5G DDNMF shall analyze the ProSe restricted code received from the UE in the MATCH_REPORT message. If the MIC value and its corresponding UTC-based counter are included, the 5G DDNMF shall check whether the MIC value and the UTC-based counter are valid and within the acceptable range respectively as defined in 3GPP TS 33.503 [34]. The 5G DDNMF shall then check in the UE context if the ProSe restricted code matches any

restricted discovery filter(s) allocated for the particular application identified by the application identity received in the MATCH_REPORT message. If such a discovery filter exists, the target RPAUID associated with the filter(s) shall be identified as the corresponding RPAUID for this code. Optionally, the 5G DDNMF may further invoke the procedure defined in 3GPP TS 29.503 [10] to verify if the target RPAUID is allowed to be discovered by the RPAUID of the requesting UE that has sent the MATCH_REPORT message, or to retrieve metadata associated for the target RPAUID if metadata flag is set to "True" in the MATCH_REPORT message and the 5G DDNMF does not have the latest metadata.

If the outcome of the above processing is successful, the 5G DDNMF shall send a MATCH_REPORT_ACK message containing a <restricted-match-ack> element with:

a) the transaction ID set to the value of the transaction ID received in the MATCH_REPORT message from the UE;

b) the RPAUID set to the target RPAUID retrieved from the UE context at the 5G DDNMF which corresponds to the ProSe restricted code contained in the MATCH_REPORT message;

c) the validity timer T5076 set to indicate for how long this ProSe restricted code is valid;

d) the match report refresh timer T5077 to indicate for how long the UE will wait before sending a new match report for this ProSe restricted code if the MIC value and the UTC-based counter are included in the MATCH_REPORT message; and

e) the metadata set to the associated metadata information, if there exists metadata information associated with this target RPAUID and the metadata flag is set to "True" in the MATCH_REPORT message.

If the corresponding PDUID of the target RPAUID does not belong to the HPLMN of the requesting UE, the 5G DDNMF may optionally invoke the procedure defined in 3GPP TS 29.555 [9] to inform the 5G DDNMF of the announcing UE about the match event.

6.2.9.4 Match report procedure completion by the UE

Upon receipt of the MATCH_REPORT_ACK message, if the transaction ID contained in the <restricted-match-ack> element matches the value sent by the UE in a MATCH_REPORT message, the UE shall store the mapping between the ProSe restricted code and RPAUID locally, start timers T5076 and T5077, and may inform the upper layers of this match of the RPAUID. Otherwise, the UE shall discard the MATCH_REPORT_ACK message.

Upon receipt of the MATCH_REPORT_ACK message, if the transaction ID contained in the <match-reject> element matches the value sent by the UE in a MATCH_REPORT message and if the received PC3a control protocol cause value is #5 "Invalid MIC", as specified in clause 6.2.9.5, the UE shall stop timer T5016 if it is running.

NOTE 1: It is an implementation specific choice whether the UE informs the upper layers every time an RPAUID triggers a match event, or only the first time this match occurs.

NOTE 2: The UE can also inform the upper layers if an RPAUID is no longer matched, because the validity timer T5076 of the corresponding ProSe restricted code expires.

NOTE 3: The UE can also inform the upper layers if a ProSe restricted code is no longer matched, because the validity timer T5016 of the corresponding ProSe restricted code is stopped upon receiving MATCH_REPORT_ACK message with a <match-reject> element with PC3a control protocol cause value #5 "Invalid MIC".

6.2.9.5 Match report procedure not accepted by the 5G DDNMF

If the MATCH_REPORT message is not accepted by the 5G DDNMF, the 5G DDNMF sends a MATCH_REPORT_ACK message with a <match-reject> element to the UE including an appropriate PC3a control protocol cause value.

If there is no associated UE context for the SUPI contained in the MATCH_REPORT message, the 5G DDNMF shall send the MATCH_REPORT_ACK message with a <match-reject> element with PC3a control protocol cause value #16 "Invalid match event".

If the ProSe restricted code contained in the MATCH_REPORT message does not match any Restricted discovery filter(s) allocated for the requesting UE for the corresponding application, the 5G DDNMF shall send the

MATCH_REPORT_ACK message with a <match-reject> element with PC3a control protocol cause value #16 "Invalid match event".

If the check of the MIC contained in the MATCH_REPORT message fails, the 5G DDNMF shall send the MATCH_REPORT_ACK message with a <match-reject> element with PC3a control protocol cause value #5 "Invalid MIC".

If the check of the UTC-based counter contained in the MATCH_REPORT message fails, the 5G DDNMF shall send the MATCH_REPORT_ACK message with a <match-reject> element with PC3a control protocol cause value #6 " Invalid UTC-based counter".

If the UE is not authorized for restricted 5G ProSe direct discovery monitoring, the 5G DDNMF shall send the MATCH_REPORT_ACK message with a <match-reject> element with PC3a control protocol cause value #3 "UE authorization failure".

6.2.9.6 Abnormal cases

6.2.9.6.1 Abnormal cases in the UE

The following abnormal cases can be identified:

a) Indication from the transport layer of transmission failure of MATCH_REPORT message (e.g., after TCP retransmission timeout)

   The UE shall close the existing secure connection to the 5G DDNMF, establish a new secure connection and then restart the match report procedure.

b) No response from the 5G DDNMF after the MATCH_REPORT message has been successfully delivered (e.g., TCP ACK has been received for the MATCH_REPORT message)

   If the TTL timer T5066 associated with the restricted discovery filter which resulted in a match event has not expired, the UE shall retransmit the MATCH_REPORT message.

NOTE: The timer to trigger retransmission and the maximum number of allowed retransmissions are UE implementation specific.

6.2.10 Match report procedure for restricted 5G ProSe direct discovery model B

6.2.10.1 General

The purpose of the Match report procedure is to allow a UE to send a ProSe response code that was matched during the restricted 5G ProSe direct discovery Model B discoverer operation and receive the corresponding RPAUID, if there is no such a mapping stored locally.

The UE shall only initiate the match report procedure if it has been authorized for restricted 5G ProSe direct discovery model B discoverer operation in the monitored PLMN based on the service authorization procedure.

As a result of the match report procedure completing successfully, the UE obtains a RPAUID and potentially other information, which the UE may store locally and pass to the upper layers.

6.2.10.2 Match report procedure initiation

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

a) a request from upper layers to discover the target RPAUID with restricted discovery model B, which resulted in the matched ProSe response code, is still in place;

b) the lower layers have provided UTC time information, along with the discovery message containing the ProSe response code; and

c) the validity timer T5070 associated with the discovery response filter, whose use resulted in a match event of the ProSe response code, has not expired.

If the UE is authorized to perform restricted 5G ProSe direct discovery model B discoverer operation in the monitored PLMN, it should initiate a match report procedure:

a) when there is a match event when applying one of the discovery response filter(s) to one of the ProSe response codes received from the lower layers, and the UE does not have a corresponding RPAUID already locally stored;

b) when the UE has a locally stored mapping for the ProSe response code that resulted in a match event, but the validity timer T5076 of the ProSe response code has expired;

c) when the UE has a locally stored mapping for the ProSe response code that resulted in a match event, but the match report refresh timer T5077 of the ProSe response code has expired;

d) when the UE desires to obtain the metadata associated with the discovered ProSe response code; or

e) when the UE has a locally stored mapping for the ProSe response code that resulted in a match event, but the UE does not have a running match report refresh timer T5077 for this ProSe response code and the UE is directed by the 5G DDNMF to perform the required MIC check via the match report procedure.

NOTE 1: The 5G DDNMF directs the UE to use the match report procedure to perform the MIC check by including the MIC Check Indicator parameter in the DISCOVERY_RESPONSE message.

The UE initiates the match report procedure by sending a MATCH_REPORT message with a new transaction ID and shall set the message contents as follows:

a) the RPAUID set to the UE's RPAUID which has requested the corresponding restricted discovery model B discoverer operation that resulted this match event;

b) the ProSe response code set to the ProSe response code for which there was a match event;

c) the UE identity set to the UE's SUPI;

d) the discovery type set to "Restricted discovery";

e) the application identity set to the application identity of the upper layer application that triggered the restricted direct discovery Model B discoverer operation;

f) optionally, the UTC-based counter set as follows if the MIC is checked via the match report procedure:

1) the UE shall generate two UTC-based counters with:

i) the first counter composed of:

A) the 27 most significant bits of the UTC-based counter set to the 27 most significant bits of the UTC time provided by the lower layers for the PROSE PC5 DISCOVERY message that contained the ProSe response code for which there was a match event encoded as specified in clause 11.2.2.18;

B) the 24th most significant bit of the UTC-based counter set to '0'; and

C) the 8 least significant bits of the UTC-based counter shall be set to the 8 least significant bits of the UTC-based counter contained in the PROSE PC5 DISCOVERY message that contained the ProSe response code for which there was a match event, as specified in 3GPP TS 33.503 [34]; and

ii) the second counter composed of:

A) the 23 most significant bits of the UTC-based counter set to the 23 most significant bits of the UTC time provided by the lower layers for the PROSE PC5 DISCOVERY message that contained the ProSe response code for which there was a match event encoded as specified in clause 11.2.2.18;

B) the 24th most significant bit of the UTC-based counter set to '1'; and

C) the 8 least significant bits of the UTC-based counter set to the 8 least significant bits of the UTC-based counter contained in the PROSE PC5 DISCOVERY message that contained the ProSe response code for which there was a match event, as specified in 3GPP TS 33.503 [34]; and

2) then the UE shall select, among the two counters described above, the counter that is nearest to the UTC time provided by the lower layers for the PROSE PC5 DISCOVERY message that contained the ProSe response code for which there was a match event encoded as specified in clause 11.2.2.18, and set the UTC-based counter in the MATCH_REPORT message to that counter;

g) optionally, the message type set to the value of message type field of the PROSE PC5 DISCOVERY message that contained the ProSe response code for which there was a match event, if the MIC is checked via the match report procedure;

h) optionally, the MIC to the MIC of the PROSE PC5 DISCOVERY message that contained the ProSe response code for which there was a match event if the MIC is checked via the match report procedure; and

i) the metadata flag set to indicate whether or not the UE wishes to receive the latest metadata information associated with the RPAUID in the MATCH_REPORT_ACK message from the 5G DDNMF.

NOTE 2: A UE can include one or multiple transactions in one MATCH_REPORT message for different ProSe response codes, and receive corresponding <restricted-match-ack> element or <match-reject> element in the MATCH_REPORT_ACK message for each respective transaction. In the following description of match report procedure, only one transaction is included.

Figure 6.2.10.2.1 illustrates the interaction between the UE and the 5G DDNMF in the match report procedure.

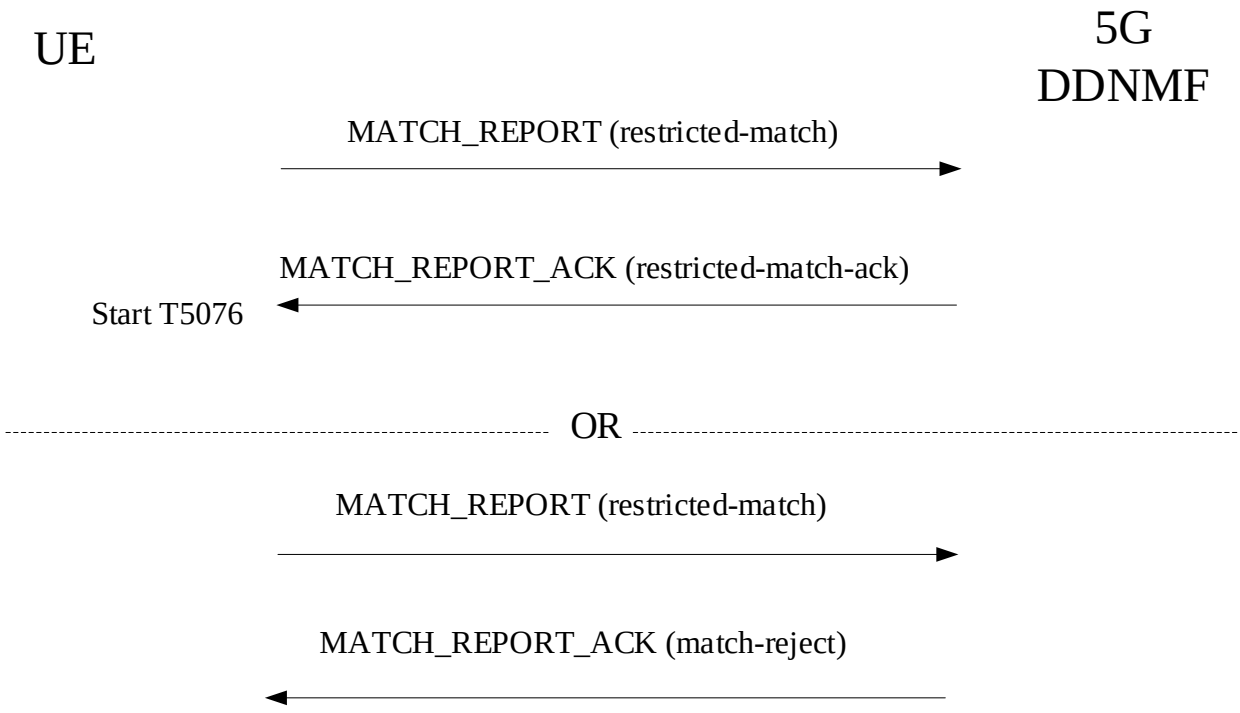

Figure 6.2.10.2.1: Match report procedure for restricted discovery model B

6.2.10.3 Match report procedure accepted by the 5G DDNMF

Upon receiving a MATCH_REPORT message, the 5G DDNMF shall check whether there is an existing discoverer UE context for the UE identified by its SUPI.

The 5G DDNMF shall analyze the ProSe response code received from the UE in the MATCH_REPORT message. If the MIC value and its corresponding UTC-based counter are included, the 5G DDNMF shall check whether the MIC value and the UTC-based counter are valid and within the acceptable range respectively, as defined in 3GPP TS 33.503 [34].

The 5G DDNMF shall then check in the UE context if the ProSe response code matches any discovery response filter(s) allocated for the particular application identified by the application identity received in the MATCH_REPORT message. If such a discovery filter exists, the target RPAUID associated with the filter(s) shall be identified as the corresponding RPAUID for this code. Optionally, the 5G DDNMF may further invoke the procedure defined in 3GPP TS 29.503 [10] to verify if the target RPAUID is allowed to be discovered by the RPAUID of the requesting UE that has sent the MATCH_REPORT message, or to retrieve metadata associated for the target RPAUID if metadata flag is set to "True" in the MATCH_REPORT message and the 5G DDNMF does not have the latest metadata.

If the outcome of the above processing is successful, the 5G DDNMF shall send a MATCH_REPORT_ACK message containing a <restricted-match-ack> element with:

a) the transaction ID set to the value of the transaction ID received in the MATCH_REPORT message from the UE;

b) the RPAUID set to the target RPAUID retrieved from the UE context at the 5G DDNMF which corresponds to the ProSe response code contained in the MATCH_REPORT message;

c) the validity timer T5076 set to indicate for how long the RPAUID is matched;

d) the match report refresh timer T5077 set to indicate for how long the UE will wait before sending a new match report for this ProSe response code if the MIC value and the UTC-based counter are included in the MATCH_REPORT message; and

e) optionally, the metadata set to the associated metadata information, if there exists metadata information associated with this target RPAUID.

If the corresponding PDUID of the target RPAUID does not belong to the HPLMN of the requesting UE, the 5G DDNMF may optionally invoke the procedure defined in 3GPP TS 29.555 [9] to inform the 5G DDNMF of the discoveree UE about the match event.

6.2.10.4 Match report procedure completion by the UE

Upon receipt of the MATCH_REPORT_ACK message, if the transaction ID contained in the <restricted-match-ack> element matches the value sent by the UE in a MATCH_REPORT message, the UE shall store the mapping between the ProSe response code and the RPAUID locally, start timers T5076 and T5077, and may inform the upper layers of this match of the RPAUID. Otherwise, the UE shall discard the MATCH_REPORT_ACK message.

Upon receipt of the MATCH_REPORT_ACK message, if the transaction ID contained in the <match-reject> element matches the value sent by the UE in a MATCH_REPORT message and if the received PC3a control protocol cause value is #5 "Invalid MIC", as specified in clause 6.2.10.5, the UE shall stop timer T5076 if it is running.

NOTE 1: It is an implementation specific choice whether the UE informs the upper layers every time a RPAUID triggers a match event, or only the first time this match occurs.

NOTE 2: The UE can also inform the upper layers if an RPAUID is no longer matched, because the validity timer T5076 of the corresponding ProSe response code expires.

NOTE 3: The UE can also inform the upper layers if a ProSe response code is no longer matched, because the validity timer T5076 of the corresponding ProSe response code is stopped upon receiving MATCH_REPORT_ACK message with a <match-reject> element with PC3a control protocol cause value #5 "Invalid MIC".

6.2.10.5 Match report procedure not accepted by the 5G DDNMF

If the MATCH_REPORT message is not accepted by the 5G DDNMF, the 5G DDNMF sends a MATCH_REPORT_ACK message with a <match-reject> element to the UE including an appropriate PC3a control protocol cause value.

If there is no associated UE context for the SUPI contained in the MATCH_REPORT, the 5G DDNMF shall send the MATCH_REPORT_ACK message with a <match-reject> element with PC3a control protocol cause value #16 "Invalid match event".

If the ProSe response code contained in the MATCH_REPORT message does not match any Discovery Response Filter(s) allocated for the requesting UE for the corresponding application, the 5G DDNMF shall send the

MATCH_REPORT_ACK message with a <match-reject> element with PC3a control protocol cause value #16 "Invalid match event".

If the check of the MIC contained in the MATCH_REPORT message fails, the 5G DDNMF shall send the MATCH_REPORT_ACK message with a <match-reject> element with PC3a control protocol cause value #5 "Invalid MIC".

If the check of the UTC-based counter contained in the MATCH_REPORT message fails, the 5G DDNMF shall send the MATCH_REPORT_ACK message with a <match-reject> element with PC3a control protocol cause value #6 " Invalid UTC-based counter".

If the UE is not authorized for restricted 5G ProSe direct discovery model B discoverer operation, the 5G DDNMF shall send the MATCH_REPORT_ACK message with a <match-reject> element with PC3a control protocol cause value #3 "UE authorization failure".

6.2.10.6 Abnormal cases

6.2.10.6.1 Abnormal cases in the UE

The following abnormal cases can be identified:

a) Indication from the transport layer of transmission failure of MATCH_REPORT message (e.g., after TCP retransmission timeout)

   The UE shall close the existing secure connection to the 5G DDNMF, establish a new secure connection and then restart the match report procedure.

b) No response from the 5G DDNMF after the MATCH_REPORT message has been successfully delivered (e.g., TCP ACK has been received for the MATCH_REPORT message)

   If the validity timer T5070 associated with the Discovery Response Filter which resulted in a match event has not expired, the UE shall retransmit the MATCH_REPORT message.

NOTE: The timer to trigger retransmission and the maximum number of allowed retransmissions are UE implementation specific.

6.2.11 Direct discovery update procedure for open discovery

6.2.11.1 General

The direct discovery update procedure is used to update or revoke a previously allocated ProSe application code, or discovery filter(s) as specified in 3GPP TS 23.304 [2].

6.2.11.2 Direct discovery update procedure initiation

When triggered to revoke a previously allocated ProSe application code for an announcing UE or revoke discovery filter(s) for a monitoring UE, the 5G DDNMF in the HPLMN sends a DISCOVERY_UPDATE_REQUEST message to the UE with:

a) a new DDNMF transaction ID not used in any other direct discovery procedures in PC3a interface;

b) the UE identity set to the UE's SUPI; and

c) the discovery entry ID set to the discovery entry ID of the corresponding discovery entry that contains the ProSe application code or the discovery filter(s) to be revoked.

When triggered to update a previously allocated ProSe application code for an announcing UE, the 5G DDNMF in the HPLMN shall allocate a new ProSe application code for the ProSe application ID with a new validity timer T5060, associate the discovery entry with the new ProSe application code and restart timer T5061.Then the 5G DDNMF sends a DISCOVERY_UPDATE_REQUEST message to the UE with:

a) a new DDNMF transaction ID not used in any other direct discovery procedures in PC3a interface;

b) the UE identity set to the UE's SUPI;

c) the discovery entry ID set to the discovery entry ID of the corresponding discovery entry that contains the ProSe application code to be updated; and

d) the Update info containing the ProSe application code set to the new ProSe application code allocated by the 5G DDNMF and a validity timer T5060 set to the T5060 timer value assigned by the 5G DDNMF to the new ProSe application code.

When triggered to update discovery filter(s) for a monitoring UE, the 5G DDNMF in the HPLMN updates the content of discovery filter(s), associate the discovery entry with the updated discovery filter(s) and restart timer T5063 for each filter. The update of discovery filter content includes setting new TTL timer(s) and if necessary, assigning new ProSe application code and ProSe application mask(s). Then the 5G DDNMF shall send a DISCOVERY_UPDATE_REQUEST message to the UE with:

a) a new DDNMF transaction ID not used in any other direct discovery procedures in PC3a interface;

b) the UE identity set to the UE's SUPI;

c) the discovery entry ID set to the discovery entry ID of the corresponding discovery entry that contains the discovery filter(s) to be updated; and

d) the Update info containing the discovery filter(s) set to the new discovery filter(s) allocated by the 5G DDNMF.

NOTE 1: The 5G DDNMF can include one or multiple transactions in one DISCOVERY_UPDATE_REQUEST message for ProSe App Codes or discovery filter(s) contained in different discovery entries, and receive corresponding < discovery-update-response> element or <response-reject> element in a DISCOVERY_UPDATE_RESPONSE message for each respective transaction. In the following description of direct discovery update request procedure, only one transaction is included.

Figure 6.2.11.2.1 illustrates the interaction of the UE and the 5G DDNMF in the direct discovery update procedure.

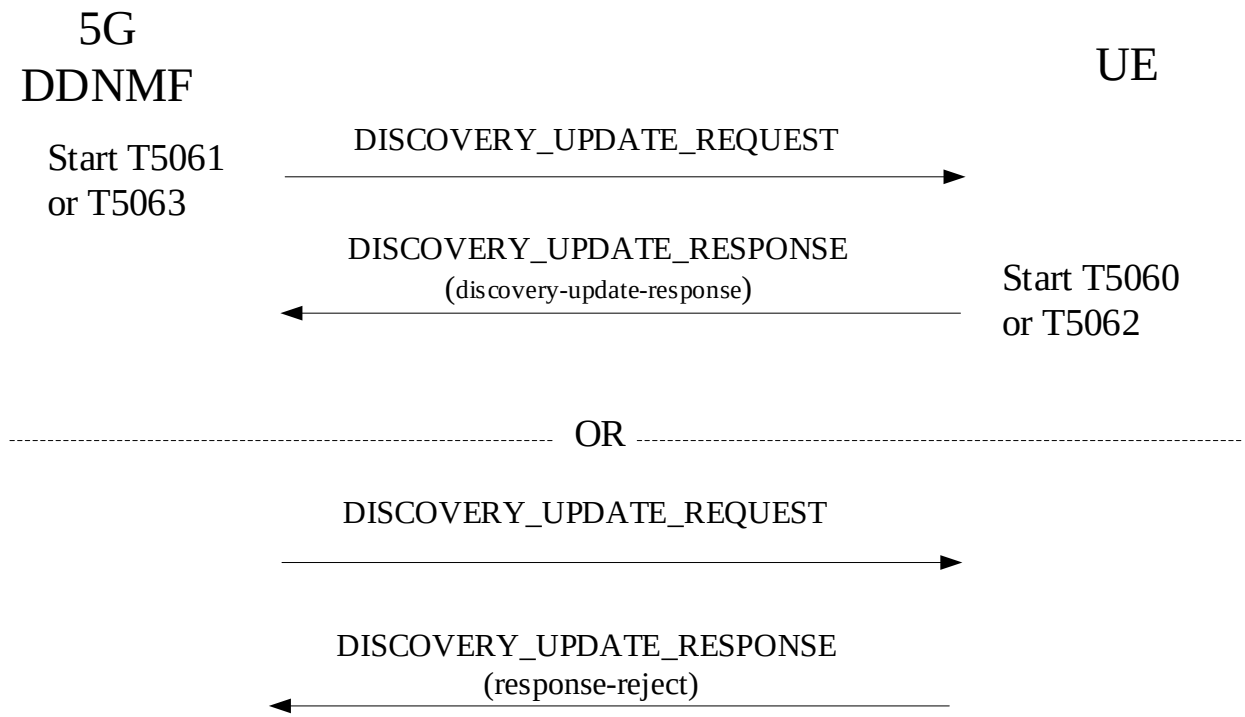

Figure 6.2.11.2.1: Direct discovery update procedure for open discovery

NOTE 2: In the figure 6.2.11.2.1, the timers are started only when the procedure is triggered to update a previously allocated ProSe application code for an announcing UE or update discovery filter(s) for a monitoring UE.

6.2.11.3 Direct discovery update procedure accepted by the UE

Upon receiving a DISCOVERY_UPDATE_REQUEST message, the UE shall check if the UE identity contained in the DISCOVERY_UPDATE_REQUEST message is the SUPI of the UE. If the UE identity is the SUPI of the UE, the UE shall check if the discovery entry ID contained in the DISCOVERY_UPDATE_REQUEST message is known. If the discovery entry ID is known, the UE shall proceed with the following direct discovery update procedure.

If the Update info is not included in the DISCOVERY_UPDATE_REQUEST message, the UE shall stop running timers corresponding to the discovery entry and delete the discovery entry corresponding to the discovery entry ID contained in the DISCOVERY_UPDATE_REQUEST message. The UE informs the lower layers to stop announcing or monitoring corresponding to the discovery entry ID contained in the DISCOVERY_UPDATE_REQUEST message.

If the Update info is included in the DISCOVERY_UPDATE_REQUEST message, the UE shall replace the existing ProSe application code or the discovery filter(s) with new ProSe application code or the discovery filter(s) contained in the Update info correspondingly. The announcing UE shall stop the timer T5060, start the validity timer T5060 with the received value for the new ProSe application code and perform open 5G ProSe direct discovery announcing with the new ProSe application code as described in clause 6.2.2.4. The monitoring UE shall stop TTL timer T5062, start TTL timer T5062 with the received value for each new discovery filter(s) and perform open 5G ProSe direct discovery monitoring with each new discovery filter(s) as described in clause 6.2.5.4.

Then the UE shall send a DISCOVERY_UPDATE_RESPONSE message containing a <response-update> element with:

a) the DDNMF transaction ID set to the value of the DDNMF transaction ID received in the DISCOVERY_UPDATE_REQUEST message; and

b) the discovery entry ID set to the value of the discovery entry ID received in the DISCOVERY_UPDATE_REQUEST message.

6.2.11.4 Direct discovery update procedure completed by the 5G DDNMF

Upon receiving a DISCOVERY_UPDATE_RESPONSE message, if the DDNMF transaction ID contained in the <response-update> element does not match the value sent by the 5G DDNMF in a DISCOVERY_UPDATE_REQUEST message, the 5G DDNMF shall discard the DISCOVERY_UPDATE_RESPONSE message. Otherwise, the 5G DDNMF shall perform the following procedure.

When the UE is an announcing UE and the radio resources that the UE intends to use are operated by a PLMN other than the HPLMN, the 5G DDNMF shall execute the procedures defined in 3GPP TS 29.555 [9] to inform the 5G DDNMF in VPLMN or local PLMN.

When the UE is a monitoring UE and the ProSe application ID monitored by the UE is PLMN-specific and that PLMN ID indicated by the ProSe application ID is not the same as that of the PLMN to which the 5G DDNMF belongs, the 5G DDNMF executes the procedures defined in 3GPP TS 29.555 [9] to inform the 5G DDNMF in the PLMN indicated by the ProSe application ID.

For each discovery entry ID received in the DISCOVERY_UPDATE_RESPONSE message, if the procedure is to revoke a previously allocated ProSe application code or discovery filter(s), the 5G DDNMF shall delete the discovery entry indicated by the discovery entry ID from the UE's context and release the associated resources.

6.2.11.5 Direct discovery update procedure not accepted by the UE

If the DISCOVERY_UPDATE_REQUEST message cannot be accepted by the UE, the UE sends a DISCOVERY_UPDATE_RESPONSE message containing a <response-reject> element to the 5G DDNMF including an appropriate PC3a control protocol cause value.

If the UE identity contained in the DISCOVERY_UPDATE_REQUEST message is not the SUPI of the UE, the UE shall send a DISCOVERY_UPDATE_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value #18 "Invalid UE identity".

If the discovery entry ID contained in the DISCOVERY_UPDATE _REQUEST message is unknown, the UE shall send the DISCOVERY_UPDATE_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value # 10 "Unknown or invalid discovery entry ID".

6.2.11.6 Abnormal cases

6.2.11.6.1 Abnormal cases in the 5G DDNMF

The following abnormal cases can be identified:

a) Indication from the transport layer of transmission failure of DISCOVERY_UPDATE_REQUEST message (e.g., after TCP retransmission timeout)

   The 5G DDNMF shall close the existing secure connection to the UE.

b) No response from the UE after the DISCOVERY_UPDATE_REQUEST message has been successfully delivered (e.g., TCP ACK has been received for the DISCOVERY_UPDATE_REQUEST message)

   The 5G DDNMF shall retransmit the DISCOVERY_UPDATE_REQUEST message.

NOTE: The timer to trigger retransmission and the maximum number of allowed retransmissions are 5G DDNMF implementation specific.

6.2.11.6.2 Abnormal cases in the UE

The following abnormal cases can be identified:

a) Indication from the lower layer of transmission failure of DISCOVERY_UPDATE_RESPONSE message.

   After receiving an indication from lower layer that the DISCOVERY_UPDATE_RESPONSE message has not been successfully acknowledged (e.g., TCP ACK is not received), the UE shall abort the procedure.

6.2.12 Direct discovery update procedure for restricted discovery

6.2.12.1 General

The discovery update procedure is used to update the discovery filters and/or allocate a new ProSe restricted code as defined in 3GPP TS 23.304 [2]. The 5G DDNMF can at any time update/revoke a previously allocated ProSe application code, or discovery filters.

6.2.12.2 Revocation of restricted discovery filters

6.2.12.2.1 Restricted discovery filters revocation procedure initiation

The 5G DDNMF in the HPLMN shall initiate the restricted discovery filters revocation procedure by sending the DISCOVERY_UPDATE_REQUEST to the UE with:

a) a new DDNMF transaction ID not used in any other direct discovery procedures in PC3a interface;

b) the UE identity set to the UE's SUPI;

c) the discovery entry ID set to the discovery entry ID of the corresponding discovery entry that contains the restricted discovery filter to be revoked; and

d) optionally update info containing the restricted discovery filters that replace the existing ones, if the 5G DDNMF decides to remove only certain filter(s) and not others.

NOTE: The 5G DDNMF can include one or multiple transactions in one DISCOVERY_UPDATE_REQUEST message for different Restricted discovery filters, and receive corresponding <response-update> element or <response-reject> element in a DISCOVERY_UPDATE_RESPONSE message for each respective transaction. In the following description of the network initiated direct discovery update request procedure, only one transaction is included.

Figure 6.2.12.2.1 illustrates the interaction of the UE and the 5G DDNMF in the restricted discovery filters revocation procedure.

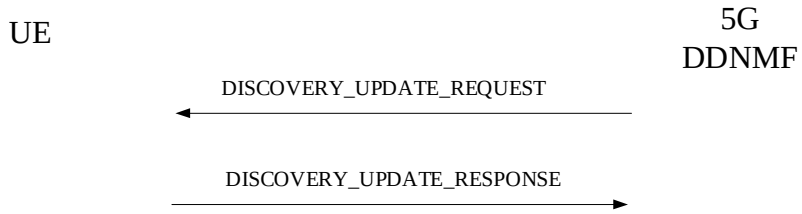

Figure 6.2.12.2.1.1: Restricted discovery filters revocation procedure

6.2.12.2.2 Restricted discovery filters revocation procedure accepted by the UE

Upon receiving a DISCOVERY_UPDATE_REQUEST message, the UE shall check if the UE identity contained in the DISCOVERY_UPDATE_REQUEST message is the SUPI of the UE. If the UE identity is the SUPI of the UE, the UE shall check if the discovery entry ID contained in the DISCOVERY_UPDATE_REQUEST message is valid. If the discovery entry ID is valid, the UE shall proceed with the following direct discovery update procedure.

The UE shall remove all the restricted discovery filters corresponding to the discovery entry ID if the Update info is not included in the DISCOVERY_UPDATE_REQUEST message or shall remove the old restricted discovery filters and store the restricted discovery filter included in the Update info in the DISCOVERY_UPDATE_REQUEST message. Then the UE shall send a DISCOVERY_UPDATE_RESPONSE message to the 5G DDNMF with:

a) the DDNMF transaction ID set to the value of the DDNMF transaction ID received in the DISCOVERY_UPDATE_REQUEST message; and

b) discovery entry ID set to the value of the discovery entry ID received in the DISCOVERY_UPDATE_REQUEST message.

6.2.12.2.3 Restricted discovery filters revocation procedure completion by the 5G DDNMF

Upon receipt of the DISCOVERY_UPDATE_ RESPONSE message by the 5G DDNMF, if the DDNMF transaction ID contained in the <response-update> element does not match the value sent by the 5G DDNMF in a DISCOVERY_UPDATE_REQUEST message, the 5G DDNMF shall discard the DISCOVERY_UPDATE_RESPONSE message. Upon receipt of the DISCOVERY_UPDATE_ RESPONSE message by the 5G DDNMF, if the DDNMF transaction ID contained in the <response-update> element matches the value sent by the 5G DDNMF in a DISCOVERY_UPDATE_REQUEST message, the restricted discovery filters revocation procedure is complete.

6.2.12.2.4 Restricted discovery filters revocation procedure not accepted by the UE

If the DISCOVERY_UPDATE_REQUEST message cannot be accepted by the UE, the UE sends a DISCOVERY_UPDATE_RESPONSE message containing a <response-reject> element to the 5G DDNMF including an appropriate PC3a control protocol cause value.

If the UE identity contained in the DISCOVERY_UPDATE_REQUEST message is not the SUPI of the UE, the UE shall send a DISCOVERY_UPDATE_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value #18 "Invalid UE Identity".

If the discovery entry ID contained in the DISCOVERY_UPDATE_REQUEST message is not found in the UE context, the UE shall send a DISCOVERY_UPDATE_RESPONSE message containing a <response-reject> element with PC3 control protocol cause value #10 "Unknown or Invalid discovery entry ID".

6.2.12.2.5 Abnormal cases

6.2.12.2.5.1 Abnormal cases in the 5G DDNMF

The following abnormal cases can be identified:

a) Indication from the transport layer of transmission failure of DISCOVERY_UPDATE_REQUEST message (e.g., after TCP retransmission timeout)

   The 5G DDNMF shall close the existing secure connection to the UE.

b) No response from the UE after the DISCOVERY_UPDATE_REQUEST message has been successfully delivered (e.g., TCP ACK has been received for the DISCOVERY_UPDATE_REQUEST message)

   The 5G DDNMF shall retransmit the DISCOVERY_UPDATE_REQUEST message.

NOTE: The timer to trigger retransmission and the maximum number of allowed retransmissions are 5G DDNMF implementation specific.

6.2.12.2.5.2 Abnormal cases in the UE

The following abnormal cases can be identified:

a) Indication from the lower layer of transmission failure of DISCOVERY_UPDATE_RESPONSE message.

   After receiving an indication from lower layer that the DISCOVERY_UPDATE_RESPONSE message has not been successfully acknowledged (e.g., TCP ACK is not received), the UE shall abort the procedure.

6.2.12.3 Allocation of new ProSe restricted code

6.2.12.3.1 New ProSe restricted code allocation procedure initiation

The 5G DDNMF in the HPLMN shall initiate the ProSe restricted code allocation procedure by sending the DISCOVERY_UPDATE_REQUEST to the UE with:

a) a new DDNMF transaction ID not used in any other direct discovery procedures in PC3a interface;

b) the UE identity set to the UE's SUPI;

c) the discovery entry ID set to the discovery entry ID of the corresponding discovery entry that contains the ProSe restricted code to be replaced; and

d) update info containing the ProSe restricted code set to the ProSe restricted code to be replaced and a validity timer T5062 set to the T5062 timer value assigned by the 5G DDNMF to the ProSe restricted code.

Figure 6.2.12.3.1.1 illustrates the interaction of the UE and the 5G DDNMF in the ProSe restricted code allocation procedure.

NOTE: The 5G DDNMF can include one or multiple transactions in one DISCOVERY_UPDATE_REQUEST message for different ProSe restricted codes, and receive corresponding <response-update> element or <response-reject> element in a DISCOVERY_UPDATE_RESPONSE message for each respective transaction. In the following description of the network initiated direct discovery update request procedure, only one transaction is included.

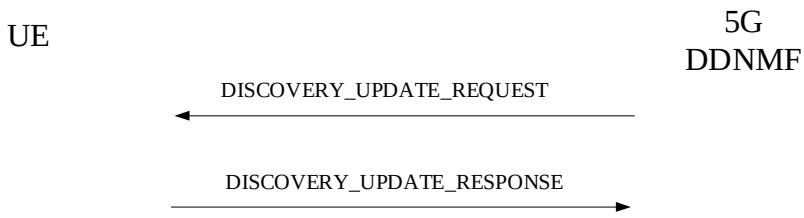

Figure 6.2.12.3.1.1: New ProSe restricted code allocation procedure

6.2.12.3.2 ProSe restricted code allocation procedure accepted by the UE

Upon receiving a DISCOVERY_UPDATE_REQUEST message, the UE shall check if the UE identity contained in the DISCOVERY_UPDATE_REQUEST message is the SUPI of the UE. If the UE identity is the SUPI of the UE, the UE shall check if the discovery entry ID contained in the DISCOVERY_UPDATE_REQUEST message is valid. If the discovery entry ID is valid, the UE shall proceed with the following direct discovery update procedure.

The UE shall replace the ProSe restricted code corresponding to the discovery entry ID included in the DISCOVERY_UPDATE_REQUEST message. The UE shall stop the validity timer T5062 if running and start the validity timer T5062 with the received value. Then the UE shall send a DISCOVERY_UPDATE_RESPONSE message to the 5G DDNMF with:

a) the DDNMF transaction ID set to the value of the DDNMF transaction ID received in the DISCOVERY_UPDATE_REQUEST message; and

b) discovery entry ID set to the value of the discovery entry ID received in the DISCOVERY_UPDATE_REQUEST message.

6.2.12.3.3 ProSe restricted code allocation procedure completion by the 5G DDNMF

Upon receipt of the DISCOVERY_UPDATE_ RESPONSE message by the 5G DDNMF, if the DDNMF transaction ID contained in the <response-update> element does not match the value sent by the 5G DDNMF in a DISCOVERY_UPDATE_REQUEST message, the 5G DDNMF shall discard the DISCOVERY_UPDATE_RESPONSE message. Upon receipt of the DISCOVERY_UPDATE_ RESPONSE message by the 5G DDNMF, if the DDNMF transaction ID contained in the <response-update> element matches the value sent by the 5G DDNMF in a DISCOVERY_UPDATE_REQUEST message, the ProSe restricted code allocation procedure is complete.

6.2.12.3.4 ProSe restricted code allocation procedure not accepted by the UE

If the DISCOVERY_UPDATE_REQUEST message cannot be accepted by the UE, the UE sends a DISCOVERY_UPDATE_RESPONSE message containing a <response-reject> element to the 5G DDNMF including an appropriate PC3a control protocol cause value.

If the UE identity contained in the DISCOVERY_UPDATE_REQUEST message is not the SUPI of the UE, the UE shall send a DISCOVERY_UPDATE_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value #18 "Invalid UE identity".

If the discovery entry ID contained in the DISCOVERY_UPDATE_REQUEST message is not found in the UE context, the UE shall send a DISCOVERY_UPDATE _RESPONSE message containing a <response-reject> element with PC3a control protocol cause value #10 "Unknown or invalid discovery entry ID".

6.2.12.3.5 Abnormal cases

6.2.12.3.5.1 Abnormal cases in the 5G DDNMF

The following abnormal cases can be identified:

a) Indication from the transport layer of transmission failure of DISCOVERY_UPDATE_REQUEST message (e.g., after TCP retransmission timeout)

The 5G DDNMF shall close the existing secure connection to the UE.

b) No response from the UE after the DISCOVERY_UPDATE_REQUEST message has been successfully delivered (e.g., TCP ACK has been received for the DISCOVERY_UPDATE_REQUEST message)

The 5G DDNMF shall retransmit the DISCOVERY_UPDATE_REQUEST message.

NOTE: The timer to trigger retransmission and the maximum number of allowed retransmissions are 5G DDNMF implementation specific.

6.2.12.3.5.2 Abnormal cases in the UE

The following abnormal cases can be identified:

a) Indication from the lower layer of transmission failure of DISCOVERY_UPDATE_RESPONSE message.

After receiving an indication from lower layer that the DISCOVERY_UPDATE_RESPONSE message has not been successfully acknowledged (e.g., TCP ACK is not received), the UE shall abort the procedure.

6.2.13 Announcing alert procedure

6.2.13.1 General

The purpose of the announcing alert procedure is for the 5G DDNMF in HPLMN to send to the announcing UE the ProSe restricted code generated in the announce request procedure for restricted 5G ProSe direct discovery model A as specified in clause 6.2.3.

Before initiating the announcing alert procedure, the 5G DDNMF shall determine whether the announcing UE and the monitoring UE are close enough to trigger the announcing alert procedure.

The announcing UE includes the ProSe restricted code in a PROSE PC5 DISCOVERY message and passes the PROSE PC5 DISCOVERY message to the lower layers for transmission over the PC5 interface in the registered PLMN or local PLMN as a result of a successful announcing alert procedure.

6.2.13.2 Announcing alert procedure initiation

If the UE has initiated an announce request procedure for restricted 5G ProSe direct discovery model A before as specified in clause 6.2.3 and the on demand announcing enabled indicator associated with the RPAUID in the announcing UE context is set to 1, the 5G DDNMF shall initiate an announcing alert procedure:

a) when the 5G DDNMF receives a pair of target PDUID - target RPAUID from the ProSe application server as described in 3GPP TS 29.503 [10], the target RPAUID is the same as the RPAUID stored in the announcing UE context, and 5G DDNMF determines the monitoring UE is in the vicinity of the announcing UE; or

b) when the 5G DDNMF receives a pair of target PDUID - target RPAUID from other 5G DDNMF as described in 3GPP TS 29.555 [9], the target RPAUID is the same as the RPAUID stored in the announcing UE context and the 5G DDNMF determines the monitoring UE is in the vicinity of the announcing UE.

NOTE: How the 5G DDNMF in the HPLMN determines whether the announcing UE and the monitoring UE are close enough to trigger the announcing alert procedure is left to the implementation of 5G DDNMF.

The 5G DDNMF shall initiate the announcing alert procedure by sending an ANNOUNCING_ALERT_REQUEST message with:

a) a new DDNMF transaction ID;

b) the UE identity set to the UE's SUPI;

c) the RPAUID set to the Target RPAUID received from ProSe application server as specified in 3GPP TS 29.503 [10] or from other 5G DDNMF as specified in 3GPP TS 29.555 [9];

d) the ProSe restricted code set to the ProSe restricted code or the ProSe restricted code prefix, and optionally one or more ProSe restricted code suffix Ranges which contain the suffix(es) for the RPAUID retrieved from the announcing UE context; and

e) the discovery entry ID set to the identifier associated with the corresponding discovery entry in the UE's context.

Figure 6.2.13.2.1 illustrates the interaction of the 5G DDNMF and the UE in the Announce Alert procedure.

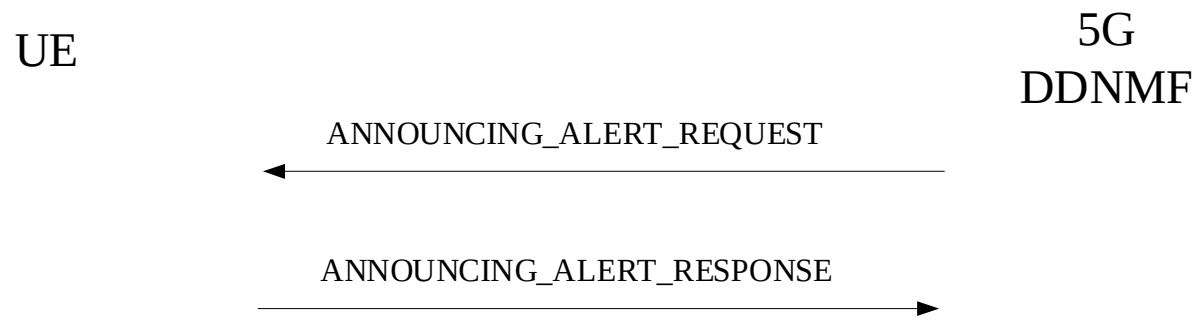

Figure 6.2.13.2.1: Announcing alert procedure

6.2.13.3 Announcing alert procedure accepted by the UE

Upon receipt of the ANNOUNCING_ALERT_REQUEST message, the UE shall check if the UE identity contained in the ANNOUNCING_ALERT_REQUEST message is the SUPI of the UE. If the UE identity is the SUPI of the UE, the UE shall check whether there is an existing discovery entry identified by the discovery entry ID included in the ANNOUNCING_ALERT_REQUEST message. If the discovery entry exists in the UE, the UE shall send an ANNOUNCE_ALERT_RESPONSE message to the 5G DDNMF with a DDNMF transaction ID set to the value of the DDNMF transaction ID received in the ANNOUNCING_ALERT_REQUEST message.

Then, the UE may perform restricted 5G ProSe direct discovery model A announcing as described below.

The UE requests the parameters from the lower layers for restricted 5G ProSe direct discovery model A announcing (see 3GPP TS 38.331 [13]). The UE shall perform restricted 5G ProSe direct discovery model A announcing only if the lower layers indicate that ProSe direct discovery is supported by the network. If the UE in 5GMM-IDLE mode has to request resources for ProSe direct discovery announcing as specified in 3GPP TS 38.331 [13], the UE shall perform a service request procedure or registration procedure as specified in 3GPP TS 24.501 [11]. The UE shall obtain the UTC time for the next discovery transmission opportunity for ProSe direct discovery from the lower layers.

If a valid UTC time is obtained, the UE shall generate the UTC-based counter corresponding to this UTC time as specified in clause 11.2.2.18. If the resulting UTC-based counter is within Max Offset of the time shown by the clock used for ProSe by the UE, the UE shall use the UTC-based counter and the DUIK contained in the <restricted-announce-response> element of the DISCOVERY_RESPONSE message to compute the MIC field for the PROSE PC5 DISCOVERY message as described in 3GPP TS 33.503 [34].

The UE shall either use the ProSe restricted code received in the ANNOUNCING_ALERT_REQUEST message, or select one ProSe restricted code based on the ProSe restricted code prefix and ProSe restricted code suffix Range(s) received in the ANNOUNCING_ALERT_REQUEST message as announced ProSe restricted code, along with the MIC and the eight least significant bits of the UTC-based counter, in order to construct a PROSE PC5 DISCOVERY message, according to the format defined in clause 10.2.5.

NOTE: The UE can use different codes formed based on different ProSe restricted code suffixes to announce, without having to send a new DISCOVERY_REQUEST message to the 5G DDNMF, as long as the validity timer T5062 of the ProSe restricted code prefix has not expired.

The UE then passes the PROSE PC5 DISCOVERY message to the lower layers for transmission if:

a) the UE is currently authorized to perform restricted 5G ProSe direct discovery model A announcing in the registered PLMN or the local PLMN operating the radio resources that the UE intends to use;

b) the validity timer T5062 for the corresponding discovery entry allocated ProSe restricted code or ProSe restricted code prefix has not expired; and

c) a request from upper layers to announce the RPAUID associated with both the ProSe restricted code or ProSe restricted code prefix, and the authorized application identity, is still in place.

The UE shall ensure that it keeps on passing PROSE PC5 DISCOVERY messages to the lower layers for transmission until the validity timer T5062 of the ProSe restricted code or ProSe restricted code prefix expires. How this is achieved is left up to UE implementation.

During the announcing operation, if one of the above conditions is no longer met, the UE may instruct the lower layers to stop announcing. When the UE stops announcing, if the lower layers indicate that the UE is required to send a discovery indication to the NG-RAN and the UE is in 5GMM-CONNECTED mode, the UE shall trigger the corresponding procedure in lower layers as specified in 3GPP TS 38.331 [13].

6.2.13.4 Announcing alert procedure completion by the 5G DDNMF

Upon receipt of the ANNOUNCE_ALERT_RESPONSE message with a DDNMF transaction ID set to the value of the DDNMF transaction ID included in the ANNOUNCING_ALERT_REQUEST message, the 5G DDNMF will set the associated on demand announcing enabled indicator to 0. Then the announcing alert procedure is successfully completed.

6.2.13.5 Announcing alert procedure not accepted by the UE

If the ANNOUNCING_ALERT_REQUEST message cannot be accepted by the UE, the UE sends an ANNOUNCING_ALERT_RESPONSE message containing a <response-reject> element to the 5G DDNMF including an appropriate PC3a control protocol cause value.

If the UE identity contained in the ANNOUNCING_ALERT_REQUEST message is not the SUPI of the UE, the UE shall send an ANNOUNCING_ALERT_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value #18 "Invalid UE identity".

If the discovery entry ID contained in the ANNOUNCING_ALERT_REQUEST message is unknown, the UE shall send the ANNOUNCING_ALERT_RESPONSE message containing a <response-reject> element with PC3a control protocol cause value #10"Unknown or invalid discovery entry ID".

6.2.13.6 Abnormal cases

6.2.13.6.1 Abnormal cases in the 5G DDNMF

The following abnormal cases can be identified:

a) Indication from the transport layer of transmission failure of ANNOUNCING_ALERT_REQUEST message (e.g., after TCP retransmission timeout)

   The 5G DDNMF shall close the existing secure connection to the UE.

b) No response from the UE after the ANNOUNCING_ALERT_REQUEST message has been successfully delivered (e.g., TCP ACK has been received for the ANNOUNCING_ALERT_REQUEST message)

   The 5G DDNMF shall retransmit the ANNOUNCING_ALERT_REQUEST message.

NOTE: The timer to trigger retransmission and the maximum number of allowed retransmissions are 5G DDNMF implementation specific.

6.2.13.6.2 Abnormal cases in the UE

The following abnormal cases can be identified:

a) Indication from the lower layer of transmission failure of ANNOUNCE_ALERT_RESPONSE message.

   After receiving an indication from lower layer that the ANNOUNCE_ALERT_RESPONSE message has not been successfully acknowledged (e.g., TCP ACK is not received), the UE shall abort the procedure.

6.2.14 5G ProSe direct discovery procedure over PC5 interface

6.2.14.1 General

This clause describes the procedures for 5G ProSe direct discovery procedure over PC5 interface. The purpose of the 5G ProSe direct discovery procedure over PC5 interface is to enable a ProSe-enabled UE to detect and identify another ProSe-enabled UE over PC5 interface.

To perform 5G ProSe direct discovery procedure over PC5 interface, the UE is configured with the related information as described in clause 5.2.3. The following models for 5G ProSe direct discovery procedure over PC5 interface as specified in 3GPP TS 23.304 [2] are supported:

a) Model A uses a single discovery protocol message (Announcement); and

b) Model B uses two discovery protocol messages (Solicitation and Response).

NOTE: If the UE is authorized to perform both 5G ProSe direct discovery Model A and 5G ProSe direct discovery Model B, it is up to UE implementation to select which model to perform or perform both models simultaneously.

The following procedures are defined for 5G ProSe direct discovery procedure over PC5 interface:

a) 5G ProSe direct discovery procedure over PC5 interface with Model A:

   1) Announcing UE procedure for 5G ProSe direct discovery initiation;

   2) Announcing UE procedure for 5G ProSe direct discovery completion;

   3) Monitoring UE procedure for 5G ProSe direct discovery initiation; and

   4) Monitoring UE procedure for 5G ProSe direct discovery completion; and

b) 5G ProSe direct discovery procedure over PC5 interface with Model B:

   1) Discoverer UE procedure for 5G ProSe direct discovery initiation;

   2) Discoverer UE procedure for 5G ProSe direct discovery completion;

   3) Discoveree UE procedure for 5G ProSe direct discovery initiation; and

   4) Discoveree UE procedure for 5G ProSe direct discovery completion.

6.2.14.2 Procedures

6.2.14.2.1 5G ProSe direct discovery procedure over PC5 interface with model A

6.2.14.2.1.1 General

In this procedure, the UE sending the PROSE PC5 DISCOVERY message is called the "announcing UE" and the "monitoring UE" is the UE that triggers the lower layer to start monitoring for PROSE PC5 DISCOVERY message.

6.2.14.2.1.2 Announcing UE procedure for 5G ProSe direct discovery initiation

The UE is authorised to perform the announcing UE procedure for 5G ProSe direct discovery if:

a) the UE is not served by NG-RAN, is authorised to perform 5G ProSe direct discovery using announcing procedure when the UE is not served by NG-RAN, and is configured with the radio parameters to be used for 5G ProSe direct discovery when not served by NG-RAN;

b) the UE is served by NG-RAN, and is authorised to perform 5G ProSe direct discovery using announcing in the PLMN indicated by the serving cell; or

c) the UE is:

1) in 5GMM-IDLE mode, in limited service state as specified in 3GPP TS 23.122 [14], and 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]; and

2) authorised to perform 5G ProSe direct discovery using announcing when the UE is not served by NG-RAN, and:

   i) configured with the radio parameters to be used for 5G ProSe direct discovery when not served by NG-RAN; or

   ii) the lower layers indicate that the UE does not need to request resources for 5G ProSe direct discovery procedure.

NOTE 1: When the lower layers indicate that the UE does not need to request resources for 5G ProSe direct discovery procedure, the serving cell broadcasts a common radio resources pool for ProSe discovery transmission and the UE can use this common radio resources pool while in limited service state.

otherwise, the UE is not authorised to perform the announcing UE procedure for 5G ProSe direct discovery.

Figure 6.2.14.2.1.2.1 illustrates the interaction of the UEs in the announcing UE procedure for 5G ProSe direct discovery.

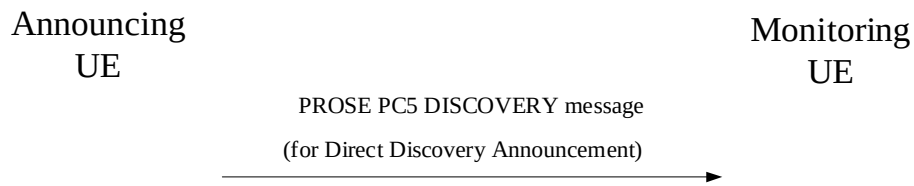

Figure 6.2.14.2.1.2.1: Announcing UE procedure for 5G ProSe direct discovery

When the UE is triggered by an upper layer application to perform announcing UE procedure for 5G ProSe direct discovery announcing procedure, if the UE is authorised to perform the announcing UE procedure for 5G ProSe direct discovery, then the UE:

a) if the UE is served by NG-RAN, and the UE in 5GMM-IDLE mode needs to request resources for sending PROSE PC5 DISCOVERY messages as specified in 3GPP TS 38.331 [13], shall perform a service request procedure as specified in 3GPP TS 24.501 [11];

b) shall obtain a valid UTC time for the discovery transmission from the lower layers and generate the UTC-based counter corresponding to this UTC time;

c) shall generate a PROSE PC5 DISCOVERY message for 5G ProSe direct discovery announcement if the resulting UTC-based counter is within the max offset of the time shown by the clock used for ProSe by the UE and if the timer T5060 or T5062 does not expire. In the PROSE PC5 DISCOVERY message for direct discovery announcement, the UE:

   1) shall set the ProSe direct discovery PC5 message type parameter as specified in table 10.2.1.1 or table 10.2.1.2;

   2) shall include either ProSe application code or ProSe restricted code;

   3) shall include the MIC filed computed as described in 3GPP TS 33.503 [34] by using the UTC-based counter and the discovery key contained in the <response-announce> element of the DISCOVERY_RESPONSE message;

   4) may include the Metadata IE to provide the application layer metadata information; and

5) shall set the UTC-based counter LSB parameter to include the 8 least significant bits of the UTC-based counter;

d) shall apply the DUIK, DUSK, or DUCK with the associated Encrypted Bitmask, along with the UTC-based counter to the PROSE PC5 DISCOVERY message for whichever security mechanism(s) configured to be applied, e.g., integrity protection, message scrambling or confidentiality protection of one or more above parameters, as specified in 3GPP TS 33.303[36]; and

e) shall pass the resulting PROSE PC5 DISCOVERY message along with the source layer-2 ID and destination layer-2 ID for direct discovery announcement and an indication that the message is for 5G ProSe direct discovery to the lower layers for transmission over the PC5 interface.

In case of open 5G ProSe direct discovery, the UE shall either use the ProSe application code received in the DISCOVERY_RESPONSE message from the 5G DDNMF, or select one ProSe application code based on the ProSe application code prefix and ProSe application code suffix range(s) received in the DISCOVERY_RESPONSE message from the 5G DDNMF as announced ProSe application code, along with the MIC and the four least significant bits of the UTC-based counter.

NOTE 2: The UE can use different codes formed based on different ProSe application code suffixes to announce, without having to send a new request to the 5G DDNMF, as long as the validity timer T5060 of the ProSe application code prefix has not expired.

In case of restricted 5G ProSe direct discovery model A, the UE shall either use the ProSe restricted code received in the DISCOVERY_RESPONSE message, or select one ProSe restricted code based on the ProSe restricted code prefix and ProSe restricted code suffix range(s) received in the DISCOVERY_RESPONSE message from the 5G DDNMF as announced ProSe restricted code, along with the 4 least significant bits of the UTC-based counter.

NOTE 3: The UE can use different codes formed based on different ProSe restricted code suffixes to announce, without having to send a new DISCOVERY_REQUEST message to the 5G DDNMF, as long as the validity timer T5062 of the ProSe restricted code prefix has not expired.

The announcing UE shall ensure that it keeps on passing the same PROSE PC5 DISCOVERY message to the lower layers for transmission until the request from upper layers to perform announcing UE procedure for 5G ProSe direct discovery is still in place, or the validity timer of the ProSe application code or ProSe application code prefix in case of open 5G ProSe direct discovery or the validity timer of the ProSe restricted code or ProSe restricted code prefix in case of restricted 5G ProSe direct discovery expires. How this is achieved is left up to UE implementation.

6.2.14.2.1.3 Announcing UE procedure for 5G ProSe direct discovery completion

When the request from upper layers to perform announcing UE procedure for 5G ProSe direct discovery is not in place, or the validity timer of the ProSe application code or ProSe application code prefix in case of open 5G ProSe direct discovery or the validity timer of the ProSe restricted code or ProSe restricted code prefix in case of restricted 5G ProSe direct discovery expires, the UE may instruct the lower layers to stop announcing.

When the UE stops announcing, if the UE is in 5GMM-CONNECTED mode, the UE shall trigger the corresponding procedure in lower layers as specified in 3GPP TS 38.331 [13].

6.2.14.2.1.4 Monitoring UE procedure for 5G ProSe direct discovery initiation

The UE is authorised to perform the monitoring UE procedure for 5G ProSe direct discovery if:

a) the UE is not served by NG-RAN, is authorised to perform 5G ProSe direct discovery using monitoring when the UE is not served by NG-RAN, and is configured with the radio parameters to be used for 5G ProSe direct discovery when not served by NG-RAN;

b) the UE is served by NG-RAN, and is authorised to perform 5G ProSe direct discovery monitoring in at least one PLMN; or

c) the UE is:

1) in 5GMM-IDLE mode, in limited service state as specified in 3GPP TS 23.122 [14], and 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]; and

2) authorised to perform 5G ProSe direct discovery using monitoring when the UE is not served by NG-RAN, and:

i) configured with the radio parameters to be used for 5G ProSe direct discovery when not served by NG-RAN; or

ii) the lower layers indicate that the UE does not need to request resources for 5G ProSe direct discovery procedure.

NOTE 1: When the lower layers indicate that the UE does not need to request resources for 5G ProSe direct discovery procedure, the serving cell broadcasts a common radio resources pool for ProSe discovery transmission and the UE can use this common radio resources pool while in limited service state.

otherwise, the UE is not authorised to perform the monitoring UE procedure for 5G ProSe direct discovery procedure.

Figure 6.2.14.2.1.4.1 illustrates the interaction of the UEs in the monitoring UE procedure for 5G ProSe direct discovery procedure.

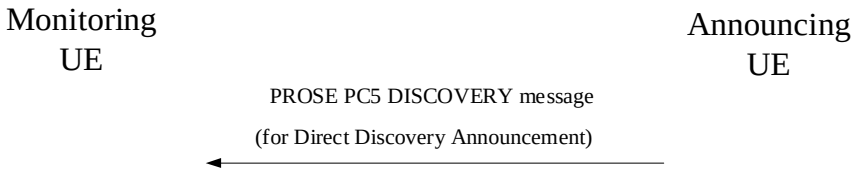

Figure 6.2.14.2.1.4.1: Monitoring UE procedure for 5G ProSe direct discovery

When the UE is triggered by an upper layer application to perform monitoring UE procedure for 5G ProSe direct discovery for a ProSe application code or ProSe restricted code, and:

a) if the UE is authorised to perform the monitoring UE procedure for 5G ProSe direct discovery;

b) if the difference between UTC-based counter associated with that discovery slot and UE's ProSe clock is not greater than the max offset of the monitoring UE's ProSe clock; and

c) if the timer T5060 or T5062 does not expire;

then the UE shall instruct the lower layers to start monitoring for PROSE PC5 DISCOVERY message.

Upon reception of a PROSE PC5 DISCOVERY message for 5G ProSe direct discovery announcement for the destination layer-2 ID to be monitored, the UE shall use the associated DUSK, if configured, and the UTC-based counter obtained during the monitoring operation to unscramble the PROSE PC5 DISCOVERY message as described in 3GPP TS 33.503 [34]. Then, if a DUCK is configured, the UE shall use the DUCK and the UTC-based counter to decrypt the configured message-specific confidentiality-protected portion, as described in 3GPP TS 33.503 [34]. Finally, if a DUIK is configured, the UE shall use the DUIK and UTC-based counter to verify the MIC field in the unscrambled PROSE PC5 DISCOVERY message for 5G ProSe direct discovery announcement.

NOTE 2: The use of an erroneous UTC-based counter for processing received PROSE PC5 DISCOVERY messages at the ProSe-enabled UE can cause MIC check failure after DUIK is used for integrity check, and malformed contents after DUSK is used for unscrambling or DUCK is used for deciphering. How a ProSe-enabled UE ensures the accuracy of the UTC-based counter is left to UE implementation.

NOTE 3: The UE can determine the received PROSE PC5 DISCOVERY message for 5G ProSe direct discovery announcement is for 5G ProSe direct discovery based on an indication from the lower layer.

In case of open 5G ProSe direct discovery, for a ProSe application ID requested by the monitoring UE, the 5G DDNMF may have assigned one or more discovery filters. If application-controlled extension is used, the UE may further apply additional filtering on the part corresponding to the ProSe application code suffix. The UE should apply all assigned

discovery filters to its monitoring operation. Using these discovery filters may result in a match event. The UE shall consider that the ProSe application code it seeks to monitor has been discovered if there is a match event as following:

When, for any of the ProSe application masks in a discovery filter, the output of a bitwise AND operation between the ProSe application code contained in the received PROSE PC5 DISCOVERY message and the ProSe application mask, matches the output of a bitwise AND operation between the ProSe application mask and the ProSe application code contained in the same discovery filter.

NOTE 4: A ProSe application mask with all bits set to "1" is assigned by the 5G DDNMF for full matching.

In case of restricted 5G ProSe direct discovery model A, the UE provides the application level container, which contains the authorized Target RPAUID(s), to the upper layer applications. For each authorized target RPAUID, the 5G DDNMF may have assigned one or more restricted discovery filters. If application-controlled extension is used, the UE may further apply additional filtering on the part corresponding to the ProSe restricted code suffix. The UE should then apply all restricted discovery filters to its monitoring operation. Using these restricted discovery filters may result in a match event. The UE shall consider that the target RPAUID it seeks to monitor has been discovered if there is a match event as follows:

When, for any of the masks in a restricted discovery filter, the output of a bitwise AND operation between the ProSe restricted code contained in the received PROSE PC5 DISCOVERY message and the mask, matches the output of a bitwise AND operation between the mask and the code contained in the same restricted discovery filter.

NOTE 5: In a restricted discovery filter, a mask with all bits set to "1" is assigned by the 5G DDNMF for full matching of a ProSe restricted code.

6.2.14.2.1.5 Monitoring UE procedure for 5G ProSe direct discovery completion

During the monitoring UE procedure for 5G ProSe direct discovery, if the request from upper layers to perform the monitoring UE procedure for 5G ProSe direct discovery is not in place, or if the validity timer of the discovery filter or the validity timer of the Restricted discovery filter expires, the UE may instruct the lower layers to stop monitoring.

When the UE stops monitoring, if the UE is in 5GMM-CONNECTED mode, the UE shall trigger the corresponding procedure in lower layers as specified in 3GPP TS 38.331 [13].

6.2.14.2.2 5G ProSe direct discovery procedure over PC5 interface with model B

6.2.14.2.2.1 General

In this procedure, the UE sending the PROSE PC5 DISCOVERY message is called the "Discoverer UE" and the other UE is called the "Discoveree UE".

6.2.14.2.2.2 Discoverer UE procedure for 5G ProSe direct discovery initiation

The UE is authorised to perform the discoverer UE procedure for 5G ProSe direct discovery if:

a) the UE is not served by NG-RAN, is authorised to perform 5G ProSe direct discovery discoverer operation when the UE is not served by NG-RAN, and is configured with the radio parameters to be used for 5G ProSe direct discovery when not served by NG-RAN;

b) the UE is served by NG-RAN, and is authorised to perform 5G ProSe direct discovery discoverer operation in the PLMN indicated by the serving cell; or

c) the UE is:

   1) in 5GMM-IDLE mode, in limited service state as specified in 3GPP TS 23.122 [14], and 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]; and

2) authorised to perform 5G ProSe direct discovery discoverer operation when the UE is not served by NG-RAN, and:

   i) configured with the radio parameters to be used for 5G ProSe direct discovery use when not served by NG-RAN; or

   ii) the lower layers indicate that the UE does not need to request resources for 5G ProSe direct discovery procedure.

NOTE: When the lower layers indicate that the UE does not need to request resources for 5G ProSe direct discovery procedure, the serving cell broadcasts a common radio resources pool for ProSe discovery transmission and the UE can use this common radio resources pool while in limited service state.

otherwise, the UE is not authorised to perform the discoverer UE procedure for 5G ProSe direct discovery.

Figure 6.2.14.2.2.2.1 illustrates the interaction of the UEs in the discoverer UE procedure for 5G ProSe direct discovery.

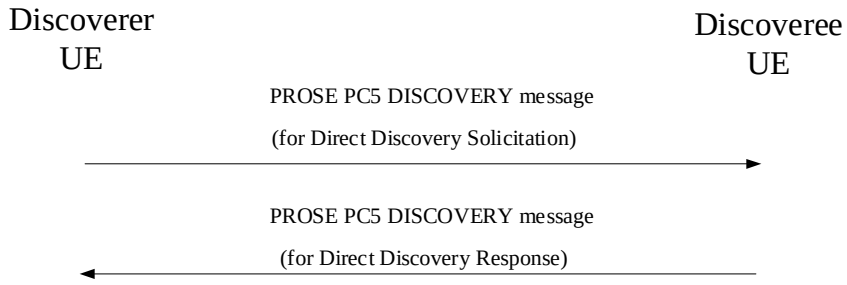

Figure 6.2.14.2.2.2.1: Discoverer UE procedure for 5G ProSe direct discovery

When the UE is triggered by an upper layer application to query the target RPAUID in restricted discovery Model B, associated with both the ProSe query code, and the authorised application identity, and

a) if the UE is authorised to perform the discoverer UE procedure for 5G ProSe direct discovery in the registered PLMN or the local PLMN operating the radio resources that the UE intends to use; and

b) if the validity timer T5070 for the ProSe query code and corresponding ProSe Response Filter(s) has not expired,

then the UE:

a) if the UE is served by NG-RAN, and the UE in 5GMM-IDLE mode needs to request resources for sending PROSE PC5 DISCOVERY messages as specified in 3GPP TS 38.331 [13], shall perform a service request procedure as specified in 3GPP TS 24.501 [11];

b) shall obtain a valid UTC time for the discovery transmission from the lower layers and generate the UTC-based counter corresponding to this UTC time, and if the resulting UTC-based counter is within max offset of the time shown by the clock used for ProSe by the UE, the UE shall for each ProSe query code in this discovery entry, use the ProSe query code to construct a PROSE PC5 DISCOVERY message as below;

c) shall generate a PROSE PC5 DISCOVERY message for 5G ProSe direct discovery solicitation. In the PROSE PC5 DISCOVERY message for 5G ProSe direct discovery solicitation, the UE:

   1) shall set the ProSe direct discovery PC5 message type parameter as specified in table 10.2.1.3;

   2) shall include ProSe query code;

   3) shall include the MIC filed computed as described in 3GPP TS 33.503 [34] by using the UTC-based counter and the discovery key contained in the <response-announce> element of the DISCOVERY_RESPONSE message; and

   4) shall set the UTC-based counter LSB parameter to include the 4 least significant bits of the UTC-based counter;

d) shall apply the DUIK, DUSK, or DUCK with the associated encrypted bitmask, along with the UTC-based counter to the PROSE PC5 DISCOVERY message for whichever security mechanism(s) configured to be

applied, e.g., integrity protection, message scrambling or confidentiality protection of one or more above parameters, as specified in 3GPP TS 33.503 [34]; and

e) shall pass the resulting PROSE PC5 DISCOVERY message along with the source layer-2 ID and destination layer-2 ID for 5G ProSe direct discovery solicitation and the PLMN ID of the intended announcing PLMN if available in the discovery entry and an indication that the message is for 5G ProSe direct discovery to the lower layers for transmission over the PC5 interface, and shall instruct the lower layer to start monitoring.

The UE shall ensure that it keeps on passing the same PROSE PC5 DISCOVERY message to the lower layers for transmission until the validity timer T5070 of the ProSe query code expires. How this is achieved is left up to UE implementation.

The UE may apply the discovery response filter(s) received from the 5G DDNMF to its monitoring operation. Using the discovery response filter may result in a match event for the target RPAUID the UE is querying for. There is match event when, for any of the masks in a discovery response filter, the output of a bitwise AND operation between the ProSe response code contained in the received PROSE PC5 DISCOVERY message and the mask, matches the output of a bitwise AND operation between the mask and the code contained in the discovery response filter.

Upon reception of a PROSE PC5 DISCOVERY message for direct discovery response, for the target destination layer-2 ID of the direct discovery to be discovered, the UE shall use the associated DUSK, if configured as a part of the discovery response filter, and the UTC-based counter obtained during the monitoring operation to unscramble the PROSE PC5 DISCOVERY message as described in 3GPP TS 33.303 [36]. Then, if a DUCK is configured, the UE shall use the DUCK and the UTC-based counter to decrypt the configured message-specific confidentiality-protected portion, as described in 3GPP TS 33.303 [36]. Finally, if a DUIK is configured, the UE shall use the DUIK and UTC-based counter to verify the MIC field in the unscrambled PROSE PC5 DISCOVERY message for direct discovery response. If a MIC Check Indicator parameter is included instead, the UE shall use the match report procedure described in clause 6.2.10 to trigger checking of the MIC of the PROSE PC5 DISCOVERY message containing the ProSe response code by the 5G DDNMF.

The UE may notify the upper layer application about the match event of restricted 5G ProSe direct discovery model B with the corresponding target RPAUID and metadata, if the RPAUID and metadata are included in the Subquery result element in the DISCOVERY_RESPONSE message from the 5G DDNMF.

Editor's note: Details of Discoverer UE procedure upon reception of a PROSE PC5 DISCOVERY message for direct discovery response are FFS and will be determinated by cooperation with SA WG3.

6.2.14.2.2.3 Discoverer UE procedure for 5G ProSe direct discovery completion

During the discoverer operation, if

a) the validity timer T5070 for the ProSe query code and corresponding ProSe Response Filter(s) has expired; and

b) the request from upper layers to query the target RPAUID in restricted discovery Model B, associated with both the ProSe query code, and the authorised application identity, is not in place, then

the UE may instruct the lower layers to stop the discoverer operation. When the UE stops discoverer operation, if the UE is in 5GMM-CONNECTED mode, the UE shall trigger the corresponding procedure in lower layers as specified in 3GPP TS 38.331 [13].

6.2.14.2.2.4 Discoveree UE procedure for 5G ProSe direct discovery initiation

The UE is authorised to perform the discoveree UE procedure for 5G ProSe direct discovery if:

a) the UE is not served by NG-RAN, is authorised to perform 5G ProSe direct discovery discoveree operation when the UE is not served by NG-RAN, and is configured with the radio parameters to be used for 5G ProSe direct discovery when not served by NG-RAN;

b) the UE is served by NG-RAN, and is authorised to perform 5G ProSe direct discovery discoverer operation in the PLMN indicated by the serving cell; or

c) the UE is:

1) in 5GMM-IDLE mode, in limited service state as specified in 3GPP TS 23.122 [14], and 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]; and

2) authorised to perform 5G ProSe direct discovery discoverer operation when the UE is not served by NG-RAN, and:

i) configured with the radio parameters to be used for 5G ProSe direct discovery use when not served by NG-RAN; or

ii) the lower layers indicate that the UE does not need to request resources for 5G ProSe direct discovery procedure.

NOTE 1: When the lower layers indicate that the UE does not need to request resources for 5G ProSe direct discovery procedure, the serving cell broadcasts a common radio resources pool for ProSe discovery transmission and the UE can use this common radio resources pool while in limited service state.

otherwise, the UE is not authorised to perform the discoveree UE procedure for 5G ProSe direct discovery.

Figure 6.2.14.2.2.4.1 illustrates the interaction of the UEs in the discoveree UE procedure for 5G ProSe direct discovery.

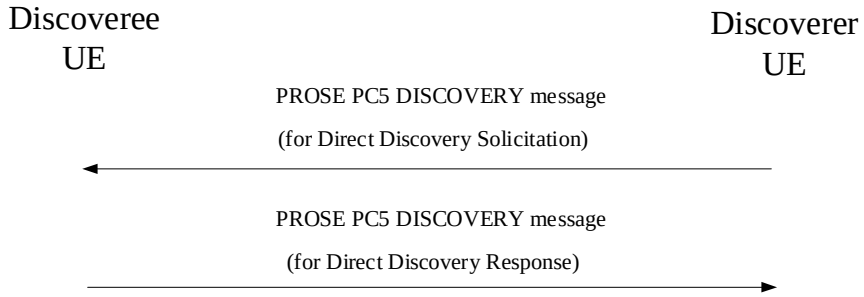

Figure 6.2.14.2.2.4.1: Discoveree UE procedure for 5G ProSe direct discovery

When the UE is triggered by an upper layer application to perform discoveree operation for the RPAUID associated with an authorized application identity, and if:

a) the UE is authorised to perform the discoveree UE procedure for 5G ProSe direct discovery;

b) the UE has obtained the ProSe response code and discovery query filter(s) and the respective validity timer T5068 for the corresponding discovery entry has not expired; and

c) the difference between UTC-based counter associated with that discovery slot and UE's ProSe clock is not greater than the max offset of the monitoring UE's ProSe clock,

then the UE:

a) if the UE is served by NG-RAN, and the UE in 5GMM-IDLE mode needs to request resources for sending PROSE PC5 DISCOVERY messages as specified in 3GPP TS 38.331 [13], shall perform a service request procedure or registration procedure as specified in 3GPP TS 24.501 [11]; and

b) shall instruct the lower layers to start monitoring for PROSE PC5 DISCOVERY messages as specified in 3GPP TS 38.331 [13].

The UE may apply the discovery query filter(s) received from the 5G DDNMF to its monitoring operation. Using the discovery query filter(s) may result in a match event. There is match event when, for any of the masks in a discovery query filter, the output of a bitwise AND operation between the ProSe query code contained in the received PROSE PC5 DISCOVERY message and the mask, matches the output of a bitwise AND operation between the mask and the code contained in the discovery query filter.

Upon reception of a PROSE PC5 DISCOVERY message for direct discovery solicitation for the destination layer-2 ID which the UE is configured to respond for, with applying a discovery query filter to a received PROSE PC5 DISCOVERY message for the above-mentioned bitwise AND operation, the UE shall use the associated DUSK, if configured in the part of the discovery query filter, and the UTC-based counter obtained during the monitoring operation to unscramble the PROSE PC5 DISCOVERY message as described in 3GPP TS 33.503 [34]. Then, if a DUCK is configured in the part of the discovery query filter, the UE shall use the DUCK and the UTC-based counter to decrypt the configured message-specific confidentiality protected portion, as described in 3GPP TS 33.503 [34]. Finally, if a DUIK is configured in the part of the discovery query filter, the UE shall use the DUIK and UTC-based counter to verify the MIC field in the unscrambled PROSE PC5 DISCOVERY message for direct discovery solicitation.

NOTE 2: The UE can look for a match on the unencrypted bits first before applying DUCK, to minimise the amount of processing performed before finding a match.

NOTE 3: The UE needs to verify the MIC field because the match report procedure is not used for checking the MIC of a PROSE PC5 DISCOVERY message containing a ProSe query code by the 5G DDNMF.

NOTE 4: The UE can determine the received PROSE PC5 DISCOVERY message for direct discovery solicitation is for 5G ProSe direct discovery based on an indication from the lower layer.

Once the match of the discovery query filter(s) occurs, the UE process this match event and requests the lower layers to announce the corresponding ProSe response code in the PC5 interface as a response, as specified in 3GPP TS 38.331 [13]. If the UE in 5GMM-IDLE mode has to request resources for 5G ProSe direct discovery announcing as specified in 3GPP TS 38.331 [13], the UE shall perform a service request procedure or registration procedure as specified in 3GPP TS 24.501 [11]. The UE shall obtain a valid UTC time for the discovery transmission from the lower layers and generate the UTC-based counter corresponding to this UTC time. If the resulting UTC-based counter is within max offset of the time shown by the clock used for ProSe by the UE, the UE shall use the ProSe response code received in the DISCOVERY_RESPONSE message from the 5G DDNMF. The UE shall generate a PROSE PC5 DISCOVERY message for 5G ProSe direct discovery response. In the PROSE PC5 DISCOVERY message for 5G ProSe direct discovery response, the UE:

a) shall set the ProSe direct discovery PC5 message type parameter as specified in table 10.2.1.4;

b) shall include ProSe response code;

c) shall include the MIC filed computed as described in 3GPP TS 33.503 [34] by using the UTC-based counter and the discovery key contained in the <response-announce> element of the DISCOVERY_RESPONSE message;

d) may include the Metadata IE to provide the application layer metadata information; and

e) shall set the UTC-based counter LSB parameter to include the 4 least significant bits of the UTC-based counter.

After generating the PROSE PC5 DISCOVERY message for 5G ProSe direct discovery response, the UE:

a) shall set the destination layer-2 ID to the source layer-2 ID of the received message;

b) shall apply the DUIK, DUSK, or DUCK with the associated encrypted bitmask, along with the UTC-based counter to the PROSE PC5 DISCOVERY message for whichever security mechanism(s) configured to be applied, e.g., integrity protection, message scrambling or confidentiality protection of one or more above parameters, as specified in 3GPP TS 33.503 [34]; and

c) shall pass the resulting PROSE PC5 DISCOVERY message along with the source layer-2 ID and destination layer-2 ID for 5G ProSe direct discovery response, the PLMN ID of the intended announcing PLMN and an indication that the message is for 5G ProSe direct discovery to the lower layers for transmission over the PC5 interface.

For each match event with the discovery query filter(s), the UE shall at least pass PROSE PC5 DISCOVERY message once to the lower layers for transmission. The UE shall ensure that it keeps on passing PROSE PC5 DISCOVERY messages to the lower layers for transmission as response(s) to the match event(s) of the corresponding discovery query filter(s) until the validity timer T5068 expires. How this is achieved is left up to UE implementation.

6.2.14.2.2.5 Discoveree UE procedure for 5G ProSe direct discovery completion

During the discoveree operation, if

a) the validity timer T5068 for the ProSe response code and corresponding discovery query filter(s) has expired; and

b) the request from upper layers to perform discoveree operation for the RPAUID associated with an authorized application identity is not in place, then

the UE may instruct the lower layers to stop monitoring.

When the UE stops monitoring, if the lower layers indicate that the UE is required to send a discovery indication to the NG-RAN and the UE is in 5GMM-CONNECTED mode, the UE shall trigger the corresponding procedure in lower layers as specified in 3GPP TS 38.331 [13].

6.2.15 Group member discovery over PC5 interface

6.2.15.1 General

This clause describes the procedures for group member discovery over PC5 interface for both public safety use and commercial services. The purpose of the group member discovery procedure over PC5 interface is to enable a ProSe-enabled UE to detect and identify another ProSe-enabled UE that belongs to the same application layer group (e.g., sharing the same application layer group ID) over PC5 interface.

To perform group member discovery over PC5 interface, the UE is configured with the related information as described in clause 5.2.3. The following models for group member discovery procedure over PC5 interface as specified in 3GPP TS 23.304 [2] are supported:

a) Model A uses a single discovery protocol message (Announcement); and

b) Model B uses two discovery protocol messages (Solicitation and Response).

NOTE: If the UE is authorized to perform both group member discovery over PC5 interface with Model A and group member discovery over PC5 interface with Model B, it is up to UE implementation to select which model to perform or perform both models simultaneously.

The following procedures are defined for group member discovery procedure over PC5 interface:

a) Group member discovery over PC5 interface with Model A:

   1) Announcing UE procedure for group member discovery initiation;

   2) Announcing UE procedure for group member discovery completion;

   3) Monitoring UE procedure for group member discovery initiation; and

   4) Monitoring UE procedure for group member discovery completion; and

b) Group member discovery over PC5 interface with Model B:

   1) Discoverer UE procedure for group member discovery initiation;

   2) Discoverer UE procedure for group member discovery completion;

   3) Discoveree UE procedure for group member discovery initiation; and

   4) Discoveree UE procedure for group member discovery completion.

The group member discovery over PC5 interface with Model A can only discover the targeted group members that are identified by the configured application layer group ID. The group member discovery over PC5 interface with Model B can either discover a specific group member of the application layer group identified by the configured application layer group ID or the targeted group members that are identified by the configured application layer group ID.

6.2.15.2 Procedures

6.2.15.2.1 Group member discovery over PC5 interface with model A

6.2.15.2.1.1 General

In this procedure, the UE sending the PROSE PC5 DISCOVERY message is called the "announcing UE" and the other UE is called the "monitoring UE".

6.2.15.2.1.2 Announcing UE procedure for group member discovery initiation

The UE is authorised to perform the announcing UE procedure for group member discovery if:

a) the following is true:

1) the UE is not served by NG-RAN, is authorised to perform 5G ProSe direct discovery using announcing procedure when the UE is not served by NG-RAN, and is configured with the radio parameters to be used for 5G ProSe direct discovery when not served by NG-RAN;

2) the UE is served by NG-RAN, and is authorised to perform 5G ProSe direct discovery using announcing in the PLMN indicated by the serving cell; or

3) the UE is:

i) in 5GMM-IDLE mode, in limited service state as specified in 3GPP TS 23.122 [14], and the reason for the UE being in limited service state is one of the following:

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

B) 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

C) 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]; and

ii) authorised to perform 5G ProSe direct discovery using announcing when the UE is not served by NG-RAN, and:

A) configured with the radio parameters to be used for 5G ProSe direct discovery when not served by NG-RAN; or

B) the lower layers indicate that the UE does not need to request resources for 5G ProSe direct discovery procedure; and

NOTE 1: When the lower layers indicate that the UE does not need to request resources for 5G ProSe direct discovery procedure, the serving cell broadcasts a common radio resources pool for 5G ProSe discovery transmission and the UE can use this common radio resources pool while in limited service state.

b) the UE is configured with the application layer group ID identifying the application layer group to be announced and with the User info ID for the group member discovery parameter;

otherwise, the UE is not authorised to perform the announcing UE procedure for group member discovery procedure.

Figure 6.2.15.2.1.2.1 illustrates the interaction of the UEs in the announcing UE procedure for group member discovery.

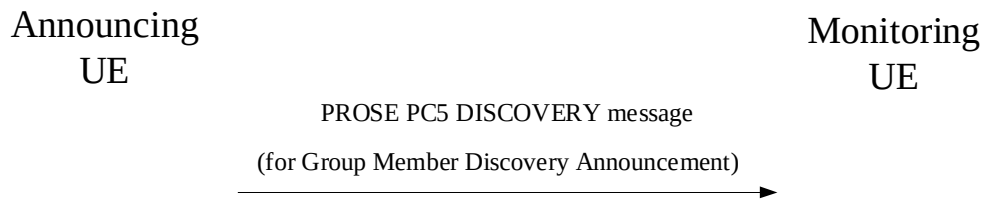

Figure 6.2.15.2.1.2.1: Announcing UE procedure for group member discovery

When the UE is triggered by an upper layer application to announce availability in a discovery group, if the UE is authorised to perform the announcing UE procedure for group member discovery, then the UE:

a) if the UE is served by NG-RAN, and the UE in 5GMM-IDLE mode needs to request resources for sending PROSE PC5 DISCOVERY messages as specified in 3GPP TS 38.331 [13], shall perform a service request procedure as specified in 3GPP TS 24.501 [11];

b) shall obtain a valid UTC time for the discovery transmission from the lower layers and generate the UTC-based counter corresponding to this UTC time;

c) shall generate a PROSE PC5 DISCOVERY message for group member discovery announcement. In the PROSE PC5 DISCOVERY message for group member discovery announcement, the UE:

   1) shall set the announcer info parameter to the User info ID for the group member discovery parameter; and

   2) shall set the application layer group ID parameter to the application layer group ID parameter identifying the discovery group to be announced;

   3) shall include the MIC filed computed as described in 3GPP TS 33.503 [34], by using the UTC-based counter and the DUIK contained in the <restricted-announce-response> element of the DISCOVERY_RESPONSE message;

   4) shall set the 4 least significant bits of UTC-based counter LSB parameter to the 4 least significant bits of the UTC-based counter;

   5) shall set the ProSe direct discovery PC5 message type parameter as specified in table 10.2.1.5; and

   6) may include the Metadata IE to provide the application layer discovery message;

d) shall apply the DUIK, DUSK, or DUCK with the associated Encrypted Bitmask, along with the UTC-based counter to the PROSE PC5 DISCOVERY message for whichever security mechanism(s) configured to be applied, e.g., integrity protection, message scrambling or confidentiality protection of one or more above parameters, as specified in 3GPP TS 33.303[36];

e) shall apply one of the following to determine the destination layer-2 ID:

   1) if the application layer group ID has a configured layer-2 group ID as specified in clause 5.2.3, set the destination layer-2 ID to the layer-2 group ID; or

   2) otherwise, convert the application layer group ID into a destination layer-2 ID as following:

      i) to use the group identifier as the input to the SHA-256 hashing algorithm as specified in ISO/IEC 10118-3:2018 [28]; and

      ii) to use the 24 least significant bits of the 256 bits of the output as destination layer-2 ID;

NOTE 2: SHA-256 hashing algorithm is implemented in the ME.

f) shall self-assign a source layer-2 ID for sending the group member discovery announcement message; and

g) shall pass the resulting PROSE PC5 DISCOVERY message for group member discovery announcement along with the source layer-2 ID and the destination layer-2 ID to the lower layers for transmission over the PC5 interface.

The announcing UE shall ensure that it keeps on passing the same PROSE PC5 DISCOVERY message to the lower layers for transmission until the announcing UE is triggered by an upper layer application to stop announcing availability in a discovery group, or until the UE stops being authorised to perform the announcing UE procedure for group member discovery.

6.2.15.2.1.3 Announcing UE procedure for group member discovery completion

When the announcing UE is triggered by an upper layer application to stop announcing availability in a discovery group, or when the announcing UE stops being authorised to perform the announcing UE procedure for group member discovery, the UE shall instruct the lower layers to stop announcing.

When the UE stops announcing, if the UE is in 5GMM-CONNECTED mode, the UE shall trigger the corresponding procedure in lower layers as specified in 3GPP TS 38.331 [13].

6.2.15.2.1.4 Monitoring UE procedure for group member discovery initiation

The UE is authorised to perform the monitoring UE procedure for group member discovery if:

a) the following is true:

1) the UE is not served by NG-RAN, is authorised to perform 5G ProSe direct discovery using monitoring when the UE is not served by NG-RAN, and is configured with the radio parameters to be used for 5G ProSe direct discovery when not served by NG-RAN;

2) the UE is served by NG-RAN, and is authorised to perform 5G ProSe direct discovery monitoring in at least one PLMN; or

3) the UE is:

i) in 5GMM-IDLE mode, in limited service state as specified in 3GPP TS 23.122 [14], and the reason for the UE being in limited service state is one of the following:

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

B) 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

C) 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]; and

ii) authorised to perform 5G ProSe direct discovery using monitoring when the UE is not served by NG-RAN, and:

A) configured with the radio parameters to be used for 5G ProSe direct discovery when not served by NG-RAN; or

B) the lower layers indicate that the UE does not need to request resources for 5G ProSe direct discovery procedure; and

NOTE 1: When the lower layers indicate that the UE does not need to request resources for 5G ProSe direct discovery procedure, the serving cell broadcasts a common radio resources pool for 5G ProSe discovery transmission and the UE can use this common radio resources pool while in limited service state.

b) the UE is configured with the application layer group ID parameter identifying the discovery group to be monitored;

otherwise, the UE is not authorised to perform the monitoring UE procedure for group member discovery.

Figure 6.2.15.2.1.4.1 illustrates the interaction of the UEs in the monitoring UE procedure for group member discovery.

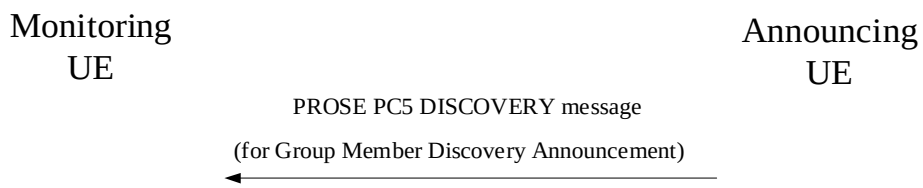

Figure 6.2.15.2.1.4.1: Monitoring UE procedure for group member discovery

When the UE is triggered by an upper layer application to monitor proximity of other UEs in a discovery group, and if the UE is authorised to perform the monitoring UE procedure for group member discovery, then the UE shall instruct the lower layers to start monitoring for PROSE PC5 DISCOVERY message as following:

a) if the application layer group ID has a configured layer-2 group ID as specified in clause 5.2.3, the UE shall monitor for PROSE PC5 DISCOVERY message with the layer-2 group ID as specified in clause 5.2.3; or

b) otherwise, the UE shall convert the application layer group ID into a destination layer-2 ID, and shall monitor for PROSE PC5 DISCOVERY message with the converted destination layer-2 ID. The UE shall convert the application layer group ID into a destination layer-2 ID as following:

1) to use the group identifier as the input to the SHA-256 hashing algorithm as specified in ISO/IEC 10118-3:2018 [28]; and

2) to use the 24 least significant bits of the 256 bits of the output as destination layer-2 ID.

NOTE 2: SHA-256 hashing algorithm is implemented in the ME.

Upon reception of a PROSE PC5 DISCOVERY message for group member discovery announcement, for the target application layer group ID of the discovery group to be monitored, the UE shall use the associated DUSK, if configured or calculated using the PSDK, and the UTC-based counter obtained during the monitoring operation to unscramble the PROSE PC5 DISCOVERY message as described in 3GPP TS 33.303 [36]. Then, if a DUCK is configured or calculated using the PSDK, the UE shall use the DUCK and the UTC-based counter to decrypt the configured message-specific confidentiality-protected portion, as described in 3GPP TS 33.303 [36]. Finally, if a DUIK is configured or calculated using the PSDK, the UE shall use the DUIK and UTC-based counter to verify the MIC field in the unscrambled PROSE PC5 DISCOVERY message for group member discovery announcement.

NOTE 3: The use of an erroneous UTC-based counter for processing received PROSE PC5 DISCOVERY messages at the ProSe-enabled UE can cause MIC check failure after DUIK is used for integrity check, and malformed contents after DUSK is used for unscrambling or DUCK is used for deciphering. How a ProSe-enabled UE ensures the accuracy of the UTC-based counter is left to UE implementation.

Then if the application layer group ID parameter of the PROSE PC5 DISCOVERY message for group member discovery announcement is the same as the configured application layer group ID parameter as specified in clause 5, the UE shall consider that other UE in the discovery group the UE seeks to monitor has been discovered.

6.2.15.2.1.5 Monitoring UE procedure for group member discovery completion

When the UE is triggered by an upper layer application to stop monitoring proximity of other UEs in a discovery group, or when the UE stops being authorised to perform the monitoring UE procedure for group member discovery, the UE shall instruct the lower layers to stop monitoring.

When the UE stops monitoring, if the UE is in 5GMM-CONNECTED mode, the UE shall trigger the corresponding procedure in lower layers as specified in 3GPP TS 38.331 [13].

6.2.15.2.2 Group member discovery over PC5 interface with model B

6.2.15.2.2.1 General

In this procedure, the UE sending the PROSE PC5 DISCOVERY message is called the "discoverer UE" and the other UE is called the "discoveree UE".

6.2.15.2.2.2 Discoverer UE procedure for group member discovery initiation

The UE is authorised to perform the discoverer UE procedure for group member discovery if:

a) the following is true:

1) the UE is not served by NG-RAN, is authorised to perform 5G ProSe direct discovery discoverer operation when the UE is not served by NG-RAN, and is configured with the radio parameters to be used for 5G ProSe direct discovery when not served by NG-RAN;

2) the UE is served by NG-RAN, and is authorised to perform 5G ProSe direct discovery discoverer operation in the PLMN indicated by the serving cell; or

3) the UE is:

i) in 5GMM-IDLE mode, in limited service state as specified in 3GPP TS 23.122 [14], and the reason for the UE being in limited service state is one of the following:

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

B) 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

C) 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]; and

ii) authorised to perform 5G ProSe direct discovery discoverer operation when the UE is not served by NG-RAN, and:

A) configured with the radio parameters to be used for 5G ProSe direct discovery use when not served by NG-RAN; or

B) the lower layers indicate that the UE does not need to request resources for 5G ProSe direct discovery procedure; and

NOTE 1: When the lower layers indicate that the UE does not need to request resources for 5G ProSe direct discovery procedure, the serving cell broadcasts a common radio resources pool for 5G ProSe discovery transmission and the UE can use this common radio resources pool while in limited service state.

b) the UE is configured with the application layer group ID parameter identifying the discovery group to be solicited and with the User info ID for the group member discovery parameter;

otherwise, the UE is not authorised to perform the discoverer UE procedure for group member discovery.

Figure 6.2.15.2.2.2.1 illustrates the interaction of the UEs in the discoverer UE procedure for group member discovery.

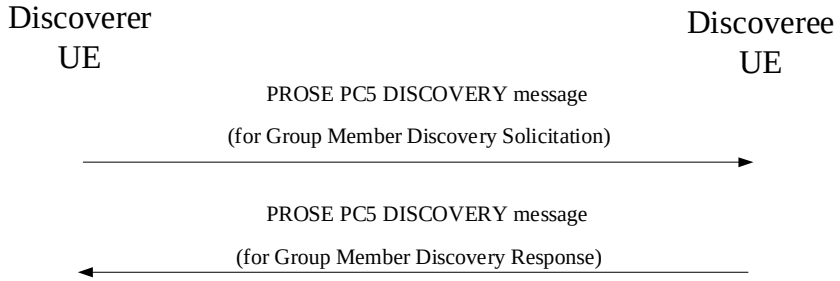

Figure 6.2.15.2.2.2.1: Discoverer UE procedure for group member discovery

When the UE is triggered by an upper layer application to solicit proximity of other UEs in a discovery group, and if the UE is authorised to perform the discoverer UE procedure for group member discovery, then the UE:

a) if the UE is served by NG-RAN, and the UE in 5GMM-IDLE mode needs to request resources for sending PROSE PC5 DISCOVERY messages as specified in 3GPP TS 38.331 [13], shall perform a service request procedure as specified in 3GPP TS 24.501 [11];

b) shall obtain a valid UTC time for the discovery transmission from the lower layers and generate the UTC-based counter corresponding to this UTC time;

c) shall generate a PROSE PC5 DISCOVERY message for group member discovery solicitation. In the PROSE PC5 DISCOVERY message for group member discovery solicitation, the UE:

1) shall set the discoverer info parameter to the user info ID for the group member discovery parameter;

2) shall set the application layer group ID parameter to the application layer group ID parameter identifying the discovery group to be solicited;

3) shall set the target user info parameter to the target info, if the target information is provided by the upper layers to identify a specific group member of the application layer group identified by the configured application layer group ID;

NOTE 2: If the PROSE PC5 DISCOVERY message for group member discovery solicitation does not indicate any specific target UE (i.e., target user info is not included in the PROSE PC5 DISCOVERY message), the PROSE PC5 DISCOVERY message for group member discovery solicitation is only used to discover the targeted group members that are identified by the configured application layer group ID.

4) shall include the MIC filed computed as described in 3GPP TS 33.503 [34] by using the UTC-based counter and the DUIK contained in the <restricted-discoverer-response> element of the DISCOVERY_RESPONSE message;

5) shall set the 4 least significant bits of UTC-based counter LSB parameter to the 4 least significant bits of the UTC-based counter; and

6) shall set the ProSe direct discovery PC5 message type parameter as specified in table 10.2.1.6;

d) shall apply the DUIK, DUSK, or DUCK with the associated Encrypted Bitmask, along with the UTC-based counter to the PROSE PC5 DISCOVERY message for whichever security mechanism(s) configured to be applied, e.g., integrity protection, message scrambling or confidentiality protection of one or more above parameters, as specified in 3GPP TS 33.303 [36];

e) shall apply one of the following to determine the destination layer-2 ID:

1) if the application layer group ID has a configured layer-2 group ID as specified in clause 5.2.3, set the destination layer-2 ID to the layer-2 group ID; or

2) otherwise, convert the application layer group ID into a destination layer-2 ID as following:

i) to use the group identifier as the input to the SHA-256 hashing algorithm as specified in ISO/IEC 10118-3:2018 [28]; and

ii) to use the 24 least significant bits of the 256 bits of the output as destination layer-2 ID;

NOTE 3: SHA-256 hashing algorithm is implemented in the ME.

f) shall self-assign a source layer-2 ID for sending the group member discovery solicitation message; and

g) shall pass the resulting PROSE PC5 DISCOVERY message for group member discovery solicitation along with the source layer-2 ID and destination layer-2 ID to the lower layers for transmission over the PC5 interface.

The UE shall ensure that it keeps on passing the same PROSE PC5 DISCOVERY message to the lower layers for transmission with an indication that the message until the UE is triggered by an upper layer application to stop soliciting proximity of other UEs in a discovery group, or until the UE stops being authorised to perform the discoverer UE procedure for group member discovery.

Upon reception of a PROSE PC5 DISCOVERY message for group member discovery response, for the target application layer group ID of the discovery group to be discovered, the UE shall use the associated DUSK, if configured or calculated using the PSDK, and the UTC-based counter obtained during the monitoring operation to unscramble the PROSE PC5 DISCOVERY message as described in 3GPP TS 33.303 [36]. Then, if a DUCK is configured or calculated using the PSDK, the UE shall use the DUCK and the UTC-based counter to decrypt the configured message-specific confidentiality-protected portion, as described in 3GPP TS 33.303 [36]. Finally, if a DUIK is configured or calculated using the PSDK, the UE shall use the DUIK and UTC-based counter to verify the MIC field in the unscrambled PROSE PC5 DISCOVERY message for group member discovery response.

Then if the application layer group ID parameter of the PROSE PC5 DISCOVERY message for group member discovery response is the same as the application layer group ID parameter of the PROSE PC5 DISCOVERY message for group member discovery solicitation, the UE shall consider that other UE in the discovery group the UE seeks to discover has been discovered.

6.2.15.2.2.3 Discoverer UE procedure for group member discovery completion

When the UE is triggered by an upper layer application to stop soliciting proximity of other UEs in a discovery group, or when the UE stops being authorised to perform the discoverer UE procedure for group member discovery, the UE shall instruct the lower layers to stop discoverer operation.

When the UE stops discoverer operation, if the UE is in 5GMM-CONNECTED mode, the UE shall trigger the corresponding procedure in lower layers as specified in 3GPP TS 38.331 [13].

6.2.15.2.2.4 Discoveree UE procedure for group member discovery initiation

The UE is authorised to perform the discoveree UE procedure for group member discovery if:

a) the following is true:

1) the UE is not served by NG-RAN, is authorised to perform 5G ProSe direct discovery discoveree operation when the UE is not served by NG-RAN, and is configured with the radio parameters to be used for 5G ProSe direct discovery when not served by NG-RAN;

2) the UE is served by NG-RAN, and is authorised to perform 5G ProSe direct discovery discoveree operation in the PLMN(s) indicated by the serving cell; or

3) the UE is:

i) in 5GMM-IDLE mode, in limited service state as specified in 3GPP TS 23.122 [14], and the reason for the UE being in limited service state is one of the following:

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

B) 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

C) 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]; and

ii) authorised to perform 5G ProSe direct discovery discoveree operation when the UE is not served by NG-RAN, and:

A) configured with the radio parameters to be used for 5G ProSe direct discovery when not served by NG-RAN; or

B) the lower layers indicate that the UE does not need to request resources for 5G ProSe direct discovery procedure; and

NOTE: When the lower layers indicate that the UE does not need to request resources for 5G ProSe direct discovery procedure, the serving cell broadcasts a common radio resources pool for 5G ProSe discovery transmission and the UE can use this common radio resources pool while in limited service state.

b) the UE is configured with the application layer group ID parameter identifying the discovery group to be responded to and with the User info ID for the group member discovery parameter;

otherwise, the UE is not authorised to perform the discoveree UE procedure for group member discovery.

Figure 6.2.15.2.2.4.1 illustrates the interaction of the UEs in the discoveree UE procedure for group member discovery.

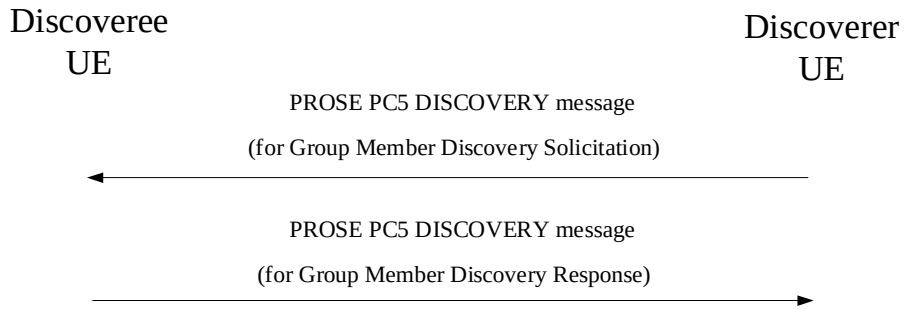

Figure 6.2.15.2.2.4.1: Discoveree UE procedure for group member discovery

When the UE is triggered by an upper layer application to start responding to solicitation on proximity of a UE in a discovery group, and if the UE is authorised to perform the discoveree UE procedure for group member discovery, then the UE:

a) if the UE is served by NG-RAN, and the UE in 5GMM-IDLE mode needs to request resources for sending PROSE PC5 DISCOVERY messages as specified in 3GPP TS 38.331 [13], shall perform a service request procedure as specified in 3GPP TS 24.501 [11]; and

b) shall instruct the lower layers to start monitoring for PROSE PC5 DISCOVERY messages.

Upon reception of a PROSE PC5 DISCOVERY message for group member discovery solicitation, for the application layer group ID of the discovery group which the UE is configured to respond for, the UE shall use the associated DUSK, if configured or calculated using the PSDK, and the UTC-based counter obtained during the monitoring operation to unscramble the PROSE PC5 DISCOVERY message as described in 3GPP TS 33.303 [36]. Then, if a DUCK is configured or calculated using the PSDK, the UE shall use the DUCK and the UTC-based counter to decrypt the configured message-specific confidentiality protected portion, as described in 3GPP TS 33.303 [36]. Finally, if a DUIK is configured or calculated using the PSDK, the UE shall use the DUIK and UTC-based counter to verify the MIC field in the unscrambled PROSE PC5 DISCOVERY message for group member discovery solicitation.

Then, if:

a) the application layer group ID parameter of the received PROSE PC5 DISCOVERY message is the same as the application layer group ID parameter for the discovery group; and

b) the target user info parameter is not included in the received PROSE PC5 DISCOVERY message or the target user info parameter in the received PROSE PC5 DISCOVERY message is the same as the target user info provided by the upper layers in the UE;

the UE:

a) shall obtain a valid UTC time for the discovery transmission from the lower layers and generate the UTC-based counter corresponding to this UTC time;

b) shall generate a PROSE PC5 DISCOVERY message for group member discovery response. In the PROSE PC5 DISCOVERY message for group member discovery response, the UE:

   1) shall set the discoveree info parameter to the user info ID for the group member discovery parameter;

   2) shall set the application layer group ID parameter to the application layer group ID parameter of the PROSE PC5 DISCOVERY message for group member discovery solicitation;

   3) shall include the MIC filed computed as described in 3GPP TS 33.503 [34] by using the UTC-based counter and the DUIK contained in the <restricted-discoveree-response> element of the DISCOVERY_RESPONSE message;

   4) shall set the 4 least significant bits of UTC-based counter LSB parameter to the 4 least significant bits of the UTC-based counter;

   5) shall set the ProSe direct discovery PC5 message type parameter as specified in table 10.2.1.7; and

   6) may include the Metadata IE to provide the application layer discovery message;

c) shall apply the DUIK, DUSK, or DUCK with the associated Encrypted Bitmask, along with the UTC-based counter to the PROSE PC5 DISCOVERY message for whichever security mechanism(s) configured to be applied, e.g., integrity protection, message scrambling or confidentiality protection of one or more above parameters, as specified in 3GPP TS 33.303 [36];

d) shall set the destination layer-2 ID to the source layer-2 ID from the discoverer UE used in the transportation of the PROSE PC5 DISCOVERY message for group member discovery solicitation, and self-assign a source layer-2 ID for sending the group member discovery response message; and

e) shall pass the resulting PROSE PC5 DISCOVERY message for group member discovery response along with the source layer-2 ID and the destination layer-2 ID to the lower layers for transmission over the PC5 interface.

6.2.15.2.2.5 Discoveree UE procedure for group member discovery completion

When the UE is triggered by an upper layer application to stop responding to solicitation on proximity of other UEs in a discovery group, or when the UE stops being authorised to perform the discoveree UE procedure for group member discovery, the UE shall instruct the lower layers to stop monitoring.

When the UE stops monitoring, if the UE is in 5GMM-CONNECTED mode, the UE shall trigger the corresponding procedure in lower layers as specified in 3GPP TS 38.331 [13].

6.2.16 Procedure for UE to use provisioned radio resources for 5G ProSe direct discovery

When the UE is not served by NG-RAN for 5G ProSe direct discovery and is authorized to use 5G ProSe direct discovery, the UE shall select the corresponding radio parameters to be used for 5G ProSe direct discovery as follows:

a) if the UE can determine itself located in a geographical area, and the UE is provisioned with radio parameters for the geographical area, the UE shall select the radio parameters associated with that geographical area; or

b) in all other cases, the UE shall not initiate 5G ProSe direct discovery over PC5.

If the UE intends to use "non-operator managed" radio parameters as specified in clause 5.2.3, the UE shall initiate 5G ProSe direct discovery with the selected radio parameters.

If the UE intends to use "operator managed" radio parameters as specified in clause 5.2.3, before initiating 5G ProSe direct discovery, the UE shall check with lower layers whether the selected radio parameters can be used in the current location without causing interference to other cells as specified in 3GPP TS 38.331 [13], and:

a) if the lower layers indicate that the usage would not cause any interference, the UE shall initiate 5G ProSe direct discovery; or

NOTE: If the lower layers find that there exists a cell operating the provisioned radio resources (i.e., carrier frequency), and the cell belongs to the registered PLMN or a PLMN equivalent to the registered PLMN, and the UE is authorized for 5G ProSe direct discovery in this PLMN, the UE can use the radio parameters indicated by the cell as specified in 3GPP TS 38.331 [13].

b) else if the lower layers report that one or more PLMNs operate in the provisioned radio resources (i.e., carrier frequency) then:

   1) if the following conditions are met:

      i) none of the PLMNs reported by the lower layers is the registered PLMN or equivalent to the registered PLMN;

      ii) at least one of the PLMNs reported by the lower layers is in the list of authorized PLMNs for 5G ProSe direct discovery and provides radio resources for 5G ProSe direct discovery as specified in 3GPP TS 38.331 [13]; and

      iii) the UE does not have an emergency PDU session;

      then the UE shall:

      i) if in 5GMM-IDLE mode, perform PLMN selection triggered by 5G ProSe direct discovery as specified in 3GPP TS 23.122 [14]; or

      ii) else if in 5GMM-CONNECTED mode, either:

         A) perform a De-registration procedure as specified in 3GPP TS 24.501 [11] and then perform PLMN selection triggered by 5G ProSe direct discovery as specified in 3GPP TS 23.122 [14]; or

         B) not initiate 5G ProSe direct discovery.

         Whether the UE performs i) or ii) above is left up to UE implementation; or

   2) else the UE shall not initiate 5G ProSe direct discovery.

If the registration to the selected PLMN is successful, the UE shall proceed with the procedure to initiate 5G ProSe direct discovery as specified in clause 6.2.14 and clause 6.2.15.

If the UE is performing 5G ProSe direct discovery using radio parameters associated with a geographical area and moves out of that geographical area, the UE shall stop performing 5G ProSe direct discovery and then if the UE is not served by NG-RAN for 5G ProSe direct discovery, the UE shall select appropriate radio parameters for the new geographical area as specified above.

7 5G ProSe direct communications

7.1 Overview

This clause describes the procedures at the UE, and between UEs, for 5G ProSe direct communication over PC5.

The UE shall support requirements for securing 5G ProSe direct communication over PC5.

The PC5 interface is selected based on the ProSe application to path preference mapping rules as specified in clause 5.2.4 before 5G ProSe direct communication.

For unicast mode 5G ProSe direct communication, the following data unit types are supported: IPv4, IPv6, Ethernet, and Unstructured.

For broadcast and groupcast mode 5G ProSe communication, the following data unit types are supported: IPv4, IPv6, Ethernet, Unstructured, and Address Resolution Protocol (see RFC 826 [32]).

5G ProSe direct communication over NR-PC5 supports broadcast mode, groupcast mode, and unicast mode. If the upper layer of the UE indicates the mode of communication, the UE shall set the mode of communication based on the request of the upper layer. Otherwise, the UE shall set the mode of communication based on the mapping rules between the 5G ProSe identifiers and the default mode of communication defined in clause 5.2.4.

NOTE: Further details about whether broadcast, unicast or groupcast can be used over PC5 are described in 3GPP TS 23.304 [3] clause 5.3.

7.2 Unicast mode 5G ProSe direct communication over PC5

7.2.1 Overview

This clause describes the PC5 signalling protocol procedures between two UEs for one-to-one (i.e., unicast) mode of ProSe direct communication. The following PC5 signalling protocol procedures are defined:

a) 5G ProSe direct link establishment;

b) 5G ProSe direct link modification;

c) 5G ProSe direct link release;

d) 5G ProSe direct link identifier update;

e) 5G ProSe direct link keep-alive;

f) 5G ProSe direct link security mode control;

g) 5G ProSe direct link re-keying; and

h) 5G ProSe direct link authentication.

Each 5G ProSe direct link is associated with a 5G ProSe direct link context. For 5G ProSe UE-to-network relay, the 5G ProSe direct link context includes:

a) user info ID and layer-2 ID of 5G ProSe remote UE;

b) user info ID and layer-2 ID of 5G ProSe UE-to-network relay UE;

c) relay service code; and

d) in the case of 5G ProSe Layer-3 UE-to-network relay, the network layer protocol and the information about PC5 QoS flow(s).

The 5G ProSe direct link context shall be created during a 5G ProSe direct link establishment procedure, be updated accordingly after a 5G ProSe direct link modification procedure or 5G ProSe direct link identifier update procedure, and

be deleted during the 5G ProSe direct link release procedure or during a local release of 5G ProSe direct link as specified in clause 7.2.

7.2.2 5G ProSe direct link establishment procedure

7.2.2.1 General

Depending on the type of the 5G ProSe direct link establishment procedure (i.e., UE oriented layer-2 link establishment or ProSe service oriented layer-2 link establishment in 3GPP TS 23.304 [2]), the 5G ProSe direct link establishment procedure is used to establish a 5G ProSe direct link between two UEs or to establish multiple 5G ProSe direct links. The UE sending the request message is called the "initiating UE" and the other UE is called the "target UE". If the request message does not indicate the specific target UE (i.e., target user info is not included in the request message), and multiple target UEs are interested in the ProSe application(s) indicated in the request message, then the initiating UE shall handle corresponding response messages received from those target UEs. The maximum number of 5G ProSe direct links established in a UE at a time shall not exceed an implementation-specific maximum number of established 5G ProSe direct links.

NOTE: The recommended maximum number of established 5G ProSe direct link is 8.

When the 5G ProSe direct link establishment procedure for a 5G ProSe layer-3 remote UE completes successfully, and if there is a PDU session established for relaying the traffic of the remote UE, the 5G ProSe layer-3 UE-to-network relay UE shall perform the remote UE report procedure as specified in 3GPP TS 24.501 [11].

After the 5G ProSe direct link establishment procedure for a 5G ProSe layer-2 remote UE completes successfully, and upon getting a request from the 5G ProSe layer-2 remote UE through lower layers, the 5G ProSe layer-2 UE-to-network relay UE, if in 5GMM-IDLE mode, shall inform lower layers to perform a service request procedure as specified in 3GPP TS 24.501 [11].

Editor's note: Any possible changes to the 5G ProSe direct link establishment procedure due to the security requirements of 5G ProSe layer-2 UE-to-network relay or 5G ProSe layer-3 UE-to-network relay (such as adding new IEs or changing existing IEs) are FFS.

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;

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 or known via prior ProSe direct communication);

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, or is authorized to use a 5G ProSe UE-to-network 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 remote UE and the UE-to-network relay UE, the existing 5G ProSe direct link for the peer UE is established with a different RSC or without an RSC;

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; and

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.

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.

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;

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 remote UE and the 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 to the identity of the 5G ProSe UE-to-network relay UE obtained during the 5G ProSe UE-to-network relay discovery procedure, or if the destination layer-2 ID is the unicast layer-2 ID of target UE;

d) 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 2: The key establishment information container is provided by upper layers.

e) shall include a Nonce_1 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";

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 most significant 8 bits (MSB) of $K_{NRP\text{-}sess}$ 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";

h) may include a K_{NRP} ID if the initiating UE has an existing K_{NRP} for the target 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 layer-3 remote UE and 5G ProSe layer-3 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; and

h) 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 layer-3 remote UE and the 5G ProSe layer-3 UE-to-network relay UE; and

2) the security for 5G ProSe layer-3 relay use the security procedure over control plane as specified in 3GPP TS 33.503 [34].

Editor's note: It is FFS how the UE determines whether the security for 5G ProSe layer-3 relay uses the security procedure over control plane or the security procedure over user plane as specified in 3GPP TS 33.503 [34].

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 initiating UE's layer-2 ID for unicast communication and:

a) the destination layer-2 ID used for unicast initial signalling; or

b) the destination layer-2 ID set to the source layer-2 ID of the selected 5G ProSe UE-to-network relay UE during the 5G ProSe UE-to-network relay discovery procedure as defined in clause 8.2.1;

and start timer T5080.

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 3: 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.

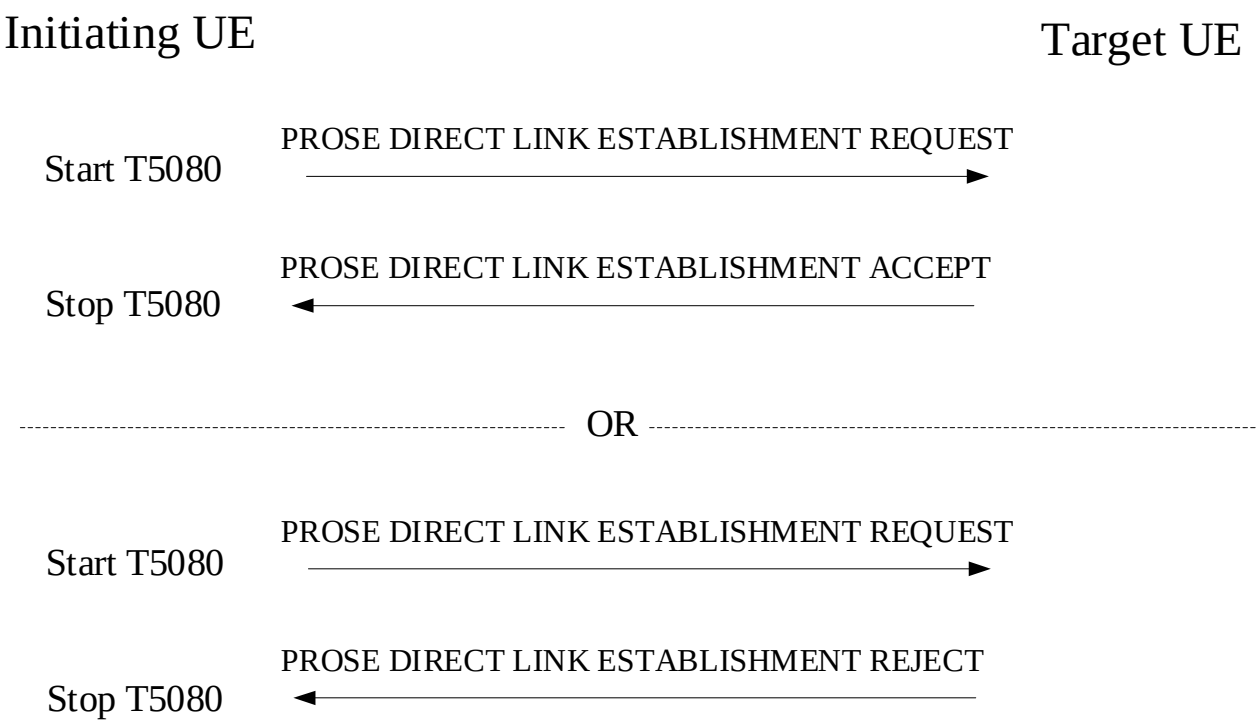

Figure 7.2.2.2.1: UE oriented 5G ProSe direct link establishment procedure

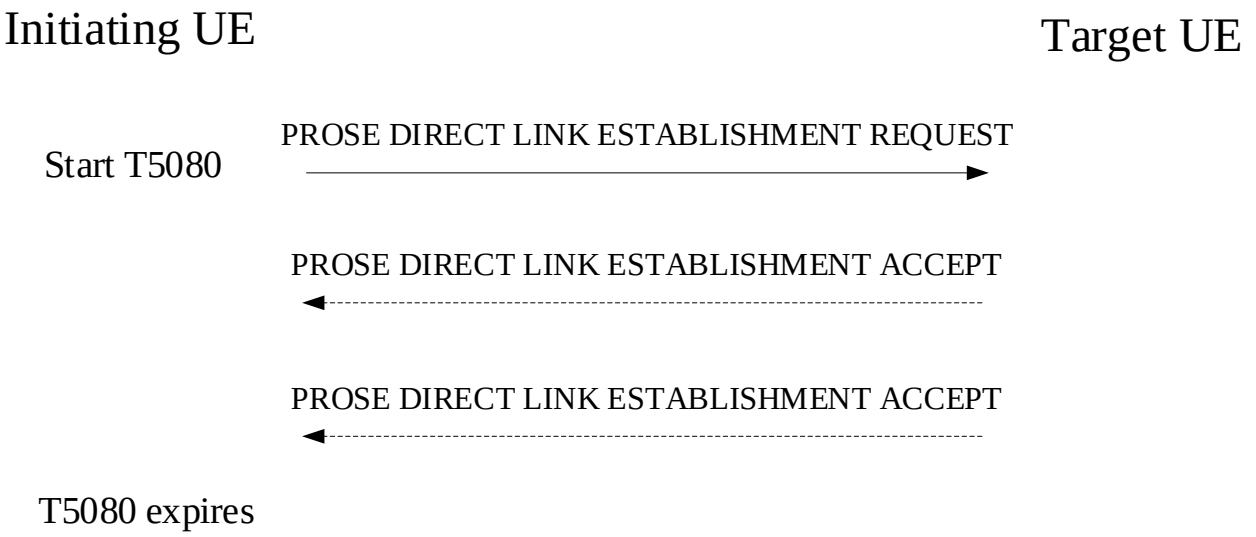

Figure 7.2.2.2.2: ProSe service oriented 5G ProSe direct link establishment procedure

7.2.2.3 5G ProSe direct link establishment procedure accepted by the target UE

Upon receipt of a PROSE DIRECT LINK ESTABLISHMENT REQUEST message, if the target UE accepts this request, the target UE shall uniquely assign a PC5 link identifier, create a 5G ProSe direct link context.

If the PROSE DIRECT LINK ESTABLISHMENT REQUEST message is not used for 5G ProSe direct communication between the remote UE and the UE-to-network relay UE, the target UE assigns a layer-2 ID for this 5G ProSe direct link. The newly assigned layer-2 ID replaces the target layer-2 ID as received on the PROSE DIRECT LINK ESTABLISHMENT REQUEST message. Then the target UE shall store this assigned layer-2 ID and the source layer-2 ID used in the transport of this message provided by the lower layers in the 5G ProSe direct link context.

The target UE may initiate 5G ProSe direct link authentication procedure as specified in clause 7.2.12 and shall initiate 5G ProSe direct link security mode control procedure as specified in clause 7.2.10.

NOTE 1: It is possible for the target UE to reuse the target UE's layer-2 ID used in the transport of the PROSE DIRECT LINK ESTABLISHMENT REQUEST message provided by the lower layers in case that the target UE's layer-2 ID has been used in previous 5G ProSe direct link with the same peer.

If:

a) the target user info IE is included in the PROSE DIRECT LINK ESTABLISHMENT REQUEST message and this IE includes the target UE's application layer ID; or

b) the target user info IE is not included in the PROSE DIRECT LINK ESTABLISHMENT REQUEST message and the target UE is interested in the ProSe application(s) identified by the ProSe identifier IE in the PROSE DIRECT LINK ESTABLISHMENT REQUEST message;

then the target UE shall either:

a) identify an existing K_{NRP} based on the K_{NRP} ID included in the PROSE DIRECT LINK ESTABLISHMENT REQUEST message; or

b) if K_{NRP} ID is not included in the PROSE DIRECT LINK ESTABLISHMENT REQUEST message, the target UE does not have an existing K_{NRP} for the K_{NRP} ID included in PROSE DIRECT LINK ESTABLISHMENT REQUEST message or the target UE wishes to derive a new K_{NRP}, derive a new K_{NRP}. This may require performing one or more 5G ProSe direct link authentication procedures as specified in clause 7.2.12.

NOTE 2: How many times the 5G ProSe direct link authentication procedure needs to be performed to derive a new K_{NRP} depends on the authentication method used.

After an existing K_{NRP} was identified or a new K_{NRP} was derived, the target UE shall initiate a 5G ProSe direct link security mode control procedure as specified in clause 7.2.10.

Upon successful completion of the 5G ProSe direct link security mode control procedure, in order to determine whether the PROSE DIRECT LINK ESTABLISHMENT REQUEST message can be accepted or not, in case of IP communication, the target UE checks whether there is at least one common IP address configuration option supported by both the initiating UE and the target UE.

Before sending the PROSE DIRECT LINK ESTABLISHMENT ACCEPT message to the remote UE, the target UE acting as a 5G ProSe layer-3 UE-to-network relay UE shall inform the lower layer to initiate the UE requested PDU session establishment procedure as specified in 3GPP TS 24.501 [11] if:

1) the PDU session for relaying the service associated with the RSC has not been established yet; or

2) the PDU session for relaying the service associated with the RSC has been established but the PDU session type is Unstructured.

If the target UE accepts the 5G ProSe direct link establishment procedure, the target UE shall create a PROSE DIRECT LINK ESTABLISHMENT ACCEPT message. The target UE:

a) shall include the source user info set to the target UE's application layer ID received from upper layers;

b) shall include PQFI(s), the corresponding PC5 QoS parameters and optionally the ProSe identifier(s) that the target UE accepts, if the target UE is not acting as a 5G ProSe layer-2 UE-to-network relay UE;

c) may include the PC5 QoS rule(s) if the target UE is not acting as a 5G ProSe layer-2 UE-to-network relay UE;

d) shall include an IP address configuration IE set to one of the following values if IP communication is used and the target UE is not acting as a 5G ProSe layer-2 UE-to-network relay UE:

1) "DHCPv4 server" if only IPv4 address allocation mechanism is supported by the target UE, i.e., acting as a DHCPv4 server; or

2) "IPv6 router" if only IPv6 address allocation mechanism is supported by the target UE, i.e., acting as an IPv6 router; or

3) "DHCPv4 server & IPv6 Router" if both IPv4 and IPv6 address allocation mechanism are supported by the target UE; or

4) "address allocation not supported" if neither IPv4 nor IPv6 address allocation mechanism is supported by the target UE and the target UE is not acting as a 5G ProSe layer-3 UE-to-network relay UE;

NOTE: The UE doesn't include an IP address configuration IE nor a link local IPv6 address IE, if Ethernet or Unstructured data unit type is used for communication.

e) shall include a link local IPv6 address IE formed locally based on IETF RFC 4862 [16] if IP address configuration IE is set to "address allocation not supported", the received PROSE DIRECT LINK SECURITY MODE COMPLETE message included a link local IPv6 address IE and the target UE is neither acting as a 5G ProSe layer-2 UE-to-network relay UE nor acting as a 5G ProSe layer-3 relay UE; and

f) shall include the configuration of UE PC5 unicast user plane security protection based on the agreed user plane security policy, as specified in 3GPP TS 33.503 [34].

After the PROSE DIRECT LINK ESTABLISHMENT ACCEPT message is generated, the target UE shall pass this message to the lower layers for transmission along with the initiating UE's layer-2 ID for unicast communication and the target UE's layer-2 ID for unicast communication, and shall start timer T5090 if at least one of ProSe identifiers for the 5G ProSe direct links satisfies the privacy requirements as specified in clause 5.2.

After sending the PROSE DIRECT LINK ESTABLISHMENT ACCEPT message, the target 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.

If the target UE accepts the 5G ProSe direct link establishment request and the 5G ProSe direct link is established not for 5G ProSe direct communication between the 5G ProSe remote UE and the 5G ProSe UE-to-network relay UE, then the target UE may perform the PC5 QoS flow establishment over 5G ProSe direct link as specified in clause 7.2.7. If the 5G ProSe direct link is established for 5G ProSe direct communication between the 5G ProSe layer-3 remote UE and the 5G ProSe layer-3 UE-to-network relay UE, then the target UE may perform the PC5 QoS flow establishment over 5G ProSe direct link as specified in clause 8.2.6.

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 delete the old security context it has for the target UE and 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 at least one of ProSe identifiers for the 5G ProSe direct links satisfies the privacy requirements as specified in clause 5.2.

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.

7.2.2.5 5G ProSe direct link establishment procedure not accepted by the target UE

If the PROSE DIRECT LINK ESTABLISHMENT REQUEST message cannot be accepted, the target UE shall send a PROSE DIRECT LINK ESTABLISHMENT REJECT message. The PROSE DIRECT LINK ESTABLISHMENT REJECT message contains a PC5 signalling protocol cause IE set to one of the following cause values:

#1 direct communication to the target UE not allowed;

#3 conflict of layer-2 ID for unicast communication is detected;

#5 lack of resources for 5G ProSe direct link;

#13 congestion situation; or

#111 protocol error, unspecified.

If the target UE is not allowed to accept the PROSE DIRECT LINK ESTABLISHMENT REQUEST message, e.g., based on operator policy or configuration parameters for ProSe direct communication over PC5 as specified in clause 5.2, or the target UE is acting as a layer-3 relay UE, is in non-allowed area of its serving PLMN, and the corresponding relay service code is not associated with an emergency services or high priority access as defined in clause 5.3.5 of 3GPP TS 24.501 [11], the target UE shall send a PROSE DIRECT LINK ESTABLISHMENT REJECT message containing PC5 signalling protocol cause value #1 "direct communication to the target UE not allowed".

For a received PROSE DIRECT LINK ESTABLISHMENT REQUEST message from a layer-2 ID (for unicast communication), if the target UE already has an existing link established to a UE using this layer-2 ID or is currently processing a PROSE DIRECT LINK ESTABLISHMENT REQUEST message from the same layer-2 ID, and with one of following parameters different from the existing link or the link for which the link establishment is in progress:

a) the source user info;

b) type of data (e.g., IP or non-IP); or

c) security policy,

the target UE shall send a PROSE DIRECT LINK ESTABLISHMENT REJECT message containing PC5 signalling protocol cause value #3 "conflict of layer-2 ID for unicast communication is detected".

NOTE 1: The type of data (e.g., IP or non-IP) is indicated by the optional IP address configuration IE included in the corresponding DIRECT LINK SECURITY MODE COMPLETE message, i.e., the type of data for the requested link is IP type if this IE is included, and the type of data for the requested link is non-IP if this IE is not included.

If the 5G ProSe direct link establishment fails due to the implementation-specific maximum number of established 5G ProSe direct links has been reached, or other temporary lower layer problems causing resource constraints, the target UE shall send a PROSE DIRECT LINK ESTABLISHMENT REJECT message containing PC5 signalling protocol cause value #5 "lack of resources for 5G ProSe direct link".

If the 5G ProSe direct link establishment request is for relaying and:

a) the NAS level mobility management congestion control as specified in clause 5.3.9 of TS 24.501 [11] is activated at the target UE; or

b) the target UE is under congestion;

the target UE shall send a PROSE DIRECT LINK ESTABLISHMENT REJECT message containing PC5 signalling protocol cause value #13 "congestion situation". The target UE may provide a back-off timer value to the initiating UE in the PROSE DIRECT LINK ESTABLISHMENT REJECT message. The target UE shall not accept any 5G ProSe direct link establishment request for relaying if the back-off timer for NAS level mobility management congestion control is running.

NOTE 2: How the target UE determines that it is under congestion is implementation specific (e.g., any relaying related operational overhead, etc).

NOTE 3: In case the target UE is under the NAS level mobility management congestion control, it is an implementation option that the provided back-off timer value to the initiating UE is set to the remaining time of the mobility management back-off timer T3346 or with an additional offset value.

If the 5G ProSe direct link establishment fails due to other reasons, the target UE shall send a PROSE DIRECT LINK ESTABLISHMENT REJECT message containing PC5 signalling protocol cause value #111 "protocol error, unspecified".

After sending the PROSE DIRECT LINK ESTABLISHMENT REJECT message, the target UE shall provide the following information along with the initiating UE's layer-2 ID for unicast communication and the target UE's layer-2 ID for unicast communication to the lower layer:

a) an indication of deactivation of the PC5 unicast security protection and deletion of security context for the 5G ProSe direct link, if applicable.

Upon receipt of the PROSE DIRECT LINK ESTABLISHMENT REJECT message, the initiating UE shall stop timer T5080 and abort the 5G ProSe direct link establishment procedure. If the PC5 signalling protocol cause value in the PROSE DIRECT LINK ESTABLISHMENT REJECT message is #1 "direct communication to the target UE not allowed" or #5 "lack of resources for 5G ProSe direct link", then the initiating UE shall not attempt to start the 5G ProSe direct link establishment procedure with the same target UE at least for a time period T. If the PC5 signalling protocol cause value in the PROSE DIRECT LINK ESTABLISHMENT REJECT message is #13 "congestion situation" and a back-off timer value is provided in the PROSE DIRECT LINK ESTABLISHMENT REJECT message, the initiating UE shall start timer T5088 associated with the layer-2 ID of the target UE and set its value to the provided timer value.

NOTE 4: The length of time period T is UE implementation specific and can be different for the case when the UE receives PC5 signalling protocol cause value #1 "direct communication to the target UE not allowed" or when the UE receives PC5 signalling protocol cause value #5 "lack of resources for 5G ProSe direct link".

After receiving the PROSE DIRECT LINK ESTABLISHMENT REJECT message, the initiating UE shall provide the following information along with the initiating UE's layer-2 ID for unicast communication and the target UE's layer-2 ID for unicast communication to the lower layer:

a) an indication of deactivation of the PC5 unicast security protection and deletion of security context for the 5G ProSe direct link, if applicable.

7.2.2.6 Abnormal cases

7.2.2.6.1 Abnormal cases at the initiating UE

If timer T5080 expires and the Target user info IE is included in the PROSE DIRECT LINK ESTABLISHMENT REQUEST message, the initiating UE shall retransmit the PROSE DIRECT LINK ESTABLISHMENT REQUEST message and restart timer T5080. After reaching the maximum number of allowed retransmissions, the initiating UE shall abort the 5G ProSe direct link establishment procedure and may notify the upper layer that the target UE is unreachable.

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 did not receive any PROSE DIRECT LINK ESTABLISHMENT ACCEPT message, the initiating UE may retransmit the PROSE DIRECT LINK ESTABLISHMENT REQUEST message and restart timer T5080. If the PROSE DIRECT LINK ESTABLISHMENT REQUEST message did not include the Target user info IE and the initiating UE did not receive any PROSE DIRECT LINK ESTABLISHMENT ACCEPT message, then after reaching the maximum number of allowed retransmissions, the initiating UE shall abort the 5G ProSe direct link establishment procedure and may notify the upper layer that no target UE is available.

NOTE: The maximum number of allowed retransmissions is UE implementation specific.

If the need to establish a link no longer exists before the procedure is completed, the initiating UE shall abort the procedure.

When the initiating UE aborts the 5G ProSe direct link establishment procedure, the initiating UE shall provide the following information along with the initiating UE's layer-2 ID for unicast communication and the target UE's layer-2 ID for unicast communication to the lower layer:

a) an indication of deactivation of the PC5 unicast security protection and deletion of security context for the 5G ProSe direct link, if applicable.

7.2.2.6.2 Abnormal cases at the target UE

For a received PROSE DIRECT LINK ESTABLISHMENT REQUEST message from a source layer-2 ID (for unicast communication), if the target UE already has an existing link established to the UE known to use the same source layer-2 ID, the same source user info, the same type of data (IP or non-IP) and the same security policy, the UE shall process the new request. However, the target UE shall only delete the existing 5G ProSe direct link context after the new link establishment procedure succeeds.

NOTE: The type of data (e.g., IP or non-IP) is indicated by the optional IP address configuration IE included in the corresponding PROSE DIRECT LINK SECURITY MODE COMPLETE message, i.e., the type of data for the requested link is IP type if this IE is included, and the type of data for the requested link is non-IP if this IE is not included.

7.2.3 5G ProSe direct link modification procedure

7.2.3.1 General

The purpose of the 5G ProSe direct link modification procedure is to modify the existing ProSe direct link to:

a) add new PC5 QoS flow(s) to the existing 5G ProSe direct link;

b) modify existing PC5 QoS flow(s) for updating PC5 QoS parameters of the existing PC5 QoS flow(s);

c) modify existing PC5 QoS flow(s) for associating new ProSe application(s) with the existing PC5 QoS flow(s);

d) modify existing PC5 QoS flow(s) for removing the associated ProSe application(s) from the existing PC5 QoS flow(s); or

e) remove existing PC5 QoS flow(s) from the existing 5G ProSe direct link.

In this procedure, the UE sending the PROSE DIRECT LINK MODIFICATION REQUEST message is called the "initiating UE" and the other UE is called the "target UE".

NOTE: The 5G ProSe direct link modification procedure is not applicable for 5G ProSe layer-2 UE-to-network relay case.

7.2.3.2 5G ProSe direct link modification procedure initiated by initiating UE

The initiating UE shall meet the following pre-conditions before initiating this procedure for adding a new ProSe application to the existing 5G ProSe direct link:

a) there is a 5G ProSe direct link between the initiating UE and the target UE;

b) the pair of application layer IDs and the network layer protocol of this 5G ProSe direct link are identical to those required by the application layer in the initiating UE for this ProSe application; and

c) the security policy corresponding to the ProSe identifier is aligned with the security policy of the existing 5G ProSe direct link.

After receiving the service data or request from the upper layers, the initiating UE shall perform the PC5 QoS flow match as specified in clause 7.2.8. If there is no matched PC5 QoS flow, 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 modification procedure is to add new PC5 QoS flow(s) to the existing 5G ProSe direct link, the initiating UE shall create a PROSE DIRECT LINK MODIFICATION REQUEST message. In this message, initiating UE:

a) shall include the PQFI(s), the corresponding PC5 QoS parameters and optionally the ProSe identifier(s);

b) shall include the link modification operation code set to "Add new PC5 QoS flow(s) to the existing 5G ProSe direct link "; and

c) may include the PC5 QoS rule(s) to indicate the packet filters of the PC5 QoS flow(s).

If the 5G ProSe direct link modification procedure is to modify the PC5 QoS parameters for existing PC5 QoS flow(s) in the existing 5G ProSe direct link, the initiating UE shall create a PROSE DIRECT LINK MODIFICATION REQUEST message. In this message, the initiating UE:

a) shall include the PQFI(s) and the corresponding PC5 QoS parameters, including the ProSe identifier(s);

b) shall include the link modification operation code set to "Modify PC5 QoS parameters of the existing PC5 QoS flow(s)"; and

c) may include the PC5 QoS rule(s) to indicate the packet filters of the PC5 QoS flow(s).

If the 5G ProSe direct link modification procedure is to associate new ProSe application(s) with existing PC5 QoS flow(s), the initiating UE shall create a PROSE DIRECT LINK MODIFICATION REQUEST message. In this message, the initiating UE:

a) shall include the PQFI(s) and the corresponding PC5 QoS parameters, including the ProSe identifier(s);

b) shall include the link modification operation code set to "Associate new ProSe application(s) with existing PC5 QoS flow(s)"; and

c) may include the PC5 QoS rule(s) to indicate the packet filters of the PC5 QoS flow(s).

If the PC5 5G ProSe direct link modification procedure is to remove the associated ProSe application(s) from existing PC5 QoS flow(s), the initiating UE shall create a PROSE DIRECT LINK MODIFICATION REQUEST message. In this message, the initiating UE:

a) shall include the PQFI(s) and the corresponding PC5 QoS parameters including the ProSe identifier(s); and

b) shall include the link modification operation code set to "Remove ProSe application(s) from existing PC5 QoS flow(s)".

If the direct link modification procedure is to remove any PC5 QoS flow(s) from the existing 5G ProSe direct link, the initiating UE shall create a PROSE DIRECT LINK MODIFICATION REQUEST message. In this message, the initiating UE:

a) shall include the PQFI(s); and

b) shall include the link modification operation code set to "Remove existing PC5 QoS flow(s) from the existing 5G ProSe direct link".

After the PROSE DIRECT LINK MODIFICATION REQUEST message is generated, the initiating UE shall pass this message to the lower layers for transmission along with the initiating UE's layer-2 ID for 5G ProSe direct communication and the target UE's layer-2 ID for 5G ProSe direct communication, and start timer T5081. The UE shall not send a new PROSE DIRECT LINK MODIFICATION REQUEST message to the same target UE while timer T5081 is running.

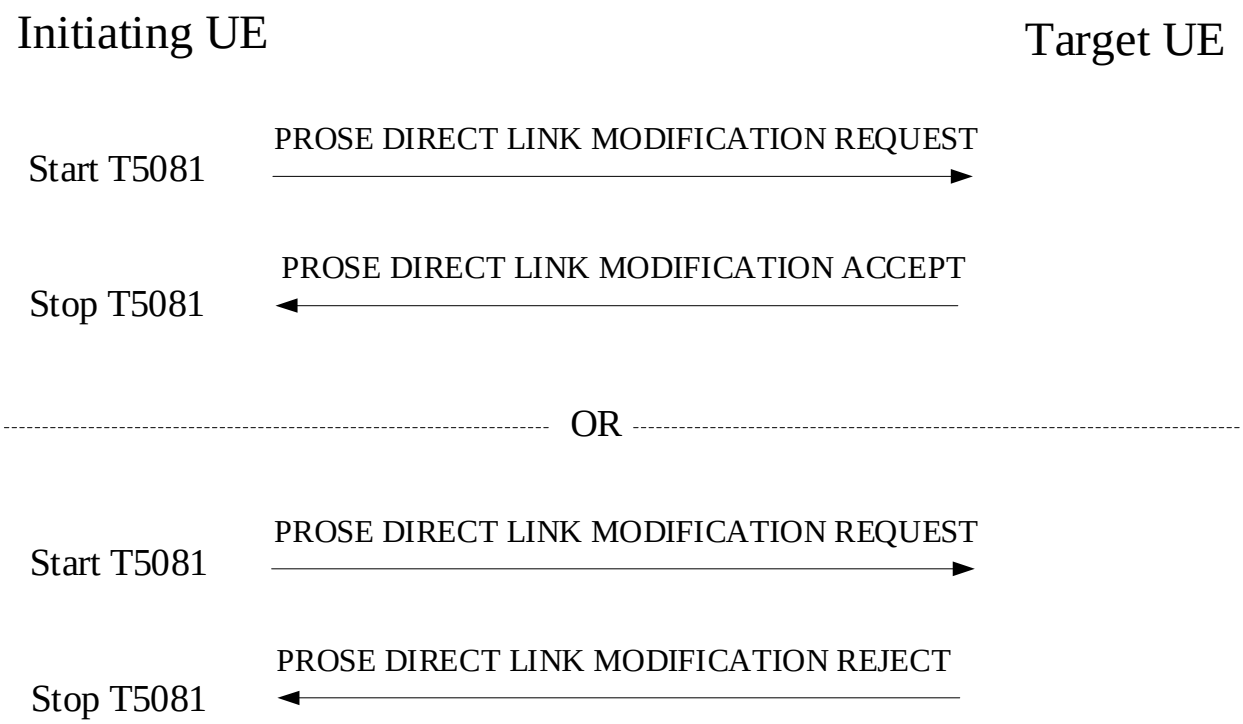

Figure 7.2.3.2.1: 5G ProSe direct link modification procedure

7.2.3.3 5G ProSe direct link modification procedure accepted by the target UE

If the PROSE DIRECT LINK MODIFICATION REQUEST message is accepted, the target UE shall respond with the DIRECT LINK MODIFICATION ACCEPT message.

If the PROSE DIRECT LINK MODIFICATION REQUEST message is to add a new ProSe application, add new PC5 QoS flow(s) or modify any existing PC5 QoS flow(s) in the 5G ProSe direct link, the target UE:

a) shall include the PQFI(s), the corresponding PC5 QoS parameters and optionally the ProSe identifier(s) that the target UE accepts; and

b) may include the PC5 QoS rule(s) to indicate the packet filters of the PC5 QoS flow(s);

in the PROSE DIRECT LINK MODIFICATION ACCEPT message.

If the PROSE DIRECT LINK MODIFICATION REQUEST message is to remove an existing ProSe application from the 5G ProSe direct link, the target UE shall delete the ProSe identifier received in the PROSE DIRECT LINK MODIFICATION REQUEST message and the corresponding PQFI(s) and PC5 QoS parameters from the profile associated with the 5G ProSe direct link.

If the PROSE DIRECT LINK MODIFICATION REQUEST message is to remove existing PC5 QoS flow(s) from the PC5 5G ProSe direct link, the target UE shall delete the PQFI(s) and the corresponding PC5 QoS parameters from the profile associated with the 5G ProSe direct link.

If the PROSE DIRECT LINK MODIFICATION REQUEST message is to add a new ProSe application, add new PC5 QoS flow(s) or modify any existing PC5 QoS flow(s) in the 5G ProSe direct link, after sending the PROSE DIRECT LINK MODIFICATION ACCEPT message, the target UE shall provide the added or modified PQFI(s) and corresponding PC5 QoS parameters along with PC5 link identifier to the lower layer.

If the PROSE DIRECT LINK MODIFICATION REQUEST message is to remove an existing ProSe application or to remove the existing PC5 QoS flow(s) from the 5G ProSe direct link, after sending the PROSE DIRECT LINK MODIFICATION ACCEPT message, the target UE shall provide the removed PQFI(s) along with the PC5 link identifier to the lower layer.

If the target UE accepts the 5G ProSe direct link modification request, then the target UE may perform the PC5 QoS flow establishment over 5G ProSe direct link as specified in clause 7.2.7 and perform the PC5 QoS flow match over 5G ProSe direct link as specified in clause 7.2.8.

7.2.3.4 5G ProSe direct link modification procedure completion by the initiating UE

Upon receipt of the PROSE DIRECT LINK MODIFICATION ACCEPT message, the initiating UE shall stop timer T5081.

Upon receipt of the PROSE DIRECT LINK MODIFICATION ACCEPT message, if the PROSE DIRECT LINK MODIFICATION REQUEST message is to add a new ProSe application, add new PC5 QoS flow(s) or modify any existing PC5 QoS flow(s) in the 5G ProSe direct link, the initiating UE shall provide the added or modified PQFI(s) and corresponding PC5 QoS parameters along with PC5 link identifier to the lower layer.

Upon receipt of the PROSE DIRECT LINK MODIFICATION ACCEPT message, if the PROSE DIRECT LINK MODIFICATION REQUEST message is to remove an existing ProSe application or to remove the existing PC5 QoS flow(s) from the 5G ProSe direct link, the initiating UE shall provide the removed PQFI(s) along with the PC5 link identifier to the lower layer.

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

7.2.3.5 5G ProSe direct link modification procedure not accepted by the target UE

If the 5G ProSe direct link modification request cannot be accepted, the target UE shall send a PROSE DIRECT LINK MODIFICATION REJECT message. The PROSE DIRECT LINK MODIFICATION REJECT message contains a PC5 signalling protocol cause IE set to one of the following cause values:

#5 lack of resources for 5G ProSe direct link;

#6 required service not allowed;

#12 security policy not aligned; or

#111 protocol error, unspecified.

If the target UE is not allowed to accept this request, e.g., because the ProSe application to be added is not allowed per the operator policy or configuration parameters for ProSe communication over PC5 as specified in clause 5.2.4, the target UE shall send a PROSE DIRECT LINK MODIFICATION REJECT message with PC5 signalling protocol cause value #6 "required service not allowed".

If the 5G ProSe direct link modification fails due to the congestion problems or other temporary lower layer problems causing resource constraints, the target UE shall send a PROSE DIRECT LINK MODIFICATION REJECT message with PC5 signalling protocol cause value #5 "lack of resources for 5G ProSe direct link".

If the link modification operation code is set to "Associate new ProSe application(s) with existing PC5 QoS flow(s)", and the security policy corresponding to the ProSe identifier(s) is not aligned with the security policy applied to the existing 5G ProSe direct link, then the target UE shall send a PROSE DIRECT LINK MODIFICATION REJECT message with PC5 signalling protocol cause value #12 "security policy not aligned".

For other reasons causing the failure of link modification, the target UE shall send a PROSE DIRECT LINK MODIFICATION REJECT message with PC5 signalling protocol cause value #111 "protocol error, unspecified".

Upon receipt of the PROSE DIRECT LINK MODIFICATION REJECT message, the initiating UE shall stop timer T5081 and abort the 5G ProSe direct link modification procedure. If the PC5 signalling protocol cause value in the PROSE DIRECT LINK MODIFICATION REJECT message is #11 "required service not allowed" or #5 "lack of resources for 5G ProSe direct link" or #12 "security policy not aligned", then the initiating UE shall not attempt to start 5G ProSe direct link modification with the same target UE to add the same ProSe application, or to add or modify the same PC5 QoS flow(s) at least for a time period T.

NOTE: The length of time period T is UE implementation specific and can be different for the case when the UE receives PC5 signalling protocol cause value #11 "required service not allowed" or when the UE receives PC5 signalling protocol cause value #5 "lack of resources for 5G ProSe direct link" or when the UE receives PC5 signalling protocol cause value #12 "security policy not aligned". The length of time period T is not less than 30 minutes.

7.2.3.6 Abnormal cases at the initiating UE

The following abnormal cases can be identified:

a) If timer T5081 expires, the initiating UE shall retransmit the PROSE DIRECT LINK MODIFICATION REQUEST message and restart timer T5081. After reaching the maximum number of allowed retransmissions, the initiating UE shall abort the 5G ProSe direct link modification procedure and may notify the upper layer that the target UE is unreachable.

NOTE 1: The maximum number of allowed retransmissions is UE implementation specific.

NOTE 2: After reaching the maximum number of allowed retransmissions, whether the initiating UE releases this 5G ProSe direct link depends on its implementation.

b) For the same 5G ProSe direct link, if the initiating UE receives a PROSE DIRECT LINK RELEASE REQUEST message after the initiation of UE-requested 5G ProSe direct link modification procedure, the initiating UE shall stop the timer T5081 and abort the 5G ProSe direct link modification procedure and proceed with the 5G ProSe direct link release procedure.

c) For the same 5G ProSe direct link, if the initiating UE receives a PROSE DIRECT LINK MODIFICATION REQUEST message during the 5G ProSe direct link modification procedure, the initiating UE shall stop the timer T5081 and abort the 5G ProSe direct link modification procedure. Following handling is implementation dependent, e.g., the initiating UE waits for an implementation dependent time for initiating a new 5G ProSe direct link modification procedure, if still needed.

NOTE 3: The implementation dependent timer value needs to be set to avoid further collisions (e.g., random timer value).

7.2.4 5G ProSe direct link identifier update procedure

7.2.4.1 General

The 5G ProSe direct link identifier update procedure is used to update and exchange the new identifiers (e.g., application layer ID, layer-2 ID, security information and IP address/prefix) between two UEs for a 5G ProSe direct link before using the new identifiers. The UE sending the PROSE DIRECT LINK IDENTIFIER UPDATE REQUEST message is called the "initiating UE" and the other UE is called the "target UE".

7.2.4.2 5G ProSe direct link identifier update procedure initiation by initiating UE

The initiating UE shall initiate the procedure if:

a) the initiating UE receives a request from upper layers to change the application layer ID and there is an existing 5G ProSe direct link associated with this application layer ID; or

b) the privacy timer (see clause 5.2.4) of the initiating UE's layer-2 ID expires for an existing 5G ProSe direct link.

If the 5G ProSe direct link identifier update procedure is triggered by a change of the initiating UE's application layer ID, the initiating UE shall create a PROSE DIRECT LINK IDENTIFIER UPDATE REQUEST message. In this message, the initiating UE:

a) shall include the initiating UE's new application layer ID received from upper layer;

b) shall include the initiating UE's new layer-2 ID assigned by itself;

c) shall include the new MSB of $K_{NRP\text{-}sess}$ ID; and

d) shall include the new IP address/prefix if IP communication is used and the 5G ProSe direct link is not for 5G ProSe direct communication between 5G ProSe layer-2 remote UE and 5G ProSe layer-2 UE-to-network relay UE.

If the 5G ProSe direct link identifier update procedure is triggered by the expiry of the initiating UE's privacy timer T5090 as specified in clause 5.2.4, the initiating UE shall create a PROSE DIRECT LINK IDENTIFIER UPDATE REQUEST message. In this message, the initiating UE:

a) shall include the initiating UE's new layer-2 ID assigned by itself;

b) shall include the new MSB of $K_{NRP-sess}$ ID;

c) may include the initiating UE's new application layer ID if received from upper layer; and

d) shall include the new IP address/prefix if IP communication is used and changed, and the 5G ProSe direct link is not for 5G ProSe direct communication between 5G ProSe layer-2 remote UE and 5G ProSe layer-2 UE-to-network relay UE.

After the PROSE DIRECT LINK IDENTIFIER UPDATE REQUEST message is generated, the initiating UE shall pass this message to the lower layers for transmission along with the initiating UE's old layer-2 ID for 5G ProSe direct communication and the target UE's layer-2 ID for 5G ProSe direct communication, and start timer T5082. The UE shall not send a new PROSE DIRECT LINK IDENTIFIER UPDATE REQUEST message to the same target UE while timer T5082 is running.

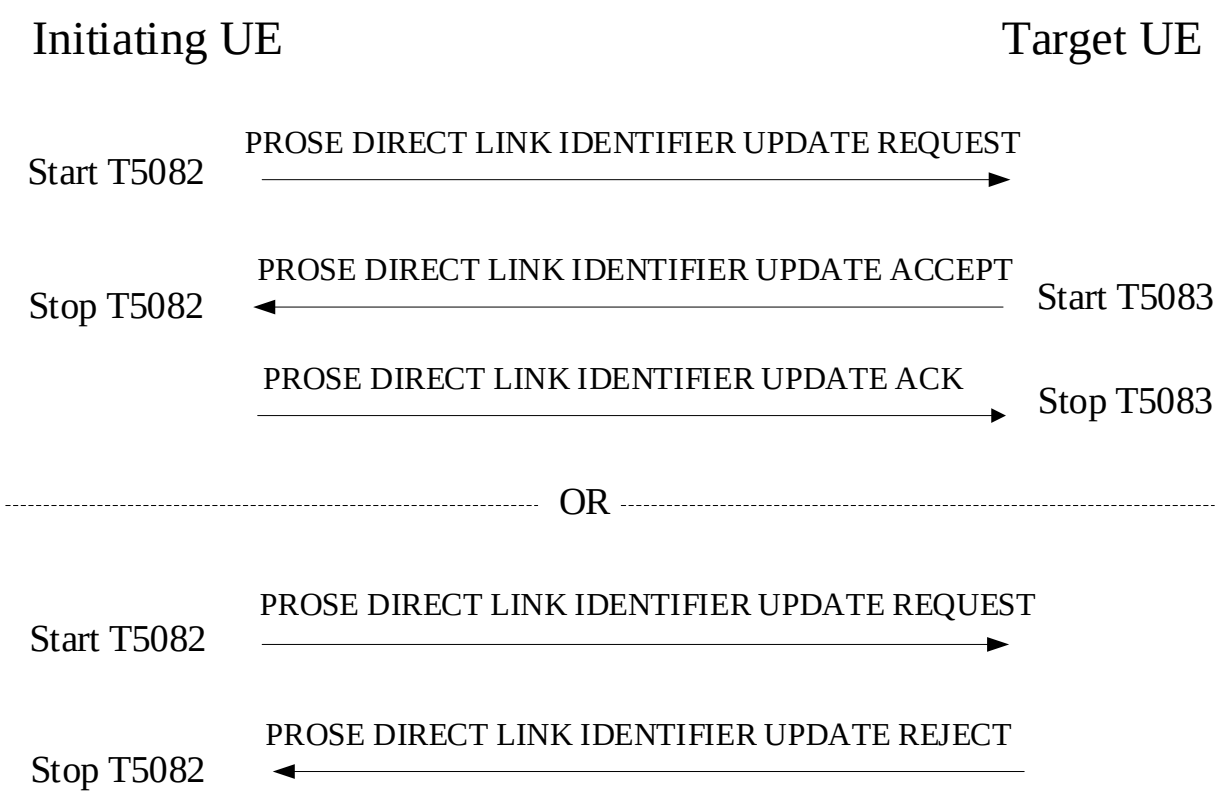

Figure 7.2.4.2.1: 5G ProSe direct link identifier update procedure

7.2.4.3 5G ProSe direct link identifier update procedure accepted by the target UE

Upon receipt of a PROSE DIRECT LINK IDENTIFIER UPDATE REQUEST message, if the target UE determines:

a) the 5G ProSe direct link associated with this request message is still valid; and

b) the timer T5083 for the 5G ProSe direct link identified by this request message is not running,

then the target UE accepts this request, and responds with a PROSE DIRECT LINK IDENTIFIER UPDATE ACCEPT message.

The target UE shall create the PROSE DIRECT LINK IDENTIFIER UPDATE ACCEPT message. In this message, the target UE:

a) shall include the target UE's new layer-2 ID assigned by itself;

b) shall include the new LSB of $K_{NRP-sess}$ ID;

c) shall include the initiating UE's new MSB of $K_{NRP-sess}$ ID;

d) shall include the initiating UE's new layer-2 ID;

e) shall include the target UE's new application layer ID if received from upper layer;

f) shall include the initiating UE's new IP address/prefix if received from the initiating UE and IP communication is used;

g) shall include the initiating UE's new application layer ID if received from the initiating UE; and

h) shall include the target UE's new IP address/prefix if IP communication is used and changed, and the 5G ProSe direct link is not for 5G ProSe direct communication between 5G ProSe layer-2 remote UE and 5G ProSe layer-2 UE-to-network relay UE.

After the PROSE DIRECT LINK IDENTIFIER UPDATE ACCEPT message is generated, the target UE shall pass this message to the lower layers for transmission along with the initiating UE's old layer-2 ID for 5G ProSe direct communication and the target UE's old layer-2 ID for 5G ProSe direct communication, and start timer T5083. The UE shall not send a new PROSE DIRECT LINK IDENTIFIER UPDATE ACCEPT message to the same initiating UE while timer T5083 is running.

Before target UE receives the traffic using the new layer-2 IDs, the target UE shall continue to receive the traffic with the old layer-2 IDs (i.e., initiating UE's old layer-2 ID and target UE's old layer-2 ID) from initiating UE.

Before target UE receives the PROSE DIRECT LINK IDENTIFIER UPDATE ACK message from initiating UE, the target UE shall keep sending traffic to the initiating UE using the old layer-2 IDs (i.e., initiating UE's old layer-2 ID for 5G ProSe direct communication and target UE's old layer-2 ID for 5G ProSe direct communication).

7.2.4.4 5G ProSe direct link identifier update procedure acknowledged by the initiating UE

Upon receipt of the PROSE DIRECT LINK IDENTIFIER UPDATE ACCEPT message, the initiating UE shall stop timer T5082 and respond with a PROSE DIRECT LINK IDENTIFIER UPDATE ACK message. In this message, the initiating UE:

a) shall include the target UE's new layer-2 ID;

b) shall include the target UE's new LSB of $K_{NRP-sess}$ ID;

c) shall include the target UE's new application layer ID, if received; and

d) shall include the target UE's new IP address/prefix, if received.

After the PROSE DIRECT LINK IDENTIFIER UPDATE ACK message is generated, the initiating UE shall pass this message to the lower layers for transmission along with the initiating UE's old layer-2 ID for 5G ProSe direct communication and the target UE's old layer-2 ID for 5G ProSe direct communication and shall stop timer T5090 if running and start a timer T5090 as configured if at least one of ProSe identifiers for the 5G ProSe direct link satisfying the privacy requirements as specified in clause 5.2.4.

Upon sending the PROSE DIRECT LINK IDENTIFIER UPDATE ACK message, the initiating UE shall update the associated 5G ProSe direct link context with the new identifiers and pass the new layer-2 IDs (i.e., initiating UE's new layer-2 ID for 5G ProSe direct communication and target UE's new layer-2 ID for 5G ProSe direct communication) along with the PC5 link identifier down to the lower layer. Then the initiating UE shall use the new layer-2 IDs (i.e., initiating UE's new layer-2 ID for 5G ProSe direct communication and target UE's new layer-2 ID for 5G ProSe direct communication) to transmit the PC5 signalling message and PC5 user plane data.

The initiating UE shall continue to receive traffic with the old layer-2 IDs (i.e., initiating UE's old layer-2 ID for 5G ProSe direct communication and target UE's old layer-2 ID for 5G ProSe direct communication) from the target UE until it receives traffic with the new layer-2 IDs (i.e., initiating UE's new layer-2 ID and target UE's new layer-2 ID) from the target UE.

7.2.4.5 5G ProSe direct link identifier update procedure completion by the target UE

Upon receipt of the PROSE DIRECT LINK IDENTIFIER UPDATE ACK message, the target UE shall update the associated 5G ProSe direct link context with the new identifiers, pass the new layer-2 IDs (i.e., initiating UE's new layer-2 ID and target UE's new layer-2 ID) down to the lower layer, stop timer T5083 and timer T5090 if running and start a timer T5090 as configured if at least one of ProSe identifiers for the 5G ProSe direct link satisfying the privacy requirements as specified in clause 5.2.4. Then the target UE shall use the new layer-2 IDs (i.e., initiating UE's new layer-2 ID for 5G ProSe direct communication and target UE's new layer-2 ID for 5G ProSe direct communication) to transmit the PC5 signalling message and PC5 user plane data.

7.2.4.6 5G ProSe direct link identifier update procedure not accepted by the target UE

If the PROSE DIRECT LINK IDENTIFIER UPDATE REQUEST message cannot be accepted, the target UE shall send a PROSE DIRECT LINK IDENTIFIER UPDATE REJECT message. The PROSE DIRECT LINK IDENTIFIER UPDATE REJECT message contains a PC5 signalling protocol cause IE set to one of the following cause values:

#3 conflict of layer-2 ID for 5G ProSe direct communication is detected; or

#111 protocol error, unspecified.

For a received PROSE DIRECT LINK IDENTIFIER UPDATE REQUEST message from a layer-2 ID (for 5G ProSe direct communication), if the target UE already has an existing link using this layer-2 ID or is currently processing a PROSE DIRECT LINK IDENTIFIER UPDATE REQUEST message from the same layer-2 ID, but with user info different from the user info IE included in this new incoming message, the target UE shall send a PROSE DIRECT LINK IDENTIFIER UPDATE REJECT message with PC5 signalling protocol cause value #3 "conflict of layer-2 ID for 5G ProSe direct communication is detected".

NOTE: After receiving the PROSE DIRECT LINK IDENTIFIER UPDATE REJECT message, whether the initiating UE initiates the 5G ProSe direct link release procedure or initiates another 5G ProSe direct link identifier update procedure with a new layer-2 ID depends on UE implementation.

For other reasons causing the failure of link identifier update, the target UE shall send a PROSE DIRECT LINK IDENTIFIER UPDATE REJECT message with PC5 signalling protocol cause value #111 "protocol error, unspecified".

Upon receipt of the PROSE DIRECT LINK IDENTIFIER UPDATE REJECT message, the initiating UE shall stop timer T5082 and abort this 5G ProSe direct link identifier update procedure.

7.2.4.7 Abnormal cases

7.2.4.7.1 Abnormal cases at the initiating UE

The following abnormal cases can be identified:

a) If timer T5082 expires, the initiating UE shall retransmit the PROSE DIRECT LINK IDENTIFIER UPDATE REQUEST message and restart timer T5082. After reaching the maximum number of allowed retransmissions, the initiating UE shall abort the 5G ProSe direct link identifier update procedure and may notify the upper layer that the target UE is unreachable.

NOTE 1: The maximum number of allowed retransmissions is UE implementation specific.

NOTE 2: After reaching the maximum number of allowed retransmissions, whether the initiating UE releases this 5G ProSe direct link depends on its implementation.

b) For the same 5G ProSe direct link, if the initiating UE receives a PROSE DIRECT LINK IDENTIFIER UPDATE REQUEST message during the 5G ProSe direct link identifier update procedure, the initiating UE shall stop the timer T5082 and abort the 5G ProSe direct link identifier update procedure. Following handling is

implementation dependent, e.g., the initiating UE waits for an implementation dependent time for initiating a new 5G ProSe direct link identifier update procedure, if still needed.

NOTE 3: The implementation dependent timer value needs to be set to avoid further collisions (e.g., random timer value).

c) For the same 5G ProSe direct link, if the initiating UE receives a PROSE DIRECT LINK REKEYING REQUEST message after initiating the 5G ProSe direct link identifier update procedure, the initiating UE shall ignore the PROSE DIRECT LINK REKEYING REQUEST message and proceed with the 5G ProSe direct link identifier update procedure.

d) For the same 5G ProSe direct link, if the initiating UE receives a PROSE DIRECT LINK RELEASE REQUEST message after the initiation of 5G ProSe direct link identifier update procedure, the initiating UE shall stop the timer T5082 and abort the 5G ProSe direct link identifier update procedure and proceed with the 5G ProSe direct link release procedure.

7.2.4.7.2 Abnormal cases at the target UE

The following abnormal cases can be identified:

a) If timer T5083 expires, the target UE shall retransmit the PROSE DIRECT LINK IDENTIFIER UPDATE ACCEPT message and restart timer T5083. After reaching the maximum number of allowed retransmissions, the target UE shall abort the 5G ProSe direct link identifier update procedure and may notify the upper layer that the initiating UE is unreachable.

NOTE 1: The maximum number of allowed retransmissions is UE implementation specific.

NOTE 2: After reaching the maximum number of allowed retransmissions, whether the target UE releases this 5G ProSe direct link depends on its implementation.

b) If PROSE DIRECT LINK IDENTIFIER UPDATE REQUEST is received when the timer T5083 is running, the target UE shall stop the timer T5083 and abort the ongoing 5G ProSe direct link identifier update procedure. The target UE shall handle the new PROSE DIRECT LINK IDENTIFIER UPDATE REQUEST as specified in clause 7.2.4.3.

c) After sending the PROSE DIRECT LINK IDENTIFIER UPDATE ACK message to the target UE, if another PROSE DIRECT LINK IDENTIFIER UPDATE ACCEPT message from the target UE is received before the traffic from the target UE with the new layer-2 IDs is received, the initiating UE shall retransmit the PROSE DIRECT LINK IDENTIFIER UPDATE ACK message along with the initiating UE's old layer-2 ID and the target UE's old layer-2 ID.

NOTE 3: It is up to implementation to handle the failure of traffic delivery for new layer-2 IDs if such traffic has been sent before the initiating UE retransmits the PROSE DIRECT LINK IDENTIFIER UPDATE ACK message.

d) After sending the PROSE DIRECT LINK IDENTIFIER UPDATE ACK message to the target UE, if the initiating UE keeps receiving traffic from the target UE with the old layer-2 IDs and traffic from the target UE with the new layer-2 IDs is not received during an implementation specific time which is greater than the value of timer T5083, the initiating UE shall abort the 5G ProSe direct link identifier update procedure and may release the 5G ProSe direct link.

7.2.5 5G ProSe direct link keep-alive procedure

7.2.5.1 General

The 5G ProSe direct link keep-alive procedure is used to maintain a 5G ProSe direct link between two UEs, i.e., check that the link between the two UEs is still valid. The UE sending the PROSE DIRECT LINK KEEPALIVE REQUEST message is called the "initiating UE" and the other UE is called the "target UE".

The 5G ProSe direct link keep-alive procedure can be initiated by only one UE or both UEs in the established 5G ProSe direct link.

NOTE: Whether the 5G ProSe direct link keep-alive procedure is initiated by only one UE or both UEs in the established 5G ProSe direct link is UE implementation specific.

7.2.5.2 5G ProSe direct link keep-alive procedure initiation by the initiating UE

The initiating UE shall meet the following pre-condition before initiating the 5G ProSe direct link keep-alive procedure:

a) there is a 5G ProSe direct link between the initiating UE and the target UE.

The initiating UE shall manage a keep-alive timer T5084 and a keep-alive counter for the 5G ProSe direct link keep-alive procedure. Timer T5084 is used to trigger the periodic initiation of the 5G ProSe direct link keep-alive procedure. The UE shall start or restart timer T5084 whenever the UE receives a PC5 signalling message or PC5 user plane data from the target UE over this 5G ProSe direct link. The UE shall set the keep-alive counter to an initial value of zero after 5G ProSe direct link establishment.

The initiating UE shall initiate the 5G ProSe direct link keep-alive procedure when:

a) timer T5084 for this link expires;

b) optionally, a request from the lower layers to check the viability of the 5G ProSe direct link is received; or

NOTE 1: Whether the lower layers can request the initiation of the 5G ProSe direct link keep-alive procedure, and what the triggers for the lower layers are to request the initiation of the 5G ProSe direct link keep-alive procedure, are UE implementation specific.

c) optionally, a request from the upper layers to check the viability of the 5G ProSe direct link is received.

NOTE 2: Whether the upper layers can request the initiation of the 5G ProSe direct link keep-alive procedure, and what the triggers for the upper layers are to request the initiation of the 5G ProSe direct link keep-alive procedure, are UE implementation specific.

In order to initiate the 5G ProSe direct link keep-alive procedure, the initiating UE shall stop timer T5084, if running, and shall create a PROSE DIRECT LINK KEEPALIVE REQUEST message. In this message, the initiating UE:

a) shall include the keep-alive counter for the 5G ProSe direct link; and

b) may include a maximum inactivity period to indicate the maximum inactivity period of the initiating UE over this 5G ProSe direct link.

NOTE 3: The value chosen for the maximum inactivity period of the initiating UE is UE implementation specific with the objective to minimize the number of keep-alive procedures as much as possible. It is desirable to have the maximum inactivity period value to be slightly higher than the value of keep-alive timer T5084.

After the PROSE DIRECT LINK KEEPALIVE REQUEST message is generated, the initiating UE shall pass this message to the lower layers for transmission along with the initiating UE's layer-2 ID for 5G ProSe direct communication and the target UE's layer-2 ID for 5G ProSe direct communication, and start timer T5085. The UE shall not send a new PROSE DIRECT LINK KEEPALIVE REQUEST message to the same target UE while timer T5085 is running.

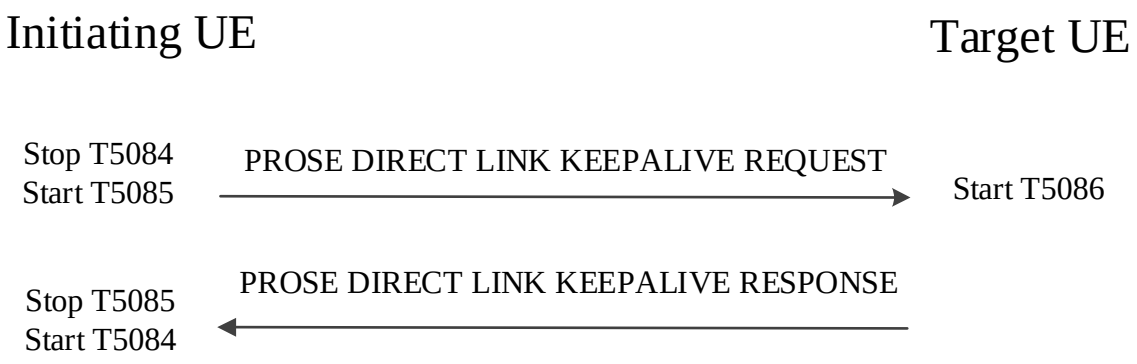

Figure 7.2.5.2.1: 5G ProSe direct link keep-alive procedure

7.2.5.3 5G ProSe direct link keep-alive procedure accepted by the target UE

Upon receipt of a PROSE DIRECT LINK KEEPALIVE REQUEST message, the target UE shall create a PROSE DIRECT LINK KEEPALIVE RESPONSE message. In this message, the target UE:

a) shall include the keep-alive counter set to the same value as that received in the PROSE DIRECT LINK KEEPALIVE REQUEST message.

After the PROSE DIRECT LINK KEEPALIVE RESPONSE message is generated, the target UE shall pass this message to the lower layers for transmission along with the target UE's layer-2 ID for 5G ProSe direct communication and the initiating UE's layer-2 ID for 5G ProSe direct communication.

If a maximum inactivity period is included in the PROSE DIRECT LINK KEEPALIVE REQUEST message, the target UE shall stop T5086, if running, and start T5086 with its value set to the maximum inactivity period. The target UE shall restart T5086 whenever the target UE receives a PC5 signalling message or PC5 user plane data from the initiating UE over this 5G ProSe direct link.

7.2.5.4 5G ProSe direct link keep-alive procedure completion by the initiating UE

Upon receipt of a PROSE DIRECT LINK KEEPALIVE RESPONSE message, the initiating UE shall stop timer T5085, start timer T5084 and increment the keep-alive counter for the 5G ProSe direct link.

7.2.5.5 Abnormal cases

7.2.5.5.1 Abnormal cases at the initiating UE

a) Timer T5085 expires.

   The initiating UE shall retransmit the PROSE DIRECT LINK KEEPALIVE REQUEST message with the last used value of the keep-alive counter and restart timer T5085. After reaching the maximum number of allowed retransmissions, the initiating UE shall abort the 5G ProSe direct link keep-alive procedure and locally release the 5G ProSe direct link.

NOTE: The maximum number of allowed retransmissions is UE implementation specific.

b) The need to use this 5G ProSe direct link no longer exists before the 5G ProSe direct link keep-alive procedure is completed.

   The initiating UE shall abort the 5G ProSe direct link keep-alive procedure and initiate a 5G ProSe direct link release procedure.

c) The initiating UE receives a PROSE DIRECT LINK KEEPALIVE RESPONSE message with a keep-alive counter value different from the value which the initiating UE had included in the last sent PROSE DIRECT LINK KEEPALIVE REQUEST message.

   The initiating UE shall discard the PROSE DIRECT LINK KEEPALIVE RESPONSE message.

d) The initiating UE receives a PC5 signalling message other than a PROSE DIRECT LINK KEEPALIVE RESPONSE message or PC5 user plane data from the target UE over this 5G ProSe direct link while timer T5085 is running.

   The initiating UE shall stop timer T5085, abort the 5G ProSe direct link keep-alive procedure, start timer T5084 and increment the keep-alive counter for the 5G ProSe direct link.

e) The initiating UE receives a PROSE DIRECT LINK KEEPALIVE RESPONSE message when T5085 is not running.

   The initiating UE shall discard the PROSE DIRECT LINK KEEPALIVE RESPONSE message.

7.2.5.5.2 Abnormal cases at the target UE

a) Timer T5086 expires.

   The target UE shall:

1) initiate a 5G ProSe direct link keep-alive procedure to check the link; or

2) initiate the 5G ProSe direct link release procedure.

Whether the UE chooses 1) or 2) is left to UE implementation.

b) The target UE receives a PROSE DIRECT LINK KEEPALIVE REQUEST message with a keep-alive counter value lower than the value which the target UE had included in the last sent PROSE DIRECT LINK KEEPALIVE RESPONSE message.

The target UE shall discard the PROSE DIRECT LINK KEEPALIVE REQUEST message.

c) The target UE receives a PROSE DIRECT LINK KEEPALIVE REQUEST message if there is a pending PC5 signalling message or PC5 user plane data to be sent to the initiating UE over this 5G ProSe direct link.

The target UE:

1) shall pass this PC5 signalling message to the lower layers for transmission along with the target UE's layer-2 ID for 5G ProSe direct communication and the initiating UE's layer-2 ID for 5G ProSe direct communication, or perform the data transmission over 5G ProSe direct link as specified in clause 7.2.9; and

2) shall consider transmission of this PC5 signalling message or PC5 user plane data to be an implicit PROSE DIRECT LINK KEEPALIVE RESPONSE message and skip generating a PROSE DIRECT LINK KEEPALIVE RESPONSE message. If a maximum inactivity period is included in the PROSE DIRECT LINK KEEPALIVE REQUEST message, the target UE shall stop T5086, if running, and start T5086 with its value set to the maximum inactivity period.

7.2.6 5G ProSe direct link release procedure

7.2.6.1 General

The 5G ProSe direct link release procedure is used to release a secure 5G ProSe direct link between two UEs. The link can be released from either end point. The UE sending the PROSE DIRECT LINK RELEASE REQUEST message is called the "initiating UE" and the other UE is called the "target UE".

If the UE receives an indication of radio link failure or an indication of PC5-RRC connection release from the lower layer, the UE shall release the 5G ProSe direct link locally and may delete the K_{NRP} ID associated with this link after an implementation specific time.

When the direct link between a remote UE and a 5G ProSe UE-to-network relay UE is released, the 5G ProSe layer-3 UE-to-network relay UE shall perform the remote UE report procedure as specified in 3GPP TS 24.501 [11].

Editor's note: Any possible changes to the 5G ProSe direct link release procedure due to the security requirements of 5G ProSe layer-2 UE-to-network relay or 5G ProSe layer-3 UE-to-network relay (such as adding new IEs or changing existing IEs) are FFS.

7.2.6.2 5G ProSe direct link release procedure initiation by initiating UE

The initiating UE shall initiate the procedure if a request from upper layers to release a 5G ProSe direct link with the target UE which uses a known layer-2 ID (for unicast communication) is received and there is an existing 5G ProSe direct link between these two UEs.

The initiating UE may initiate the procedure if the target UE has been non-responsive, e.g., no response in the 5G ProSe direct link modification procedure, 5G ProSe direct link identifier update procedure, 5G ProSe direct link re-keying procedure or 5G ProSe direct link keep-alive procedure.

The initiating UE may initiate the procedure to release an established 5G ProSe direct link if the UE has reached the maximum number of established 5G ProSe direct links and there is a need to establish a new 5G ProSe direct link. In this case, which 5G ProSe direct link is to be released is up to UE implementation.

The initiating UE may initiate the procedure to release an established 5G ProSe direct link upon expiry of the timer T5084.

If:

a) the initiating UE acts as 5G ProSe layer-3 UE-to-network relay UE; and

b) the PDU session established for relaying the traffic of the target UE is released by the initiating UE or the network as specified in 3GPP TS 24.501 [11] clause 6.3.3 or clause 6.4.3;

the initiating UE should initiate the 5G ProSe direct link release procedure.

If:

a) the initiating UE acts as 5G ProSe layer-2 remote UE or 5G ProSe layer-3 remote UE for relay with N3IWF support; and

b) the initiating UE is in 5GMM-IDLE mode;

the initiating UE may initiate the 5G ProSe direct link release procedure.

If:

a) the initiating UE acts as 5G ProSe layer-2 remote UE, 5G ProSe layer-3 remote UE or 5G ProSe layer-2 UE-to-network relay UE; and

b) the service authorization for the initiating UE to act as 5G ProSe layer-2 remote UE, 5G ProSe layer-3 remote UE or 5G ProSe layer-2 UE-to-network relay UE is revoked after receiving the configuration parameters for 5G ProSe UE-to-network relay as specified in clause 5.2.5;

the initiating UE should initiate the 5G ProSe direct link release procedure.

If:

a) the initiating UE acts as 5G ProSe layer-3 UE-to-network relay UE; and

b) the service authorization for the initiating UE to act as 5G ProSe layer-3 UE-to-network relay UE in the serving PLMN is revoked after receiving the configuration parameters for 5G ProSe UE-to-network relay as specified in clause 5.2.5;

the initiating UE should initiate the 5G ProSe direct link release procedure and shall inform lower layers to release the PDU session established for relaying the traffic of the target UE as specified in 3GPP TS 24.501 [11] clause 6.4.3.

In order to initiate the 5G ProSe direct link release procedure, the initiating UE shall create a PROSE DIRECT LINK RELEASE REQUEST message with a PC5 signalling protocol cause IE indicating one of the following cause values:

#1 direct communication to the target UE not allowed;

#2 direct communication to the target UE no longer needed;

#4 direct connection is not available anymore;

#5 lack of resources for 5G ProSe direct link;

#13 congestion situation; or

#111 protocol error, unspecified.

If the 5G ProSe direct link was established for relaying and:

a) the NAS level mobility management congestion control as specified in clause 5.3.9 of TS 24.501 [11] is activated at the initiating UE; or

b) the initiating UE is under congestion;

the initiating UE shall send a PROSE DIRECT LINK RELEASE REQUEST message containing PC5 signalling protocol cause value #13 "congestion situation". The initiating UE may provide a back-off timer value to the target UE in the PROSE DIRECT LINK RELEASE REQUEST message. The initiating UE shall not accept any 5G ProSe direct link establishment request for relaying if the back-off timer NAS level mobility management congestion control is running.

NOTE 1: How the initiating UE determines that it is under congestion is implementation specific (e.g., any relaying related operational overhead, etc).

NOTE 2: In case the initiating UE is under the NAS level mobility management congestion control, it is an implementation option that the provided back-off timer value to the target UE is set to the mobility management back-off timer T3346 or with an additional offset value.

The initiating UE shall include the new MSBs of K_{NRP} ID in the PROSE DIRECT LINK RELEASE REQUEST message.

After the PROSE DIRECT LINK RELEASE REQUEST message is generated, the initiating UE shall pass this message to the lower layers for transmission along with the initiating UE's layer-2 ID for unicast communication and the target UE's layer-2 ID for unicast communication, and shall stop T5090 if running. The initiating UE shall start timer T5087.

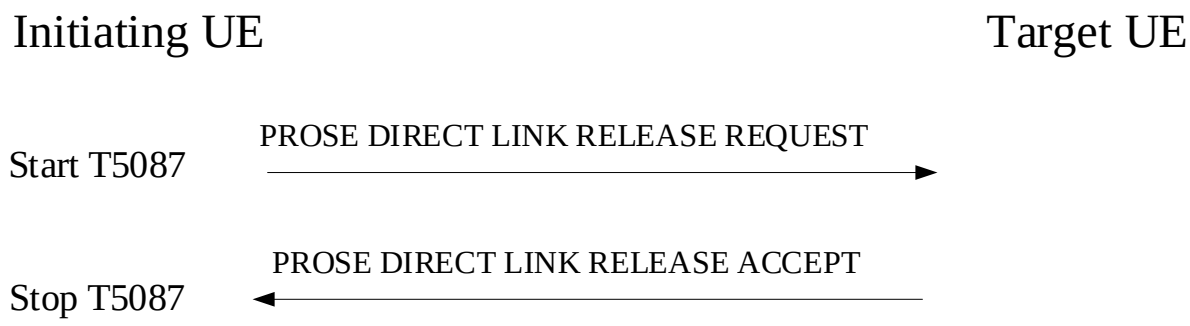

Figure 7.2.6.2.1: 5G ProSe direct link release procedure

7.2.6.3 5G ProSe direct link release procedure accepted by the target UE

Upon receiving a PROSE DIRECT LINK RELEASE REQUEST message, the target UE shall stop all running timers for this 5G ProSe direct link and abort any other ongoing PC5 signalling protocol procedures on this 5G ProSe direct link.

If the PC5 signalling protocol cause value in the PROSE DIRECT LINK RELEASE REQUEST message is #13 "congestion situation" and a back-off timer value is provided in the PROSE DIRECT LINK RELEASE REQUEST message, the target UE shall start timer T5088 associated with the layer-2 ID of the initiating UE and set its value to the provided timer value.

The target UE shall respond with a PROSE DIRECT LINK RELEASE ACCEPT message. The target UE shall include the new LSBs of K_{NRP} ID in the PROSE DIRECT LINK RELEASE ACCEPT message. After the message is sent, the target UE shall release the 5G ProSe direct link by performing the following behaviours:

a) inform the lower layer along with the PC5 link identifier that the 5G ProSe direct link has been released; and

b) delete the 5G ProSe direct link context of the 5G ProSe direct link after an implementation specific time.

The target UE shall form the new K_{NRP} ID from the new MSBs of K_{NRP} ID received in the PROSE DIRECT LINK RELEASE REQUEST message and the new LSBs of K_{NRP} ID included in the PROSE DIRECT LINK RELEASE ACCEPT message. The target UE shall replace the existing K_{NRP} ID with the new K_{NRP} ID. The target UE may include the new K_{NRP} ID in PROSE DIRECT LINK ESTABLISHMENT REQUEST message with the initiating UE as specified in clause 7.2.2.2.

7.2.6.4 5G ProSe direct link release procedure completion by the initiating UE

Upon receipt of the PROSE DIRECT LINK RELEASE ACCEPT message, the initiating UE shall stop timer T5087 and shall release the 5G ProSe direct link by performing the following behaviours:

a) inform the lower layer along with the PC5 link identifier that the 5G ProSe direct link has been released; and

b) delete the 5G ProSe direct link context of the 5G ProSe direct link after an implementation specific time.

The initiating UE shall form the new K_{NRP} ID from the MSBs of K_{NRP} ID included in the PROSE DIRECT LINK RELEASE REQUEST message and the LSBs of K_{NRP} ID received in the PROSE DIRECT LINK RELEASE ACCEPT message. The initiating UE shall replace the existing K_{NRP} ID with the new K_{NRP} ID. The initiating UE may include the new K_{NRP} ID in PROSE DIRECT LINK ESTABLISHMENT REQUEST message with the target UE as specified in clause 7.2.2.2.

7.2.6.5 Abnormal cases

7.2.6.5.1 Abnormal cases at the initiating UE

If retransmission timer T5087 expires and the PC5 signalling protocol cause included in the PC5 signalling protocol cause IE in the PROSE DIRECT LINK RELEASE REQUEST message was #4 "direct connection is not available anymore", the initiating UE shall release the 5G ProSe direct link locally and delete the K_{NRP} ID associated with this link. From this time onward the initiating UE shall no longer send or receive any messages via this link.

If retransmission timer T5087 expires and the PC5 signalling protocol cause included in the PC5 signalling protocol cause IE in the PROSE DIRECT LINK RELEASE REQUEST message was not #4 "direct connection is not available anymore", the initiating UE shall initiate the transmission of the PROSE DIRECT LINK RELEASE REQUEST message again and restart timer T5087.

If no response is received from the target UE after reaching the maximum number of allowed retransmissions, the initiating UE shall release the 5G ProSe direct link locally and delete the K_{NRP} ID associated with this link. From this time onward the initiating UE shall no longer send or receive any messages via this link.

NOTE: The maximum number of allowed retransmissions is UE implementation specific.

7.2.7 PC5 QoS flow establishment over 5G ProSe direct link

In order to establish a PC5 QoS flow establishment over 5G ProSe direct link, the UE shall derive the PC5 QoS parameters based on the ProSe application requirements provided by the upper layers (if available) and the ProSe identifier(s) according to the PC5 QoS mapping rules defined in clause 5.2.4. The UE shall create the PC5 QoS flow(s) based on the derived PC5 QoS parameters. For each PC5 QoS flow to be created, the UE shall perform the following operations:

a) self-assign a PQFI;

b) create a PC5 QoS flow context, which contains:

   1) the PQFI;

   2) the ProSe identifier(s); and

   3) the derived PC5 QoS parameters;

c) create a new PC5 QoS rule which contains:

   1) a PC5 QoS rule identifier;

   2) the PQFI;

   3) a set of packet filters; and

   4) a precedence value; and

d) pass the following parameters to the lower layers:

   1) the PQFI;

   2) the PC5 QoS parameters;

   3) the PC5 link identifier; and

   4) optionally, the source and destination layer-2 IDs.

Three types of packet filters are supported for unicast mode 5G ProSe direct communication over PC5, i.e., the ProSe IP packet filter set, the ProSe packet filter set, and the ProSe Ethernet packet filter set. A PC5 QoS Rule contains one of the following:

a) the ProSe IP packet filter set;

b) the ProSe packet filter set; or

c) the ProSe Ethernet packet filter set.

The ProSe IP packet filter set is defined as content of the packet filter contents field specified in 3GPP TS 24.501 [11] figure 9.11.4.13.4 and table 9.11.4.13.1.

The ProSe packet filter set shall support packet filters based on at least any combination of:

a) ProSe identifier;

b) the source layer-2 ID and the destination layer-2 ID; and

c) application layer ID (e.g., Station ID).

The ProSe Ethernet packet filter set is defined as content of the Ethernet packet filter set as specified in 3GPP TS 24.501 [11] figure 9.11.4.13.4 and table 9.11.4.13.1.

Each PC5 QoS rule additionally contains the ProSe identifier(s) when the ProSe identifier is not included in the PC5 packet filter set.

7.2.8 PC5 QoS flow match over 5G ProSe direct link

When service data or request from the upper layers is received, the UE determines if there is any existing PC5 QoS flow(s) matching the service data or request, i.e., based on the PC5 QoS rules for the existing PC5 QoS flow(s).

If there is no PC5 QoS rules for the existing PC5 QoS flow(s) matching the service data or request, the UE shall derive the PC5 QoS parameters based on the ProSe application requirements provided by the upper layers (if available) and the ProSe identifier(s) according to the PC5 QoS mapping rules defined in clause 5.2.4 and shall perform the following:

a) if there is no existing PC5 QoS flow that fulfils the derived PC5 QoS parameters, then the UE shall create a new PC5 QoS flow as specified in clause 7.2.7;

b) if there is an existing PC5 QoS flow that fulfils the derived PC5 QoS parameters, then the UE shall update the PC5 packet filter set in the PC5 QoS rule of this PC5 QoS flow, e.g., add the new packet filter in the PC5 QoS rule of this existing PC5 QoS flow; and

c) the UE shall use the new PC5 QoS flow created as described in bullet a) or the existing PC5 QoS flow with the updated PC5 QoS rules as described in bullet b) to perform the transmission of ProSe direct communication over PC5 as specified in clause 7.2.9.

If there is a PC5 QoS rule for the existing PC5 QoS flow matching the service data or request, the UE shall use this existing PC5 QoS flow to perform transmission of ProSe direct communication over PC5 as specified in clause 7.2.9.

7.2.9 Data transmission over 5G ProSe direct link

7.2.9.1 Transmission

When receiving user data from upper layers to be sent over 5G ProSe direct link to a specific UE, the transmitting UE shall determine the 5G ProSe direct link context corresponding to the application layer ID, and then shall tag each outgoing protocol data unit with the following information before passing it to the lower layers for transmission:

a) a layer-3 protocol data unit type (see 3GPP TS 38.323 [16]) set to:

   1) IP packet, if the ProSe message contains IP data; or

   2) non-IP packet, if the ProSe message contains Ethernet or Unstructured data unit types;

b) the PC5 link identifier associated with the 5G ProSe direct link context;

c) optionally, the source layer-2 ID set to the source layer-2 ID associated with the 5G ProSe direct link context;

d) optionally, the destination layer-2 ID set to the destination layer-2 ID associated with the 5G ProSe direct link context; and

e) the PQFI set to the value corresponding to the ProSe identifier and the optional ProSe application requirements according to the mapping rules specified in clause 5.2.4.

7.2.9.2 Procedure for UE to use provisioned radio resources for ProSe communication over PC5

The procedures described for using NR-PC5 in clause 7.3.2.3 apply.

7.2.10 5G ProSe direct link security mode control procedure

7.2.10.1 General

The 5G ProSe direct link security mode control procedure is used to establish security between two UEs during a 5G ProSe direct link establishment procedure or a 5G ProSe direct link re-keying procedure. Security is not established if the UE PC5 signalling integrity protection is not activated. After successful completion of the 5G ProSe direct link security mode control procedure, the selected security algorithms and keys are used to integrity protect and cipher all PC5 signalling messages exchanged over this 5G ProSe direct link between the UEs and the security context can be used to protect all PC5 user plane data exchanged over this 5G ProSe direct link between the UEs. The UE sending the PROSE DIRECT LINK SECURITY MODE COMMAND message is called the "initiating UE" and the other UE is called the "target UE".

Editor's note: Any possible changes to the 5G ProSe direct link security mode control procedure due to the security requirements of 5G ProSe layer-2 UE-to-network relay and 5G ProSe layer-3 UE-to-network relay are FFS and waiting for SA3 conclusion.

7.2.10.2 5G ProSe direct link security mode control procedure initiation by the initiating UE

The initiating UE shall meet the following pre-conditions before initiating the 5G ProSe direct link security mode control procedure:

a) the target UE has initiated a 5G ProSe direct link establishment procedure toward the initiating UE by sending a PROSE DIRECT LINK ESTABLISHMENT REQUEST message and:

   1) the PROSE DIRECT LINK ESTABLISHMENT REQUEST message:

      i) includes a target user info IE which includes the application layer ID of the initiating UE; or

      ii) does not include a target user info IE and the initiating UE is interested in the ProSe service identified by the ProSe identifier in the PROSE DIRECT LINK ESTABLISHMENT REQUEST message; and

   2) the initiating UE:

      i) has either identified an existing K_{NRP} based on the K_{NRP} ID included in the PROSE DIRECT LINK ESTABLISHMENT REQUEST message or derived a new K_{NRP}; or

      ii) has decided not to activate security protection based on its UE 5G ProSe direct signalling security policy and the target UE's 5G ProSe direct signalling security policy; or

b) the target UE has initiated a 5G ProSe direct link re-keying procedure toward the initiating UE by sending a PROSE DIRECT LINK REKEYING REQUEST message and:

   1) if the target UE has included a Re-authentication indication in the PROSE DIRECT LINK REKEYING REQUEST message, the initiating UE has derived a new K_{NRP}.

If a new K_{NRP} has been derived by the initiating UE, the initiating UE shall generate the 2 MSBs of K_{NRP} ID to ensure that the resultant K_{NRP} ID will be unique in the initiating UE.

The initiating UE shall select security algorithms in accordance with its UE 5G ProSe direct signalling security policy and the target UE's 5G ProSe direct signalling security policy. If the 5G ProSe direct link security mode control procedure was triggered during a 5G ProSe direct link establishment procedure, the initiating UE shall not select the null integrity protection algorithm if the initiating UE or the target UE's 5G ProSe direct signalling integrity protection policy is set to "Signalling integrity protection required". If the 5G ProSe direct link security mode control procedure was triggered during a 5G ProSe direct link re-keying procedure, the initiating UE:

a) shall not select the null integrity protection algorithm if the integrity protection algorithm currently in use for the 5G ProSe direct link is different from the null integrity protection algorithm;

b) shall not select the null ciphering protection algorithm if the ciphering protection algorithm currently in use for the 5G ProSe direct link is different from the null ciphering protection algorithm;

c) shall select the null integrity protection algorithm if the integrity protection algorithm currently in use is the null integrity protection algorithm; and

d) shall select the null ciphering protection algorithm if the ciphering protection algorithm currently in use is the null ciphering protection algorithm.

Then the initiating UE shall:

a) generate a 128-bit Nonce_2 value;

b) derive $K_{NRP\text{-}sess}$ from K_{NRP}, Nonce_2 and Nonce_1 received in the PROSE DIRECT LINK ESTABLISHMENT REQUEST message as specified in 3GPP TS 33.536 [37];

c) derive the NR PC5 encryption key NRPEK and the NR PC5 integrity key NRPIK from $K_{NRP\text{-}sess}$ and the selected security algorithms as specified in 3GPP TS 33.536 [37], and

d) create a PROSE DIRECT LINK SECURITY MODE COMMAND message. In this message, the initiating UE:

1) shall include the key establishment information container IE if a new K_{NRP} has been derived at the initiating UE and the authentication method used to generate K_{NRP} requires sending information to complete the 5G ProSe direct link authentication procedure;

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

2) shall include the MSB of K_{NRP} ID IE if a new K_{NRP} has been derived at the initiating UE;

3) shall include a Nonce_2 IE 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 selected integrity protection algorithm is not the null integrity protection algorithm;

4) shall include the selected security algorithms;

5) shall include the UE security capabilities received from the target UE in the PROSE DIRECT LINK ESTABLISHMENT REQUEST message or PROSE DIRECT LINK REKEYING REQUEST message;

6) shall include the UE 5G ProSe direct signalling security policy received from the target UE in the PROSE DIRECT LINK ESTABLISHMENT REQUEST message; and

7) shall include the LSB of $K_{NRP\text{-}sess}$ ID chosen by the initiating UE as specified in 3GPP TS 33.536 [37] if the selected integrity protection algorithm is not the null integrity protection algorithm.

If the security protection of this 5G ProSe direct link is activated, the initiating UE shall form the $K_{NRP\text{-}sess}$ ID from the MSB of $K_{NRP\text{-}sess}$ ID received in the PROSE DIRECT LINK ESTABLISHMENT REQUEST message or PROSE DIRECT LINK REKEYING REQUEST message and the LSB of $K_{NRP\text{-}sess}$ ID included in the PROSE DIRECT LINK SECURITY MODE COMMAND message. The initiating UE shall use the $K_{NRP\text{-}sess}$ ID to identify the new security context.

After the PROSE DIRECT LINK SECURITY MODE COMMAND message is generated, the initiating UE shall pass this message to the lower layers for transmission along with the initiating UE's layer-2 ID for 5G ProSe direct communication and the target UE's layer-2 ID for 5G ProSe direct communication, NRPIK, NRPEK if applicable, $K_{NRP\text{-}}$

$_{sess}$ ID, the selected security algorithm as specified in TS 33.536 [37]; an indication of activation of the 5G ProSe direct signalling security protection for the 5G ProSe direct link with the new security context, if applicable, and start timer T5089. The initiating UE shall not send a new PROSE DIRECT LINK SECURITY MODE COMMAND message to the same target UE while timer T5089 is running.

NOTE: The PROSE DIRECT LINK SECURITY MODE COMMAND message is integrity protected (and not ciphered) at the lower layer using the new security context.

If the 5G ProSe direct link security mode control procedure was triggered during a 5G ProSe direct link re-keying procedure, the initiating UE shall provide to the lower layers an indication of activation of the 5G ProSe direct user plane security protection for the 5G ProSe direct link with the new security context, if applicable, along with the initiating UE's layer-2 ID for 5G ProSe direct communication and the target UE's layer-2 ID for 5G ProSe direct communication.

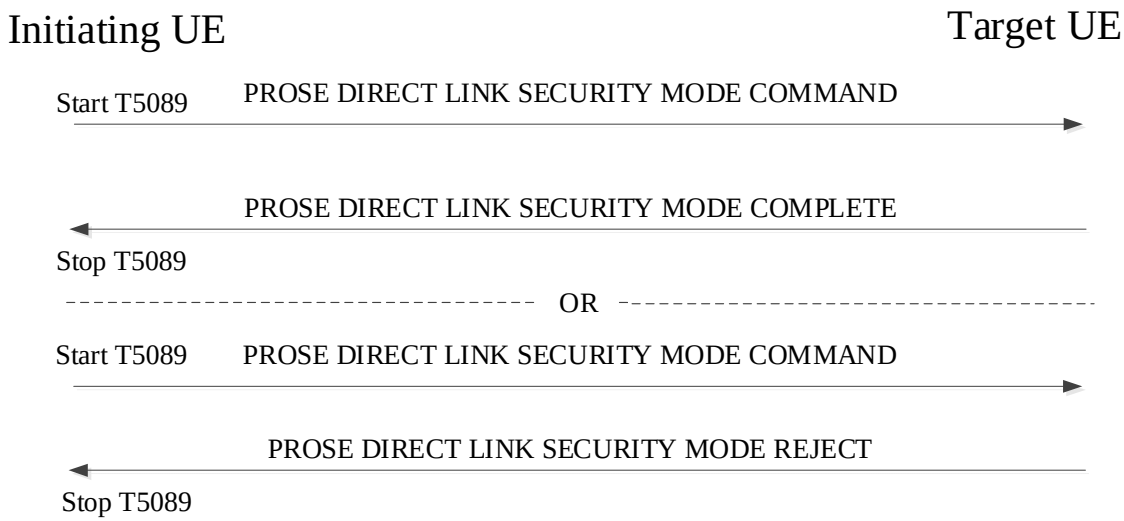

Figure 7.2.10.2.1: 5G ProSe direct link security mode control procedure

7.2.10.3 5G ProSe direct link security mode control procedure accepted by the target UE

Upon receipt of a PROSE DIRECT LINK SECURITY MODE COMMAND message, if a new assigned initiating UE's layer-2 ID is included and if the 5G ProSe direct link authentication procedure has not been executed, the target UE shall replace the original initiating UE's layer-2 ID with the new assigned initiating UE's layer-2 ID for 5G ProSe direct communication. The target UE shall check the selected security algorithms IE included in the PROSE DIRECT LINK SECURITY MODE COMMAND message. If "null integrity algorithm" is included in the selected security algorithms IE, the security of this 5G ProSe direct link is not activated. If "null ciphering algorithm" and an integrity algorithm other than "null integrity algorithm" are included in the selected algorithms IE, the signalling ciphering protection is not activated. If the target UE's 5G ProSe direct signalling integrity protection policy is set to "Signalling integrity protection required", the target UE shall check the selected security algorithms IE in the PROSE DIRECT LINK SECURITY MODE COMMAND message does not include the null integrity protection algorithm. If the selected integrity protection algorithm is not the null integrity protection algorithm, the target UE shall:

a) derive $K_{NRP\text{-}sess}$ from K_{NRP}, Nonce_1 and Nonce_2 received in the PROSE DIRECT LINK SECURITY MODE COMMAND message as specified in 3GPP TS 33.536 [37]; and

b) derive NRPIK from $K_{NRP\text{-}sess}$ and the selected integrity algorithm as specified in 3GPP TS 33.536 [37].

If the $K_{NRP\text{-}sess}$ is derived and the selected ciphering protection algorithm is not the null ciphering protection algorithm, then the target UE shall derive NRPEK from $K_{NRP\text{-}sess}$ and the selected ciphering algorithm as specified in 3GPP TS 33.536 [37].

The target UE shall determine whether or not the PROSE DIRECT LINK SECURITY MODE COMMAND message can be accepted by:

a) checking that the selected security algorithms in the PROSE DIRECT LINK SECURITY MODE COMMAND message does not include the null integrity protection algorithm if the target UE's 5G ProSe direct signalling integrity protection policy is set to "Signalling integrity protection required";

b) asking the lower layers to check the integrity of the PROSE DIRECT LINK SECURITY MODE COMMAND message using NRPIK and the selected integrity protection algorithm, if the selected integrity protection algorithm is not the null integrity protection algorithm;

c) checking that the received UE security capabilities have not been altered compared to the values that the target UE sent to the initiating UE in the PROSE DIRECT LINK ESTABLISHMENT REQUEST message or PROSE DIRECT LINK REKEYING REQUEST message;

d) if the 5G ProSe direct link security mode control procedure was triggered during a 5G ProSe direct link establishment procedure,

   1) checking that the received UE 5G ProSe direct signalling security policy has not been altered compared to the values that the target UE sent to the initiating UE in the PROSE DIRECT LINK ESTABLISHMENT REQUEST message; and

   2) checking that the LSB of $K_{NRP-sess}$ ID included in the PROSE DIRECT LINK SECURITY MODE COMMAND message are not set to the same value as those received from another UE in response to the target UE's PROSE DIRECT LINK ESTABLISHMENT REQUEST message; and

e) if the 5G ProSe direct link security mode control procedure was triggered during a 5G ProSe direct link re-keying procedure and the integrity protection algorithm currently in use for the 5G ProSe direct link is different from the null integrity protection algorithm, checking that the selected security algorithms in the PROSE DIRECT LINK SECURITY MODE COMMAND message do not include the null integrity protection algorithm.

If the target UE did not include a K_{NRP} ID in the PROSE DIRECT LINK ESTABLISHMENT REQUEST message, the target UE included a Re-authentication indication in the PROSE DIRECT LINK REKEYING REQUEST message or the initiating UE has chosen to derive a new K_{NRP}, the target UE shall derive K_{NRP} as specified in 3GPP TS 33.536 [37]. The target UE shall choose the 2 LSBs of K_{NRP} ID to ensure that the resultant K_{NRP} ID will be unique in the target UE. The target UE shall form K_{NRP} ID from the received MSB of K_{NRP} ID and its chosen LSB of K_{NRP} ID and shall store the complete K_{NRP} ID with K_{NRP}.

If the target UE accepts the PROSE DIRECT LINK SECURITY MODE COMMAND message, the target UE shall create a PROSE DIRECT LINK SECURITY MODE COMPLETE message. In this message, the target UE:

a) shall include the PQFI and the corresponding PC5 QoS parameters if the direct communication is not for 5G ProSe direct communication between the 5G ProSe layer-2 remote UE and the 5G ProSe layer-2 UE-to-network relay UE;

b) if IP communication is used and the 5G ProSe direct link security mode control procedure was triggered during a 5G ProSe direct link establishment procedure, shall include an IP address configuration IE set to one of the following values:

   1) "IPv6 router" if IPv6 address allocation mechanism is supported by the target UE, i.e., acting as an IPv6 router; or

   2) "address allocation not supported" if IPv6 address allocation mechanism is not supported by the target UE;

c) if IP communication is used, the IP address configuration IE is set to "address allocation not supported" and the 5G ProSe direct link security mode control procedure was triggered during a 5G ProSe direct link establishment procedure, shall include a link local IPv6 address IE formed locally based on IETF RFC 4862 [25];

d) if a new K_{NRP} was derived, shall include the 2 LSBs of K_{NRP} ID; and

e) if the 5G ProSe direct link security mode control procedure was triggered during a 5G ProSe direct link establishment procedure, shall include its UE 5G ProSe direct user plane security policy for this 5G ProSe direct link. In the case where the different ProSe services are mapped to the different 5G ProSe direct user plane security policies, when more than one ProSe identifier is included in the PROSE DIRECT LINK ESTABLISHMENT REQUEST message, each of the user plane security polices of those ProSe services shall be compatible, e.g., "user plane integrity protection not needed" and "user plane integrity protection required" are not compatible.

If the selected integrity protection algorithm is not the null integrity protection algorithm, the target UE shall form the $K_{NRP-sess}$ ID from the MSB of $K_{NRP-sess}$ ID it had sent in the PROSE DIRECT LINK ESTABLISHMENT REQUEST message or PROSE DIRECT LINK REKEYING REQUEST message and the LSB of $K_{NRP-sess}$ ID received in the PROSE DIRECT LINK SECURITY MODE COMMAND message. The target UE shall use the $K_{NRP-sess}$ ID to identify the new security context.

After the PROSE DIRECT LINK SECURITY MODE COMPLETE message is generated, the target UE shall pass this message to the lower layers for transmission along with the target UE's layer-2 ID for 5G ProSe direct communication and the initiating UE's layer-2 ID for 5G ProSe direct communication, NRPIK, NRPEK if applicable, $K_{NRP-sess}$ ID, the selected security algorithm as specified in 3GPP TS 33.536 [37] , and an indication of activation of the 5G ProSe direct signalling security protection for the 5G ProSe direct link with the new security context, if applicable.

NOTE: The PROSE DIRECT LINK SECURITY MODE COMPLETE message and further 5G ProSe direct signalling messages are integrity protected and ciphered (if applicable) at the lower layer using the new security context.

If the 5G ProSe direct link security mode control procedure was triggered during a 5G ProSe direct link re-keying procedure, the target UE shall provide to the lower layers an indication of activation of the 5G ProSe direct user plane security protection for the 5G ProSe direct link with the new security context, if applicable, along with the initiating UE's layer-2 ID for 5G ProSe direct communication and the target UE's layer-2 ID for 5G ProSe direct communication.

7.2.10.4 5G ProSe direct link security mode control procedure completion by the initiating UE

Upon receiving a PROSE DIRECT LINK SECURITY MODE COMPLETE message, the initiating UE shall stop timer T5089. If the selected integrity protection algorithm is not the null integrity protection algorithm, the UE checks the integrity of the PROSE DIRECT LINK SECURITY MODE COMPLETE message. If the integrity check passes, the initiating UE shall then continue the procedure which triggered the 5G ProSe direct link security mode control procedure. If the selected integrity protection algorithm is the null integrity protection algorithm, the UE continues the procedure without checking the integrity protection.

After receiving the PROSE DIRECT LINK SECURITY MODE COMPLETE message, the initiating UE shall delete the old security context it has for the target UE.

7.2.10.5 5G ProSe direct link security mode control procedure not accepted by the target UE

If the PROSE DIRECT LINK SECURITY MODE COMMAND message cannot be accepted, the target UE shall send a PROSE DIRECT LINK SECURITY MODE REJECT message, and the target UE shall abort the ongoing procedure that triggered the initiation of the 5G ProSe direct link security mode control procedure unless the ongoing procedure is a 5G ProSe direct link establishment procedure and the Target user info is not included in the PROSE DIRECT LINK ESTABLISHMENT REQUEST message. The PROSE DIRECT LINK SECURITY MODE REJECT message contains a PC5 signalling protocol cause IE indicating one of the following cause values:

#5: lack of resources for 5G ProSe direct link;

#7: integrity failure;

#8: UE security capabilities mismatch;

#9: LSB of $K_{NRP-sess}$ ID conflict;

#10: UE PC5 unicast signalling security policy mismatch; or

#111: protocol error, unspecified.

If this 5G ProSe direct link security mode control procedure is triggered during the 5G ProSe direct link establishment procedure and the implementation-specific maximum number of established NR 5G ProSe direct links has been reached, then the target UE shall send a PROSE DIRECT LINK SECURITY MODE REJECT message containing PC5 signalling protocol cause value #5 "lack of resources for 5G ProSe direct link".

If the PROSE DIRECT LINK SECURITY MODE COMMAND message cannot be accepted because the 5G ProSe direct link security mode control procedure was triggered during a 5G ProSe direct link establishment procedure, that

the selected security algorithms in the PROSE DIRECT LINK SECURITY MODE COMMAND message included the null integrity protection algorithm and the target UE's 5G ProSe direct signalling integrity protection policy is set to "Signalling integrity protection required", the target UE shall include PC5 signalling protocol cause #10 "UE PC5 unicast signalling security policy mismatch" in the PROSE DIRECT LINK SECURITY MODE REJECT message.

If the PROSE DIRECT LINK SECURITY MODE COMMAND message cannot be accepted because the 5G ProSe direct link security mode control procedure was triggered during a 5G ProSe direct link re-keying procedure, the integrity protection algorithm currently in use for the 5G ProSe direct link is different from the null integrity protection algorithm and the selected security algorithms in the PROSE DIRECT LINK SECURITY MODE COMMAND message include the null integrity protection algorithm, the target UE, the target UE shall include PC5 signalling protocol cause #10 "UE PC5 unicast signalling security policy mismatch" in the PROSE DIRECT LINK SECURITY MODE REJECT message.

If the target UE detects that the received UE security capabilities IE in the PROSE DIRECT LINK SECURITY MODE COMMAND message has been altered compared to the latest values that the target UE sent to the initiating UE in the PROSE DIRECT LINK ESTABLISHMENT REQUEST message or PROSE DIRECT LINK REKEYING REQUEST message, the target UE shall include PC5 signalling protocol cause #8 "UE security capabilities mismatch" in the PROSE DIRECT LINK SECURITY MODE REJECT message.

If the target UE detects that the LSB of $K_{NRP\text{-}sess}$ ID included in the PROSE DIRECT LINK SECURITY MODE COMMAND message are set to the same value as those received from another UE in response to the target UE's PROSE DIRECT LINK ESTABLISHMENT REQUEST message, the target UE shall include PC5 signalling protocol cause #9 "LSB of $K_{NRP\text{-}sess}$ ID conflict" in the PROSE DIRECT LINK SECURITY MODE REJECT message.

After the PROSE DIRECT LINK SECURITY MODE REJECT message is generated, the target UE shall pass this message to the lower layers for transmission along with the initiating UE's layer-2 ID for 5G ProSe direct communication and the target UE's layer-2 ID for 5G ProSe direct communication.

Upon receipt of the PROSE DIRECT LINK SECURITY MODE REJECT message, the initiating UE shall stop timer T5089, provide an indication to the lower layer of deactivation of the 5G ProSe direct security protection and deletion of security context for the 5G ProSe direct link, if applicable and:

a) if the PC5 signalling protocol cause IE in the PROSE DIRECT LINK SECURITY MODE REJECT message is set to #9 "LSB of $K_{NRP\text{-}sess}$ ID conflict", retransmit the PROSE DIRECT LINK SECURITY MODE COMMAND message with a different value for the LSB of $K_{NRP\text{-}sess}$ ID and restart timer T5089; or

b) if the PC5 signalling protocol cause IE is set to the value other than #9 "LSB of KNRP-sess ID conflict", abort the ongoing procedure that triggered the initiation of the 5G ProSe direct link security mode control procedure.

7.2.10.6 Abnormal cases

7.2.10.6.1 Abnormal cases at the initiating UE

a) Timer T5089 expires.

   The initiating UE shall retransmit the PROSE DIRECT LINK SECURITY MODE COMMAND message and restart timer T5089. After reaching the maximum number of allowed retransmissions, the initiating UE shall abort the 5G ProSe direct link security mode control procedure, shall provide an indication to the lower layer of deactivation of the 5G ProSe direct security protection and deletion of security context for the 5G ProSe direct link, if applicable, and shall abort the ongoing procedure that triggered the initiation of the 5G ProSe direct link security mode control procedure.

NOTE: The maximum number of allowed retransmissions is UE implementation specific.

b) The need to use this 5G ProSe direct link no longer exists before the 5G ProSe direct link security mode control procedure is completed.

   The initiating UE shall abort the procedure, shall provide an indication to the lower layer of deactivation of the 5G ProSe direct security protection and deletion of security context for the 5G ProSe direct link, if applicable, and shall abort the ongoing procedure that triggered the initiation of the 5G ProSe direct link security mode control procedure.

7.2.11 5G ProSe direct link re-keying procedure

7.2.11.1 General

The purpose of the 5G ProSe direct link re-keying procedure is to derive a new $K_{NRP-sess}$ and, optionally, a new K_{NRP} for an existing 5G ProSe direct link. The UE sending the PROSE DIRECT LINK REKEYING REQUEST message is called the "initiating UE" and the other UE is called the "target UE".

NOTE 1: There is no benefit in performing the 5G ProSe direct link re-keying procedure when using the null integrity protection algorithm, hence it is recommended not to trigger it when using the null integrity protection algorithm.

Editor's note: Any possible changes to the 5G ProSe direct link re-keying procedure due to the security requirements of 5G ProSe layer-2 UE-to-network relay or 5G ProSe layer-3 UE-to-network relay are FFS and waiting for SA3 conclusion.

7.2.11.2 5G ProSe direct link re-keying procedure initiation by the initiating UE

The initiating UE shall meet the following pre-condition before initiating the 5G ProSe direct link re-keying procedure:

a) there is a 5G ProSe direct link between the initiating UE and the target UE; and

   1) if the session key $K_{NRP-sess}$ used to protect 5G ProSe direct link needs to be refreshed and neither timer T5089 nor T5091 are running;

   2) if the UE wants to refresh K_{NRP} and neither timer T5089 nor T5091 are running; or

   3) if the lower layers indicate that a 5G ProSe direct link re-keying procedure needs to be performed.

In order to initiate the 5G ProSe direct link re-keying procedure, the initiating UE shall create a PROSE DIRECT LINK REKEYING REQUEST message. In this message, the initiating UE:

a) shall include the Key establishment information container IE if the null integrity protection algorithm is not in use;

NOTE 1: The key establishment information container is provided by upper layers.

b) shall include a Nonce_1 IE set to the 128-bit nonce value generated by the initiating UE for the purpose of session key refresh over this 5G ProSe direct link if the null integrity protection algorithm is not in use;

c) shall include its UE security capabilities indicating the list of algorithms that the initiating UE supports for the re-keying of this 5G ProSe direct link;

d) shall include the MSB of $K_{NRP-sess}$ ID chosen by the initiating UE as specified in 3GPP TS 33.503 [34] if the null integrity protection algorithm is not in use; and

e) may include a Re-authentication indication if the initiating UE wants to derive a new K_{NRP}.

After the PROSE DIRECT LINK REKEYING REQUEST message is generated, the initiating UE shall pass this message to the lower layers for transmission along with the initiating UE's layer-2 ID for unicast communication and the target UE's layer-2 ID for unicast communication, and start timer T5091. The UE shall not send a new PROSE DIRECT LINK REKEYING REQUEST message to the same target UE while timer T5091 is running.

NOTE 2: In order to ensure successful 5G ProSe direct link re-keying, T5091 should be set to a value larger than the sum of T5092 and T5089.

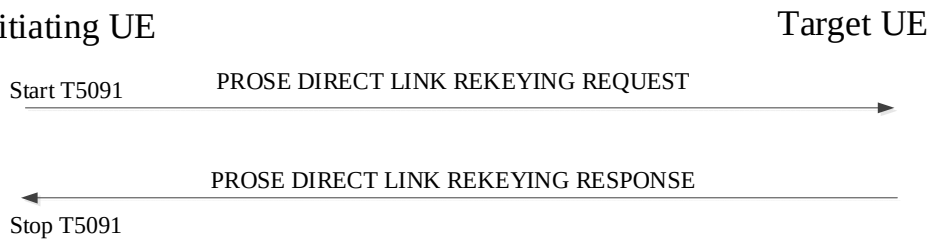

Figure 7.2.11.2.1: 5G ProSe direct link re-keying procedure

7.2.11.3 5G ProSe direct link re-keying procedure accepted by the target UE

Upon receipt of a PROSE DIRECT LINK REKEYING REQUEST message, if the PROSE DIRECT LINK REKEYING REQUEST message includes a Re-authentication indication, the target UE shall derive a new K_{NRP}. This may require performing one or more 5G ProSe direct link authentication procedures as specified in clause 7.2.z.

NOTE: How many times the 5G ProSe direct link authentication procedure needs to be performed to derive a new K_{NRP} depends on the authentication method used.

Then the target UE shall initiate a 5G ProSe direct link security mode control procedure as specified in in clause 7.2.10

Upon successful completion of the 5G ProSe direct link security mode control procedure, the target UE shall create a PROSE DIRECT LINK REKEYING RESPONSE message.

After the PROSE DIRECT LINK REKEYING RESPONSE message is generated, the target UE shall pass this message to the lower layers for transmission along with the initiating UE's layer-2 ID for unicast communication and the target UE's layer-2 ID for unicast communication.

7.2.11.4 5G ProSe direct link re-keying procedure completion by the initiating UE

Upon receipt of the PROSE DIRECT LINK REKEYING RESPONSE message, the initiating UE shall stop timer T5091 and check the integrity of the PROSE DIRECT LINK REKEYING RESPONSE message using the new NRPIK.

After receiving the PROSE DIRECT LINK REKEYING RESPONSE message, the initiating UE shall delete the old security context it has for the target UE.

7.2.11.5 Abnormal cases at the initiating UE

The following abnormal cases can be identified:

a) Timer T5091 expires.

The initiating UE shall retransmit the PROSE DIRECT LINK REKEYING REQUEST message and restart timer T5091. After reaching the maximum number of allowed retransmissions, the initiating UE shall abort the 5G ProSe direct link re-keying procedure, shall provide an indication of deactivation of the PC5 unicast security protection and deletion of security context for the 5G ProSe direct link to the lower layer, if applicable, along with the initiating UE's layer-2 ID for unicast communication and the target UE's layer-2 ID for unicast communication and may initiate the 5G ProSe direct link release procedure.

NOTE: The maximum number of allowed retransmissions is UE implementation specific.

b) The need to use this 5G ProSe direct link no longer exists before the 5G ProSe direct link re-keying procedure is completed.

The initiating UE shall abort the procedure and shall provide an indication of deactivation of the PC5 unicast security protection and deletion of security context for the 5G ProSe direct link to the lower layer, if applicable, along with the initiating UE's layer-2 ID for unicast communication and the target UE's layer-2 ID for unicast communication.

c) For the same 5G ProSe direct link, if the initiating UE receives a DIRECT LINK IDENTIFIER UPDATE REQUEST message after initiating the 5G ProSe direct link re-keying procedure, the initiating UE shall stop the timer T5091, abort the 5G ProSe direct link re-keying procedure and proceed with the 5G ProSe direct link identifier update procedure.

7.2.12 5G ProSe direct link authentication procedure

7.2.12.1 General

The 5G ProSe direct link authentication procedure is used to perform mutual authentication of UEs establishing a 5G ProSe direct link and to derive a new K_{NRP} shared between two UEs during a 5G ProSe direct link establishment procedure or a 5G ProSe direct link re-keying procedure. After successful completion of the 5G ProSe direct link authentication procedure, the new K_{NRP} is used for security establishment during the 5G ProSe direct link security mode control procedure as specified in clause 7.2.10. The UE sending the PROSE DIRECT LINK AUTHENTICATION REQUEST message is called the "initiating UE" and the other UE is called the "target UE".

NOTE: The 5G ProSe direct link authentication procedure is not applicable for 5G ProSe layer-3 UE-to-network relay.

7.2.12.2 5G ProSe direct link authentication procedure initiation by the initiating UE

The initiating UE shall meet one of the following pre-conditions if signalling integrity protection is activated based on the decision of the initiating UE, before initiating the 5G ProSe direct link authentication procedure:

a) the target UE has initiated a 5G ProSe direct link establishment procedure toward the initiating UE by sending a PROSE DIRECT LINK ESTABLISHMENT REQUEST message and:

   1) the PROSE DIRECT LINK ESTABLISHMENT REQUEST message:

      i) includes a target user info IE which includes the application layer ID of the initiating UE; or

      ii) does not include a target user info IE and the initiating UE is interested in the ProSe service identified by the ProSe identifier in the PROSE DIRECT LINK ESTABLISHMENT REQUEST message; and

   2) the K_{NRP} ID is not included in the PROSE DIRECT LINK ESTABLISHMENT REQUEST message or the initiating UE does not have an existing K_{NRP} for the K_{NRP} ID included in PROSE DIRECT LINK ESTABLISHMENT REQUEST message or the initiating UE derives a new K_{NRP}; or

b) the target UE has initiated a 5G ProSe direct link re-keying procedure toward the initiating UE by sending a PROSE DIRECT LINK REKEYING REQUEST message and the PROSE DIRECT LINK REKEYING REQUEST message includes a Re-authentication indication.

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

a) shall include the key establishment information container IE.

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

After the PROSE DIRECT LINK AUTHENTICATION REQUEST message is generated, the initiating UE shall pass this message to the lower layers for transmission along with the initiating UE's layer-2 ID for unicast communication and the target UE's layer-2 ID for unicast communication.

The initiating UE shall start timer T5092. The UE shall not send a new PROSE DIRECT LINK AUTHENTICATION REQUEST message to the same target UE while timer T5092 is running.

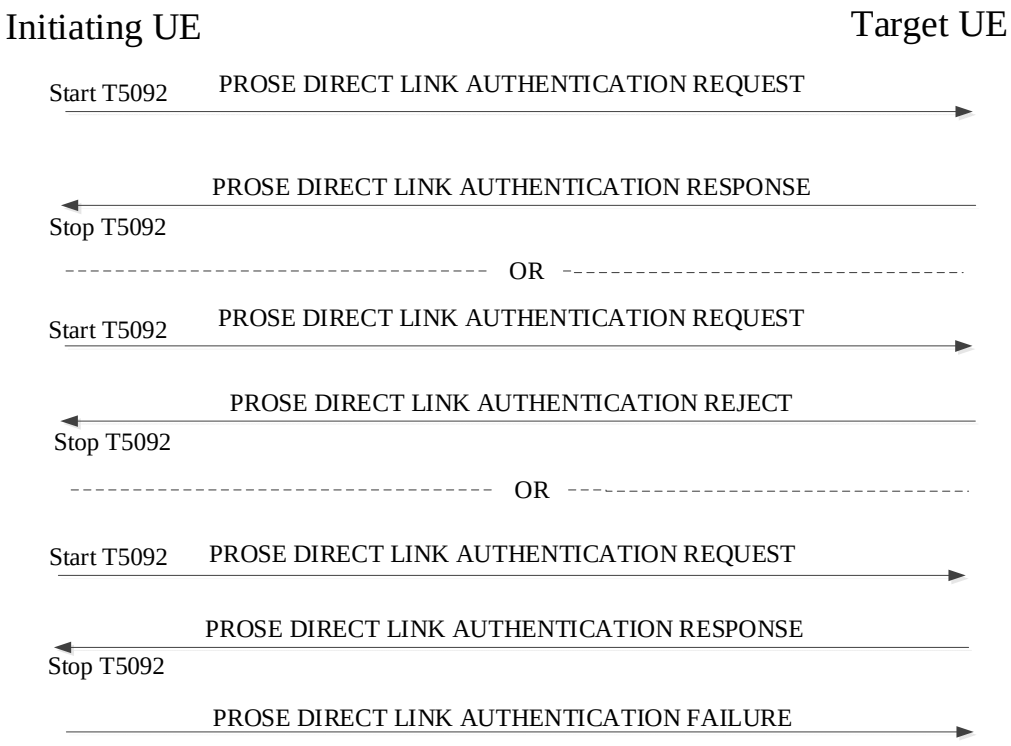

Figure 7.2.12.2.1: 5G ProSe direct link authentication procedure

7.2.12.3 5G ProSe direct link authentication procedure accepted by the target UE

Upon receipt of a PROSE DIRECT LINK AUTHENTICATION REQUEST message, if a new assigned initiating UE's layer-2 ID is included, the target UE shall replace the original initiating UE's layer-2 ID with the new assigned initiating UE's layer-2 ID for unicast communication. If the target UE determines that the PROSE DIRECT LINK AUTHENTICATION REQUEST message can be accepted, the target UE shall create a PROSE DIRECT LINK AUTHENTICATION RESPONSE message. The target UE shall check if the number of established 5G ProSe direct links is less than the implementation-specific maximum number of established NR 5G ProSe direct links allowed in the UE at a time. In this message, the target UE:

a) shall include the Key establishment information container IE.

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

After the PROSE DIRECT LINK AUTHENTICATION RESPONSE message is generated, the target UE shall pass this message to the lower layers for transmission along with the target UE's layer-2 ID for unicast communication and the initiating UE's layer-2 ID for unicast communication.

7.2.12.4 5G ProSe direct link authentication procedure completion by the initiating UE

Upon receiving a PROSE DIRECT LINK AUTHENTICATION RESPONSE message, if the initiating UE determines that the PROSE DIRECT LINK AUTHENTICATION RESPONSE message can be accepted, the initiating UE shall stop timer T5092.

NOTE: When the initiating UE derives the new K_{NRP} during the 5G ProSe direct link authentication procedure depends on the authentication method in use.

7.2.12.5 5G ProSe direct link authentication procedure not accepted by the target UE

If the PROSE DIRECT LINK AUTHENTICATION REQUEST message cannot be accepted, the target UE shall create a DIRECT LINK AUTHENTICATION REJECT message. In this message, the target UE shall include a PC5 signalling protocol cause IE indicating one of the following cause values:

#5: lack of resources for 5G ProSe direct link;

#6: authentication failure5G ProSe direct link.

If this 5G ProSe direct link authentication procedure is triggered during the 5G ProSe direct link establishment procedure and the implementation-specific maximum number of established NR 5G ProSe direct links has been reached, then the target UE shall send a DIRECT LINK AUTHENTICATION REJECT message containing PC5 signalling protocol cause value #5 "lack of resources for 5G ProSe direct link".

After the DIRECT LINK AUTHENTICATION REJECT message is generated, the target UE shall pass this message to the lower layers for transmission along with the initiating UE's layer-2 ID for unicast communication and the target UE's layer-2 ID for unicast communication.

The target UE shall abort the ongoing procedure that triggered the initiation of the 5G ProSe direct link authentication procedure if the ongoing procedure is the 5G ProSe direct link establishment procedure and the Target user info is included in the PROSE DIRECT LINK ESTABLISHMENT REQUEST message.

Upon receipt of the DIRECT LINK AUTHENTICATION REJECT message, the initiating UE shall stop timer T5092 and abort the ongoing procedure that triggered the initiation of the 5G ProSe direct link authentication procedure.

7.2.12.6 5G ProSe direct link authentication procedure not accepted by the initiating UE

If the PROSE DIRECT LINK AUTHENTICATION RESPONSE message cannot be accepted, the initiating UE shall stop timer T5092 and create a DIRECT LINK AUTHENTICATION FAILURE message. In this message, the initiating UE may include the Key establishment information container IE if provided by upper layers.

After the DIRECT LINK AUTHENTICATION FAILURE message is generated, the initiating UE shall pass this message to the lower layers for transmission along with the initiating UE's layer-2 ID for unicast communication and the target UE's layer-2 ID for unicast communication.

The initiating UE shall abort the ongoing procedure that triggered the initiation of the 5G ProSe direct link authentication procedure.

Upon receipt of the DIRECT LINK AUTHENTICATION FAILURE message, the target UE shall abort the ongoing procedure that triggered the initiation of the 5G ProSe direct link authentication procedure and shall indicate to upper layers that authentication has failed.

7.2.12.7 Abnormal cases

7.2.12.7.1 Abnormal cases at the initiating UE

a) Timer T5092 expires.

   The initiating UE shall retransmit the PROSE DIRECT LINK AUTHENTICATION REQUEST message and restart timer T5092. After reaching the maximum number of allowed retransmissions, the initiating UE shall abort the 5G ProSe direct link authentication procedure and shall abort the ongoing procedure that triggered the initiation of the 5G ProSe direct link authentication procedure.

NOTE: The maximum number of allowed retransmissions is UE implementation specific.

b) The need to use this 5G ProSe direct link no longer exists before the 5G ProSe direct link authentication procedure is completed.

   The initiating UE shall abort the 5G ProSe direct link authentication procedure and shall abort the ongoing procedure that triggered the initiation of the 5G ProSe direct link authentication procedure.

7.3 Broadcast mode 5G ProSe direct communication over PC5

7.3.1 Overview

This clause describes the 5G ProSe communication over PC5 reference point in broadcast mode operation. The UE is configured with the related information as described in clause 5.2.4.

7.3.2 Transmission of broadcast mode 5G ProSe communication over PC5

7.3.2.1 Initiation

7.3.2.1.1 Broadcast mode 5G ProSe communication over PC5 triggered by upper layers

When the UE is requested by upper layers to send data unit(s) of a ProSe application identified by a ProSe identifier using 5G ProSe communication over PC5, the request from the upper layers includes:

a) the data unit(s) of the ProSe application;

b) the ProSe identifier of the ProSe application for the data unit(s);

c) the type of data in the data unit(s) (i.e., IP, Ethernet, Address Resolution Protocol, or Unstructured);

d) optionally the communication mode which is set to broadcast mode; and

e) optionally the 5G ProSe application requirements (e.g., priority requirement, reliability requirement, delay requirement).

Upon a request from upper layers to send data unit(s) of a ProSe application identified by a ProSe identifier using 5G ProSe communication over PC5, if:

a) the UE is configured with ProSe identifier to ProSe NR frequency mapping rules for 5G ProSe communication over PC5 as specified in clause 5.2.4; and

b) there are one or more ProSe NR frequencies associated with the ProSe identifier of the ProSe application for the data unit(s) in the current geographical area,

then the UE passes the one or more ProSe NR frequencies associated with the ProSe identifier of the ProSe application and the communication mode which is set to broadcast mode for the data unit(s) to the lower layers.

Then, if:

a) the following conditions are met:

   1) the UE is served by NG-RAN for 5G ProSe communication;

   2) the UE intends to use the radio resources (i.e., carrier frequency) provided by a serving cell;

   3) the registered PLMN is in the list of PLMNs in which the UE is authorized to use 5G ProSe communication over PC5 when the UE is served by NG-RAN for 5G ProSe communication over PC5 as specified in clause 5.2.4; and

   4) the ProSe identifier of the ProSe application is included in the list of ProSe applications authorized for 5G ProSe communication over PC5 as specified in clause 5.2.4 or the UE is configured with a default destination layer-2 ID for broadcast mode 5G ProSe communication over PC5 as specified in clause 5.2.4; or

b) the following conditions are met:

   1) the UE is:

      i) not served by NG-RAN for 5G ProSe communication over PC5;

ii) 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:

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

B) 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

C) 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

iii) in limited service state as specified in 3GPP TS 23.122 [14] for reasons other than A), B) or C) above, and located in a geographical area for which the UE is provisioned with "non-operator managed" radio parameters as specified in clause 5.2.4;

2) the UE is authorized to use 5G ProSe communication over PC5 when the UE is not served by NG-RAN for 5G ProSe communication as specified in clause 5.2.4; and

3) the ProSe identifier of the ProSe application is included in the list of ProSe applications authorized for 5G ProSe communication over PC5 as specified in clause 5.2.4 or the UE is configured with a default destination layer-2 ID for broadcast mode 5G ProSe communication over PC5 as specified in clause 5.2.4;

then the UE shall proceed as specified in clause 7.3.2.1.2, else the UE shall not perform transmission of 5G ProSe communication over PC5.

7.3.2.1.2 PC5 QoS flow match and establishment

In order to determine if any existing PC5 QoS flow matches the request from upper layers, UE shall proceed as follows:

a) according to the PC5 QoS mapping rules specified in clause 5.2.4, the UE shall use the PC5 QoS parameters corresponding to the ProSe identifier and optionally 5G ProSe application requirements;

b) according to the ProSe identifier to destination layer-2 ID for broadcast mapping rules specified in clause 5.2.4, the UE shall use the destination layer-2 ID corresponding to the ProSe identifier;

c) if there is no existing context for the destination layer-2 ID, then:

1) build a new context for the destination layer-2 ID;

2) self-assign a new source layer-2 ID; and

3) pass the source layer-2 ID and the destination layer-2 ID to lower layers.

d) if in the context for the destination layer-2 ID, there is no PC5 QoS rule for the existing PC5 QoS flow(s) matching the service data or request, the UE shall derive the PC5 QoS parameters based on the 5G ProSe application requirements provided by the upper layers (if available) and the ProSe identifier according to the PC5 QoS mapping rules defined in clause 5.2.4 and shall perform the following:

1) if there is no existing PC5 QoS flow that fulfils the derived PC5 QoS parameters, then the UE shall create a new PC5 QoS flow by performing the following operations:

i) self-assign a new PQFI;

ii) create a new PC5 QoS flow context which contains:

A) the PQFI;

B) the ProSe identifier(s); and

C) the derived PC5 QoS parameters;

iii) create a new PC5 QoS rule which contains:

A) a PC5 QoS rule identifier;

B) the PQFI;

C) a set of packet filters; and

D) a precedence value; and

iv) pass the following parameters to the lower layers:

A) the PQFI;

B) the PC5 QoS parameters; and

C) the source layer-2 ID and the destination layer-2 ID;

2) if there is an existing PC5 QoS flow that fulfils the derived PC5 QoS parameters, then the UE shall update the PC5 packet filter set in the PC5 QoS rule of this PC5 QoS flow, e.g. add the new packet filter in the PC5 QoS rule of this existing PC5 QoS flow; and

3) the UE shall use the new PC5 QoS flow created as described in bullet 1) or the existing PC5 QoS flow with the updated PC5 QoS rules as described in bullet 2) to perform the transmission of 5G ProSe communication over PC5 as specified in clause 7.3.2.2; and

e) if in the context for the destination layer-2 ID, there is a PC5 QoS rule for the existing PC5 QoS flow matching the service data or request, the UE shall use this existing PC5 QoS flow to perform transmission of 5G ProSe communication over PC5 as specified in clause 7.3.2.2.

Three types of packet filters are supported for broadcast mode 5G ProSe direct communication over PC5, i.e., the ProSe IP packet filter set, the ProSe packet filter set, and the ProSe Ethernet packet filter set. The three types of packet filters are defined the same as specified in clause 7.2.7.

7.3.2.2 Transmission

The UE shall include the data unit(s) in a protocol data unit with the following parameters:

a) a layer-3 protocol data unit type (see 3GPP TS 38.323 [16]) set to:

1) IP packet, if the data unit(s) contains IP data; or

2) non-IP packet, if the data unit(s) contains Ethernet, Address Resolution Protocol, or Unstructured data;

b) the source layer-2 ID set to the layer-2 ID self-assigned by the UE for 5G ProSe communication over PC5;

c) the destination layer-2 ID set to:

1) the destination layer-2 ID associated with the ProSe identifier of the ProSe application in this list of ProSe applications authorized for 5G ProSe communication over PC5 as specified in clause 5.2.4, if the ProSe identifier of the ProSe application is included in the list of ProSe applications authorized for 5G ProSe communication over PC5 as specified in clause 5.2.4; or

2) the default destination layer-2 ID configured to the UE for broadcast mode 5G ProSe communication over PC5 as specified in clause 5.2.4, if the ProSe identifier of the ProSe application is not included in the list of ProSe applications authorized for 5G ProSe communication over PC5 and the UE is configured with a default destination layer-2 ID for broadcast mode 5G ProSe communication over PC5;

d) if the data unit(s) contains IP data, the source IP address set to the source IP address allocated to the UE as specified in clause 7.3.4; and

NOTE: How to set the destination IP address is left to UE implementation.

e) the PQFI set to the value corresponding to the PC5 QoS rules as specified in clause 7.3.2.1,

then UE shall request radio resources for 5G ProSe communication over PC5 as specified in 3GPP TS 38.300 [21], and pass the data unit(s) on the PC5 QoS Flow identified by the PQFI to lower layers for transmission. The PC5 QoS Rules corresponding to the PQFIs map the data unit(s) with the same ProSe identifier and with the same PC5 QoS parameters to the same PC5 QoS Flow, and apply PQFI to the data unit(s).

If the UE is camped on a serving cell indicating that 5G ProSe communication over PC5 is supported by the network, but not broadcasting any carrier frequencies and radio resources for 5G ProSe communication over PC5 as specified in

3GPP TS 38.331 [13], the UE shall request radio resources for 5G ProSe communication over PC5 as specified in 3GPP TS 24.501 [11].

7.3.2.3 Procedure for UE to use provisioned radio resources for 5G ProSe communication over PC5

When the UE is not served by NG-RAN for 5G ProSe communication and is authorized to use 5G ProSe communication over PC5, the UE shall identify the NR-PC5 to be used for 5G ProSe communication over PC5. After identifying NR-PC5 to be used for 5G ProSe communication over PC5, the UE shall select the corresponding radio parameters to be used for 5G ProSe communication over PC5 as follows:

a) if the UE can determine itself located in a geographical area, and the UE is provisioned with radio parameters for the geographical area, the UE shall select the radio parameters associated with that geographical area; or

b) in all other cases, the UE shall not initiate 5G ProSe communication over PC5.

If the UE intends to use "non-operator managed" radio parameters as specified in clause 5.2.4, the UE shall initiate 5G ProSe communication over PC5 with the selected radio parameters.

If the UE intends to use "operator managed" radio parameters as specified in clause 5.2.4, before initiating 5G ProSe communication over PC5, the UE shall check with lower layers whether the selected radio parameters can be used in the current location without causing interference to other cells as specified in 3GPP TS 38.331 [13], and:

a) if the lower layers indicate that the usage would not cause any interference, the UE shall initiate 5G ProSe communication over PC5; or

NOTE: If the lower layers find that there exists a cell operating the provisioned radio resources (i.e., carrier frequency), and the cell belongs to the registered PLMN or a PLMN equivalent to the registered PLMN, and the UE is authorized for 5G ProSe communication over PC5 in this PLMN, the UE can use the radio parameters indicated by the cell as specified in 3GPP TS 38.331 [13].

b) else if the lower layers report that one or more PLMNs operate in the provisioned radio resources (i.e., carrier frequency) then:

   1) if the following conditions are met:

      i) none of the PLMNs reported by the lower layers is the registered PLMN or equivalent to the registered PLMN;

      ii) at least one of the PLMNs reported by the lower layers is in the list of authorized PLMNs for 5G ProSe communication over PC5 and provides radio resources for 5G ProSe communication over PC5 as specified in 3GPP TS 38.331 [13]; and

      iii) the UE does not have an emergency PDU session;

      then the UE shall:

      i) if in 5GMM-IDLE mode, perform PLMN selection triggered by 5G ProSe communication over PC5 as specified in 3GPP TS 23.122 [14]; or

      ii) else if in 5GMM-CONNECTED mode, either:

         A) perform a De-registration procedure as specified in 3GPP TS 24.501 [11] and then perform PLMN selection triggered by 5G ProSe communication over PC5 as specified in 3GPP TS 23.122 [14]; or

         B) not initiate 5G ProSe communication over PC5.

         Whether the UE performs i) or ii) above is left up to UE implementation; or

   2) else the UE shall not initiate 5G ProSe communication over PC5.

If the registration to the selected PLMN is successful, the UE shall proceed with the procedure to initiate 5G ProSe communication over PC5 as specified in clause 7.3.2.1.

If the UE is performing 5G ProSe communication over PC5 using radio parameters associated with a geographical area and moves out of that geographical area, the UE shall stop performing 5G ProSe communication over PC5 and then:

a) if the UE is not served by NG-RAN for 5G ProSe communication over PC5 or the UE intends to use radio resources for 5G ProSe communication over PC5 other than those operated by the serving cell, the UE shall select appropriate radio parameters for the new geographical area as specified above; or

b) if the UE is served by NG-RAN for 5G ProSe communication over PC5 and intends to use radio resources for 5G ProSe communication over PC5 operated by the serving cell, the UE shall proceed with the procedure to initiate 5G ProSe communication over PC5 when served by NG-RAN for 5G ProSe communication over PC5.

7.3.2.4 Privacy of 5G ProSe transmission over PC5

Upon initiating transmission of 5G ProSe communication over PC5, if:

a) the ProSe identifier of a ProSe application requesting transmission of 5G ProSe communication over PC5 is in the list of ProSe applications which require privacy for 5G ProSe communication over PC5 as specified in clause 5.2.4; and

b) the UE is located in a geographical area in which this ProSe application requires privacy for 5G ProSe communication over PC5 as specified in clause 5.2.4, or the UE is not provisioned any geographical areas in which this ProSe applications requires privacy for 5G ProSe communication over PC5,

then the UE shall proceed as follows:

a) if timer T5100 is not running, start timer T5aaa and set its timer value as the privacy timer value as specified in clause 5.2.4;

b) upon:

   1) getting an indication from upper layers that the application layer identifier has been changed; or

   2) timer T5100 expiry,

   then:

   1) change the value of the source layer-2 ID self-assigned by the UE for the 5G ProSe communication over PC5;

   2) if the data unit(s) contains IP data, change the value of the source IP address self-assigned by the UE for 5G ProSe communication over PC5;

   3) provide an indication to upper layers that the source layer-2 ID, or the source IP address, or both the source layer-2 ID and the source IP address are changed;

   4) pass the changed source layer-2 ID and destination layer-2 ID, along with the corresponding PQFI down to the lower layer;

   5) restart timer T5100; and

   6) upon stopping transmission of the 5G ProSe communication over PC5, stop timer T5100.

7.3.3 Reception of broadcast mode 5G ProSe communication over PC5

The UE may be configured by upper layers with one or more destination layer-2 ID(s) for reception of data unit(s) over PC5. For each received protocol data unit over PC5, the receiving UE shall check if the destination layer-2 ID of the received protocol data unit matches one of the configured destination layer-2 IDs. If yes, the UE shall then check whether the protocol data unit type as defined 3GPP TS 38.323 [16] provided by the lower layers for the received packet is set to IP packet or non-IP packet, and pass the protocol data unit to the corresponding upper layer entity.

7.3.4 IP address allocation for broadcast mode 5G ProSe communication over PC5

When the UE needs to perform 5G ProSe communication over PC5 reference point in broadcast mode operation and the type of data in the data unit is IP, the UE:

a) for IPv4,

   1) shall use the pre-configured link local IPv4 address as source address; or

   2) shall use dynamic configuration of IPv4 link-local addresses as specified in IETF RFC 3927 [38] if there is no pre-configured link local IPv4 address; and

b) for IPv6,

   1) shall auto-configure a link local IPv6 address following procedures defined in IETF RFC 4862 [25]; and

   2) may use this IP address for direct communication without sending Neighbour Solicitation and Neighbour Advertisement message for Duplicate Address Detection.

7.4 Groupcast mode 5G ProSe direct communication over PC5

7.4.1 Overview

This clause describes the 5G ProSe communication over PC5 reference point in groupcast mode operation. The UE is configured with the related information as described in clause 5.2.4. For commercial services, the application layer group ID is provided by application server. For public safety services, the pre-configured or provisioned application layer group ID as described in clause 5.2.4 will be used for groupcast communication.

7.4.2 Transmission of groupcast mode 5G ProSe communication over PC5

7.4.2.1 Initiation

7.4.2.1.1 Initiation of forming a group

Before the UE is requested by upper layers to send data unit(s) of a ProSe application identified by a ProSe identifier using 5G ProSe communication over PC5, for the users sharing the same application layer group ID as configured in clause 5.2.4 may perform a group member discovery procedure as specified in clause 6.2.15.

When the group is formed, the following information may be exchanged within the group members included in the application layer discovery message:

a) group size; and

b) member ID.

NOTE: Whether to transmit the application layer discovery message as metadata in a 5G ProSe direct discovery message or as user traffic over PC5 is UE implementation specific.

7.4.2.1.2 Requirements for 5G ProSe direct communication over PC5

The requirements for groupcast mode 5G ProSe direct communication over PC5 is the same as described in clause 7.3.2.1.1, with the following additions:

a) When the UE is requested by upper layers to send data unit(s) of a ProSe application identified by a ProSe identifier using 5G ProSe communication over PC5, the request from the upper layers includes:

   1) the application layer group ID;

2) the group size and the member IDs;

3) the range requirement; or

4) the communication mode which is set to groupcast mode.

7.4.2.1.3 PC5 QoS flow match and establishment

The PC5 QoS flow match and establishment for groupcast mode 5G ProSe direct communication over PC5 is the same as described in clause 7.3.2.1.2, with the following modifications:

a) The UE shall determine the destination layer-2 ID as:

1) if no application layer group ID is provided by the application layer, then according to the mapping rules specified in clause 5.2.4, the UE shall set the destination layer-2 ID to the destination layer-2 ID corresponding to the ProSe identifier as specified in clause 5.2.4;

2) if application layer group ID is provided by the application layer, and there is a context for the application layer group ID as specified in clause 5.2.4, then UE shall set the destination layer-2 ID to the ProSe layer-2 group ID in the context; and

3) if application layer group ID is provided by the application layer, and there is no context for the application layer group ID as specified in clause 5.2.4, then the UE shall convert the application layer group ID into a destination layer-2 ID as following:

i) to use the group identifier as the input to the SHA-256 hashing algorithm as specified in ISO/IEC 10118-3:2018 [28]; and

ii) to use the 24 least significant bits of the 256 bits of the output as destination layer-2 ID; and

NOTE: SHA-256 hashing algorithm is implemented in the ME.

b) If there is no existing context for the destination layer-2 ID and optional group identifier, the UE shall proceed as:

1) to establish a new context for the destination layer-2 ID and optional group identifier;

2) self-assign a new source layer-2 ID; and

3) to pass the source/destination layer-2 IDs, optional group size and optional member IDs to lower layers.

7.4.2.2 Transmission

The transmission of groupcast mode 5G ProSe direct communication over PC5 is same as described in clause 7.3.2.2, with the following additions:

a) If group identifier is provided, then the destination layer-2 ID shall be set to the destination layer-2 ID in the context for the group identifier as specified in clause 7.4.2.1.3.

7.4.2.3 Procedure for UE to use provisioned radio resources for 5G ProSe direct communication over PC5

The procedures described in clause 7.3.2.3 apply.

7.4.2.4 Privacy of 5G ProSe direct transmission over PC5

The procedures described in clause 7.3.2.4 apply with using the privacy timer T5200 for groupcast.

7.4.3 Reception of groupcast mode 5G ProSe direct communication over PC5

The reception of groupcast mode 5G ProSe direct communication over PC5 is the same as described in clause 7.3.3, with the following additions:

a) besides the configured destination layer-2 ID(s) for receiving messages over PC5, the UE shall also derive the destination layer-2 ID(s) based on group identifier(s) if provided by upper layers as specified in clause 7.4.2.1.

7.4.4 IP address allocation for groupcast mode 5G ProSe communication over PC5

When the UE needs to perform 5G ProSe communication over PC5 reference point in groupcast mode operation and the type of data in the data unit is IP, the UE uses the same IP address allocation mechanism as specified in clause 7.3.4.

7.5 Non-IP data transport procedure

7.5.1 General

The purpose of the non-IP data transport procedure is to transport, from the upper layers of a sending UE to the upper layers of the receiving UE, the following information over the PC5 interface:

a) non-IP data; and

b) non-IP type.

7.5.2 Non-IP data transmission over PC5

Upon a request from upper layers to send an Ethernet data, Address Resolution Protocol, or Unstructured data, the UE shall create a non-IP PDU, shall set the non-IP payload field of the non-IP PDU to the data provided by upper layers, and shall set the non-IP type field of the non-IP PDU to the non-IP type provided by upper layers, as specified in clause 11.5. The UE shall then pass the non-IP PDU to the lower layers for transmission.

7.5.3 Non-IP data reception over PC5

Upon receiving a non-IP PDU from the lower layers, the UE shall either:

a) check the non-IP type field in the non-IP PDU and provide the non-IP data in the non-IP payload field of the non-IP PDU to the corresponding upper layer entity; or

b) provide the upper layers with the non-IP data in the non-IP payload field of the non-IP PDU and with the non-IP type in the non-IP type field of the non-IP PDU.

8 5G ProSe UE-to-network relay

8.1 Overview

This clause describes the procedures for 5G ProSe UE-to-network relay. The UE is configured with the related information as described in clause 5.2.5.

8.2 Procedures

8.2.1 UE-to-network relay discovery over PC5 interface

8.2.1.1 General

This clause describes the procedures for both layer-3 and layer-2 UE-to-network relay discovery for public safety use and commercial services at a ProSe-enabled UE over the PC5 interface. The purpose of the UE-to-network relay discovery procedure over PC5 interface is to enable a ProSe-enabled UE to detect and identify another ProSe-enabled UE over PC5 interface for UE-to-network relay communication between a UE and 5GC.

NOTE 1: Relaying Multicast/Broadcast Service traffic to a 5G ProSe remote UE by a 5G ProSe UE-to-network relay is not supported in this release of the specification.

A UE-to-network relay supporting multiple relay service codes can advertise the relay service codes using multiple discovery messages, with one relay service code per discovery message.

The following principles for 5G ProSe UE-to-network relay apply when the relay UE or the remote UE is in service area restriction as defined in clause 5.3.5 of 3GPP TS 24.501 [11]:

a) in non-allowed area of its serving PLMN, the 5G ProSe layer-3 UE-to-network relay UE is not allowed to perform relay operations (e.g., UE-to-network relay discovery as specified in clause 8.2.1, or accept the 5G ProSe direct link establishment procedure as specified in clause 7.2.2) except for e.g., emergency services and high priority access as defined in clause 5.3.5 of 3GPP TS 24.501 [11] based on relay service codes as specified in clause 5.2.5;

b) service area restriction is not applicable to the 5G ProSe layer-3 remote UE;

c) in non-allowed area of its serving PLMN, the 5G ProSe layer-2 UE-to-network relay UE may perform relay operations (e.g., UE-to-network relay discovery as specified in clause 8.2.1, or accept the 5G ProSe direct link establishment procedure as specified in clause 7.2.2); and

d) in non-allowed area of its serving PLMN, the 5G ProSe layer-2 remote UE follows the same principles of service area restrictions as specified in clause 5.3.5 of 3GPP TS 24.501 [11].

To perform UE-to-network relay discovery over PC5 interface, the UE is configured with the related information as described in clause 5.2.5. The following models for UE-to-network relay discovery procedure over PC5 interface as specified in 3GPP TS 23.304 [2] are supported:

a) Model A uses a single discovery protocol message (Announcement); and

b) Model B uses two discovery protocol messages (Solicitation and Response).

NOTE 2: If the UE is authorized to perform both 5G ProSe UE-to-network relay discovery Model A and 5G ProSe UE-to-network relay discovery Model B, it is up to UE implementation to select which model to perform or perform both models simultaneously.

The following procedures are defined for UE-to-network relay discovery procedure over PC5 interface:

a) UE-to-network relay discovery over PC5 interface with Model A:

   1) Announcing UE procedure for UE-to-network relay discovery initiation;

   2) Announcing UE procedure for UE-to-network relay discovery completion;

   3) Monitoring UE procedure for UE-to-network relay discovery initiation;

   4) Monitoring UE procedure for UE-to-network relay discovery completion;

   5) Announcing UE procedure for UE-to-network relay discovery additional information; and

   6) Monitoring UE procedure for UE-to-network relay discovery additional information; and

b) UE-to-network relay discovery over PC5 interface with Model B:

   1) Discoverer UE procedure for UE-to-network relay discovery initiation;

   2) Discoverer UE procedure for UE-to-network relay discovery completion;

   3) Discoveree UE procedure for UE-to-network relay discovery initiation; and

   4) Discoveree UE procedure for UE-to-network relay discovery completion.

8.2.1.2 UE-to-network relay discovery over PC5 interface with model A

8.2.1.2.1 General

In this procedure, the UE-to-network relay acts as an "announcing UE" and the Remote UE acts as a "monitoring UE".

8.2.1.2.2 Announcing UE relay discovery for UE-to-network relay discovery

8.2.1.2.2.1 General

The purpose of the announcing UE procedure for UE-to-network relay discovery is:

a) to enable a ProSe-enabled UE to announce availability of a connectivity service provided by a UE-to-network relay of the ProSe-enabled UE to other ProSe-enabled UEs, upon a request from upper layers as defined in 3GPP TS 23.304 [2]; or

b) to enable a ProSe-enabled UE to measure the PROSE PC5 DISCOVERY message signal strength between the ProSe-enabled UE and the 5G ProSe UE-to-network relay UE(s) for relay selection/reselection.

8.2.1.2.2.2 Announcing UE procedure for UE-to-network relay discovery initiation

The UE is authorised to perform the announcing UE procedure for UE-to-network relay discovery if:

a) the UE is authorised to act as a UE-to-network relay in the PLMN indicated by the serving cell as specified in clause 5.2.5, and

   1) the UE is served by NG-RAN and the UE is authorised to perform 5G ProSe direct discovery in the PLMN as specified in clause 5; or

   2) the UE is authorised to perform 5G ProSe direct discovery when not served by NG-RAN as specified in clause 5 and intends to use the provisioned radio resources for UE-to-network relay discovery;

b) the UE is configured with:

   1) the relay service code parameter identifying the connectivity service to be announced as specified in clause 5.2.5, and for 5G ProSe layer-3 UE-to-network relay UE,

      i) the S-NSSAI associated with that relay service code shall belong to the allowed NSSAI of the UE; and

      ii) if the UE is camped on a cell whose TAI is in the list of "non-allowed tracking areas" or is camped on a cell whose TAI is not in the list of "allowed tracking areas", then the relay service code shall be associated with an emergency service or high priority access as defined in clause 5.3.5 of 3GPP TS 24.501 [11]; and

   2) the User info ID for the UE-to-network relay discovery parameter as specified in clause 5.2.5;

c) for 5G ProSe layer-3 UE-to-network relay UE, the UE is configured with PDU Session parameters which is used for relayed traffic for the associated relay service code, as specified in clause 5.2.5; and

d) the back-off timer T3346 used for NAS mobility management congestion control as specified in clause 5.3.9 of 3GPP TS 24.501 [11] is not running at the UE;

otherwise, the UE is not authorised to perform the announcing UE procedure for UE-to-network relay discovery.

Figure 8.2.1.2.2.1 illustrates the interaction of the UEs in the announcing UE procedure for UE-to-network relay discovery.

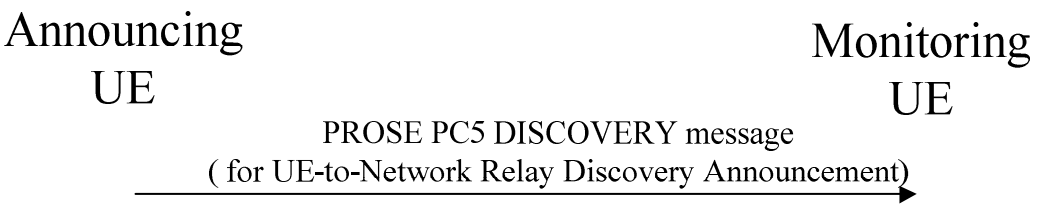

Figure 8.2.1.2.2.2.1: Announcing UE procedure for UE-to-network relay discovery

When the UE is triggered by an upper layer application to announce availability of a connectivity service provided by a UE-to-network relay, if the UE is authorised to perform the announcing UE procedure for UE-to-network relay discovery, then the UE:

a) if the UE is served by NG-RAN, and the UE in 5GMM-IDLE mode needs to request resources for sending PROSE PC5 DISCOVERY messages for relay discovery as specified in 3GPP TS 38.331 [13], shall perform a service request procedure or mobility registration procedure as specified in 3GPP TS 24.501 [11];

b) shall obtain a valid UTC time for the discovery transmission from the lower layers and generate the UTC-based counter corresponding to this UTC time as specified in clause 11.2.5;

c) shall generate a PROSE PC5 DISCOVERY message for UE-to-network relay discovery announcement according to clause 10.2.1. In the PROSE PC5 DISCOVERY message for UE-to-network relay discovery announcement, the UE:

   1) shall set the announcer info parameter to the User info ID for the UE-to-network relay discovery parameter, as specified in clause 5.2.5;

   2) shall set the relay service code parameter to the relay service code parameter identifying the connectivity service to be announced, as specified in clause 5.2.5;

   3) shall set the UTC-based counter LSB parameter to include the eight least significant bits of the UTC-based counter;

   4) shall set the Resource Status Indicator bit of the status indicator parameter to indicate whether or not the UE has resources available to provide a connectivity service for additional ProSe-enabled UEs;

   5) shall set the ProSe direct discovery PC5 message type parameter as specified in table 10.2.1.8; and

   6) if acting as 5G ProSe layer-2 UE-to-network relay UE, shall set the NCGI parameter to the NCGI of its serving cell;

d) shall apply the DUIK, DUSK, or DUCK with the associated Encrypted Bitmask, along with the UTC-based counter to the PROSE PC5 DISCOVERY message for whichever security mechanism(s) configured to be applied, e.g., integrity protection, message scrambling or confidentiality protection of one or more above parameters, as specified in 3GPP TS 33.503 [34];

e) shall set the destination layer-2 ID to the default destination layer-2 ID as specified in clause 5.2.5, and self-assign a source layer-2 ID for sending the UE-to-network relay discovery announcement; and

f) shall pass the resulting PROSE PC5 DISCOVERY message for UE-to-network relay discovery announcement to the lower layers for transmission over the PC5 interface with the source layer-2 ID, destination layer-2 ID, and an indication that the message is for 5G ProSe direct discovery.

The UE shall ensure that it keeps on passing the same PROSE PC5 DISCOVERY message along with the same source layer-2 ID, destination layer-2 ID, and an indication that the message is for 5G ProSe direct discovery to the lower layers for transmission until the UE is triggered by an upper layer application to stop announcing availability of a connectivity service provided by a UE-to-network relay, or until the UE stops being authorised to perform the announcing UE procedure for UE-to-network relay discovery. How this is achieved is left up to UE implementation.

Editor's note: Details of security aspects of a PROSE PC5 DISCOVERY message for UE-to-network relay discovery announcement are FFS and will be determinated by cooperation with SA WG2 and SA WG3.

8.2.1.2.2.3 Announcing UE procedure for UE-to-network relay discovery completion

When the announcing UE is triggered by an upper layer application to stop announcing availability in a discovery group, or when the announcing UE stops being authorised to perform the announcing UE procedure for UE-to-network relay discovery, the UE shall instruct the lower layers to stop announcing.

When the UE stops announcing, if the UE is in 5GMM-CONNECTED mode, the UE shall trigger the corresponding procedure in lower layers as specified in 3GPP TS 38.331 [13].

8.2.1.2.3 Monitoring UE relay discovery for UE-to-network relay discovery

8.2.1.2.3.1 General

The purpose of the monitoring UE procedure for UE-to-network relay discovery is:

a) to enable a ProSe-enabled UE to become aware of proximity of a connectivity service provided by a UE-to-network relay, upon a request from upper layers as defined in 3GPP TS 23.304 [2]; or

b) to enable a ProSe-enabled UE to perform measurements of signal strength of PROSE PC5 DISCOVERY messages from 5G ProSe UE-to-network relay UE(s) for relay selection/reselection.

8.2.1.2.3.2 Monitoring UE procedure for UE-to-network relay discovery initiation

The UE is authorised to perform the monitoring UE procedure for UE-to-network relay discovery if:

a) the following is true:

1) the UE is not served by NG-RAN, is authorised to perform 5G ProSe direct discovery using monitoring when the UE is not served by NG-RAN, and is configured with the radio parameters to be used for 5G ProSe direct discovery when not served by NG-RAN;

2) the UE is served by NG-RAN, and is authorised to perform 5G ProSe direct discovery monitoring in at least one PLMN; or

3) the UE is:

i) in 5GMM-IDLE mode, in limited service state as specified in 3GPP TS 23.122 [14], and the reason for the UE being in limited service state is one of the following:

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

B) 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

C) 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]; and

ii) authorised to perform 5G ProSe direct discovery using monitoring when the UE is not served by NG-RAN, and:

A) configured with the radio parameters to be used for 5G ProSe direct discovery when not served by NG-RAN;

b) the UE is configured with the relay service code parameter identifying the connectivity service to be monitored, as specified in clause 5.2.5; and

c) for 5G ProSe layer-2 remote UE, the UE is camped on a cell whose TAI is not in the list of "non-allowed tracking areas" or is camped on a cell whose TAI is in the list of "allowed tracking areas",

otherwise, the UE is not authorised to perform the monitoring UE procedure for UE-to-network relay discovery.

Figure 8.2.1.2.3.2.1 illustrates the interaction of the UEs in the monitoring UE procedure for UE-to-network relay discovery.

Figure 8.2.1.2.3.2.1: Monitoring UE procedure for UE-to-network relay discovery

When the UE is triggered by an upper layer application to monitor proximity of a connectivity service provided by a UE-to-network relay; or when the UE has established a direct link with a 5G ProSe UE-to-network relay UE as specified in clause 7.2, and if the UE is authorised to perform the monitoring UE procedure for UE-to-network relay discovery, then the UE shall instruct the lower layers to start monitoring for PROSE PC5 DISCOVERY messages with the default destination layer-2 ID as specified in clause 5.2.5.

Upon reception of a PROSE PC5 DISCOVERY message for UE-to-network relay discovery announcement according to clause 10.2.1, for the target relay service code of the connectivity service which the UE is authorized to monitor, the UE shall use the associated DUSK, if configured, and the UTC-based counter obtained during the monitoring operation to unscramble the PROSE PC5 DISCOVERY message as described in 3GPP TS 33.yyy [xxx]. Then, if a DUCK is configured, the UE shall use the DUCK and the UTC-based counter to decrypt the configured message-specific confidentiality-protected portion, as described in 3GPP TS 33.yyy [xxx]. Finally, if a DUIK is configured, the UE shall use the DUIK and the UTC-based counter to verify the MIC field in the unscrambled PROSE PC5 DISCOVERY message for UE-to-network relay discovery announcement.

NOTE 1: The use of an erroneous UTC-based counter for processing received PROSE PC5 DISCOVERY messages at the ProSe-enabled UE can cause MIC check failure after DUIK is used for integrity check, and malformed contents after DUSK is used for unscrambling or DUCK is used for deciphering. How a ProSe-enabled UE ensures the accuracy of the UTC-based counter is left to UE implementation.

NOTE 2: The UE can determine the received PROSE PC5 DISCOVERY message for UE-to-network relay discovery announcement is for 5G ProSe direct discovery based on an indication from the lower layer.

Then if:

a) the relay service code parameter of the PROSE PC5 DISCOVERY message for UE-to-network relay discovery announcement is the same as the relay service code parameter configured as specified in clause 5 for the connectivity service being monitored; and

b) the User info ID of the UE-to-network relay is not configured as specified in clause 5 for the connectivity service being monitored, or the announcer info parameter of the PROSE PC5 DISCOVERY message for UE-to-network relay discovery announcement is the same as the User info ID of the UE-to-network relay configured as specified in clause 5.2.5 for the connectivity service being monitored,

then the UE shall consider that the connectivity service the UE seeks to monitor has been discovered. In addition, the UE can measure the signal strength of the PROSE PC5 DISCOVERY message for UE-to-network relay discovery announcement for relay selection or reselection.

Editor's note: Details of security aspects for Monitoring UE procedure upon reception of a PROSE PC5 DISCOVERY message for UE-to-network relay discovery announcement are FFS and will be determinated by cooperation with SA WG3.

8.2.1.2.3.3 Monitoring UE procedure for UE-to-network relay discovery completion

When the UE is triggered by an upper layer application to stop monitoring proximity of other UEs in a discovery group, or when the UE stops being authorised to perform the monitoring UE procedure for UE-to-network relay discovery, the UE shall instruct the lower layers to stop monitoring.

When the UE stops monitoring, if the UE is in 5GMM-CONNECTED mode, the UE shall trigger the corresponding procedure in lower layers as specified in 3GPP TS 38.331 [13].

8.2.1.2.4 Announcing UE procedure for relay discovery additional information

8.2.1.2.4.1 General

The purpose of the announcing UE procedure for relay discovery additional information is to announce to the 5G ProSe remote UEs additional information about:

a) the relay service code of the 5G ProSe UE-to-network relay UE;

b) the announcer info of the announcing user;

c) the NCGI of the cell serving the 5G ProSe layer-3 UE-to-network relay UE; and

d) the TAI of the cell serving the 5G ProSe layer-3 UE-to-network relay UE;

as defined in 3GPP TS 23.304 [2].

8.2.1.2.4.2 Announcing procedure for relay discovery additional information

The 5G ProSe UE-to-network relay UE announces the relay discovery additional information:

a) if the 5G ProSe remote UE requests the 5G ProSe UE-to-network relay UE to announce the NG-RAN Cell Global ID (NCGI) or TAI of the cell serving the 5G ProSe UE-to-network relay UE, and as a response the 5G ProSe UE-to-network relay UE acknowledges with the ProSe additional parameters announcement response message, then the 5G ProSe UE-to-network relay UE includes the NCGI or TAI of the serving cell in the PROSE PC5 DISCOVERY message for relay discovery additional information until the timer T5107 expires (see the clause 8.2.8).

NOTE 1: 5G ProSe UE-to-network relay UE announces the relay discovery additional information only when it is in NG-RAN coverage.

Figure 8.2.1.2.4.2.1 illustrates the interaction of the 5G ProSe UE-to-network relay UE and the 5G ProSe remote UE in the announcing UE procedure for relay discovery additional information.

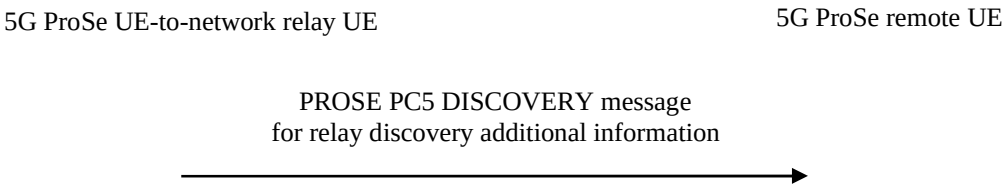

Figure 8.2.1.2.4.2.1: Announcing procedure for relay discovery additional information

The 5G ProSe UE-to-network relay UE may start announcing relay discovery additional information if:

a) the 5G ProSe UE-to-network relay UE is currently authorised to perform 5G ProSe direct discovery Model A announcing in the serving PLMN if the UE is served by NG-RAN; and

1) additional parameters announcement for the serving cell of the 5G ProSe UE-to-network relay UE has been requested and responded to 5G ProSe remote UEs, the timer T5107 has not expired (periodic reporting); or

2) additional parameters announcement for the serving cell of the 5G ProSe UE-to-network relay UE has been requested and responded to 5G ProSe remote UEs, the timer T5107 has not expired, and the 5G ProSe UE-to-network relay UE detects camping on a new serving cell; or

3) additional parameters announcement for the serving cell of the 5G ProSe UE-to-network relay UE has been requested and responded to 5G ProSe remote UEs, the timer T5107 has not expired, and the 5G ProSe UE-to-network relay UE detects entering a new tracking area.

When the 5G ProSe UE-to-network relay UE has some additional information to broadcast (i.e., NCGI, due to the periodic reporting or due to camping on a new serving cell), then the 5G ProSe UE-to-network relay UE:

a) shall request the parameters from the lower layers for ProSe direct discovery announcing (see 3GPP TS 38.331 [13]). If the 5G ProSe UE-to-network relay UE in 5GMM-IDLE mode needs to request resources for sending PROSE PC5 DISCOVERY messages as specified in 3GPP TS 38.331 [13], the 5G ProSe UE-to-network relay UE shall perform a service request procedure or mobility registration procedure as specified in 3GPP TS 24.501 [11];

b) shall obtain a valid UTC time for the discovery transmission from the lower layers and generate the UTC-based counter corresponding to this UTC time as specified in clause 11.2.5;

c) shall generate PROSE PC5 DISCOVERY message(s) for relay discovery additional information according to clause 10.2.1. In the PROSE PC5 DISCOVERY message for relay discovery additional information, the 5G ProSe UE-to-network relay UE shall:

   1) include the relay service code used for 5G ProSe direct communication which the 5G ProSe remote UE used to request for the relay discovery additional information;

   2) set the announcer info parameter to the User info ID parameter, configured in clause 5.2.5;

   3) set the relay discovery additional information contents by the additional information to broadcast;

   4) shall set the UTC-based counter LSB parameter to include the eight least significant bits of the UTC-based counter; and

   5) shall set the ProSe direct discovery PC5 message type parameter as specified in table 10.2.1.11;

d) shall apply the DUIK, DUSK, or DUCK with the associated Encrypted Bitmask, along with the UTC-based counter to the PROSE PC5 DISCOVERY message for whichever security mechanism(s) configured to be applied, e.g., integrity protection, message scrambling or confidentiality protection of one or more above parameters, as specified in 3GPP TS 33.503 [34];

Editor's note: Details of security related content in d) are FFS and will be determinated by SA WG3.

e) shall set the default destination layer-2 ID as specified in clause 5.2.5 to the destination layer-2 ID, and self-assign a source layer-2 ID for sending the UE-to-network relay discovery announcement; and

f) shall pass the resulting PROSE PC5 DISCOVERY message for relay discovery additional information along with the source layer-2 ID, destination layer-2 ID, and an indication that the message is for 5G ProSe direct discovery to the lower layers for transmission over the PC5 interface.

The 5G ProSe UE-to-network relay UE shall ensure that it keeps on passing the PROSE PC5 DISCOVERY messages periodically to the lower layers for transmission until the corresponding timer (i.e., timer T5107 when the additional information is NCGI or TAI) expires.

NOTE 2: The periodicity of sending the PROSE PC5 DISCOVERY messages for relay discovery additional information by the 5G ProSe UE-to-network relay UE is implementation specific and is normally lower than the one related to the additional parameters announcement request refresh timer T5016.

During the announcing operation, if one of the above conditions is no longer met, the 5G ProSe UE-to-network relay UE may instruct the lower layers to stop announcing.

8.2.1.2.5 Monitoring UE procedure for relay discovery additional information

8.2.1.2.5.1 General

The purpose of the monitoring UE procedure for relay discovery additional information is to enable a remote UE to become aware of the additional information of the 5G ProSe UE-to-network relay UE as described in clause 8.2.1.2.4.1.

8.2.1.2.5.2 Monitoring procedure for relay discovery additional information

The 5G ProSe remote UE monitors relay discovery additional information:

a) until the additional parameters announcement request refresh timer T5016 expires if the 5G ProSe remote UE has requested the 5G ProSe UE-to-network relay UE to announce the NCGI or TAI of the cell serving the 5G ProSe UE-to-network relay UE and received the ProSe additional parameters announcement response message from the 5G ProSe UE-to-network relay UE.

The UE may instruct the lower layers to start monitoring if:

a) a request from upper layers to monitor for relay discovery additional information is still in place and either:

1) the UE is currently authorised to perform 5G ProSe direct discovery Model A monitoring in at least one PLMN if the UE is served by NG-RAN;

2) the UE is currently authorised to perform 5G ProSe direct discovery Model A monitoring if the UE is not served by NG-RAN; or

3) the UE is:

i) in 5GMM-IDLE mode, in limited service state as specified in 3GPP TS 23.122 [14], and the reason for the UE being in limited service state is one of the following:

A) the UE is unable to find a suitable cell in the selected PLMN as specified in 3GPP TS 36.304 [15];

B) 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

C) 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]; and

ii) authorised to perform 5G ProSe direct discovery Model A monitoring when the UE is not served by NG-RAN and configured with the radio parameters to be used for 5G ProSe direct discovery when not served by NG-RAN.

If the UE is in 5GMM-CONNECTED mode, the monitoring UE shall also trigger the corresponding procedure in lower layers as specified in 3GPP TS 38.331 [13].

During the monitoring operation, if one of the above conditions is no longer met, the UE may instruct the lower layers to stop monitoring. When the UE stops monitoring, if the UE is in 5GMM-CONNECTED mode, the UE shall trigger the corresponding procedure in lower layers as specified in 3GPP TS 38.331 [13].

Upon reception of a PROSE PC5 DISCOVERY message for relay discovery additional information according to clause 10.2.1, for the target relay service code to be monitored, the UE shall use the associated DUSK, if configured, and the UTC-based counter obtained during the monitoring operation to unscramble the PROSE PC5 DISCOVERY message as described in 3GPP TS 33.303 [36]. Then, if a DUCK is configured, the UE shall use the DUCK and the UTC-based counter to decrypt the configured message-specific confidentiality protected portion, as described in 3GPP TS 33.303 [36]. Finally, if a DUIK is configured, the UE shall use the DUIK and UTC-based counter to verify the MIC field in the unscrambled PROSE PC5 DISCOVERY message for relay discovery additional information.

NOTE 1: The use of an erroneous UTC-based counter for processing received PROSE PC5 DISCOVERY messages at the ProSe-enabled UE can cause MIC check failure after DUIK is used for integrity check, and malformed contents after DUSK is used for unscrambling or DUCK is used for deciphering. How a ProSe-enabled UE ensures the accuracy of the UTC-based counter is left to UE implementation.

NOTE 2: The UE can determine the received PROSE PC5 DISCOVERY message for relay discovery additional information is for 5G ProSe direct discovery based on an indication from the lower layer.

Editor's note: Details of security related content in d) are FFS and will be determinated by SA WG3.

Then, if:

a) the relay service code parameter of the PROSE PC5 DISCOVERY message for relay discovery additional information is the same as the relay service code parameter configured as specified in clause 5.2.5 for the connectivity service being monitored; and

b) the User info ID of the UE-to-network relay UE is not configured as specified in clause 5 for the connectivity service being monitored, or the announcer info parameter of the PROSE PC5 DISCOVERY message for UE-to-

network relay discovery announcement is the same as the User info ID of the UE-to-network relay UE configured as specified in clause 5.2.5 for the connectivity service being monitored,

then the UE shall consider that the relay discovery additional information it intends to monitor has been discovered. In addition, the UE can measure the signal strength of the PROSE PC5 DISCOVERY message for relay discovery additional information for relay selection or reselection.

8.2.1.3 UE-to-network relay discovery over PC5 interface with model B

8.2.1.3.1 Discoverer UE procedure for UE-to-network Relay discovery

8.2.1.3.1.1 General

The purpose of the discoverer UE procedure for UE-to-network Relay discovery is:

a) to enable a ProSe-enabled UE to solicit proximity of a connectivity service provided by a UE-to-network Relay, upon a request from upper layers; or

b) to enable a ProSe-enabled UE to measure the PROSE PC5 DISCOVERY message signal strength between the ProSe-enabled UE and the 5G ProSe UE-to-network Relay UE(s) for relay selection/reselection.

In this procedure, the UE sending the PROSE PC5 DISCOVERY message is called the "discoverer UE" and the other UE is called the "discoveree UE".

8.2.1.3.1.2 Discoverer UE procedure for UE-to-network relay discovery initiation

The UE is authorised to perform the discoverer UE procedure for UE-to-network relay discovery if:

a) one of the following is true:

1) the UE is not served by NG-RAN, is authorised to act as a remote UE towards a UE-to-network relay UE, and is configured with the radio parameters to be used for ProSe UE-to-network relay discovery when not served by NG-RAN;

2) the UE is served by NG-RAN, is authorised to act as a remote UE towards a UE-to-network relay UE; or

3) the UE is:

i) in 5GMM-IDLE mode, in limited service state as specified in 3GPP TS 23.122 [14], and the reason for the UE being in limited service state is one of the following:

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

B) 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

C) 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]; and

ii) authorised to act as a remote UE towards a UE-to-network relay UE when the UE is not served by NG-RAN, and configured with the radio parameters to be used for ProSe UE-to-network relay discovery use when not served by NG-RAN;

b) the UE is configured with the relay service code parameter identifying the connectivity service to be solicited and with the User info ID for the UE-to-network relay discovery parameter, as specified in clause 5.2.5; and

c) for 5G ProSe layer-2 remote UE, the UE is camped on a cell whose TAI is not in the list of "non-allowed tracking areas" or is camped on a cell whose TAI is in the list of "allowed tracking areas",

otherwise, the UE is not authorised to perform the discoverer UE procedure for UE-to-network relay discovery.

Figure 8.2.1.3.1.2.1 illustrates the interaction of the UEs in the discoverer UE procedure for UE-to-network relay discovery.

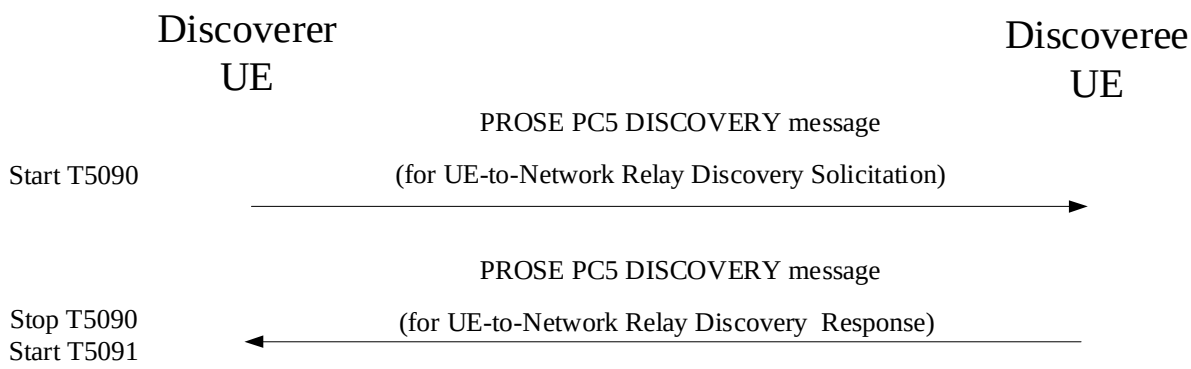

Figure 8.2.1.3.1.2.1: Discoverer UE procedure for UE-to-network Relay discovery

For PROSE PC5 DISCOVERY message signal strength measurement, the UE manages a periodic measurement timer T5091, which is used to trigger the periodic PROSE PC5 DISCOVERY message signal strength measurement between the UE and the ProSe UE-to-network relay UE with which the UE has a link established. It is started whenever the UE has established a direct link with a 5G ProSe UE-to-network relay UE and restarted whenever the UE receives the PROSE PC5 DISCOVERY message for UE-to-network relay discovery response from the 5G ProSe UE-to-network relay UE with which the UE has a link established.

When the UE is triggered by an upper layer application to solicit proximity of a connectivity service provided by a UE-to-network relay UE, or when the periodic measurement timer T5091 expires, and if the UE is authorised to perform the discoverer UE procedure for UE-to-network relay discovery, then the UE:

a) if the UE is served by NG-RAN, and the UE in 5GMM-IDLE mode needs to request resources for sending PROSE PC5 DISCOVERY messages for relay discovery as specified in 3GPP TS 38.331 [13], shall perform a service request procedure as specified in 3GPP TS 24.501 [11];

b) shall obtain a valid UTC time for the discovery transmission from the lower layers and generate the UTC-based counter corresponding to this UTC time;

c) shall generate a PROSE PC5 DISCOVERY message for UE-to-network relay discovery solicitation. In the PROSE PC5 DISCOVERY message for UE-to-network relay discovery solicitation, the UE:

   1) shall set the discoverer info parameter to the User info ID for the UE-to-network relay discovery parameter, configured in clause 5.2.5;

   2) shall set the relay service code parameter to the relay service code parameter identifying the connectivity service to be solicited, configured in clause 5.2.5;

   3) shall set the UTC-based counter LSB parameter to include the four least significant bits of the UTC-based counter; and

   4) shall set the ProSe direct discovery PC5 message type parameter as specified in table 10.2.1.9;

d) shall apply the DUIK, DUSK, or DUCK with the associated Encrypted Bitmask, along with the UTC-based counter to the PROSE PC5 DISCOVERY message for whichever security mechanism(s) configured to be applied, e.g., integrity protection, message scrambling or confidentiality protection of one or more above parameters, as specified in 3GPP TS 33.503 [34];

Editor's note: Details of security related content in d) are FFS and will be determinated by SA3.

e) shall set the default destination layer-2 ID as specified in clause 5.2.5 to the destination layer-2 ID, and self-assign a source layer-2 ID for sending the UE-to-network relay discovery solicitation message; and

f) shall pass the resulting PROSE PC5 DISCOVERY message for UE-to-network relay discovery solicitation along with the source layer-2 ID, destination layer-2 ID, and an indication that the message is for 5G ProSe direct discovery to the lower layers for transmission over the PC5 interface.

If the PROSE PC5 DISCOVERY message for UE-to-network relay discovery solicitation is used to solicit proximity of a connectivity service provided by a UE-to-network relay UE, the UE shall ensure that it keeps on passing the PROSE PC5 DISCOVERY message for UE-to-network relay discovery solicitation for transmission until the UE is triggered by an upper layer application to stop soliciting proximity of a connectivity service provided by a UE-to-network relay UE,

or until the UE stops being authorised to perform the discoverer UE procedure for UE-to-network relay discovery. How this is achieved is left up to UE implementation.

If the PROSE PC5 DISCOVERY message for UE-to-network relay discovery solicitation is used to trigger the PROSE PC5 DISCOVERY message signal strength measurement between the UE and the 5G ProSe UE-to-network Relay UE with which the UE has a link established, the UE shall start the retransmission timer T5090. If retransmission timer T5090 expires, the UE shall retransmit the PROSE PC5 DISCOVERY message for UE-to-network relay discovery solicitation and restart timer T5090. If no response is received from the ProSe UE-to-network relay UE with which the UE has a link established after reaching the maximum number of allowed retransmissions, the UE shall trigger relay reselection procedure.

NOTE 1: The maximum number of allowed retransmissions is UE implementation specific.

Upon reception of a PROSE PC5 DISCOVERY message for UE-to-network relay discovery response along with the destination layer-2 ID which the UE is configure to respond for, for the target relay service code of the connectivity service which the UE is authorized to discover, the UE shall use the associated DUSK, if configured, and the UTC-based counter obtained during the reception operation to unscramble the PROSE PC5 DISCOVERY message as described in 3GPP TS 33.503 [34]. Then, if a DUCK is configured, the UE shall use the DUCK and the UTC-based counter to decrypt the configured message-specific confidentiality-protected portion, as described in 3GPP TS 33.503 [34]. Finally, if a DUIK is configured, the UE shall use the DUIK and the UTC-based counter to verify the MIC field in the unscrambled PROSE PC5 DISCOVERY message for UE-to-network relay discovery response.

Editor's note: Details of Discoverer UE procedure upon reception of a PROSE PC5 DISCOVERY message for direct discovery response are FFS and will be determinated by cooperation with SA WG3.

NOTE 2: The UE can determine the received PROSE PC5 DISCOVERY message for UE-to-network relay discovery response is for 5G ProSe direct discovery based on an indication from the lower layer.

Then if:

a) the relay service code parameter of the PROSE PC5 DISCOVERY message for UE-to-network relay discovery response is the same as the relay service code parameter of the PROSE PC5 DISCOVERY message for UE-to-network relay discovery solicitation; and

b) the User info ID of the UE-to-network Relay is not configured as specified in clause 5.2.5 for the connectivity service being solicited, or the Discoverer info parameter of the PROSE PC5 DISCOVERY message for UE-to-network relay discovery response is the same as the User info ID of the UE-to-network Relay configured as specified in clause 5.2.5 for the connectivity service being solicited,

then the UE shall consider that the connectivity service the UE seeks to discover has been discovered. In addition, the UE can measure the signal strength of the PROSE PC5 DISCOVERY message for UE-to-network relay discovery response for relay selection or reselection. If the UE has received the PROSE PC5 DISCOVERY message for UE-to-network relay discovery response from the ProSe UE-to-network Relay UE with which the UE has a link established, the UE shall stop the retransmission timer T5090, and start the periodic measurement timer T5091.

8.2.1.3.1.3 Discoverer UE procedure for UE-to-network Relay discovery completion

When the UE is triggered by an upper layer application to stop soliciting for proximity of a connectivity service provided by a UE-to-network Relay, or when the UE stops being authorised to perform the Discoverer UE procedure for UE-to-network Relay discovery, the UE shall instruct the lower layers to stop the discoverer operation.

When the UE stops discoverer operation, if the UE is in 5GMM-CONNECTED mode, the UE shall trigger the corresponding procedure in lower layers as specified in 3GPP TS 38.331 [13].

8.2.1.3.2 Discoveree UE procedure for UE-to-network Relay discovery

8.2.1.3.2.1 General

The purpose of the discoveree UE procedure for UE-to-network relay discovery is to enable a ProSe-enabled UE with a UE-to-network Relay to respond to solicitation from other ProSe-enabled UEs on proximity of a connectivity service provided by the UE-to-network relay UE, upon a request from upper layers.

In this procedure, the UE sending the PROSE PC5 DISCOVERY message is called the "discoverer UE" and the other UE is called the "discoveree UE".

8.2.1.3.2.2 Discoveree UE procedure for UE-to-network relay discovery initiation

The UE is authorised to perform the discoveree UE procedure for UE-to-network relay discovery if:

a) the UE is authorised to act as a UE-to-network relay UE in the PLMN indicated by the serving cell, and

   1) the UE is served by NG-RAN; or

   2) the UE is not served by NG-RAN, and intends to use the provisioned radio resources for UE-to-network relay discovery;

b) the UE is configured with:

   1) the relay service code parameter identifying the connectivity service to be responded to as specified in clause 5.2.5, and for 5G ProSe layer-3 UE-to-network relay UE,

      i) the S-NSSAI associated with that relay service code shall belong to the allowed NSSAI of the UE; and

      ii) if the UE is camped on a cell whose TAI is in the list of "non-allowed tracking areas" or is camped on a cell whose TAI is not in the list of "allowed tracking areas", then the relay service code shall be associated with an emergency service or high priority access as defined in clause 5.3.5 of 3GPP TS 24.501 [11]; and

   2) the User info ID for the UE-to-network relay discovery parameter, as specified in clause 5.2.5; and

c) the back-off timer T3346 used for NAS mobility management congestion control as specified in clause 5.3.9 of 3GPP TS 24.501 [11] is not running at the UE;

otherwise, the UE is not authorised to perform the discoveree UE procedure for UE-to-network relay discovery.

Figure 8.2.1.3.2.2.1 illustrates the interaction of the UEs in the discoveree UE procedure for UE-to-network relay discovery.

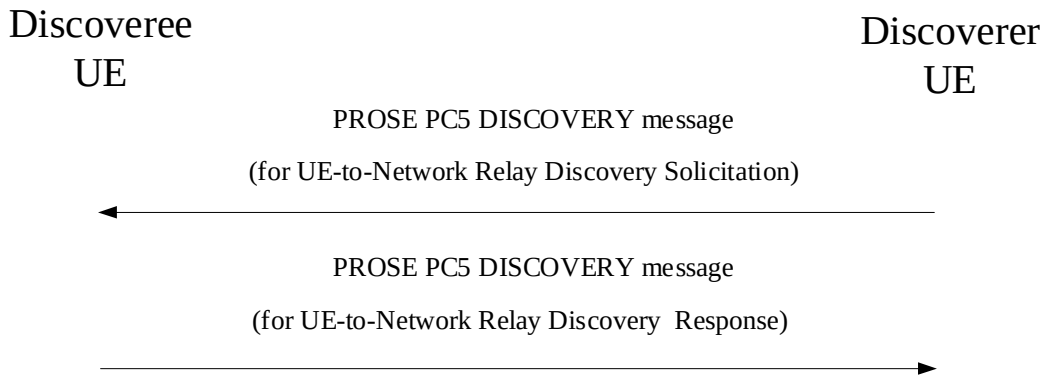

Figure 8.2.1.3.2.2.1: Discoveree UE procedure for UE-to-network Relay discovery

When the UE is triggered by an upper layer application to start responding to solicitation on proximity of a connectivity service provided by the UE-to-network Relay, and if the UE is authorised to perform the discoveree UE procedure for UE-to-network Relay discovery, then the UE:

a) if the UE is served by NG-RAN, and the UE in 5GMM-IDLE mode needs to request resources for sending PROSE PC5 DISCOVERY messages as specified in 3GPP TS 38.331 [13], shall perform a service request procedure as specified in 3GPP TS 24.501 [11]; and

b) shall instruct the lower layers to start monitoring for PROSE PC5 DISCOVERY messages.

Upon reception of a PROSE PC5 DISCOVERY message for UE-to-network relay discovery solicitation, for the relay service code of the connectivity service which the UE is authorized to respond, the UE shall use the associated DUSK, if configured, and the UTC-based counter obtained during the reception operation to unscramble the PROSE PC5

DISCOVERY message as described in 3GPP TS 33.503 [34]. Then, if a DUCK is configured, the UE shall use the DUCK and the UTC-based counter to decrypt the configured message-specific confidentiality-protected portion, as described in 3GPP TS 33.503 [34]. Finally, if a DUIK is configured, the UE shall use the DUIK and the UTC-based counter to verify the MIC field in the unscrambled PROSE PC5 DISCOVERY message for UE-to-network relay discovery solicitation.

Editor's note: Details of Discoverer UE procedure upon reception of a PROSE PC5 DISCOVERY message for direct discovery response are FFS and will be determinated by cooperation with SA WG3.

NOTE: The UE can determine the received PROSE PC5 DISCOVERY message for 5G ProSe direct discovery announcement is for 5G ProSe direct discovery based on an indication from the lower layer.

Then, if the relay service code parameter of the PROSE PC5 DISCOVERY message for UE-to-network relay discovery solicitation is the same as the relay service code parameter configured as specified in clause 5.2.5 for the connectivity service,

then the UE:

a) shall obtain a valid UTC time for the discovery transmission from the lower layers and generate the UTC-based counter corresponding to this UTC time;

b) shall generate a PROSE PC5 DISCOVERY message for UE-to-network relay discovery response. In the PROSE PC5 DISCOVERY message for UE-to-network relay discovery response, the UE:

   1) shall set the Discoveree info parameter to the User info ID for the UE-to-network Relay discovery parameter, configured in clause 5.2.5;

   2) shall set the relay service code parameter to the relay service code parameter of the PROSE PC5 DISCOVERY message for UE-to-network relay discovery solicitation;

   3) shall set the UTC-based counter LSB parameter to include the eight least significant bits of the UTC-based counter;

   4) shall set the ProSe direct discovery PC5 message type parameter as specified in table 10.2.1.10; and

   5) if acting as 5G ProSe layer-2 UE-to-network relay UE, shall set the NCGI parameter to the NCGI of its serving cell;

c) shall apply the DUIK, DUSK, or DUCK with the associated Encrypted Bitmask, along with the UTC-based counter to the PROSE PC5 DISCOVERY message for whichever security mechanism(s) configured to be applied, e.g., integrity protection, message scrambling or confidentiality protection of one or more above parameters, as specified in 3GPP TS 33.503 [34];

Editor's note: Details of security related content in c) are FFS and will be determinated by SA3.

d) shall set the destination layer-2 ID to the source layer-2 ID from the discoverer UE used in the transportation of the PROSE PC5 DISCOVERY message for UE-to-network relay discovery solicitation, and self-assign a source layer-2 ID for sending the UE-to-network relay discovery response message; and

e) shall pass the resulting PROSE PC5 DISCOVERY message for UE-to-network relay discovery response along with the source layer-2 ID, destination layer-2 ID, and an indication that the message is for 5G ProSe direct discovery to the lower layers for transmission over the PC5 interface.

8.2.1.3.2.3 Discoveree UE procedure for UE-to-network relay discovery completion

When the UE is triggered by an upper layer application to stop responding to solicitation on proximity of a connectivity service provided by a UE-to-network relay UE, or when the UE stops being authorised to perform the discoveree UE procedure for UE-to-network relay discovery, the UE shall instruct the lower layers to stop monitoring.

When the UE stops monitoring, if the UE is in 5GMM-CONNECTED mode, the UE shall trigger the corresponding procedure in lower layers as specified in 3GPP TS 38.331 [13].

8.2.1.4 Procedure for UE to use provisioned radio resources for 5G ProSe UE-to-network discovery

When the UE is not served by NG-RAN for 5G ProSe UE-to-network relay discovery and is authorized to use 5G ProSe UE-to-network relay discovery, the UE shall select the corresponding radio parameters to be used for 5G ProSe UE-to-network relay discovery as follows:

a) if the UE can determine itself located in a geographical area, and the UE is provisioned with radio parameters for the geographical area, the UE shall select the radio parameters associated with that geographical area; or

b) in all other cases, the UE shall not initiate 5G ProSe UE-to-network relay discovery.

If the UE intends to use "non-operator managed" radio parameters as specified in clause 5.2.5, the UE shall initiate 5G ProSe UE-to-network relay discovery with the selected radio parameters.

If the UE intends to use "operator managed" radio parameters as specified in clause 5.2.5, before initiating 5G ProSe UE-to-network relay discovery, the UE shall check with lower layers whether the selected radio parameters can be used in the current location without causing interference to other cells as specified in 3GPP TS 38.331 [13], and:

a) if the lower layers indicate that the usage would not cause any interference, the UE shall initiate 5G ProSe UE-to-network relay discovery; or

NOTE: If the lower layers find that there exists a cell operating the provisioned radio resources (i.e., carrier frequency), and the cell belongs to the registered PLMN or a PLMN equivalent to the registered PLMN, and the UE is authorized for 5G ProSe UE-to-network relay discovery in this PLMN, the UE can use the radio parameters indicated by the cell as specified in 3GPP TS 38.331 [13].

b) else if the lower layers report that one or more PLMNs operate in the provisioned radio resources (i.e., carrier frequency) then:

   1) if the following conditions are met:

      i) none of the PLMNs reported by the lower layers is the registered PLMN or equivalent to the registered PLMN;

      ii) at least one of the PLMNs reported by the lower layers is in the list of authorized PLMNs for 5G ProSe UE-to-network relay discovery and provides radio resources for 5G ProSe UE-to-network relay discovery as specified in 3GPP TS 38.331 [13]; and

      iii) the UE does not have an emergency PDU session;

      then the UE shall:

      i) if in 5GMM-IDLE mode, perform PLMN selection triggered by 5G ProSe UE-to-network relay discovery as specified in 3GPP TS 23.122 [14]; or

      ii) else if in 5GMM-CONNECTED mode, either:

         A) perform a De-registration procedure as specified in 3GPP TS 24.501 [11] and then perform PLMN selection triggered by 5G ProSe UE-to-network relay discovery as specified in 3GPP TS 23.122 [14]; or

         B) not initiate 5G ProSe direct discovery.

         Whether the UE performs i) or ii) above is left up to UE implementation; or

   2) else the UE shall not initiate 5G ProSe UE-to-network relay discovery.

If the registration to the selected PLMN is successful, the UE shall proceed with the procedure to initiate 5G ProSe UE-to-network relay discovery as specified in clause 8.2.1.

If the UE is performing 5G ProSe UE-to-network relay discovery using radio parameters associated with a geographical area and moves out of that geographical area, the UE shall stop performing 5G ProSe UE-to-network relay discovery and then if the UE is not served by NG-RAN for 5G ProSe UE-to-network relay discovery, the UE shall select appropriate radio parameters for the new geographical area as specified above.

8.2.2 UE-to-network relay selection procedure

8.2.2.1 General

The purpose of the UE-to-network relay selection procedure is to enable a remote UE to select a suitable 5G ProSe UE-to-network relay UE to obtain a connectivity service to 5GC.

8.2.2.2 UE-to-network relay selection procedure initiation

The remote UE shall trigger the UE-to-network relay selection procedure if the following conditions are met:

a) the UE is authorised to act as a 5G ProSe remote UE towards a 5G ProSe UE-to-network relay UE as specified in clause 5.2.5:

   1) if the 5G ProSe remote UE is expected to use 5G ProSe layer-3 UE-to-network relay, the indication whether the UE is authorized to use a 5G ProSe layer-3 UE-to-network relay UE shall be set; and

   2) if the 5G ProSe remote UE is expected to use 5G ProSe layer-2 UE-to-network relay, the PLMN that the 5G ProSe layer-2 UE-to-network relay UE is camped on shall be in the list of PLMNs in which the UE is authorized to use a 5G ProSe layer-2 UE-to-network relay UE;

b) the UE has obtained a list of 5G ProSe UE-to-network relay UE candidate(s) fulfilling ProSe layer criteria with the monitoring procedure for UE-to-network relay discovery as specified in clause 8.2.1.2.2 or the discoverer procedure for UE-to-network relay discovery as specified in clause 8.2.1.3.1; and

c) the UE has obtained a list of 5G ProSe UE-to-network relay UE candidate(s) fulfilling lower layers criteria as specified in 3GPP TS 38.331 [13].

8.2.2.3 UE-to-network relay selection procedure completion

If there exists only one 5G ProSe UE-to-network relay candidate satisfying the conditions in clause 8.2.2.2, then that 5G ProSe UE-to-network relay UE is selected. If there exist more than one 5G ProSe UE-to-network relay candidate satisfying the conditions in clause 8.2.2.2, any relay candidates not satisfying the non-radio related ProSe layer criteria shall be discarded, and out of the remaining relay candidates, the relay candidate with the highest ranking of the lower layer criteria shall be selected. The UE may take the value of the resource status indicator bit of the status indicator parameter of the PROSE PC5 DISCOVERY message for UE-to-network relay discovery announcement or PROSE PC5 DISCOVERY message for UE-to-network relay discovery response into account when deciding which 5G ProSe UE-to-network relay to select. It is up to the UE implementation whether the ProSe layer or the lower layers takes the final selection on which 5G ProSe UE-to-network relay UE to select.

8.2.3 UE-to-network relay reselection procedure

8.2.3.1 General

The purpose of the UE-to-network relay reselection procedure is to enable a remote UE to reselect a 5G ProSe UE-to-network relay UE to obtain a connectivity service to 5GC when the serving 5G ProSe UE-to-network relay UE is no longer suitable.

8.2.3.2 UE-to-network relay reselection procedure initiation

The remote UE shall trigger the UE-to-network relay reselection procedure if one of the following conditions is met:

a) the UE has received a lower layers indication that the serving 5G ProSe UE-to-network relay UE no longer fulfills the lower layers criteria as specified in 3GPP TS 38.331 [13];

b) the parameters related to 5G ProSe UE-to-network relay in the configuration parameters for 5G ProSe UE-to-network relay as specified in clause 5.2.5 (e.g., relay service code, User info ID, etc.) have been updated and the serving 5G ProSe UE-to-network relay UE no longer fulfills the conditions specified in clause 8.2.1.2.2;

c) the UE has received a PROSE DIRECT LINK ESTABLISHMENT REJECT message from the 5G ProSe UE-to-network relay UE with the PC5 signalling protocol cause value #1 "direct communication to the target UE not allowed";

d) the UE has received a PROSE DIRECT LINK RELEASE REQUEST message from the 5G ProSe UE-to-network relay UE with the PC5 signalling protocol cause value #1 "direct communication to the target UE not allowed";

e) the UE has received a PROSE DIRECT LINK RELEASE REQUEST message from the 5G ProSe UE-to-network relay UE with the PC5 signalling protocol cause value #4 "direct connection is not available anymore";

f) the UE has not received any response from the 5G ProSe UE-to-network relay UE after M consecutive retransmissions of PROSE DIRECT LINK ESTABLISHMENT REQUEST or PROSE DIRECT LINK KEEPALIVE REQUEST messages;

g) the UE has not received any response from the 5G ProSe UE-to-network relay UE after M consecutive retransmissions of PROSE PC5 DISCOVERY message for UE-to-network relay discovery solicitation used to trigger the PROSE PC5 DISCOVERY message signal strength measurement between the UE and the 5G ProSe UE-to-network relay UE with which the UE has a link established;

h) the UE has received a PROSE DIRECT LINK ESTABLISHMENT REJECT message from the ProSe UE-to-network relay UE with the cause value #13 "congestion situation"; or

i) the UE has received a PROSE DIRECT LINK RELEASE REQUEST message from the ProSe UE-to-network relay UE with the cause value #13 "congestion situation".

NOTE: The value of M is implementation specific and is less than or equal to the maximum number of retransmissions allowed for PC5 Signalling protocol.

In cases c), d), h) and i), the remote UE shall exclude the 5G ProSe UE-to-network relay UE which sent the message specified in cases c), d), h) or i) from the UE-to-network relay reselection process described below (at least for the indicated back-off time period if provided from the ProSe UE-to-network relay UE in cases h) and i)).

To conduct UE-to-network relay reselection process, the UE shall first initiate one of the following procedures or both depending on UE's configuration parameters for 5G ProSe UE-to-network relay as specified in clause 5.2.5:

a) monitoring procedure for UE-to-network relay discovery as specified in clause 8.2.1.2.2; or

b) discoverer procedure for UE-to-network relay discovery as specified in clause 8.2.1.3.1.

After the execution of the above discovery procedure(s), the remote UE performs the UE-to-network relay selection procedure as specified in clause 8.2.2.

8.2.4 Procedure for UE to use provisioned radio resources for 5G ProSe UE-to-network relay communication

When the UE is not served by NG-RAN for 5G ProSe UE-to-network relay communication and is authorized to use 5G ProSe UE-to-network relay communication, the UE shall select the corresponding radio parameters to be used for 5G ProSe UE-to-network relay communication as follows:

a) if the UE can determine itself located in a geographical area, and the UE is provisioned with radio parameters for the geographical area, the UE shall select the radio parameters associated with that geographical area; or

b) in all other cases, the UE shall not initiate 5G ProSe UE-to-network relay communication.

If the UE intends to use "non-operator managed" radio parameters as specified in clause 5.2.5, the UE shall initiate 5G ProSe UE-to-network relay communication with the selected radio parameters.

If the UE intends to use "operator managed" radio parameters as specified in clause 5.2.5, before initiating 5G ProSe UE-to-network relay communication, the UE shall check with lower layers whether the selected radio parameters can be used in the current location without causing interference to other cells as specified in 3GPP TS 38.331 [13], and:

a) if the lower layers indicate that the usage would not cause any interference, the UE shall initiate 5G ProSe UE-to-network relay communication; or

NOTE: If the lower layers find that there exists a cell operating the provisioned radio resources (i.e., carrier frequency), and the cell belongs to the registered PLMN or a PLMN equivalent to the registered PLMN, and the UE is authorized for 5G ProSe UE-to-network relay communication in this PLMN, the UE can use the radio parameters indicated by the cell as specified in 3GPP TS 38.331 [13].

b) else if the lower layers report that one or more PLMNs operate in the provisioned radio resources (i.e., carrier frequency) then:

1) if the following conditions are met:

i) none of the PLMNs reported by the lower layers is the registered PLMN or equivalent to the registered PLMN;

ii) at least one of the PLMNs reported by the lower layers is in the list of authorized PLMNs for 5G ProSe UE-to-network relay communication and provides radio resources for 5G ProSe UE-to-network communication as specified in 3GPP TS 38.331 [13]; and

iii) the UE does not have an emergency PDU session;

then the UE shall:

i) if in 5GMM-IDLE mode, perform PLMN selection triggered by 5G ProSe UE-to-network discovery as specified in 3GPP TS 23.122 [14]; or

ii) else if in 5GMM-CONNECTED mode, either:

A) perform a De-registration procedure as specified in 3GPP TS 24.501 [11] and then perform PLMN selection triggered by 5G ProSe UE-to-network discovery as specified in 3GPP TS 23.122 [14]; or

B) not initiate 5G ProSe UE-to-network communication.

Whether the UE performs i) or ii) above is left up to UE implementation; or

2) else the UE shall not initiate 5G ProSe UE-to-network relay communication.

If the registration to the selected PLMN is successful, the UE shall proceed with the procedure to initiate 5G ProSe communication over PC5 as specified in clause 7.2.

If the UE is performing 5G ProSe UE-to-network relay communication using radio parameters associated with a geographical area and moves out of that geographical area, the UE shall stop performing 5G ProSe UE-to-network relay communication.

8.2.5 IP address allocation for remote UE in 5G ProSe layer-3 UE-to-network relay procedure

When one of the two UEs on the direct link acts as a 5G ProSe layer-3 UE-to-network relay UE, the PDU session type is IPv4, IPv6 or IPv4v6 and is used for relaying IP traffic over PC5 reference point, the two UEs shall select the IP version (IPv4 or IPv6) to be used based on the following rules:

a) if the 5G ProSe layer-3 UE-to-network relay UE has indicated "DHCPv4 Server" in the IP address configuration IE, the remote UE shall initiate the IPv4 address configuration with DHCPv4 procedure acting as a DHCP client, according to IETF RFC 2131 [23] and IETF RFC 4039 [24];

b) if the 5G ProSe layer-3 UE-to-network relay UE has indicated "IPv6 Router" in the IP address configuration IE, the remote UE shall initiate the IPv6 address configuration with IPv6 stateless address auto-configuration acting as an IPv6 host based on IETF RFC 4862 [25];

NOTE: The 5G ProSe layer-3 UE-to-network relay UE uses IPv6 prefix delegation via DHCPv6 (see clause 8.2.5a) to obtain the IPv6 prefix assigned to the 5G ProSe layer-3 remote UE.

c) if the 5G ProSe layer-3 UE-to-network relay UE has indicated "IPv6 Router" in the IP address configuration IE, the remote UE may use stateless DHCPv6 for additional parameter configuration, as defined in TS 23.501 [22]; and

d) if the 5G ProSe layer-3 UE-to-network relay UE has indicated "DHCPv4 Server & IPv6 Router" in the IP address configuration IE, the remote UE shall choose the IP version and initiate the corresponding IP address configuration procedure as a client or host.

8.2.5a IPv6 prefix delegation via DHCPv6 for 5G ProSe layer-3 UE-to-network relay

If the 5G ProSe layer-3 UE-to-network relay UE can indicate "IPv6 Router" or "DHCPv4 Server & IPv6 Router" in the IP address configuration IE, the 5G ProSe layer-3 UE-to-network relay UE requests additional IPv6 prefixes (i.e., prefixes in addition to the /64 default prefix which was allocated via stateless IPv6 address autoconfiguration) from the SMF as specified in 3GPP TS 24.501 [11].

Once the 5G ProSe layer-3 UE-to-network relay UE successfully obtains the network prefix shorter than the default /64 prefix using DHCPv6, the 5G ProSe layer-3 UE-to-network relay UE can assign /64 prefix from the network prefix when the 5G ProSe layer-3 UE-to-network remote UE requests IPv6 prefix via stateless IPv6 address autoconfiguration.

8.2.6 QoS handling for 5G ProSe UE-to-network relay

8.2.6.1 General

This clause describes the QoS handling between a 5G ProSe UE-to-network relay UE and a 5G ProSe remote UE. The purpose of QoS handling for 5G ProSe UE-to-network relay is to meet the end-to-end QoS requirement between 5G ProSe remote UE and the network.

The QoS handling for 5G ProSe UE-to-network relay can be classified with the following three cases according to the type of 5G ProSe UE-to-network relay:

a) QoS handling for 5G ProSe remote UE accessing the network via a 5G ProSe layer-2 UE-to-network relay;

b) QoS handling for 5G ProSe remote UE accessing the network via a 5G ProSe layer-3 UE-to-network relay without N3IWF; and

c) QoS handling for 5G ProSe remote UE accessing the network via a 5G ProSe layer-3 UE-to-network relay with N3IWF.

8.2.6.2 QoS handling for 5G ProSe layer-2 UE-to-network relay

For a 5G ProSe layer-2 remote UE accessing the network via a 5G ProSe layer-2 UE-to-network relay, the end-to-end QoS requirement between 5G ProSe layer-2 remote UE and the network can be met by the existing 5G QoS control between the 5G ProSe layer-2 remote UE and the core network that is serving the 5G ProSe layer-2 remote UE as specified in 3GPP TS 24.501 [11].

8.2.6.3 QoS handling for 5G ProSe layer-3 UE-to-network relay without N3IWF

8.2.6.3.1 General

The QoS handling by a 5G ProSe layer-3 UE-to-network relay without an N3IWF to achieve an end-to-end QoS between the 5G ProSe layer-3 remote UE and the network is described in clause 5.6.2.1 of 3GPP TS 23.304 [2].

For a 5G ProSe layer-3 remote UE accessing the network via a 5G ProSe layer-3 UE-to-network relay without N3IWF, the end-to-end QoS requirement between 5G ProSe layer-3 remote UE and the network can be satisfied by the corresponding QoS control:

a) QoS control between 5G ProSe layer-3 remote UE and 5G ProSe layer-3 UE-to-network relay UE (PC5 QoS control); and

b) QoS control between 5G ProSe layer-3 UE-to-network relay UE and the network (Uu QoS control).

To achieve this, the QoS mapping can be pre-configured as specified in clause 5.2.5 or provided to the 5G ProSe UE-to-network relay UE by the PCF using Prose Policy as specified in clause 5.3.2.

8.2.6.3.2 QoS flows handling initiated by the network

For QoS flows setup initiated by the network, upon reception QoS rules and QoS flow level QoS parameters from the SMF, the 5G ProSe layer-3 UE-to-network relay UE:

a) shall determine the PQI based on the QoS mapping rules configured in clause 5.2.5;

b) shall set the GFBR value for the PC5 GBR QoS flow to the GFBR value from the SMF, if any;

c) shall set the MFBR value for the PC5 GBR QoS flow to the MFBR value from the SMF, if any;

d) shall set the averaging window value for the PC5 GBR QoS flow to the averaging value from the SMF, if any;

e) may derive the packet filter(s) used for PC5 QoS rule(s) from the packet filter(s) used over Uu reference; and

f) may initiate the 5G ProSe direct link modification procedure as defined in clause 7.2.3 to either update the existing PC5 QoS flow or to set up a new PC5 QoS flow. The 5G ProSe layer-3 UE-to-network relay UE may include the PC5 QoS rule(s) when initiating the 5G ProSe direct link modification procedure.

Alternatively, for dynamic QoS handling of 5G ProSe layer-3 remote UE using reflective QoS mechanism, upon the 5G ProSe layer-3 UE-to-network relay UE receiving a downlink user data packet along with the Reflective QoS Indication (RQI) as specified in 3GPP TS 24.501 [11], the 5G ProSe layer-3 UE-to-network relay UE:

a) creates a derived QoS rule by reflective QoS in the UE as specified in clause 6.2.5.1.4, 3GPP TS 24.501 [11];

b) shall create a new derived PC5 QoS rule or update the existing derived PC5 QoS rule for the PC5 QoS flow based on the derived QoS rule from a);

c) shall determine the corresponding PQI for the PC5 QoS flow based on the QoS mapping rules as specified in clause 5.2.5 and the 5QI value that corresponds to the QFI of the QoS rule from b);

d) shall perform one of the following:

   1) if there is a PC5 QoS flow with the determined PQI, the 5G ProSe layer-3 UE-to-network relay UE shall perform the 5G ProSe direct link modification procedure as specified in clause 7.2.3 to associate the ProSe application on the existing PC5 QoS flow. The 5G ProSe layer-3 UE-to-network relay UE may include the PC5 QoS rule(s) associated with the updated PC5 QoS flow; or

   2) if there is no PC5 QoS flow with the determined PQI, the 5G ProSe layer-3 UE-to-network relay UE shall perform the 5G ProSe direct link modification procedure as specified in clause 7.2.3 to add a new PC5 QoS flow with the determined PQI and associate the ProSe application on the new PC5 QoS flow. The 5G ProSe layer-3 UE-to-network relay UE may include the PC5 QoS rule(s) associated with the newly added PC5 QoS flow.

When a derived QoS rule is deleted, the 5G ProSe layer-3 UE-to-network relay UE performs the 5G ProSe direct link modification procedure as specified in clause 7.2.3 to associate the ProSe application with a PC5 QoS flow such that the determined PQI maps to the 5QI of the signaled QoS rule.

8.2.6.3.3 PC5 QoS flows handling initiated by the 5G ProSe layer-3 remote UE

For PC5 QoS flows setup or modification initiated by the 5G ProSe layer-3 remote UE, the 5G ProSe layer-3 remote UE shall provide the PC5 QoS flow context as defined in clause 7.2.7 to the 5G ProSe layer-3 UE-to-network relay UE to indicate the end-to-end QoS requirements for the traffic transmission between 5G ProSe layer-3 remote UE and the network.

In addition, if the 5G ProSe layer-3 remote UE wants to add new PC5 QoS flow(s) or modify the existing PC5 QoS flow(s) for IP traffic or Ethernet traffic, the 5G ProSe layer-3 remote UE may also provide the PC5 QoS rule(s) for the PC5 QoS flow(s) to be added or modified to the 5G ProSe layer-3 UE-to-network relay UE.

Upon reception of the PC5 QoS context from the 5G ProSe layer-3 remote UE, the 5G ProSe layer-3 UE-to-network relay UE:

a) shall perform one of the following:

1) if the end-to-end QoS requirements can be supported by an entry in QoS mapping configured in clause 5.2.5, then the 5G ProSe layer-3 UE-to-network relay UE uses the 5QI of the entry for the Uu QoS control, and uses the PQI of the entry for the PC5 QoS control; or

2) if the end-to-end QoS requirements cannot be supported by any entry in QoS mapping configured in clause 5.2.5, then the 5G ProSe layer-3 UE-to-network relay UE determines the 5QI for the Uu QoS control and PQI for the PC5 QoS control based on its implementation;

b) shall provide the 5G ProSe layer-3 remote UE with the PQI determined in bullet a), the corresponding PC5 QoS parameters and the corresponding ProSe identifier(s);

c) optionally, derives the packet filter(s) used over Uu reference point if the 5G ProSe layer-3 UE-to-network relay UE received PC5 QoS rule(s) from 5G ProSe layer-3 remote UE;

d) if a new QoS flow needs to be established or the existing QoS flow(s) needs to be modified, shall perform UE-requested PDU session modification procedure as specified in clause 6.4.2 in 3GPP TS 24.501 [11] providing:

1) the Requested QoS flow descriptions IE with the 5QI value determined in bullet a); or

2) the Requested QoS rules IE with the packet filter(s) if packet filter(s) are derived in bullet c); and

e) shall further update the corresponding PC5 QoS flow with the updated PQI value if the 5G ProSe layer-3 UE-to-network relay UE receives the authorized QoS flow descriptions with a 5QI value which is different from the 5QI value indicated by the 5G ProSe layer-3 UE-to-network relay UE as described in bullet d).

8.2.6.4 QoS handling for 5G ProSe layer-3 UE-to-network relay with N3IWF

8.2.6.4.1 General

As specified in clause 5.6.2.2 of 3GPP TS 23.304 [2], when the 5G ProSe layer-3 remote UE accesses 5GS via a 5G ProSe layer-3 UE-to-network relay with N3IWF, the N3IWF can use one of the following operations for QoS support in 5G ProSe layer-3 UE-to-network relay UE's serving PLMN:

a) a static QoS mapping mechanism; or

b) a dynamic QoS signalling based mechanism.

For a), there is no signalling impact to the 5G ProSe layer-3 remote UE and the 5G ProSe layer-3 UE-to-network relay UE.

For b), clause 8.2.6.4.2 specifies the QoS handling with QoS signalling procedure to transport the IPsec traffic in the 5G ProSe layer-3 UE-to-network relay UE's 5GCN.

8.2.6.4.2 QoS handling with QoS signalling procedure

When the 5G ProSe layer-3 remote UE establishes or handovers a PDU session via the N3IWF as described in clause 4.12.5 of 3GPP TS 23.502 [5], the N3IWF initiates a child SA creation procedure by sending a CREATE_CHILD_SA request message to associate the QoS flow(s) of the PDU session with the child SA of the user plane as specified in clause 7.5 of 3GPP TS 24.502 [26]. In the CREATE_CHILD_SA request message, the 5G_QOS_INFO Notify payload includes the PDU session ID, one or more QFI(s), optionally a DSCP value, and optionally Additional QoS Information as defined in clause 9.3.1.1 of 3GPP TS 24.502 [26]. The N3IWF can also initiate the user plane IPsec child SA modification procedure by sending an INFORMATIONAL request message including the 5G_QOS_INFO Notify payload if the child SA associated with the QoS flows of the PDU session needs to be modified as specified in clause 7.6 of 3GPP TS 24.502 [26].

Based on information in the received 5G_QoS_INFO Notify payload, the 5G ProSe layer-3 remote UE determines whether to initiate the 5G ProSe direct link modification procedure to setup or modify the PC5 QoS flows. If the 5G ProSe direct link modification procedure needs to be initiated, the 5G ProSe layer-3 remote UE shall perform the procedure as specified in clause 8.2.6.3.3 with following additions:

a) if the Additional QoS Information is received in the 5G_QoS_INFO Notify payload, the 5G ProSe layer-3 remote UE shall set the PC5 QoS flow descriptions IE based on the Additional QoS Information; and

b) the 5G ProSe layer-3 remote UE shall include the PC5 QoS rules IE with the packet filter containing the N3IWF IP address, the security parameter index of the child SA, and the DSCP value if received in the 5G_QoS_INFO Notify payload.

The 5G ProSe layer-3 UE-to-network relay UE determines whether to initiate PDU session modification procedure to request establishment or modification of the QoS flow of the dedicated QoS rules which is associated with the IPsec traffic between the 5G ProSe layer-3 remote UE and the N3IWF. If the PDU session modification procedure needs to be initiated, the 5G ProSe layer-3 UE-to-network relay UE shall perform the procedure as specified in clause 6.4.2 of 3GPP TS 24.501 [11].

8.2.7 5G ProSe layer-3 UE-to-network relay with N3IWF support

8.2.7.1 General

As specified in clause 5.4.1.2 of 3GPP TS 23.304 [2], the 5G ProSe layer-3 UE-to-network relay with N3IWF support shall provide the 5G ProSe layer-3 remote UE with the connection which can access to the N3IWF. In this way, the 5G ProSe layer-3 remote UE is able to select the N3IWF and access to the 5GC via the N3IWF.

The layer-3 ProSe UE-to-network relay UE is provisioned with the UE policies for 5G ProSe layer-3 UE-to-network relay including the relay service code which corresponds to use N3IWF access for the relayed traffic as defined in 3GPP TS 24.555 [17].

For UE-to-network relay discovery with model A, the UE-to-network relay UE includes the relay service code in the PROSE PC5 DISCOVERY message for UE-to-network relay discovery announcement as specified in clause 8.2.1.2. For UE-to-network relay discovery with model B, the 5G ProSe layer-3 remote UE includes the relay service code which corresponds to use N3IWF access for the relayed traffic in the PROSE PC5 DISCOVERY message for UE-to-network relay discovery solicitation as specified in clause 8.2.1.3. The relay service code in the PROSE PC5 DISCOVERY message for UE-to-network relay discovery response shall match the relay service code received from the 5G ProSe layer-3 remote UE.

If the 5G ProSe layer-3 remote UE intends to access 5GC via N3IWF, the 5G ProSe layer-3 remote UE:

a) selects the relay service code which corresponds to use N3IWF access for the relayed traffic in the received PROSE PC5 DISCOVERY message; and

b) sends the PROSE DIRECT LINK ESTABLISHMENT REQUEST message including the selected relay service code in a) to the 5G ProSe layer-3 UE-to-network relay UE.

The 5G ProSe layer-3 UE-to-network relay UE establishes the PDU session with corresponding parameters for the requested relay service code as specified in clause 8.2.7.2.

The 5G ProSe layer-3 remote UE performs the N3IWF selection as specified in 8.2.7.3 once the IP address/prefix allocation is completed.

8.2.7.2 5G ProSe layer-3 UE-to-network relay UE establishing PDU session to access N3IWF

The 5G ProSe layer-3 UE-to-network relay UE establishes the PDU session based on the UE policies for 5G ProSe layer-3 UE-to-network relay service codes defined in 3GPP TS 24.555 [17]. The PDU session establishment is triggered upon receipt of the PROSE DIRECT LINK ESTABLISHMENT REQUEST message including the relay service code.

NOTE: If there is an existing PDU session for 5G ProSe layer-3 UE-to-network relay without N3IWF, whether to reuse that existing PDU session or to establish a new PDU session for 5G ProSe layer-3 UE-to-network relay with N3IWF is determined by 5G ProSe layer-3 UE-to-network relay UE as specified in 3GPP TS 23.503[33].

8.2.7.3 N3IWF selection for 5G ProSe layer-3 remote UE

As specified in clause 6.5.1.2.2 of 3GPP TS 23.304 [2], the 5G ProSe layer-3 remote UE selects the N3IWF using following information included in UE policies for 5G ProSe UE-to-network remote UE as defined in clause 5.6.2 of 3GPP TS 24.555 [17]:

a) N3IWF identifier configuration for 5G ProSe layer-3 remote UE; and

b) 5G ProSe layer-3 UE-to-network relay access node selection information.

The 5G ProSe layer-3 remote UE shall perform the N3IWF selection procedure as specified in clause 7.2.4.3 of 3GPP TS 24.502 [26].

8.2.8 5G ProSe additional parameters announcement procedure

8.2.8.1 General

The purpose of the 5G ProSe additional parameters announcement procedure is for the 5G ProSe layer-3 remote UE to obtain NCGI or TAI of the cell serving the 5G ProSe layer-3 UE-to-network relay UE.

The remote UE in this procedure shall be a 5G ProSe-enabled UE and is authorised to act as a 5G ProSe layer-3 remote UE towards a 5G ProSe layer-3 UE-to-network relay UE based on the service authorisation procedure as specified in clause 5. The 5G ProSe layer-3 UE-to-network relay UE in this procedure shall be a 5G ProSe-enabled UE and is authorised to act as a 5G layer-3 ProSe UE-to-network relay UE based on the service authorisation procedure as specified in clause 5.

8.2.8.2 5G ProSe additional parameters announcement procedure initiation by the 5G ProSe layer-3 remote UE

Before initiating the 5G ProSe additional parameters announcement procedure, a direct link has been successfully established between the 5G ProSe layer-3 remote UE and the 5G ProSe layer-3 UE-to-network relay UE.

The 5G ProSe layer-3 remote UE shall initiate a 5G ProSe additional parameters announcement procedure:

a) when the 5G ProSe layer-3 remote UE is triggered by an upper layer application to report NCGI or TAI of the serving cell to the application server, but cannot receive the PROSE PC5 DISCOVERY message for relay discovery additional information from the 5G ProSe layer-3 UE-to-network relay UE, or the NCGI or TAI is not included in the PROSE PC5 DISCOVERY message for relay discovery additional information from the 5G ProSe layer-3 UE-to-network relay UE; or

b) when the additional parameters announcement request refresh timer T5106 expires and the 5G ProSe layer-3 remote UE still needs to obtain NCGI or TAI of the cell serving the 5G ProSe layer-3 UE-to-network relay.

The 5G ProSe layer-3 remote UE shall generate a PROSE ADDITIONAL PARAMETERS ANNOUNCEMENT REQUEST message and pass this message to the lower layers for transmission along with the 5G ProSe layer-3 remote UE's layer-2 ID (for unicast communication) and the 5G ProSe layer-3 UE-to-network relay UE's layer-2 ID (for unicast communication).

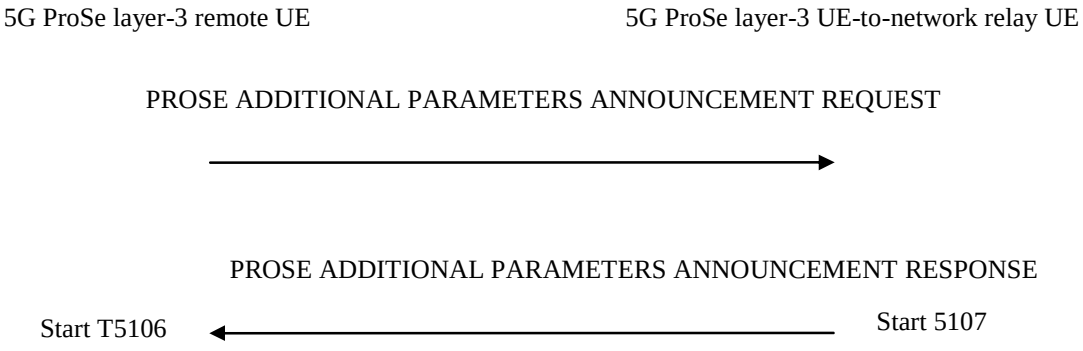

Figure 8.2.8.2.1: 5G ProSe additional parameters announcement procedure

8.2.8.3 5G ProSe additional parameters announcement procedure accepted by the 5G ProSe layer-3 UE-to-network relay UE

Upon receiving a PROSE ADDITIONAL PARAMETERS ANNOUNCEMENT REQUEST message, the 5G ProSe layer-3 UE-to-network relay UE shall allocate an additional parameters announcement request refresh timer T5106 to the remote UE, and start a timer T5107. The timer T5107 shall be longer than the additional parameters announcement request refresh timer T5106.

Then the 5G ProSe layer-3 UE-to-network relay UE shall respond a PROSE ADDITIONAL PARAMETERS ANNOUNCEMENT RESPONSE message with an additional parameters announcement request refresh timer T5106 IE set to the T5106 timer value assigned by the 5G ProSe layer-3 UE-to-network relay UE. The 5G ProSe layer-3 UE-to-network relay UE shall start announcing the NCGI or TAI of the serving cell by triggering the announcing UE procedure for relay discovery additional information as described in clause 8.2.1.2.4.

8.2.8.4 5G ProSe additional parameters announcement procedure completion by the 5G ProSe layer-3 remote UE

Upon receiving a PROSE ADDITIONAL PARAMETERS ANNOUNCEMENT RESPONSE message, the UE shall start the additional parameters announcement request refresh timer T5106 with the received value.

8.2.8.5 Abnormal cases

8.2.8.5.1 Abnormal cases in the 5G ProSe layer-3 remote UE

If there is no response from the 5G ProSe layer-3 UE-to-network relay UE after the PROSE ADDITIONAL PARAMETERS ANNOUNCEMENT REQUEST message has been successfully delivered, the 5G ProSe layer-3 remote UE shall retransmit the PROSE ADDITIONAL PARAMETERS ANNOUNCEMENT REQUEST message.

NOTE: The timer to trigger retransmission and the maximum number of allowed retransmissions are UE implementation specific.

9 Handling of unknown, unforeseen, and erroneous protocol data

9.1 General

The procedures specified in the present document apply to those PC3a or PC5 messages which pass the checks described in this clause.

This clause also specifies procedures for the handling of unknown, unforeseen, and erroneous protocol data by the receiving entity. These procedures are called "error handling procedures", but in addition to providing recovery mechanisms for error situations they define a compatibility mechanism for future extensions of the protocols.

Detailed error handling procedures in the network are implementation dependent and may vary from PLMN to PLMN. However, when extensions of this protocol are developed, networks will be assumed to have the error handling that is indicated in this clause as mandatory ("shall") and that is indicated as strongly recommended ("should").

Also, the error handling of the network is only considered as mandatory or strongly recommended when certain thresholds for errors are not reached during a dedicated connection.

9.2 Handling of unknown, unforeseen, and erroneous protocol data in messages sent over the PC3a interface

9.2.1 Unforeseen message type

If the UE receives a PC3a message with a message type corresponding to a ProSe discovery mechanism that the UE is not authorised to use by the network, the UE shall discard the message.

If the DDNMF receives a PC3a message whose message type indicates that this is a ProSe discovery mechanism the sending UE is not authorised to support, the DDNMF shall discard the message.

9.3 Handling of unknown, unforeseen, and erroneous protocol data in messages sent over the PC5 interface

9.3.1 Message too short or too long

9.3.1.1 Message too short

When a message is received that is too short to contain a complete message type information element, that message shall be ignored, cf. 3GPP TS 24.007 [20].

9.3.1.2 Message too long

The maximum size of a PC5 signalling message is 65535 octets.

9.3.2 Unknown or unforeseen message type

If the UE receives a PC5 signalling message with message type not defined for the PC5 signalling protocol or not implemented by the receiver, it shall ignore the PC5 signalling message.

NOTE: A message type not defined for the PC5 signalling protocol in the given direction is regarded by the receiver as a message type not defined for the PC5 signalling protocol, see 3GPP TS 24.007 [20].

If the UE receives a message not compatible with the PC5 signalling protocol state, the UE shall ignore the PC5 signalling message.

9.3.3 Non-semantical mandatory information element errors

When on receipt of a message,

a) an "imperative message part" error; or

b) a "missing mandatory IE" error

is diagnosed or when a message containing:

a) a syntactically incorrect mandatory IE;

b) an IE unknown in the message, but encoded as "comprehension required" (see 3GPP TS 24.007 [20]); or

c) an out of sequence IE encoded as "comprehension required" (see 3GPP TS 24.007 [20]) is received,

the UE shall ignore the PC5 signalling message.

9.3.4 Unknown and unforeseen IEs in the non-imperative message part

9.3.4.1 IEIs unknown in the message

The UE shall ignore all IEs unknown in a message which are not encoded as "comprehension required" (see 3GPP TS 24.007 [20]).

9.3.4.2 Out of sequence IEs

The UE shall ignore all out of sequence IEs in a message which are not encoded as "comprehension required" (see 3GPP TS 24.007 [20]).

9.3.4.3 Repeated IEs

If an information element with format T, TV, TLV, or TLV-E is repeated in a message in which repetition of the information element is not specified in clause 11.3, the UE shall handle only the contents of the information element appearing first and shall ignore all subsequent repetitions of the information element. When repetition of information elements is specified, the UE shall handle only the contents of specified repeated information elements. If the limit on repetition of information elements is exceeded, the UE shall handle the contents of information elements appearing first up to the limit of repetitions and shall ignore all subsequent repetitions of the information element.

9.3.5 Non-imperative message part errors

9.3.5.1 General

This category includes:

a) syntactically incorrect optional IEs; and

b) conditional IE errors.

9.3.5.2 Syntactically incorrect optional IEs

The UE shall treat all optional IEs that are syntactically incorrect in a message as not present in the message.

9.3.5.3 Conditional IE errors

When upon receipt of a PC5 signalling message, the UE diagnoses a "missing conditional IE" error or an "unexpected conditional IE" error, or when it receives a PC5 signalling message containing at least one syntactically incorrect conditional IE, the UE shall ignore the message.

9.3.6 Messages with semantically incorrect contents

When a message with semantically incorrect contents is received, the UE shall perform the foreseen reactions of the procedural part of clause 7.2. If, however no such reactions are specified, the UE shall ignore the message.

10 Message functional definitions and contents

10.1 Overview

This clause contains the definition and contents of the messages used in the procedures described in the present document.

10.2 5G ProSe direct discovery messages

10.2.1 Message definition

This message is sent by the UE over the PC5 interface for open 5G ProSe direct discovery and restricted 5G ProSe direct discovery. See table 10.2.1.1, table 10.2.1.2, table 10.2.1.3, table 10.2.1.4, table 10.2.1.5, table 10.2.1.6, table 10.2.1.7, table 10.2.1.8, table 10.2.1.9, table 10.2.1.10 and table 10.2.1.11.

Message type: PROSE PC5 DISCOVERY

Significance: dual

Direction: UE to peer UE

Editor's note: Whether Metadata IE and all other optional IEs are subject to security protection is FFS and depends on SA3 requirements.

Table 10.2.1.1: PROSE PC5 DISCOVERY message content for open 5G ProSe direct discovery announcement

IEI	Information Element	Type/Reference	Presence	Format	Length
	ProSe direct discovery PC5 message type (NOTE)	ProSe direct discovery PC5 message type 11.2.1	M	V	1
	ProSe application code	ProSe application code 11.2.2	M	V	23
	MIC	MIC 11.2.4	M	V	4
	UTC-based counter LSB	UTC-based counter LSB 11.2.14	M	V	1
7A	Metadata	Metadata 11.2.13	O	TLV-E	4-8195
NOTE: The discovery type is set to "Open discovery" and the content type is set to "Announcement".					

Table 10.2.1.2: PROSE PC5 DISCOVERY message content for restricted 5G ProSe direct discovery announcement

IEI	Information Element	Type/Reference	Presence	Format	Length
	ProSe direct discovery PC5 message type (NOTE)	ProSe direct discovery PC5 message type 11.2.1	M	V	1
	ProSe restricted code	ProSe restricted code 11.2.3	M	V	23
	MIC	MIC 11.2.4	M	V	4
	UTC-based counter LSB	UTC-based counter LSB 11.2.14	M	V	1
7A	Metadata	Metadata 11.2.13	O	TLV-E	4-8195
NOTE: The discovery type is set to "Restricted discovery" and the content type is set to "Announcement".					

Table 10.2.1.3: PROSE PC5 DISCOVERY message content for restricted 5G ProSe direct discovery solicitation

IEI	Information Element	Type/Reference	Presence	Format	Length
	ProSe direct discovery PC5 message type (NOTE)	ProSe direct discovery PC5 message type 11.2.1	M	V	1
	ProSe query code	ProSe restricted code 11.2.3	M	V	23
	MIC	MIC 11.2.4	M	V	4
	UTC-based counter LSB	UTC-based counter LSB 11.2.14	M	V	1
NOTE: The discovery type is set to "Restricted discovery" and the content type is set to "Solicitation".					

Table 10.2.1.4: PROSE PC5 DISCOVERY message content for restricted 5G ProSe direct discovery response

IEI	Information Element	Type/Reference	Presence	Format	Length
	ProSe direct discovery PC5 message type (NOTE)	ProSe direct discovery PC5 message type 11.2.1	M	V	1
	ProSe response code	ProSe restricted code 11.2.3	M	V	23
	MIC	MIC 11.2.4	M	V	4
	UTC-based counter LSB	UTC-based counter LSB 11.2.14	M	V	1
7A	Metadata	Metadata 11.2.13	O	TLV-E	4-8195
NOTE: The discovery type is set to "Restricted discovery" and the content type is set to "response".					

Table 10.2.1.5: PROSE PC5 DISCOVERY message for group member discovery announcement

IEI	Information Element	Type/Reference	Presence	Format	Length
	ProSe direct discovery PC5 message type (NOTE)	ProSe direct discovery PC5 message type 11.2.1	M	V	1
	Application layer group ID	Application layer group ID 11.2.6	M	LV	2-257
	Announcer info	User info ID 11.2.7	M	V	6
	MIC	MIC 11.2.4	M	V	4
	UTC-based counter LSB	UTC-based counter LSB 11.2.14	M	V	1
7A	Metadata	Metadata 11.2.13	O	TLV-E	4-8195
NOTE: The discovery type is set to "Restricted discovery", the content type is set to "Group member discovery announcement/group member discovery response" and the discovery model is set to "Model A".					

Table 10.2.1.6: PROSE PC5 DISCOVERY message for group member discovery solicitation

IEI	Information Element	Type/Reference	Presence	Format	Length
	ProSe direct discovery PC5 message type (NOTE)	ProSe direct discovery PC5 message type 11.2.1	M	V	1
	Application layer group ID	Application layer group ID 11.2.6	M	LV	2-256
	Discoverer info	User info ID 11.2.7	M	V	6
	MIC	MIC 11.2.4	M	V	4
	UTC-based counter LSB	UTC-based counter LSB 11.2.14	M	V	1
28	Target user info	User info ID 11.2.7	O	TV	7
NOTE: The discovery type is set to "Restricted discovery", the content type is set to "Group member discovery solicitation" and the discovery model is set to "Model B".					

Table 10.2.1.7: PROSE PC5 DISCOVERY message for group member discovery response

IEI	Information Element	Type/Reference	Presence	Format	Length
	ProSe direct discovery PC5 message type (NOTE)	ProSe direct discovery PC5 message type 11.2.1	M	V	1
	Application layer group ID	Application layer group ID 11.2.6	M	LV	2-256
	Discoveree info	User info ID 11.2.7	M	V	6
	MIC	MIC 11.2.4	M	V	4
	UTC-based counter LSB	UTC-based counter LSB 11.2.14	M	V	1
7A	Metadata	Metadata 11.2.13	O	TLV-E	4-8195
NOTE: The discovery type is set to "Restricted discovery", the content type is set to "Group member discovery announcement/group member discovery response" and the discovery model is set to "Model B".					

Table 10.2.1.8: PROSE PC5 DISCOVERY message for UE-to-network relay discovery announcement

IEI	Information Element	Type/Reference	Presence	Format	Length
	ProSe direct discovery PC5 message type (NOTE 1)	ProSe direct discovery PC5 message type 11.2.1	M	V	1
	Announcer info	User info ID 11.2.7	M	V	6
	Relay service code (NOTE 2)	Relay service code 11.2.8	M	V	3
	Status indicator	Status indicator 11.2.9	M	V	1
	MIC	MIC 11.2.4	M	V	4
	UTC-based counter LSB	UTC-based counter LSB 11.2.11	M	V	1
52	NCGI	NCGI 11.2.12	O	TV	9
NOTE 1: The discovery type is set to "Restricted discovery", the content type is set to "UE-to-network relay discovery announcement/UE-to-network relay discovery response" and the discovery model is set to "Model A". NOTE 2: If the announcing UE works as a 5G ProSe Layer-3 UE-to-network relay UE, the S-NSSAI associated with the relay service code belongs to the allowed NSSAI of the UE.					

Table 10.2.1.9: PROSE PC5 DISCOVERY message for UE-to-network relay discovery solicitation

IEI	Information Element	Type/Reference	Presence	Format	Length
	ProSe direct discovery PC5 message type (NOTE)	ProSe direct discovery PC5 message type 11.2.1	M	V	1
	Discoverer info	User info ID 11.2.7	M	V	6
	Relay service code	Relay service code 11.2.8	M	V	3
	MIC	MIC 11.2.4	M	V	4
	UTC-based counter LSB	UTC-based counter LSB 11.2.11	M	V	1
NOTE: The discovery type is set to "Restricted discovery", the content type is set to "UE-to-network relay discovery solicitation" and the discovery model is set to "Model B".					

Table 10.2.1.10: PROSE PC5 DISCOVERY message for UE-to-network relay discovery response

IEI	Information Element	Type/Reference	Presence	Format	Length
	ProSe direct discovery PC5 message type (NOTE 1)	ProSe direct discovery PC5 message type 11.2.1	M	V	1
	Discoveree info	User info ID 11.2.7	M	V	6
	Relay service code (NOTE 2)	Relay service code 11.2.8	M	V	3
	Status indicator	Status indicator 11.2.9	M	V	1
	MIC	MIC 11.2.4	M	V	4
	UTC-based counter LSB	UTC-based counter LSB 11.2.11	M	V	1
52	NCGI	NCGI 11.2.12	O	TV	9
NOTE 1: The discovery type is set to "Restricted discovery", the content type is set to "UE-to-network relay discovery announcement/UE-to-network relay discovery response" and the discovery model is set to "Model B". NOTE 2: If the discoveree UE works as a 5G ProSe Layer-3 UE-to-network relay UE, the S-NSSAI associated with the relay service code belongs to the allowed NSSAI of the UE.					

Table 10.2.1.11: PROSE PC5 DISCOVERY message for relay discovery additional information

IEI	Information Element	Type/Reference	Presence	Format	Length
	ProSe direct discovery PC5 message type (NOTE)	ProSe direct discovery PC5 message type 11.2.1	M	V	1
	Relay service code	Relay service code 11.2.8	M	V	3
	Announcer info	User info ID 11.2.7	M	V	1
	MIC	MIC 11.2.4	M	V	4
	UTC-based counter LSB	UTC-based counter LSB 11.2.11	M	V	1
52	NCGI	NCGI 11.2.12	O	TV	9
51	Relay TAI	TAI 11.2.10	O	TV	4
NOTE: The discovery type is set to "Restricted discovery", the content type is set to "Relay discovery additional information" and the discovery model is set to "Model A".					

10.2.2 Relay TAI

The information element may be included in PROSE PC5 DISCOVERY message for relay discovery additional information as in table 10.2.1.11 to indicate the tracking area identity corresponding to the serving cell of the 5G ProSe layer-3 UE-to-network relay for discoveree UEs supporting N3IWF discovery procedure.

10.2.3 NCGI

The NCGI information element shall be included in:

a) PROSE PC5 DISCOVERY message for UE-to-network relay discovery announcement as in table 10.2.1.8; or

b) PROSE PC5 DISCOVERY message for UE-to-network relay discovery response as in table 10.2.1.10;

to indicate the NCGI of the serving cell if the UE acts as a 5G ProSe layer-2 UE-to-network relay UE.

When the UE acts as a 5G ProSe layer-3 UE-to-network relay UE, the UE may include the NCGI information element in PROSE PC5 DISCOVERY message for relay discovery additional information as in table 10.2.1.11 to indicate the NCGI of the serving cell.

10.2.4 Target user info

The target user info IE shall be included in PROSE PC5 DISCOVERY message for group member discovery solicitation in as in table 10.2.1.6 if the target information is provided by the upper layers to identify a specific group member of the application layer group identified by the configured application layer group ID.

10.2.5 Metadata

The Metadata information element may be included:

a) to provide the application layer metadata information in the following messages:

1) the PROSE PC5 DISCOVERY message for open 5G ProSe direct discovery announcement as in table 10.2.1.1;

2) the PROSE PC5 DISCOVERY message for restricted 5G ProSe direct discovery announcement as in table 10.2.1.2, and

3) the PROSE PC5 DISCOVERY message for restricted 5G ProSe direct discovery response as in table 10.2.1.4; or

b) to provide the application layer discovery message in the following messages:

1) the PROSE PC5 DISCOVERY message for group member discovery announcement as in table 10.2.1.5; and

2) the PROSE PC5 DISCOVERY message for group member discovery response as in table 10.2.1.7.

NOTE 1: The format of the application layer metadata information and the application layer discovery message are out of scope of this specification.

NOTE 2: Possible impact on the performance of the 5G ProSe direct discovery procedure is to be considered if the resulted Metadata information element size is too big, e.g., longer delay and lower reliability.

10.3 PC5 signalling messages

10.3.1 ProSe direct link establishment request

10.3.1.1 Message definition

This message is sent by a UE to another peer UE to establish a direct link. See table 10.3.1.1.1.

Message type: PROSE DIRECT LINK ESTABLISHMENT REQUEST

Significance: dual

Direction: UE to peer UE

Table 10.3.1.1.1: PROSE DIRECT LINK ESTABLISHMENT REQUEST message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	PROSE DIRECT LINK ESTABLISHMENT REQUEST message identity	ProSe PC5 signalling message type 11.3.1	M	V	1
	Sequence number	Sequence number 11.3.2	M	V	1
	Source user info	Application layer ID 11.3.4	M	LV	2-256
	UE security capabilities	UE security capabilities 11.3.11	M	LV	3-9
	UE PC5 unicast signalling security policy	UE PC5 unicast signalling security policy 11.3.12	M	V	1
7B	ProSe identifiers	ProSe identifier 11.3.3	O	TLV-E	21-65538
74	Key establishment information container	Key establishment information container 11.3.9	O	TLV-E	4-65538
56	Nonce_1	Nonce 11.3.10	O	TV	17
5C	MSB of $K_{NRP-sess}$ ID	MSB of $K_{NRP-sess}$ ID 11.3.13	O	TV	2
28	Target user info	Application layer ID 11.3.4	O	TLV	3-257
58	K_{NRP} ID	K_{NRP} ID 11.3.14	O	TV	5
54	Relay service code	Relay service code 11.3.26	O	TV	4
7D	UE identity	5GS mobile identity 11.3.30	O	TLV-E	4-n

10.3.1.2 Target user info

The UE shall include this IE if it has received the target UE's application layer ID from upper layers or if the destination layer-2 ID is the unicast layer-2 ID of target UE.

10.3.1.3 Key establishment information container

The UE shall include this IE if the UE PC5 unicast signalling security policy is set to "Signalling integrity protection required" or "Signalling integrity protection preferred".

10.3.1.4 Nonce_1

The UE shall include this IE if the UE PC5 unicast signalling security policy is set to "Signalling integrity protection required" or "Signalling integrity protection preferred".

10.3.1.5 MSB of $K_{NRP-sess}$ ID

The UE shall include this IE if the UE PC5 unicast signalling security policy is set to "Signalling integrity protection required" or "Signalling integrity protection preferred".

10.3.1.6 K_{NRP} ID

The UE may include this IE if it has an existing K_{NRP} for the target UE.

10.3.1.7 Relay service code

The UE shall include this IE if the 5G ProSe direct link establishment procedure is for direct communication between the remote UE and the UE-to-network relay UE.

10.3.1.8 ProSe identifiers

The UE shall include this IE if the 5G ProSe direct link establishment procedure is not for 5G ProSe direct communication between the remote UE and the UE-to-network relay UE.

10.3.1.7 UE identity

The UE shall include this IE if 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.

10.3.2 ProSe direct link establishment accept

10.3.2.1 Message definition

This message is sent by a UE to another peer UE to accept the received PROSE DIRECT LINK ESTABLISHMENT REQUEST message. See table 10.3.2.1.1.

Message type: PROSE DIRECT LINK ESTABLISHMENT ACCEPT

Significance: dual

Direction: UE to peer UE

Table 10.3.2.1.1: PROSE DIRECT LINK ESTABLISHMENT ACCEPT message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	PROSE DIRECT LINK ESTABLISHMENT ACCEPT message identity	ProSe PC5 signalling message type 11.3.1	M	V	1
	Sequence number	Sequence number 11.3.2	M	V	1
	Source user info	Application layer ID 11.3.4	M	LV	2-256
	Configuration of UE PC5 unicast user plane security protection	Configuration of UE PC5 unicast user plane security protection 11.3.23	M	V	1
79	QoS flow descriptions	PC5 QoS flow descriptions 11.3.5	O	TLV-E	6-65538
7C	QoS rules	PC5 QoS rules 11.3.x	O	TLV-E	7-65538
62	IP address configuration	IP address configuration 11.3.6	O	TV	2
61	Target link local IPv6 address	Link local IPv6 address 11.3.7	O	TV	17

10.3.2.2 IP address configuration

The UE shall include this IE if IP communication is used.

10.3.2.3 Target link local IPv6 address

The UE shall include this IE if IP communication is used and the IP address configuration is set to "address allocation not supported".

10.3.2.4 QoS flow descriptions

The UE shall include this IE if:

a) the 5G ProSe direct link establishment procedure is not for 5G ProSe direct communication between the remote UE and the UE-to-network relay UE; or

b) the 5G ProSe direct link establishment procedure is for 5G ProSe direct communication between the 5G ProSe layer-3 remote UE and the 5G ProSe layer-3 UE-to-network relay UE.

10.3.2.5 QoS rules

The UE may include this IE to indicate the PC5 QoS rules for the established PC5 QoS flow(s).

10.3.3 ProSe direct link establishment reject

10.3.3.1 Message definition

This message is sent by the UE to another peer UE to indicate that the link establishment request is not accepted. See table 10.3.3.1.1.

Message type: PROSE DIRECT LINK ESTABLISHMENT REJECT

Significance: dual

Direction: UE to peer UE

Table 10.3.3.1.1: PROSE DIRECT LINK ESTABLISHMENT REJECT message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	PROSE DIRECT LINK ESTABLISHMENT REJECT message identity	ProSe PC5 signalling message type 11.3.1	M	V	1
	Sequence number	Sequence number 11.3.2	M	V	1
	PC5 signalling protocol cause	PC5 signalling protocol cause 11.3.8	M	V	1
5E	Back-off value	GPRS timer 11.3.27	O	TV	2

10.3.3.2 Back-off value

The UE may include this IE when it needs to indicate a back-off timer to another peer UE for congestion control purpose.

10.3.4 ProSe direct link release request

10.3.4.1 Message definition

This message is sent by the UE to another peer UE to initiate the direct link release procedure. See table 10.3.4.1.1.

Message type: PROSE DIRECT LINK RELEASE REQUEST

Significance: dual

Direction: UE to peer UE

Table 10.3.4.1.1: PROSE DIRECT LINK RELEASE REQUEST message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	PROSE DIRECT LINK RELEASE REQUEST message identity	ProSe PC5 signalling message type 11.3.1	M	V	1
	Sequence number	Sequence number 11.3.2	M	V	1
	PC5 signalling protocol cause	PC5 signalling protocol cause 11.3.8	M	V	1
	MSBs of K_{NRP} ID	MSBs of K_{NRP} ID 11.3.16	M	V	2
5E	Back-off value	GPRS timer 11.3.27	O	TV	2

10.3.4.2 Back-off value

The UE may include this IE when it needs to indicate a back-off timer to another peer UE for congestion control purpose.

10.3.5 ProSe direct link release accept

10.3.5.1 Message definition

This message is sent by the UE to another peer UE to indicate that the link release request is accepted. See table 10.3.5.1.1.

Message type: PROSE DIRECT LINK RELEASE ACCEPT

Significance: dual

Direction: UE to peer UE

Table 10.3.5.1.1: PROSE DIRECT LINK RELEASE ACCEPT message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	PROSE DIRECT LINK RELEASE ACCEPT message identity	ProSe PC5 signalling message type 11.3.1	M	V	1
	Sequence number	Sequence number 11.3.2	M	V	1
	LSBs of K_{NRP} ID	LSBs of K_{NRP} ID 11.3.17	M	V	2

10.3.6 ProSe direct link modification request

10.3.6.1 Message definition

This message is sent by the UE to another peer UE to initiate the direct link modification procedure. See table 10.3.6.1.1.

Message type: PROSE DIRECT LINK MODIFICATION REQUEST

Significance: dual

Direction: UE to peer UE

Table 10.3.6.1.1: PROSE DIRECT LINK MODIFICATION REQUEST message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	PROSE DIRECT LINK MODIFICATION REQUEST message identity	ProSe PC5 signalling message type 11.3.1	M	V	1
	Sequence number	Sequence number 11.3.2	M	V	1
	Link modification operation code	Link modification operation code 11.3.19	M	V	1
	QoS flow descriptions	PC5 QoS flow descriptions 11.3.5	M	LV-E	5-65537
7C	QoS rules	PC5 QoS rules 11.3.29	O	TLV-E	7-65538

10.3.6.2 QoS rules

The UE may include this IE to indicate the PC5 QoS rules for the PC5 QoS flow(s) to be added or modified.

10.3.7 ProSe direct link modification accept

10.3.7.1 Message definition

This message is sent by the UE to another peer UE to indicate that the link modification request is accepted. See table 10.3.7.1.1.

Message type: PROSE DIRECT LINK MODIFICATION ACCEPT

Significance: dual

Direction: UE to peer UE

Table 10.3.7.1.1: PROSE DIRECT LINK MODIFICATION ACCEPT message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	PROSE DIRECT LINK MODIFICATION ACCEPT message identity	ProSe PC5 signalling message type 11.3.1	M	V	1
	Sequence number	Sequence number 11.3.2	M	V	1
79	QoS flow descriptions	PC5 QoS flow descriptions 11.3.5	O	TLV-E	6-65538
7C	QoS rules	PC5 QoS rules 11.3.29	O	TLV-E	7-65538

10.3.7.2 QoS flow descriptions

The UE shall include this IE if the 5G ProSe direct link modification procedure is to:

a) add new PC5 QoS flow(s) to the existing 5G ProSe direct link;

b) modify PC5 QoS parameters of the existing PC5 QoS flow(s);

c) associate new ProSe application(s) with existing PC5 QoS flow(s); or

d) remove ProSe application(s) from existing PC5 QoS flow(s).

10.3.7.3 QoS rules

The UE may include this IE to indicate the PC5 QoS rules for the PC5 QoS flow(s) to be added or modified.

10.3.8 ProSe direct link keepalive request

10.3.8.1 Message definition

This message is sent by a UE to another peer UE when a 5G ProSe direct link keep-alive procedure is initiated. See table 10.3.8.1.1.

Message type: PROSE DIRECT LINK KEEPALIVE REQUEST

Significance: dual

Direction: UE to peer UE

Table 10.3.8.1.1: PROSE DIRECT LINK KEEPALIVE REQUEST message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	PROSE DIRECT LINK KEEPALIVE REQUEST message identity	ProSe PC5 signalling message type 11.3.1.	M	V	1
	Sequence number	Sequence number 11.3.2	M	V	1
	Keep-alive counter	Keep-alive counter 11.3.20	M	V	4
5F	Maximum inactivity period	Maximum inactivity period 11.3.21	O	TV	5

10.3.8.2 Maximum inactivity period

The UE may include this IE to indicate its maximum inactivity period to the peer UE.

10.3.9 ProSe direct link keepalive response

10.3.9.1 Message definition

This message is sent by a UE to another peer UE to respond to a PROSE DIRECT LINK KEEPALIVE REQUEST message. See table 10.3.9.1.1.

Message type: PROSE DIRECT LINK KEEPALIVE RESPONSE

Significance: dual

Direction: UE to peer UE

Table 10.3.9.1.1: PROSE DIRECT LINK KEEPALIVE RESPONSE message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	PROSE DIRECT LINK KEEPALIVE RESPONSE message identity	ProSe PC5 signalling message type 11.3.1.	M	V	1
	Sequence number	Sequence number 11.3.2	M	V	1
	Keep-alive counter	Keep-alive counter 11.3.20	M	V	4

10.3.10 ProSe direct link authentication request

10.3.10.1 Message definition

This message is sent by a UE to another peer UE when a 5G ProSe direct link authentication procedure is initiated. See table 10.3.10.1.1.

Message type: PROSE DIRECT LINK AUTHENTICATION REQUEST

Significance: dual

Direction: UE to peer UE

Table 10.3.10.1.1: PROSE DIRECT LINK AUTHENTICATION REQUEST message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	PROSE DIRECT LINK AUTHENTICATION REQUEST message identity	ProSe PC5 signalling message type 11.3.1.	M	V	1
	Sequence number	Sequence number 11.3.2	M	V	1
	Key establishment information container	Key establishment information container 11.3.9	M	LV-E	3-65537

10.3.11 ProSe direct link authentication response

10.3.11.1 Message definition

This message is sent by a UE to another peer UE to respond to a PROSE DIRECT LINK AUTHENTICATION REQUEST message. See table 10.3.11.1.1.

Message type: PROSE DIRECT LINK AUTHENTICATION RESPONSE

Significance: dual

Direction: UE to peer UE

Table 10.3.11.1.1: PROSE DIRECT LINK AUTHENTICATION RESPONSE message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	PROSE DIRECT LINK AUTHENTICATION RESPONSE message identity	ProSe PC5 signalling message type 11.3.1.	M	V	1
	Sequence number	Sequence number 11.3.2	M	V	1
	Key establishment information container	Key establishment information container 11.3.9	M	LV-E	3-65537

10.3.12 ProSe direct link authentication reject

10.3.12.1 Message definition

This message is sent by a UE to another peer UE to reject a PROSE DIRECT LINK AUTHENTICATION REQUEST message. See table 10.3.12.1.1.

Message type: PROSE DIRECT LINK AUTHENTICATION REJECT

Significance: dual

Direction: UE to peer UE

Table 10.3.12.1.1: PROSE DIRECT LINK AUTHENTICATION REJECT message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	PROSE DIRECT LINK AUTHENTICATION REJECT message identity	ProSe PC5 signalling message type 11.3.1.	M	V	1
	Sequence number	Sequence number 11.3.2	M	V	1
	PC5 signalling protocol cause	PC5 signalling protocol cause 11.3.8	M	V	1

10.3.13 ProSe direct link security mode command

10.3.13.1 Message definition

This message is sent by a UE to another peer UE when a 5G ProSe direct link security mode control procedure is initiated. See table 10.3.13.1.1.

Message type: PROSE DIRECT LINK SECURITY MODE COMMAND

Significance: dual

Direction: UE to peer UE

Table 10.3.13.1.1: PROSE DIRECT LINK SECURITY MODE COMMAND message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	PROSE DIRECT LINK SECURITY MODE COMMAND message identity	ProSe PC5 signalling message type 11.3.1.	M	V	1
	Sequence number	Sequence number 11.3.2	M	V	1
	Selected security algorithms	Selected security algorithms 11.3.22	M	V	1
	UE security capabilities	UE security capabilities 11.3.11	M	LV	3-9
59	UE PC5 unicast signalling security policy	UE PC5 unicast signalling security policy 11.3.12	O	TV	2
57	Nonce_2	Nonce 11.3.10	O	TV	17
5D	LSB of $K_{NRP-sess}$ ID	LSB of $K_{NRP-sess}$ ID 11.3.15	O	TV	2
74	Key establishment information container	Key establishment information container 11.3.9	O	TLV-E	4-65538
5A	MSBs of K_{NRP} ID	MSBs of K_{NRP} ID 11.3.16	O	TV	3

10.3.13.2 Nonce_2

The UE shall include this IE if the selected integrity protection algorithms is not the null integrity protection algorithm.

10.3.13.3 LSB of KNRP-sess ID

The UE shall include this IE if the selected integrity protection algorithms is not the null integrity protection algorithm.

10.3.13.4 Key establishment information container

The UE shall include this IE if the UE has derived a new K_{NRP} and the authentication method used to generate K_{NRP} requires sending information to complete the authentication procedure.

10.3.13.5 MSBs of K_{NRP} ID

The UE shall include this IE if the UE has derived a new K_{NRP}.

10.3.13.6 UE PC5 unicast signalling security policy

The UE shall include this IE if the PROSE DIRECT LINK SECURITY MODE COMMAND message is triggered by the PROSE DIRECT LINK ESTABLISHMENT REQUEST message. The content of the IE is the same as the content of UE PC5 unicast signalling security policy IE in the received PROSE DIRECT LINK ESTABLISHMENT REQUEST message in order to provide protection against bidding down attacks.

10.3.14 ProSe direct link security mode complete

10.3.14.1 Message definition

This message is sent by a UE to another peer UE to respond to a PROSE DIRECT LINK SECURITY MODE COMMAND message. See table 10.3.14.1.1.

Message type: PROSE DIRECT LINK SECURITY MODE COMPLETE

Significance: dual

Direction: UE to peer UE

Table 10.3.14.1.1: PROSE DIRECT LINK SECURITY MODE COMPLETE message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	PROSE DIRECT LINK SECURITY MODE COMPLETE message identity	ProSe PC5 signalling message type 11.3.1.	M	V	1
	Sequence number	Sequence number 11.3.2	M	V	1
	UE PC5 unicast user plane security policy	UE PC5 unicast user plane security policy 11.3.23	M	V	1
79	QoS flow descriptions	PC5 QoS flow descriptions 11.3.5	O	TLV-E	6-65538
62	IP address configuration	IP address configuration 11.3.6	O	TV	2
61	Target link local IPv6 address	Link local IPv6 address 11.3.7	O	TV	17
5B	LSBs of K_{NRP} ID	LSBs of K_{NRP} ID 11.3.17	O	TV	3
7C	QoS rules	PC5 QoS rules 11.3.29	O	TLV-E	7-65538

10.3.14.2 IP address configuration

The UE shall include this IE if IP communication is used and the 5G ProSe direct link security mode control procedure was triggered during a 5G ProSe direct link establishment procedure.

10.3.14.3 Target link local IPv6 address

The UE shall include this IE if IP communication is used, the IP address configuration is set to "address allocation not supported" and the 5G ProSe direct link security mode control procedure was triggered during a 5G ProSe direct link establishment procedure.

10.3.14.4 LSBs of K_{NRP} ID

The UE shall include this IE if a new K_{NRP} was derived.

10.3.14.5 QoS rules

The UE may include this IE to indicate the PC5 QoS rules for the PC5 QoS flow(s) to be added.

10.3.14.6 QoS flow descriptions

The UE shall include this IE if:

a) the 5G ProSe direct link security mode control procedure is not for 5G ProSe direct communication between a remote UE and a UE-to-network relay UE; or

b) the 5G ProSe direct link security mode control procedure is for 5G ProSe direct communication between the 5G ProSe layer-3 remote UE and the 5G ProSe layer-3 UE-to-network relay UE.

10.3.15 ProSe direct link security mode reject

10.3.15.1 Message definition

This message is sent by a UE to another peer UE to reject a PROSE DIRECT LINK SECURITY MODE COMMAND message. See table 10.3.15.1.1.

Message type: PROSE DIRECT LINK SECURITY MODE REJECT

Significance: dual

Direction: UE to peer UE

Table 10.3.15.1.1: PROSE DIRECT LINK SECURITY MODE REJECT message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	PROSE DIRECT LINK SECURITY MODE REJECT message identity	ProSe PC5 signalling message type 11.3.1.	M	V	1
	Sequence number	Sequence number 11.3.2	M	V	1
	PC5 signalling protocol cause	PC5 signalling protocol cause 11.3.8	M	V	1

10.3.16 ProSe direct link rekeying request

10.3.16.1 Message definition

This message is sent by a UE to another peer UE when a 5G ProSe direct link re-keying procedure is initiated. See table 10.3.16.1.1.

Message type: PROSE DIRECT LINK REKEYING REQUEST

Significance: dual

Direction: UE to peer UE

Table 10.3.16.1.1: PROSE DIRECT LINK REKEYING REQUEST message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	PROSE DIRECT LINK REKEYING REQUEST message identity	ProSe PC5 signalling message type 11.3.1.	M	V	1
	Sequence number	Sequence number 11.3.2	M	V	1
	UE security capabilities	UE security capabilities 11.3.11	M	LV	3-9
74	Key establishment information container	Key establishment information container 11.3.9	O	TLV-E	4-65538
56	Nonce_1	Nonce 11.3.10	O	TV	17
5C	MSB of $K_{NRP-sess}$ ID	MSB of $K_{NRP-sess}$ ID 11.3.13	O	TV	2
55	Re-authentication indication	Re-authentication indication 11.3.24	O	TV	2

10.3.16.2 Key establishment information container

The UE shall include this IE if the null integrity protection algorithm is not in use.

10.3.16.3 Nonce_1

The UE shall include this IE if the null integrity protection algorithm is not in use.

10.3.16.4 MSB of KNRP-sess ID

The UE shall include this IE if the null integrity protection algorithm is not in use.

10.3.16.5 Re-authentication indication

The UE shall include this IE if the UE wants to derive a new K_{NRP}.

10.3.17 ProSe direct link rekeying response

10.3.17.1 Message definition

This message is sent by a UE to another peer UE to respond to a PROSE DIRECT LINK REKEYING REQUEST message. See table 10.3.17.1.1.

Message type: PROSE DIRECT LINK REKEYING RESPONSE

Significance: dual

Direction: UE to peer UE

Table 10.3.17.1.1: PROSE DIRECT LINK REKEYING RESPONSE message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	PROSE DIRECT LINK REKEYING RESPONSE message identity	ProSe PC5 signalling message type 11.3.1.	M	V	1
	Sequence number	Sequence number 11.3.2	M	V	1

10.3.18 ProSe direct link identifier update request

10.3.18.1 Message definition

This message is sent by a UE to another peer UE to initiate the direct link identifier procedure. See table 10.3.18.1.1.

Message type: PROSE DIRECT LINK IDENTIFIER UPDATE REQUEST

Significance: dual

Direction: UE to peer UE

Table 10.3.18.1.1: PROSE DIRECT LINK IDENTIFIER UPDATE REQUEST message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	PROSE DIRECT LINK IDENTIFIER UPDATE REQUEST message identity	ProSe PC5 signalling message type 11.3.1	M	V	1
	Sequence number	Sequence number 11.3.2	M	V	1
	MSB of $K_{NRP-sess}$ ID	MSB of $K_{NRP-sess}$ ID 11.3.13	M	V	1
	Source layer-2 ID	Layer-2 ID 11.3.25	M	V	3
27	Source user info	Application layer ID 11.3.4	O	TLV	3-257
60	Source link local IPv6 address	Link local IPv6 address 11.3.7	O	TV	17

10.3.18.2 Source user info

This IE is included when the initiating UE receives a new application layer ID.

10.3.18.3 Source link local IPv6 address

This IE is included when the link local IPv6 address changes at the initiating UE and the 5G ProSe direct link is not for 5G ProSe direct communication between 5G ProSe layer-2 remote UE and 5G ProSe layer-2 UE-to-network relay UE.

10.3.19 ProSe direct link identifier update accept

10.3.19.1 Message definition

This message is sent by the UE to another peer UE to indicate that the link identifier update request is accepted. See table 10.3.19.1.1.

Message type: PROSE DIRECT LINK IDENTIFIER UPDATE ACCEPT

Significance: dual

Direction: UE to peer UE

Table 10.3.19.1.1: PROSE DIRECT LINK IDENTIFIER UPDATE ACCEPT message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	PROSE DIRECT LINK IDENTIFIER UPDATE ACCEPT message identity	ProSe PC5 signalling message type 11.3.1	M	V	1
	Sequence number	Sequence number 11.3.2	M	V	1
	LSB of $K_{NRP-sess}$ ID	LSB of $K_{NRP-sess}$ ID 11.3.15	M	V	1
	MSB of $K_{NRP-sess}$ ID	MSB of $K_{NRP-sess}$ ID 11.3.13	M	V	1
	Source layer-2 ID	Layer-2 ID 11.3.25	M	V	3
	Target layer-2 ID	Layer-2 ID 11.3.25	M	V	3
28	Target user info	Application layer ID 11.3.4	O	TLV	3-257
61	Target link local IPv6 address	Link local IPv6 address 11.3.7	O	TV	17
27	Source user info	Application layer ID 11.3.4	O	TLV	3-257
60	Source link local IPv6 address	Link local IPv6 address 11.3.7	O	TV	17

10.3.19.2 Target user info

This IE is included if the target UE receives the Source user info IE in the PROSE DIRECT LINK IDENTIFIER UPDATE REQUEST message.

10.3.19.3 Target link local IPv6 address

This IE is included if the target UE receives the Source link local IPv6 address IE in the PROSE DIRECT LINK IDENTIFIER UPDATE REQUEST message.

10.3.19.4 Source user info

This IE is included when the application layer ID changes at the target UE and the target UE receives a new application layer ID from the upper layers.

10.3.19.5 Source link local IPv6 address

This IE is included when the link local IPv6 address changes at the target UE and the target UE receives a new Link local IPv6 address from the upper layers, and the 5G ProSe direct link is not for 5G ProSe direct communication between 5G ProSe layer-2 remote UE and 5G ProSe layer-2 UE-to-network relay UE.

10.3.20 ProSe direct link identifier update ack

10.3.20.1 Message definition

This message is sent by the initiating UE to target UE to indicate that the initiating UE has received target UE's accept message. See table 10.3.20.1.1.

Message type: PROSE DIRECT LINK IDENTIFIER UPDATE ACK

Significance: dual

Direction: UE to peer UE

Table 10.3.20.1.1: PROSE DIRECT LINK IDENTIFIER UPDATE ACK message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	PROSE DIRECT LINK IDENTIFIER UPDATE ACK message identity	ProSe PC5 signalling message type 11.3.1	M	V	1
	Sequence number	Sequence number 11.3.2	M	V	1
	LSB of $K_{NRP-sess}$ ID	LSB of $K_{NRP-sess}$ ID 11.3.15	M	V	1
	Target layer-2 ID	Layer-2 ID 11.3.25	M	V	3
28	Target user info	Application layer ID 11.3.4	O	TLV	3-257
61	Target link local IPv6 address	Link local IPv6 address 11.3.7	O	TV	17

10.3.20.2 Target user info

This IE is included when the initiating UE receives the Source user info IE in the PROSE DIRECT LINK IDENTIFIER UPDATE ACCEPT message.

10.3.20.3 Target link local IPv6 address

This IE is included when the initiating UE receives the Source link local IPv6 address IE in the PROSE DIRECT LINK IDENTIFIER UPDATE ACCEPT message.

10.3.21 ProSe direct link identifier update reject

10.3.21.1 Message definition

This message is sent by the target UE to initiating UE to indicate that the link identifier update request is not accepted. See table 10.3.21.1.1.

Message type: PROSE DIRECT LINK IDENTIFIER UPDATE REJECT

Significance: dual

Direction: UE to peer UE

Table 10.3.21.1.1: PROSE DIRECT LINK IDENTIFIER UPDATE REJECT message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	PROSE DIRECT LINK IDENTIFIER UPDATE REJECT message identity	ProSe PC5 signalling message type 11.3.1	M	V	1
	Sequence number	Sequence number 11.3.2	M	V	1
	PC5 signalling protocol cause	PC5 signalling protocol cause 11.3.8	M	V	1

10.3.22 ProSe direct link modification reject

10.3.22.1 Message definition

This message is sent by the UE to another peer UE to indicate that the link modification request is not accepted. See table 10.3.22.1.1.

Message type: PROSE DIRECT LINK MODIFICATION REJECT

Significance: dual

Direction: UE to peer UE

Table 10.3.22.1.1: PROSE DIRECT LINK MODIFICATION REJECT message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	PROSE DIRECT LINK MODIFICATION REJECT message identity	ProSe PC5 signalling message type 11.3.1	M	V	1
	Sequence number	Sequence number 11.3.2	M	V	1
	PC5 signalling protocol cause	PC5 signalling protocol cause 11.3.8	M	V	1

10.3.23 ProSe direct link authentication failure

10.3.23.1 Message definition

This message is sent by a UE to another peer UE to reject a PROSE DIRECT LINK AUTHENTICATION RESPONSE message. See table 10.3.23.1.1.

Message type: PROSE DIRECT LINK AUTHENTICATION FAILURE

Significance: dual

Direction: UE to peer UE

Table 10.3.23.1.1: PROSE DIRECT LINK AUTHENTICATION FAILURE message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	PROSE DIRECT LINK AUTHENTICATION FAILURE message identity	ProSe PC5 signalling message type 11.3.1.	M	V	1
	Sequence number	Sequence number 11.3.2	M	V	1
74	Key establishment information container	Key establishment information container 11.3.9	O	TLV-E	4-65538

10.3.23.2 Key establishment information container

The UE shall include this IE if it is provided by upper layers.

10.3.24 ProSe additional parameters announcement request

10.3.24.1 Message definition

This message is sent by the 5G ProSe layer-3 remote UE to 5G ProSe layer-3 UE-to-network relay UE to initiate the ProSe additional parameters announcement request procedure. See table 10.3.24.1.1.

Message type: PROSE ADDITIONAL PARAMETERS ANNOUNCEMENT REQUEST

Significance: dual

Direction: UE to peer UE

Table 10.3.24.1.1: PROSE ADDITIONAL PARAMETERS ANNOUNCEMENT REQUEST content

IEI	Information Element	Type/Reference	Presence	Format	Length
	PROSE ADDITIONAL PARAMETERS ANNOUNCEMENT REQUEST identity	ProSe PC5 signalling message type 11.3.1	M	V	1
	Sequence Number	Sequence Number 11.3.2	M	V	1

10.3.25 ProSe additional parameters announcement response

10.3.25.1 Message definition

This message is sent by the 5G ProSe layer-3 UE-to-network relay UE to the 5G ProSe layer-3 remote UE to acknowledge and respond to the ProSe additional parameters announcement request. See table 10.3.25.1.1.

Message type: PROSE ADDITIONAL PARAMETERS ANNOUNCEMENT RESPONSE

Significance: dual

Direction: UE to peer UE

Table 10.3.25.1.1: PROSE ADDITIONAL PARAMETERS ANNOUNCEMENT RESPONSE content

IEI	Information Element	Type/Reference	Presence	Format	Length
	PROSE ADDITIONAL PARAMETERS ANNOUNCEMENT RESPONSE identity	ProSe PC5 signalling message type 11.3.1	M	V	1
	Sequence Number	Sequence number 11.3.2	M	V	1
	Additional parameters announcement request refresh timer T5106	Binary 11.3.28	M	V	2

10.4 Provisioning of 5G ProSe configuration information signalling messages

10.4.1 UE policy provisioning request

The UE POLICY PROVISIONING REQUEST message is sent by the UE to the PCF to request the PCF to manage ProSeP, see 3GPP TS 24.587 [18] clause 7.2.1 for the message definition.

10.4.2 UE policy provisioning reject

The UE POLICY PROVISIONING REJECT message is sent by the PCF to the UE to report that the PCF rejects the request to manage ProSeP, see 3GPP TS 24.587 [18] clause 7.2.2 for the message definition.

10.5 5G ProSe discovery messages over PC3a

10.5.1 General

This clause defines the XML schema and MIME type related to 5G ProSe direct discovery messages.

10.5.2 application/3gpp-5gprose+xml

The MIME type is used to carry information related to the 5G ProSe discovery operation. It shall be coded as an XML document containing one of the following 5G ProSe discovery messages:

a) DISCOVERY_REQUEST;

b) DISCOVERY_RESPONSE;

c) MATCH_REPORT;

d) MATCH_REPORT_ACK;

e) DISCOVERY_UPDATE_REQUEST;

f) DISCOVERY_UPDATE_RESPONSE;

g) ANNOUNCING_ALERT_REQUEST; or

h) ANNOUNCING_ALERT_RESPONSE.

Each of those messages is presented in the XML document as an XML element named after the corresponding message.

10.5.3 XML schema

Implementations in compliance with the present document shall implement the XML schema defined below for messages used in 5G ProSe direct discovery procedures over PC3a interface.

```
<?xml version="1.0" encoding="UTF-8"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema"
           xmlns="urn:3GPP:ns:5GProSe:Discovery:2021"
           elementFormDefault="qualified"
           targetNamespace="urn:3GPP:ns:5GProSe:Discovery:2021">
       <xs:annotation>
           <xs:documentation>
               Info for 5G ProSe Discovery Control Messages Syntax
           </xs:documentation>
       </xs:annotation>


  <!-- Complex types defined for parameters with complicated structure -->

  <xs:complexType name="AppID-info">
    <xs:sequence>
      <xs:element name="OS-ID">
        <xs:simpleType>
          <xs:restriction base="xs:hexBinary">
            <xs:length value="16"/>
          </xs:restriction>
        </xs:simpleType>
      </xs:element>
      <xs:element name="OS-App-ID" type="xs:string"/>
      <xs:any namespace="##any" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>

  <xs:complexType name="PLMN-info">
    <xs:sequence>
      <xs:element name="mcc" type="xs:integer"/>
        <xs:element name="mnc" type="xs:integer"/>
      <xs:any namespace="##any" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>

  <xs:complexType name="SUPI-info">
    <xs:sequence>
      <xs:element name="MCC" type="xs:integer"/>
      <xs:element name="MNC" type="xs:integer"/>
      <xs:element name="MSIN" type="xs:integer"/>
      <xs:any namespace="##any" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
```

```
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>

  <xs:complexType name="DiscFilter-info">
    <xs:sequence>
      <xs:element name="ProSe-Application-Code" type="xs:hexBinary"/>
      <xs:element name="ProSe-Application-Mask" type="xs:hexBinary" maxOccurs="unbounded"/>
      <xs:element name="TTL-timer-T5064" type="xs:integer"/>
      <xs:any namespace="##any" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>

<xs:complexType name="MatchingFilter-info">
    <xs:sequence>
      <xs:element name="Code" type="xs:hexBinary"/>
      <xs:element name="Mask" type="xs:hexBinary" maxOccurs="unbounded"/>
      <xs:element name="anyExt" type="anyExtType" minOccurs="0"/>
      <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>

<xs:complexType name="DUCK-info">
    <xs:sequence>
         <xs:element name="discovery-user-confidentiality-key" type="xs:hexBinary"/>
         <xs:element name="encrypted-bitmask" type="xs:hexBinary"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
</xs:complexType>


  <xs:complexType name="RestrictedDiscFilter-info">
    <xs:sequence>
       <xs:element name="filter" type="MatchingFilter-info" maxOccurs="unbounded"/>
      <xs:element name="TTL-timer-T5066" type="xs:integer"/>
      <xs:element name="RPAUID" type="xs:string" minOccurs="0" />
      <xs:element name="metadata-indicator" type="xs:integer" minOccurs="0"/>
      <xs:element name="metadata" type="xs:string" minOccurs="0"/>
       <xs:element name="anyExt" type="anyExtType" minOccurs="0"/>
       <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>

  <xs:complexType name="RestrictedCodeSuffixRange-info">
    <xs:sequence>
       <xs:element name="beginning-suffix-code" type="xs:hexBinary" />
       <xs:element name="ending-suffix-code" type="xs:hexBinary" minOccurs="0"/>
       <xs:element name="anyExt" type="anyExtType" minOccurs="0"/>
       <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>


  <xs:complexType name="RestrictedMonitoringUpdate-info">
    <xs:sequence>
      <xs:element name="updated-filter" type="RestrictedDiscFilter-info" maxOccurs="unbounded"/>
      <xs:element name="anyExt" type="anyExtType" minOccurs="0"/>
      <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>


  <xs:complexType name="RestrictedAnnouncingUpdate-info">
    <xs:sequence>
      <xs:element name="ProSe-Restricted-Code" type="xs:hexBinary" />
      <xs:element name="validity-timer-T5062" type="xs:integer" />
      <xs:any namespace="##any" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>

  <xs:complexType name="MonitoringUpdate-info">
    <xs:sequence>
      <xs:element name="updated-filter" type="DiscFilter-info" maxOccurs="unbounded"/>
```

```
      <xs:element name="anyExt" type="anyExtType" minOccurs="0"/>
      <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>

  <xs:complexType name="AnnouncingUpdate-info">
    <xs:sequence>
      <xs:element name="ProSe-Application-Code" type="xs:hexBinary" />
      <xs:element name="validity-timer-T5060" type="xs:integer" />
      <xs:any namespace="##any" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>

  <xs:complexType name="Update-Option-info">
    <xs:choice>
      <xs:element name="update-info-restricted-announce" type="RestrictedAnnouncingUpdate-info" />
      <xs:element name="update-info-restricted-monitor" type="RestrictedMonitoringUpdate-info" />
      <xs:element name="update-info-open-annnounce" type="AnnouncingUpdate-info" />
      <xs:element name="update-info-open-monitor" type="MonitoringUpdate-info"/>
      <xs:element name="anyExt" type="anyExtType" />
      <xs:any namespace="##other" processContents="lax"/>
    </xs:choice>
  </xs:complexType>

  <xs:complexType name="Restricted-Code-Option-info">
    <xs:choice>
      <xs:element name="ProSe-Restricted-Code" type="xs:hexBinary" />
      <xs:element name="ProSe-Response-Code" type="xs:hexBinary" />
      <xs:element name="anyExt" type="anyExtType" />
      <xs:any namespace="##other" processContents="lax"/>
    </xs:choice>
  </xs:complexType>


  <xs:complexType name="Subquery-info">
    <xs:sequence>
     <xs:element name="ProSe-Rquery-Code" type="xs:hexBinary" />
      <xs:element name="response-filter" type="MatchingFilter-info" maxOccurs="unbounded"/>
      <xs:element name="validity-timer-T5070" type="xs:integer"/>
      <xs:element name="code-sending-security-parameter" type="Restricted-Security-info" />
      <xs:element name="code-receiving-security-parameter" type="Restricted-Security-info"
minOccurs="0" />
      <xs:element name="RPAUID" type="xs:string" minOccurs="0" />
     <xs:element name="metadata" type="xs:string" minOccurs="0"/>
      <xs:element name="anyExt" type="anyExtType" minOccurs="0"/>
      <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>


  <xs:complexType name="Restricted-Security-info">
    <xs:sequence>
      <xs:element name="DUSK" type="xs:hexBinary" minOccurs="0" />
      <xs:element name="DUIK" type="xs:hexBinary" minOccurs="0" />
      <xs:element name="DUCK" type="DUCK-info" minOccurs="0" />
      <xs:element name="MIC-check-indicator" type="xs:boolean" minOccurs="0" />
      <xs:element name="anyExt" type="anyExtType" minOccurs="0"/>
      <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>

  <xs:complexType name="ApplicationCodeSuffixRange-info">
    <xs:sequence>
       <xs:element name="beginning-suffix-code" type="xs:hexBinary" />
       <xs:element name="ending-suffix-code" type="xs:hexBinary" minOccurs="0"/>
       <xs:element name="anyExt" type="anyExtType" minOccurs="0"/>
       <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>

  <xs:complexType name="ProSeApplicationCodeACE-info">
    <xs:sequence>
       <xs:element name=" ProSe-Application-Code-Prefix" type="xs:hexBinary" />
```

```
       <xs:element name=" ProSe-Application-Code-Suffix-Range" type="ApplicationCodeSuffixRange-
info" maxOccurs="unbounded" />
       <xs:element name="anyExt" type="anyExtType" minOccurs="0"/>
       <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>

  <xs:complexType name="PC5-Security-Policies-info">
    <xs:sequence>
      <xs:element name="signalling-integrity-protection-policy" type="xs:integer"/>
      <xs:element name="signalling-ciphering-policy" type="xs:integer"/>
      <xs:element name="user-plane-integrity-protection-policy" type="xs:integer"/>
      <xs:element name="user-plane-ciphering-policy" type="xs:integer"/>
      <xs:any namespace="##any" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>


  <!-- Complex types defined for transaction-level -->

  <xs:complexType name="AnnounceRsp-info">
    <xs:sequence>
      <xs:element name="transaction-ID" type="xs:integer"/>
      <xs:element name="ProSe-Application-Code" type="xs:hexBinary" minOccurs="0"
maxOccurs="unbounded"/>
      <xs:element name="ProSe-Application-Code-ACE" type="ProSeApplicationCodeACE-info"
minOccurs="0"/>
      <xs:element name="validity-timer-T5060" type="xs:integer" minOccurs="0" />
      <xs:element name="discovery-key" type="xs:hexBinary" minOccurs="0" />
      <xs:element name="discovery-entry-ID" type="xs:integer" minOccurs="0" />
      <xs:element name="ACE-enabled-indicator" type="xs:integer" minOccurs="0"/>
     <xs:element name="anyExt" type="anyExtType" minOccurs="0"/>
      <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>

  <xs:complexType name="MonitorRsp-info">
    <xs:sequence>
      <xs:element name="transaction-ID" type="xs:integer"/>
      <xs:element name="discovery-filter" type="DiscFilter-info" minOccurs="0"
maxOccurs="unbounded"/>
      <xs:element name="discovery-entry-ID" type="xs:integer" minOccurs="0" />
      <xs:element name="ACE-enabled-indicator" type="xs:integer" minOccurs="0"/>
      <xs:element name="anyExt" type="anyExtType" minOccurs="0"/>
      <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>


  <xs:complexType name="DiscReq-info">
    <xs:sequence>
      <xs:element name="transaction-ID" type="xs:integer"/>
      <xs:element name="command" type="xs:integer"/>
      <xs:element name="UE-identity" type="SUPI-info"/>
      <xs:element name="ProSe-Application-ID" type="xs:string"/>
      <xs:element name="application-identity" type="AppID-info"/>
      <xs:element name="discovery-entry-ID" type="xs:integer" minOccurs="0" />
      <xs:element name="Requested-Timer" type="xs:integer" minOccurs="0" />
      <xs:element name="metadata" type="xs:string" minOccurs="0"/>
      <xs:element name="Announcing-PLMN-ID" type="PLMN-info" minOccurs="0" />
      <xs:element name="ACE-enabled-indicator" type="xs:integer" minOccurs="0"/>
      <xs:element name="anyExt" type="anyExtType" minOccurs="0"/>
      <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>

  <xs:complexType name="RestrictedDiscReq-info">
    <xs:sequence>
      <xs:element name="transaction-ID" type="xs:integer"/>
      <xs:element name="command" type="xs:integer"/>
      <xs:element name="UE-identity" type="SUPI-info"/>
      <xs:element name="RPAUID" type="xs:string"/>
      <xs:element name="application-identity" type="AppID-info"/>
```

```
      <xs:element name="discovery-type" type="xs:integer"/>
      <xs:element name="ACE-enabled-indicator" type="xs:integer" minOccurs="0"/>
      <xs:element name="announcing-type" type="xs:integer" minOccurs="0"/>
      <xs:element name="application-level-container" type="xs:hexBinary" minOccurs="0"/>
      <xs:element name="discovery-model" type="xs:integer" minOccurs="0"/>
      <xs:element name="Announcing-PLMN-ID" type="PLMN-info" minOccurs="0" />
      <xs:element name="discovery-entry-ID" type="xs:integer"/>
      <xs:element name="Requested-Timer" type="xs:integer" minOccurs="0" />
      <xs:element name="anyExt" type="anyExtType" minOccurs="0"/>
      <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>

  <xs:complexType name="RestrictedAnnounceRsp-info">
    <xs:sequence>
      <xs:element name="transaction-ID" type="xs:integer"/>
      <xs:element name="ProSe-Restricted-Code" type="xs:hexBinary" minOccurs="0"/>
      <xs:element name="ProSe-Restricted-Code-Suffix-Range" type="RestrictedCodeSuffixRange-info"
minOccurs="0"/>
      <xs:element name="validity-timer-T5062" type="xs:integer" minOccurs="0"/>
      <xs:element name="ACE-enabled-indicator" type="xs:integer" minOccurs="0" />
      <xs:element name="code-sending-security-parameter" type="Restricted-Security-info" />
      <xs:element name="on-demand-announcing-enabled-indicator" type="xs:boolean" minOccurs="0" />
      <xs:element name="discovery-entry-ID" type="xs:integer"/>
      <xs:element name="PC5-security-policies" type="xs:PC5-Security-Policies-info" minOccurs="0" />
     <xs:element name="anyExt" type="anyExtType" minOccurs="0"/>
      <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>

  <xs:complexType name="RestrictedMonitorRsp-info">
    <xs:sequence>
      <xs:element name="transaction-ID" type="xs:integer"/>
      <xs:element name="restricted-discovery-filter" type="RestrictedDiscFilter-info" minOccurs="0"
maxOccurs="unbounded"/>
      <xs:element name="ACE-enabled-indicator" type="xs:integer" minOccurs="0" />
      <xs:element name="application-level-container" type="xs:hexBinary"/>
      <xs:element name="code-receiving-security-parameter" type="Restricted-Security-info"
minOccurs="0" />
      <xs:element name="discovery-entry-ID" type="xs:integer"/>
      <xs:element name="PC5-security-policies" type="xs:PC5-Security-Policies-info" minOccurs="0" />
     <xs:element name="anyExt" type="anyExtType" minOccurs="0"/>
      <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>


  <xs:complexType name="RestrictedDiscovereeRsp-info">
    <xs:sequence>
      <xs:element name="transaction-ID" type="xs:integer"/>
      <xs:element name="ProSe-Response-Code" type="xs:hexBinary" />
      <xs:element name="query-filter" type="MatchingFilter-info" maxOccurs="unbounded"/>
      <xs:element name="validity-timer-T5068" type="xs:integer"/>
      <xs:element name="code-sending-security-parameter" type="Restricted-Security-info" />
      <xs:element name="code-receiving-security-parameter" type="Restricted-Security-info"
minOccurs="0" />
      <xs:element name="discovery-entry-ID" type="xs:integer"/>
      <xs:element name="PC5-security-policies" type="xs:PC5-Security-Policies-info" minOccurs="0" />
     <xs:element name="anyExt" type="anyExtType" minOccurs="0"/>
      <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>

  <xs:complexType name="RestrictedDiscovererRsp-info">
    <xs:sequence>
      <xs:element name="transaction-ID" type="xs:integer"/>
      <xs:element name="subquery-result" type="Subquery-info" minOccurs="1" maxOccurs="unbounded"/>
      <xs:element name="discovery-entry-ID" type="xs:integer"/>
      <xs:element name="PC5-security-policies" type="xs:PC5-Security-Policies-info" minOccurs="0" />
     <xs:element name="anyExt" type="anyExtType" minOccurs="0"/>
      <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>
```

```
<xs:complexType name="RejectRsp-info">
  <xs:sequence>
    <xs:element name="transaction-ID" type="xs:integer"/>
    <xs:element name="PC3a-control-protocol-cause-value" type="xs:integer"/>
    <xs:any namespace="##any" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
  </xs:sequence>
  <xs:anyAttribute namespace="##any" processContents="lax"/>
</xs:complexType>

<xs:complexType name="UE-RejectRsp-info">
  <xs:sequence>
    <xs:element name="DDNMF-transaction-ID" type="xs:integer"/>
    <xs:element name="PC3a-control-protocol-cause-value" type="xs:integer"/>
    <xs:any namespace="##any" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
  </xs:sequence>
  <xs:anyAttribute namespace="##any" processContents="lax"/>
</xs:complexType>

<xs:complexType name="MatchRep-info">
  <xs:sequence>
    <xs:element name="transaction-ID" type="xs:integer"/>
    <xs:element name="ProSe-Application-Code" type="xs:hexBinary"/>
    <xs:element name="UE-identity" type="SUPI-info"/>
    <xs:element name="Monitored-PLMN-ID" type="PLMN-info"/>
    <xs:element name="VPLMN-ID" type="PLMN-info" minOccurs="0"/>
    <xs:element name="MIC" type="xs:hexBinary"/>
    <xs:element name="UTC-based-counter" type="xs:hexBinary"/>
    <xs:element name="Metadata-flag" type="xs:boolean"/>
    <xs:element name="MessageType" type="xs:hexBinary" minOccurs="0"/>
   <xs:element name="anyExt" type="anyExtType" minOccurs="0"/>
    <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
  </xs:sequence>
  <xs:anyAttribute namespace="##any" processContents="lax"/>
</xs:complexType>

<xs:complexType name="RestrictedMatch-info">
  <xs:sequence>
    <xs:element name="transaction-ID" type="xs:integer"/>
    <xs:element name="UE-identity" type="SUPI-info"/>
    <xs:element name="discovery-type" type="xs:integer"/>
    <xs:element name="application-identity" type="AppID-info"/>
    <xs:element name="RPAUID" type="xs:string"/>
    <xs:element name="Restricted-Code-Discovered" type="Restricted-Code-Option-info" />
    <xs:element name="MIC" type="xs:hexBinary" minOccurs="0"/>
    <xs:element name="MessageType" type="xs:hexBinary" minOccurs="0"/>
    <xs:element name="UTC-based-counter" type="xs:hexBinary" minOccurs="0"/>
    <xs:element name="Metadata-flag" type="xs:boolean" />
   <xs:element name="anyExt" type="anyExtType" minOccurs="0"/>
    <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
  </xs:sequence>
  <xs:anyAttribute namespace="##any" processContents="lax"/>
</xs:complexType>

<xs:complexType name="MatchAck-info">
  <xs:sequence>
    <xs:element name="transaction-ID" type="xs:integer"/>
    <xs:element name="ProSe-Application-ID" type="xs:string"/>
    <xs:element name="validity-timer-T5072" type="xs:integer"/>
    <xs:element name="metadata" type="xs:string" minOccurs="0"/>
    <xs:element name="metadata-index-mask" type="xs:hexBinary" minOccurs="0"/>
    <xs:element name="anyExt" type="anyExtType" minOccurs="0"/>
    <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
  </xs:sequence>
  <xs:attribute name="match-report-refresh-timer-T5074" type="xs:integer"/>
  <xs:anyAttribute namespace="##any" processContents="lax"/>
</xs:complexType>


<xs:complexType name="RestrictedMatchAck-info">
  <xs:sequence>
    <xs:element name="transaction-ID" type="xs:integer"/>
    <xs:element name="application-identity" type="AppID-info"/>
    <xs:element name="RPAUID" type="xs:string"/>
    <xs:element name="validity-timer-T5076" type="xs:integer"/>
    <xs:element name="metadata" type="xs:string" minOccurs="0"/>
    <xs:element name="anyExt" type="anyExtType" minOccurs="0"/>
    <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
```

```
    </xs:sequence>
    <xs:attribute name="match-report-refresh-timer-T5077" type="xs:integer"/>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>

  <xs:complexType name="MatchReject-info">
    <xs:sequence>
      <xs:element name="transaction-ID" type="xs:integer"/>
      <xs:element name="PC3a-control-protocol-cause-value" type="xs:integer"/>
     <xs:any namespace="##any" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>

  <xs:complexType name="DiscUpdateReq-info">
    <xs:sequence>
      <xs:element name="DDNMF-transaction-ID" type="xs:integer"/>
      <xs:element name="UE-identity" type="SUPI-info"/>
      <xs:element name="discovery-entry-ID" type="xs:integer"/>
      <xs:element name="update-info" type="Update-Option-info" minOccurs="0"/>
      <xs:element name="anyExt" type="anyExtType" minOccurs="0"/>
      <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>

  <xs:complexType name="DiscUpdateRsp-info">
    <xs:sequence>
      <xs:element name="DDNMF-transaction-ID" type="xs:integer"/>
      <xs:element name="discovery-entry-ID" type="xs:integer"/>
      <xs:any namespace="##any" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>

  <xs:complexType name="AnnouncingAlertReq-info">
    <xs:sequence>
      <xs:element name="DDNMF-transaction-ID" type="xs:integer"/>
      <xs:element name="RPAUID" type="xs:string"/>
      <xs:element name="UE-identity" type="SUPI-info"/>
      <xs:element name="discovery-entry-ID" type="xs:integer"/>
      <xs:element name="ProSe-Restricted-Code" type="xs:hexBinary"/>
      <xs:element name="ProSe-Restricted-Code-Suffix-Range" type="RestrictedCodeSuffixRange-info"
minOccurs="0" maxOccurs="unbounded"/>
      <xs:element name="anyExt" type="anyExtType" minOccurs="0"/>
      <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>

  <xs:complexType name="AnnouncingAlertRsp-info">
    <xs:sequence>
      <xs:element name="DDNMF-transaction-ID" type="xs:integer"/>
      <xs:any namespace="##any" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>

  <!-- Complex types defined for Message-level -->

  <xs:complexType name="prose-direct-discovery-request">
    <xs:sequence>
     <xs:element name="discovery-request" type="DiscReq-info" minOccurs="0" maxOccurs="unbounded"/>
     <xs:element name="restricted-discovery-request" type="RestrictedDiscReq-info" minOccurs="0"
maxOccurs="unbounded"/>
     <xs:element name="anyExt" type="anyExtType" minOccurs="0"/>
     <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:attribute name="network-initiated-transaction-method" type="xs:integer"/>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>

  <xs:complexType name="prose-direct-discovery-response">
    <xs:sequence>
      <xs:element name="Current-Time" type="xs:dateTime"/>
      <xs:element name="Max-Offset" type="xs:integer"/>
      <xs:element name="response-announce" type="AnnounceRsp-info" minOccurs="0"
maxOccurs="unbounded"/>
```

```
      <xs:element name="response-monitor" type="MonitorRsp-info" minOccurs="0"
maxOccurs="unbounded"/>
      <xs:element name="restricted-announce-response" type="RestrictedAnnounceRsp-info"
minOccurs="0" maxOccurs="unbounded"/>
      <xs:element name="restricted-monitor-response" type="RestrictedMonitorRsp-info" minOccurs="0"
maxOccurs="unbounded"/>
      <xs:element name="restricted-discoveree-response" type="RestrictedDiscovereeRsp-info"
minOccurs="0" maxOccurs="unbounded"/>
      <xs:element name="restricted-discoverer-response" type="RestrictedDiscovererRsp-info"
minOccurs="0" maxOccurs="unbounded"/>
      <xs:element name="response-reject" type="RejectRsp-info" minOccurs="0" maxOccurs="unbounded"/>
      <xs:element name="anyExt" type="anyExtType" minOccurs="0"/>
      <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:attribute name="network-initiated-transaction-method" type="xs:integer"/>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>

  <xs:complexType name="prose-direct-discovery-update-request">
    <xs:sequence>
     <xs:element name="discovery-update-request" type="DiscUpdateReq-info" maxOccurs="unbounded"/>
     <xs:element name="anyExt" type="anyExtType" minOccurs="0"/>
     <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>

  <xs:complexType name="prose-direct-discovery-update-response">
    <xs:sequence>
      <xs:element name="response-update" type="DiscUpdateRsp-info" minOccurs="0"
maxOccurs="unbounded"/>
      <xs:element name="response-reject" type="UE-RejectRsp-info" minOccurs="0"
maxOccurs="unbounded"/>
      <xs:element name="anyExt" type="anyExtType" minOccurs="0"/>
      <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>

  <xs:complexType name="prose-direct-discovery-match-report">
    <xs:sequence>
     <xs:element name="match-report" type="MatchRep-info" minOccurs="0" maxOccurs="unbounded"/>
     <xs:element name="restricted-match" type="RestrictedMatch-info" minOccurs="0"
maxOccurs="unbounded"/>
     <xs:element name="anyExt" type="anyExtType" minOccurs="0"/>
     <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>

  <xs:complexType name="prose-direct-discovery-match-report-ack">
    <xs:sequence>
      <xs:element name="Current-Time" type="xs:dateTime"/>
      <xs:element name="match-ack" type="MatchAck-info" minOccurs="0" maxOccurs="unbounded"/>
      <xs:element name="match-reject" type="MatchReject-info" minOccurs="0" maxOccurs="unbounded"/>
      <xs:element name="restricted-match-ack" type="RestrictedMatchAck-info" minOccurs="0"
maxOccurs="unbounded"/>
      <xs:element name="anyExt" type="anyExtType" minOccurs="0"/>
      <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>

  <xs:complexType name="prose-direct-discovery-announcing-alert-request">
    <xs:sequence>
     <xs:element name="announcing-alert-request" type="AnnouncingAlertReq-info"
maxOccurs="unbounded"/>
     <xs:element name="anyExt" type="anyExtType" minOccurs="0"/>
     <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>

  <xs:complexType name="prose-direct-discovery-announcing-alert-response">
    <xs:sequence>
     <xs:element name="announcing-alert-response" type="AnnouncingAlertRsp-info"
maxOccurs="unbounded"/>
```

```
      <xs:element name="response-reject" type="UE-RejectRsp-info" minOccurs="0"
maxOccurs="unbounded"/>
     <xs:element name="anyExt" type="anyExtType" minOccurs="0"/>
     <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>

  <!--  extension allowed -->
  <xs:complexType name="DiscMsgExtType">
    <xs:sequence>
      <xs:any namespace="##any" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>

  <!--  XML attribute for any future extensions  -->
  <xs:complexType name="anyExtType">
    <xs:sequence>
      <xs:any namespace="##any" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
  </xs:complexType>


<!--  Top levelDiscovery Message definition  -->
  <xs:element name="prose-discovery-message">
    <xs:complexType>
      <xs:choice>
        <xs:element name="DISCOVERY_REQUEST" type="prose-direct-discovery-request"/>
        <xs:element name="DISCOVERY_RESPONSE" type="prose-direct-discovery-response"/>
        <xs:element name="MATCH_REPORT" type="prose-direct-discovery-match-report"/>
        <xs:element name="MATCH_REPORT_ACK" type="prose-direct-discovery-match-report-ack"/>
        <xs:element name="DISCOVERY_UPDATE_REQUEST" type="prose-direct-discovery-update-request"/>
        <xs:element name="DISCOVERY_UPDATE_RESPONSE" type="prose-direct-discovery-update-response"/>
        <xs:element name="ANNOUNCING_ALERT_REQUEST" type="prose-direct-discovery-announcing-alert-
request"/>
        <xs:element name="ANNOUNCING_ALERT_RESPONSE" type="prose-direct-discovery-announcing-alert-
response"/>

        <xs:element name="message-ext" type="DiscMsgExtType"/>
        <xs:any namespace="##other" processContents="lax"/>
      </xs:choice>
    </xs:complexType>
  </xs:element>

</xs:schema>
```

An entity receiving the XML body ignores any unknown XML element and any unknown XML attribute.

10.5.4 Semantics

10.5.4.1 General

The <prose-discovery-message> element is the root element of this XML document and it can be one of the following elements:

a) <DISCOVERY_REQUEST>;

b) <DISCOVERY_RESPONSE>;

c) <MATCH_REPORT>;

d) <MATCH_REPORT_ACK>;

e) <DISCOVERY_UPDATE_REQUEST>;

f) <DISCOVERY_UPDATE_RESPONSE>

g) <ANNOUNCE_ALERT_REQUEST>;

h) <ANNOUNCE_ALERT_RESPONSE>;

i) <message-ext> element containing other discovery message defined in future releases; or

j) an element from other namespaces defined in future releases.

10.5.4.2 Semantics of <DISCOVERY_REQUEST>

The <DISCOVERY_REQUEST> element contains one or more of the following elements:

a) zero, one or more <discovery-request> element which contains transactions sent from the UE to the 5G DDNMF as announcing or monitoring requests for open 5G ProSe direct discovery. Each <discovery-request> consists of:

1) a <transaction-ID> element containing the parameter defined in clause 11.4.2.1;

2) a <command> element containing the parameter defined in clause 11.4.2.2;

3) a <UE-identity> element containing the parameter defined in clause 11.4.2.3;

4) a <Prose-Application-ID> element containing the parameter defined in clause 11.4.2.4;

5) an <application-identity> element containing the parameter defined in clause 11.4.2.5;

6) a <Discovery-Entry-ID> element containing the parameter defined in clause 11.4.2.26;

7) an optional <Requested-Timer> element containing the parameter defined in clause 11.4.2.20;

8) an optional <metadata> element containing the parameter defined in clause 11.4.2.15;

9) an optional <Announcing-PLMN-ID> element containing the parameter defined in clause 11.4.2.43;

10) zero or one <ACE-enabled-indicator> element containing the parameter defined in clause 11.4.2.31;

11) zero or one <anyExt> element containing elements defined in future releases;

12) zero, one or more elements from other namespaces defined in future releases; and

13) zero, one or more attributes defined in future releases;

b) zero, one, or more <restricted-discovery-request> element which contains transactions sent from the UE to the 5G DDNMF as announcing or monitoring requests for restricted 5G ProSe directed discovery model A or transactions sent from the UE to the 5G DDNMF as discoveree or discoverer requests for restricted 5G ProSe directed discovery model B. Each <restricted-discovery-request> consists of:

1) a <transaction-ID> element containing the parameter defined in clause 11.4.2.1;

2) a <command> element containing the parameter defined in clause 11.4.2.2;

3) a <UE-identity> element containing the parameter defined in clause 11.4.2.3;

4) a <RPAUID> element containing the parameter defined in clause 11.4.2.23;

5) an <application-identity> element containing the parameter defined in clause 11.4.2.5;

6) a <discovery-type> element containing the parameter defined in clause 11.4.2.18;

7) zero or one <ACE-enabled-indicator> element containing the parameter defined in clause 11.4.2.31;

8) an <announcing-type> element containing the parameter defined in clause 11.4.2.24;

9) an <application-level-container> element containing the parameter defined in clause 11.4.2.25;

10) zero or one <discovery-model> element containing the parameter defined in clause 11.4.2.34;

11) zero or one <Announcing-PLMN-ID> element containing the parameter defined in clause 11.4.2.43;

12) a <discovery-entry-id> element containing the parameter defined in clause 11.4.2.26;

13) an optional <Requested-Timer> element containing the parameter defined in clause 11.4.2.20;

14) zero or one <anyExt> element containing elements defined in future releases;

15) zero, one or more elements from other namespaces defined in future releases; and

16) zero, one or more attributes defined in future releases;

c) zero or one <anyExt> element containing elements defined in future releases;

d) zero, one or more elements from other namespaces defined in future releases;

e) an optional "network-initiated transaction method" attribute containing the parameter defined in clause 11.4.2.42; and

f) zero, one or more attributes defined in future releases.

10.5.4.3 Semantics of <DISCOVERY_RESPONSE>

The <DISCOVERY_RESPONSE> element contains one or more of the following elements:

a) a <Current-Time> element containing the parameter defined in clause 11.4.2.16;

b) a <Max-Offset> element containing the parameter defined in clause 11.4.2.17;

c) zero, one or more <response-announce> element which contains transactions sent from the 5G DDNMF to the UE as a response to an announcing request if the 5G DDNMF accepts the request. Each <response-announce> consists of:

1) a <transaction-ID> element containing the parameter defined in clause 11.4.2.1;

2) zero, one or more <ProSe-Application-Code> elements containing the parameter defined in clause 11.4.2.6;

3) zero or one <ProSe application code-ACE> element containing the parameter defined in clause 11.4.2.45;

4) zero, or one <validity-timer-T5060> element containing the parameter defined in 11.4.2.7;

5) zero, or, one <discovery-key> element containing the parameter defined in clause 11.4.2.48;

6) a <discovery-entry-ID> element containing the parameter defined in clause 11.4.2.26;

7) zero or one <ACE-enabled-indicator> element containing the parameter defined in clause 11.4.2.31;

8) zero or one <anyExt> element containing elements defined in future releases;

9) zero, one or more elements from other namespaces defined in future releases; and

10) zero, one or more attributes defined in future releases;

d) zero, one or more <response-monitor> element which contains transactions sent from the 5G DDNMF to the UE as a response to a monitoring request if the 5G DDNMF accepts the request. Each <response-monitor> consists of:

1) a <transaction-ID> element containing the parameter defined in clause 11.4.2.1;

2) zero, one or more <discovery-filter> elements containing the parameter defined in clause 11.4.2.9;

3) a <discovery-entry-ID> element containing the parameter defined in clause 11.4.2.26;

4) zero or one <ACE-enabled-indicator> element containing the parameter defined in clause 11.4.2.31;

5) zero or one <anyExt> element containing elements defined in future releases;

6) zero, one or more elements from other namespaces defined in future releases; and

7) zero, one or more attributes defined in future releases;

e) zero, one or more <restricted-announce-response> element which contains transactions sent from the 5G DDNMF to the UE as a response to an announcing request for restricted 5G ProSe direct discovery model A if the 5G DDNMF accepts the request. Each <restricted-announce-response> consists of:

1) a <transaction-ID> element containing the parameter defined in clause 11.4.2.1;

2) zero or one <ProSe-Restricted-Code> element containing the parameter defined in clause 11.4.2.27;

3) zero, one or more <ProSe-Restricted-Code-Suffix-Range> element containing the parameter defined in clause 11.4.2.28;

4) zero or one <validity-timer-T5062> element containing the parameter defined in 11.4.2.32;

5) zero or one <ACE-enabled-indicator> element containing the parameter defined in clause 11.4.2.31;

6) a <code-sending-security-parameter> element containing the parameter defined in clause 11.4.2.33;

7) zero or one <on-demand-announcing-enabled-indicator> element containing the parameter defined in clause 11.4.2.29;

8) a <discovery-entry-id> element containing the parameter defined in clause 11.4.2.26;

9) zero or one <PC5-security-policies> element containing the parameter defined in clause 11.4.2.49;

10) zero or one <anyExt> element containing elements defined in future releases;

11) zero, one or more elements from other namespaces defined in future releases; and

12) zero, one or more attributes defined in future releases;

f) zero, one or more <restricted-monitor-response> element which contains transactions sent from the 5G DDNMF to the UE as a response to a monitoring request for restricted 5G ProSe direct discovery model A if the 5G DDNMF accepts the request. Each <restricted-monitor-response> consists of:

1) a <transaction-ID> element containing the parameter defined in clause 11.4.2.1;

2) one or more <restricted-discovery-filter> elements containing the parameter defined in clause 11.4.2.30;

3) zero or one <ACE-enabled-indicator> element containing the parameter defined in clause 11.4.2.31

4) a <discovery-entry-id> element containing the parameter defined in clause 11.4.2.26;

5) an <application-level-container> element containing the parameter defined in clause 11.4.2.25;

6) one or more <code-receiving-security-parameter> element containing the parameter defined in clause 11.4.2.33;

7) zero or one <PC5-security-policies> element containing the parameter defined in clause 11.4.2.49;

8) zero or one <anyExt> element containing elements defined in future releases;

9) zero, one or more elements from other namespaces defined in future releases; and

10) zero, one or more attributes defined in future releases;

g) zero, one or more <restricted-discoveree-response> element which contains transactions sent from the 5G DDNMF to the UE as a response to a discoveree UE's request for restricted 5G ProSe direct discovery model B if the 5G DDNMF accepts the request. Each <restricted-discoveree-response> consists of:

1) a <transaction-ID> element containing the parameter defined in clause 11.4.2.1;

2) a <ProSe-Response-Code> element containing the element defined in clause11.4.2.35;

3) one or more <query-filter> elements containing the parameter defined in clause 11.4.2.36;

4) a <validity-timer-T5068> element containing the parameter defined in clause 11.4.2.37;

5) a <code-sending-security-material > element containing the parameter defined in clause 11.4.2.33;

6) one or more <code-receiving-security-parameter> element containing the parameter defined in clause 11.4.2.33;

7) a <discovery-entry-id> element containing the parameter defined in clause 11.4.2.26;

8) zero or one <PC5-security-policies> element containing the parameter defined in clause 11.4.2.49;

9) zero or one <anyExt> element containing elements defined in future releases;

10) zero, one or more elements from other namespaces defined in future releases; and

11) zero, one or more attributes defined in future releases;

h) zero, one or more <restricted-discoverer-response> element which contains transactions sent from the 5G DDNMF to the UE as a response to a discoverer UE's request for restricted 5G ProSe direct discovery model B if the 5G DDNMF accepts the request. Each <restricted-discoverer-response> consists of:

1) a <transaction-ID> element containing the parameter defined in clause 11.4.2.1;

2) one or more <subquery-result> elements containing the parameter defined in clause 11.4.2.38;

3) a <discovery-entry-id> element containing the parameter defined in clause 11.4.2.26;

4) zero or one <PC5-security-policies> element containing the parameter defined in clause 11.4.2.49;

5) zero or one <anyExt> element containing elements defined in future releases;

6) zero, one or more elements from other namespaces defined in future releases; and

7) zero, one or more attributes defined in future releases;

i) zero, one or more <response-reject> element which contains transactions sent from the 5G DDNMF to the UE as a response to an announcing or monitoring requests if the 5G DDNMF cannot accept the request. Each <response-reject> consists of:

1) a <transaction-ID> element containing the parameter defined in clause 11.4.2.1;

2) a <PC3a-control-protocol-cause-value> element containing the parameter defined in clause 11.4.2.8.

3) zero, one or more elements defined in future releases; and

4) zero, one or more attributes defined in future releases;

j) zero or one <anyExt> element containing elements defined in future releases;

k) zero, one or more elements from other namespaces defined in future releases;

l) an optional "network-initiated transaction method" attribute containing the parameter defined in clause 11.4.2.42; and

m) zero, one or more attributes defined in future releases.

10.5.4.4 Semantics of <MATCH_REPORT>

The <MATCH_REPORT> element contains one or more of the following elements:

a) zero, one or more <match-report> element which contains transactions sent from the UE to the 5G DDNMF to report a matching of the direct discovery. Each <match-report> consists of:

1) a <transaction-ID> element containing the parameter defined in clause 11.4.2.1;

2) a <ProSe-Application-Code> element containing the parameter defined in clause 11.4.2.6;

3) a <UE-identity> element containing the parameter defined in clause 11.4.2.3;

4) a <Monitored-PLMN-id> element containing the parameter defined in clause 11.4.2.10;

5) an optional <VPLMN-id> element containing the parameter defined in clause 11.4.2.11;

6) a <MIC> element containing the parameter defined in clause 11.4.2.11;

7) a <UTC-based-counter> element containing the parameter defined in clause 11.4.2.12;

8) a <metadata-flag> element containing the parameter defined in clause 11.4.2.14;

9) a <MessageType> element containing the parameter defined in clause 11.4.2.10;

10) zero or one <anyExt> element containing elements defined in future releases;

11) zero, one or more elements from other namespaces defined in future releases; and

12) zero, one or more attributes defined in future releases;

b) zero, one or more <restricted-match> element which contain transactions sent from the UE to the 5G DDNMF to report a matching of the restricted direct discovery model A or model B. Each <restricted-match> consists of:

1) a <transaction-ID> element containing the parameter defined in clause 11.4.2.1;

2) a <UE-identity> element containing the parameter defined in clause 11.4.2.3;

3) a <discovery-type> element containing the parameter defined in clause 11.4.2.18

4) an <application-identity> element containing the parameter defined in clause 11.4.2.5

5) an <RPAUID> element containing the parameter defined in clause 11.4.2.23;

6) a <Restricted-Code-Discovered> element containing the ProSe Restricted Code parameter defined in clause 11.4.2.27 or ProSe Response Code parameter defined in clause 11.4.2.35;

7) an optional <MIC> element containing the parameter defined in clause 11.4.2.11;

8) an optional <MessageType> element containing the parameter defined in clause 11.4.2.10;

9) an optional <UTC-based-counter> element containing the parameter defined in clause 11.4.2.12;

10) a <metadata-flag> element containing the parameter defined in clause 11.4.2.14;

11) zero or one <anyExt> element containing elements defined in future releases;

12) zero, one or more elements from other namespaces defined in future releases; and

13) zero, one or more attributes defined in future releases.

c) zero or one <anyExt> element containing elements defined in future releases;

d) zero, one or more elements from other namespaces defined in future releases; and

e) zero, one or more attributes defined in future releases.

10.5.4.5 Semantics of <MATCH_REPORT_ACK>

The <MATCH_REPORT_ACK> element contains one or more of the following elements:

a) a <Current-Time> element containing the parameter defined in clause 11.4.2.16;

b) zero, one or more <match-ack> element which contains transactions sent from the 5G DDNMF to the UE as a response to a match report if the 5G DDNMF accepts the report. Each <match-ack> consists of:

1) a <transaction-ID> element containing the parameter defined in clause 11.4.2.1;

2) a <ProSe-Application-ID> element containing the parameter defined in clause 11.4.2.4;

3) a <validity-timer-T5072> element containing the parameter defined in clause 11.4.2.13;

4) an optional <metadata> element containing the parameter defined in clause 11.4.2.15;

5) an optional <metadata-index-mask> element containing the parameter defined in clause 11.4.2.41;

6) a mandatory "match-report-refresh-timer-T5074" attribute containing the parameter defined in clause 11.4.2.19;

7) zero or one <anyExt> element containing elements defined in future releases;

8) zero, one or more elements from other namespaces defined in future releases; and

9) zero, one or more attributes defined in future releases;

c) zero, one or more <restricted-match-ack> element which contain transactions sent from the 5G DDNMF to the UE as a response to a match report if the 5G DDNMF accepts the report. Each <restricted-match-ack> consists of:

1) a <transaction-ID> element containing the parameter defined in clause 11.4.2.1;

2) an <application-identity> element containing the parameter defined in clause 11.4.2.5;

3) an <RPAUID> element containing the parameter defined in clause 11.4.2.23;

4) a <validity-timer-T5076> element containing the parameter defined in clause 11.4.2.39;

5) an optional <metadata> element containing the parameter defined in clause 11.4.2.15;

6) zero or one <anyExt> element containing elements defined in future releases;

7) zero, one or more elements from other namespaces defined in future releases;

8) an optional "match-report-refresh-timer-T5077" attribute containing the parameter defined in clause 11.4.2.40; and

9) zero, one or more attributes defined in future releases;

d) zero, one or more <match-reject> element which contains transactions sent from the 5G DDNMF to the UE as a response to a match report if the 5G DDNMF cannot accept the match report. Each <match-reject> consists of:

1) a <transaction-ID> element containing the parameter defined in clause 11.4.2.1;

2) a <PC3a-control-protocol-cause-value> element containing the parameter defined in clause 11.4.2.8;

3) zero, one or more elements defined in future releases; and

4) zero, one or more attributes defined in future releases;

e) zero or one <anyExt> element containing elements defined in future releases;

f) zero, one or more elements from other namespaces defined in future releases; and

g) zero, one or more attributes defined in future releases.

10.5.4.6 Semantics of < DISCOVERY_UPDATE_REQUEST>

The < DISCOVERY_UPDATE_REQUEST> element contains one or more of the following elements:

a) One or more <discovery-update-request> element which contains transactions sent from the 5G DDNMF to the UE as announcing or monitoring requests. Each <discovery-update-request> consists of:

1) a <DDNMF-transaction-ID> element containing the parameter defined in clause 11.4.2.21;

2) a <UE-identity> element containing the parameter defined in clause 11.4.2.3;

3) a <discovery-entry-id> element containing the parameter defined in clause 11.4.2.26;

4) an optional <update-info> element containing the parameter defined in clause 11.4.2.22;

5) zero or one <anyExt> element containing elements defined in future releases;

6) zero, one or more elements defined in future releases; and

7) zero, one or more attributes defined in future releases;

b) zero or one <anyExt> element containing elements defined in future releases;

c) zero, one or more elements from other namespaces defined in future releases; and

d) zero, one or more attributes defined in future releases.

10.5.4.7 Semantics of < DISCOVERY_UPDATE_RESPONSE>

The < DISCOVERY_UPDATE _RESPONSE> element contains one or more of the following elements:

a) one or more <response-update> element which contains transactions sent from the UE to the 5G DDNMF as a response if the UE accepts the request. Each <discovery-update-response> consists of:

1) a <DDNMF-transaction-ID> element containing the parameter defined in clause 11.4.2.21;

2) a <discovery-entry-id> element containing the parameter defined in clause 11.4.2.26;

3) zero, one or more elements defined in future releases; and

4) zero, one or more attributes defined in future releases;

b) zero, one or more <response-reject> element which contains transactions sent from the UE to the 5G DDNMF as a response if the UE cannot accept the request. Each <response-reject> consists of:

1) a <DDNMF-transaction-ID> element containing the parameter defined in clause 11.4.2.21;

2) a <PC3a-control-protocol-cause-value> element containing the parameter defined in clause 11.4.2.8.

3) zero, one or more elements defined in future releases; and

4) zero, one or more attributes defined in future releases;

c) zero or one <anyExt> element containing elements defined in future releases;

d) zero, one or more elements from other namespaces defined in future releases; and

e) zero, one or more attributes defined in future releases.

10.5.4.8 Semantics of <ANNOUNCING_ALERT_REQUEST>

The <ANNOUNCING_ALERT_REQUEST> element contains one or more of the following elements:

a) One or more <announcing-alert-request> element which contains transactions sent from the UE to the 5G DDNMF as announcing or monitoring requests. Each <announcing-alert-request> consists of:

1) a <DDNMF-transaction-ID> element containing the parameter defined in clause 11.4.2.21;

2) a <UE-identity> element containing the parameter defined in clause 11.4.2.3;

3) a <RPAUID> element containing the parameter defined in clause 11.4.2.23;

4) a <Discovery-Entry-ID> element containing the parameter defined in clause 11.4.2.26;

5) a <ProSe-Restricted-Code> element containing the parameter defined in clause 11.4.2.27;

6) zero, one or more <ProSe-Restricted-Code-Suffix-Range> element containing the parameter defined in clause 11.4.2.28;

7) zero or one <anyExt> element containing elements defined in future releases;

8) zero, one or more elements from other namespaces defined in future releases; and

9) zero, one or more attributes defined in future releases;

b) zero or one <anyExt> element containing elements defined in future releases;

c) zero, one or more elements from other namespaces defined in future releases; and

d) zero, one or more attributes defined in future releases.

10.5.4.9 Semantics of < ANNOUNCING_ALERT_RESPONSE >

The <ANNOUNCING_ALERT_RESPONSE> element contains one or more of the following elements:

a) One or more <announcing-alert-response> element which contains transactions sent from the UE to the 5G DDNMF as announcing or monitoring requests. Each <announcing-alert-response> consists of:

   1) a <DDNMF-transaction-ID> element containing the parameter defined in clause 11.4.2.21;

   2) zero, one or more elements defined in future releases; and

   3) zero, one or more attributes defined in future releases;

b) zero, one or more <response-reject> element which contains transactions sent from the UE to the 5G DDNMF as a response if the UE cannot accept the request. Each <response-reject> consists of:

   1) a <DDNMF-transaction-ID> element containing the parameter defined in clause 11.4.2.21;

   2) a <PC3a-control-protocol-cause-value> element containing the parameter defined in clause 11.4.2.8.

   3) zero, one or more elements defined in future releases; and

   4) zero, one or more attributes defined in future releases;

c) zero or one <anyExt> element containing elements defined in future releases;

d) zero, one or more elements from other namespaces defined in future releases; and

e) zero, one or more attributes defined in future releases.

11 Information elements coding

11.1 Overview

This clause contains general message format and information elements coding for the messages used in the procedures described in the present document.

11.2 5G ProSe direct discovery message formats

11.2.1 ProSe direct discovery PC5 message type

This parameter is used to indicate the type of ProSe direct discovery message over PC5 interface.

This parameter is coded as shown in figure 11.2.1.1 and table 11.2.1.1.

The ProSe direct discovery PC5 message type is a type 1 information element, with the length of 1 octet.

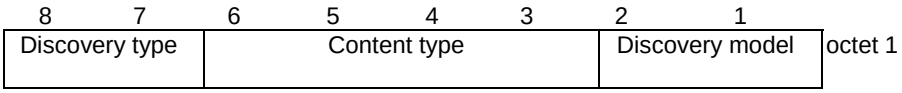

Figure 11.2.1.1: ProSe direct discovery PC5 message type parameter

Table 11.2.1.1: ProSe direct discovery PC5 message type parameter

Discovery type value (octet 1):
Bit

8	**7**	
0	0	Reserved
0	1	Open discovery
1	0	Restricted discovery
1	1	Reserved

Content type value (octet 1):
Bit

6	**5**	**4**	**3**	
0	0	0	0	Announcement/response
0	0	0	1	Solicitation
0	1	0	0	UE-to-network relay discovery announcement/UE-to-network relay discovery response
0	1	0	1	UE-to-network relay discovery solicitation
0	1	1	0	Group member discovery announcement/group member discovery response
0	1	1	1	Group member discovery solicitation
1	0	0	0	Relay discovery additional information

The other values are reserved.

Discovery model value (octet 1):
Bit

2	**1**	
0	0	Reserved
0	1	Model A
1	0	Model B
1	1	Reserved

NOTE 1: Content type '0000' (announce/response) is used for model A announcing and for model B discoveree operation.

NOTE 2: Content type '0100' (UE-to-network relay discovery announcement or UE-to-network relay discovery response) is used for model A announcing and for model B discoveree operation.

NOTE 3: Content type '0110' (group member discovery announcement or group member discovery response) is used for model A announcing and for model B discoveree operation.

11.2.2 ProSe application code

This parameter is used to contain a ProSe application code. The format of the ProSe application code is as follows:

a) if the ProSe application code is included in a PROSE PC5 DISCOVERY message and application-controlled extension is used, the ProSe application code is encoded as a 184 bitstring composed of:

   1) the ProSe application code prefix; and

   2) the ProSe application code suffix; or

b) in all other cases, the ProSe application is encoded as a 184 bitstring as defined in 3GPP TS 23.003 [12].

11.2.3 ProSe restricted code

This parameter is used to contain a ProSe restricted code. The format of the ProSe restricted code is as follows:

a) if the ProSe restricted code is included in a PROSE PC5 DISCOVERY message and application-controlled extension is not used, the ProSe restricted code is encoded as a 184 bitstring composed of:

   1) the ProSe restricted code in the 64 most significant bits; and

   2) the remaining 120 bits set to zero;

b) if the ProSe restricted code is included in a PROSE PC5 DISCOVERY message and application-controlled extension is used, the ProSe restricted code is encoded as a 184 bitstring composed of

   1) the ProSe restricted code prefix in the 64 most significant bits;

   2) the ProSe restricted code suffix; and

   3) any remaining unused least significant bits set to zero; or

c) in all other cases, the ProSe restricted code is encoded as a 64 bitstring as defined in 3GPP TS 23.003 [12].

11.2.4 MIC

This parameter is used to carry the MIC (Message Integrity Check) associated with the ProSe application code contained in a PROSE PC5 DISCOVERY message.

11.2.5 UTC-based counter

This parameter is used to indicate the UTC time associated with the discovery transmission opportunity in which a PROSE PC5 DISCOVERY message is sent. It is expressed in unit of seconds and coded in binary format as the 32 least significant bits of the Coordinated Universal Time as defined in 3GPP TS 38.331 [13].

11.2.6 Application layer group ID

The application layer group ID parameter carries an identifier of an application layer group that the UE belongs to.

The application layer group ID information element is coded as shown in figure 11.2.6.1 and table 11.2.6.1.

The application layer group ID is a type 4 information element.

8	7	6	5	4	3	2	1	
Application layer group ID IEI								octet 1
Length of application layer group ID contents								octet 2
Application layer group ID contents								octet 3
								octet m

Figure 11.2.6.1: Application layer group ID information element

Table 11.2.6.1: Application layer group ID information element

The length of application layer group ID contents field contains the binary coded representation of the length of the application layer group ID contents field. The application layer group ID contents field contains the octets indicating the application layer group ID. The format of the application layer group ID parameter is out of scope of this specification.

11.2.7 User info ID

The user info ID parameter carries a user info ID as specified in 3GPP TS 23.304 [2]. The value of the user info ID parameter is a 48-bit long bit string. The format of the user info ID parameter is out of scope of this specification.

NOTE: Depending on operation, user info ID is indicated as the announcer info parameter, the discoverer info parameter or the discoveree info parameter.

11.2.8 Relay service code

The relay service code parameter is used to indicate the connectivity service the UE-to-network relay provides to the remote UE in the UE-to-network relay direct discovery. The value of the relay service code parameter is 24-bit long bit string. The format of the relay service code parameter is out of scope of this specification.

The relay service code is a type 3 information element with a length of 4 octets.

The relay service code IE is coded as shown in figure 11.2.8.1 and table 11.2.8.1.

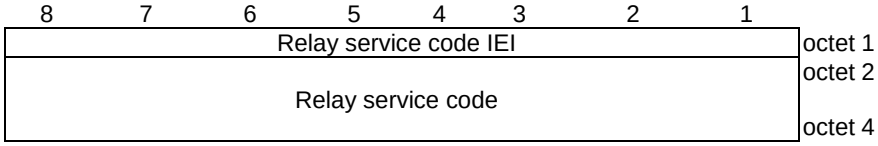

Figure 11.2.8.1: Relay service code information element

Table 11.2.8.1: Relay service code information element

Relay service code (octet 2 to 4) This field contains the 24-bit relay service code.

11.2.9 Status indicator

The status indicator parameter is used to indicate the status of 5G ProSe UE-to-network relay UE.

The status indicator is a type 3 information element with a length of 2 octets.

The status indicator IE is coded as shown in figure 11.2.9.1 and table 11.2.9.1.

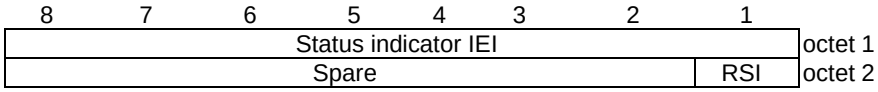

Figure 11.2.9.1: Status indicator information element

Table 11.2.9.1: Status indicator information element

Resource status indicator (RSI) (octet 2, bit 1) The bit is used to indicate whether or not the UE has resources available to provide a connectivity service for additional ProSe-enabled UEs. Bit 1 0 the UE does not have resources available to provide a connectivity service for additional ProSe-enabled UEs 1 the UE has resources available to provide a connectivity service for additional ProSe-enabled UEs Bits 2 to 8 of octet 1 are spare and shall be coded as zero.

11.2.10 TAI

The TAI information element in coded as the 5GS tracking area identity specified in clause 9.11.3.8 of 3GPP TS 24.501 [11].

11.2.11 UTC-based counter LSB

This parameter is used to carry:

a) the four least significant bits of the UTC-based counter associated with the discovery transmission opportunity used by the UE performing open 5G ProSe direct discovery announcing; or

b) the eight least significant bits of the UTC-based counter associated with the discovery transmission opportunity used by the UE performing ProSe direct discovery announcing for restricted 5G ProSe direct discovery or for ProSe direct discovery for public safety use.

The UTC-based counter LSB IE is coded as shown in figures 11.2.11.1, figure 11.2.11.2, and table 11.2.11.1.

8	7	6	5	4	3	2	1	
LSBs of UTC-based counter LSB								octet 1
0	0	0	0	Four LSBs of UTC-based counter				octet 2
Spare								

Figure 11.2.11.1: UTC-based counter LSB parameter for open 5G ProSe direct discovery

8	7	6	5	4	3	2	1	
LSBs of UTC-based counter LSB								octet 1
Eight LSBs of UTC-based counter								octet 2

Figure 11.2.11.2: UTC-based counter LSB parameter for restricted 5G ProSe direct discovery and for ProSe direct discovery for public safety use

Table 11.2.11.1: UTC-based counter LSB information element

UTC-based counter LSB value (octet 2) For open 5G ProSe direct discovery: Bits 1 to 4 of octet 1 are set to the four least significant bits of the UTC-based counter encoded as specified in clause 11.2.5. Bits 5 to 8 of octet 1 are spare and shall be coded as zero. For restricted 5G ProSe direct discovery and for ProSe direct discovery for public safety use: Bits 1 to 8 of octet 1 are set to the eight least significant bits of the UTC-based counter encoded as specified in clause 11.2.5

11.2.12 NCGI

The NCGI information element is used to indicate the NCGI of the serving cell where the 5G ProSe UE-to-network relay UE is camping.

The NCGI is a type 3 information element with a length of 9 octets.

The NCGI information element is coded as shown in figure 11.2.12.1 and table 11.2.12.2.

8	7	6	5	4	3	2	1	
NCGI IEI								octet 1
MCC digit 2				MCC digit 1				octet 2
MNC digit 3				MCC digit 3				octet 3
MNC digit 2				MNC digit 1				octet 4
NCI digit 2				NCI digit 1				octet 5
NCI digit 4				NCI digit 3				octet 6
NCI digit 6				NCI digit 5				octet 7
NCI digit 8				NCI digit 7				octet 8
Spare				NCI digit 9				octet 9

Figure 11.2.12.1: UE-to-network relay NCGI parameter

Table 11.2.12.1: UE-to-network relay NCGI parameter

MCC, Mobile country code (octet 2, octet 3 bits 1 to 4) The MCC field is coded as in ITU-T Rec. E.212 [27], Annex A. MNC, Mobile network code (octet 3 bits 5 to 8, octet 4) The coding of this field is the responsibility of each administration but BCD coding shall be used. If MNC consists of 2 digits, Bits 5 to 8 of octet 2 is coded as "1111". NCI, NR cell identity (octet 5, octet 6, octet 7, octet 8, octet 9 bits 1 to 4) The NCI field is coded as in 3GPP TS 23.003 [12]. Spare (octet 9 bits 5 to 8) The Spare field is coded as zeros.

11.2.13 Metadata

The Metadata parameter carries the application layer metadata information.

The Metadata information element is coded as shown in figure 11.2.13.1 and table 11.2.13.1.

The Metadata is a type 6 information element.

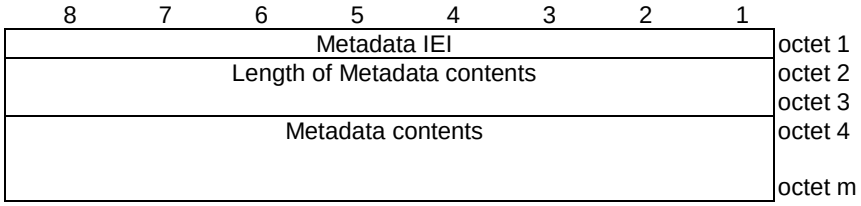

Figure 11.2.13.1: Metadata information element

Table 11.2.13.1: Metadata information element

The length of Metadata contents field contains the binary coded representation of the length of the Metadata contents field. The Metadata contents field contains the octets indicating the Metadata parameter. The format of the Metadata parameter is out of scope of this specification.

11.3 PC5 signalling message formats

11.3.1 ProSe PC5 signalling message type

The purpose of the ProSe PC5 signalling message type information element is to indicate the type of messages used in ProSe PC5 signalling protocol.

The value part of the ProSe PC5 signalling message type information element used in the ProSe PC5 signalling messages is coded as shown in table 11.3.1.1.

The ProSe PC5 signalling message type is a type 3 information element, with the length of 1 octet.

Table 11.3.1.1: ProSe PC5 signalling message type

Bits 8	7	6	5	4	3	2	1	
0	0	0	0	0	0	0	1	PROSE DIRECT LINK ESTABLISHMENT REQUEST
0	0	0	0	0	0	1	0	PROSE DIRECT LINK ESTABLISHMENT ACCEPT
0	0	0	0	0	0	1	1	PROSE DIRECT LINK ESTABLISHMENT REJECT
0	0	0	0	0	1	0	0	PROSE DIRECT LINK MODIFICATION REQUEST
0	0	0	0	0	1	0	1	PROSE DIRECT LINK MODIFICATION ACCEPT
0	0	0	0	0	1	1	0	PROSE DIRECT LINK MODIFICATION REJECT
0	0	0	0	0	1	1	1	PROSE DIRECT LINK RELEASE REQUEST
0	0	0	0	1	0	0	0	PROSE DIRECT LINK RELEASE ACCEPT
0	0	0	0	1	0	0	1	PROSE DIRECT LINK KEEPALIVE REQUEST
0	0	0	0	1	0	1	0	PROSE DIRECT LINK KEEPALIVE RESPONSE
0	0	0	0	1	0	1	1	PROSE DIRECT LINK AUTHENTICATION REQUEST
0	0	0	0	1	1	0	0	PROSE DIRECT LINK AUTHENTICATION RESPONSE
0	0	0	0	1	1	0	1	PROSE DIRECT LINK AUTHENTICATION REJECT
0	0	0	0	1	1	1	0	PROSE DIRECT LINK SECURITY MODE COMMAND
0	0	0	0	1	1	1	1	PROSE DIRECT LINK SECURITY MODE COMPLETE
0	0	0	1	0	0	0	0	PROSE DIRECT LINK SECURITY MODE REJECT
0	0	0	1	0	0	0	1	PROSE DIRECT LINK REKEYING REQUEST
0	0	0	1	0	0	1	0	PROSE DIRECT LINK REKEYING RESPONSE
0	0	0	1	0	0	1	1	PROSE DIRECT LINK IDENTIFIER UPDATE REQUEST
0	0	0	1	0	1	0	0	PROSE DIRECT LINK IDENTIFIER UPDATE ACCEPT
0	0	0	1	0	1	0	1	PROSE DIRECT LINK IDENTIFIER UPDATE ACK
0	0	0	1	0	1	1	0	PROSE DIRECT LINK IDENTIFIER UPDATE REJECT
0	0	0	1	0	1	1	1	PROSE DIRECT LINK AUTHENTICATION FAILURE
0	0	0	1	1	0	0	0	PROSE ADDITIONAL PARAMETERS ANNOUNCEMENT REQUEST
0	0	0	1	1	0	0	1	PROSE ADDITIONAL PARAMETERS ANNOUNCEMENT RESPONSE

11.3.2 Sequence number

The purpose of the Sequence number information element is to uniquely identify a ProSe PC5 signalling message being sent or received. The sending UE will increment the sequence number for each outgoing new ProSe PC5 signalling message.

The Sequence number information element is an integer in the 0-255 range.

The Sequence number is a type 3 information element, with a length of 1 octet.

11.3.3 ProSe identifier

The purpose of the ProSe identifier parameter is to carry the identifier of a ProSe application.

The ProSe identifier information element is coded as shown in figure 11.3.3.1 and table 11.3.3.1.

The ProSe identifier is a type 6 information element with a minimum length of 21 octets.

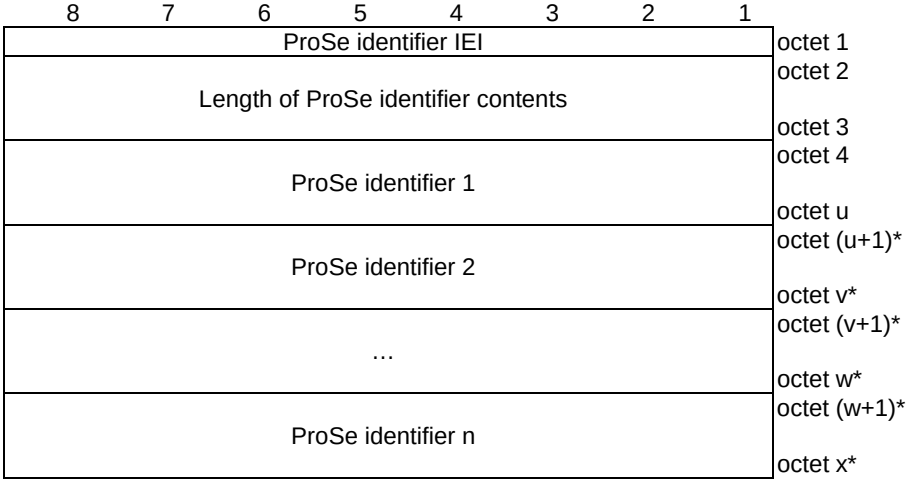

Figure 11.3.3.1: ProSe identifier information element

Table 11.3.3.1: ProSe identifier information element

ProSe identifier: The ProSe identifier field contains a sequence of a sixteen octet OS Id field, a one octet OS App Id length field, and an OS App Id field. The OS Id field shall be transmitted first. The OS Id field contains a Universally Unique IDentifier (UUID) as specified in IETF RFC 4122 [30].
NOTE: Further definition of the format of OS App Id is beyond the scope of this specification.

11.3.4 Application layer ID

The purpose of the application layer ID parameter information element carries an application layer ID as specified in 3GPP TS 23.304 [2].

The application layer ID information element is coded as shown in figure 11.3.4.1 and table 11.3.4.1.

The application layer ID is a type 4 information element.

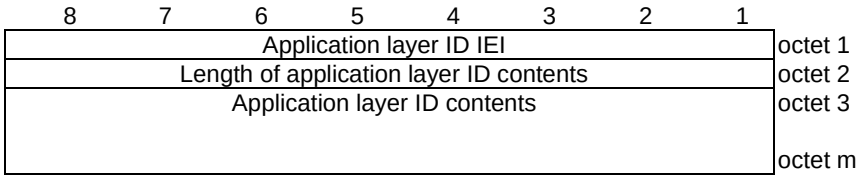

Figure 11.3.4.1: Application layer ID information element

Table 11.3.4.1: Application layer ID information element

The length of application layer ID contents field contains the binary coded representation of the length of the application layer ID contents field. The application layer ID contents field contains the octets indicating the application layer ID. The format of the application layer ID parameter is out of scope of this specification.

11.3.5 PC5 QoS flow descriptions

The purpose of the PC5 QoS flow descriptions information element is to indicate a set of PC5 QoS flow descriptions to be used by the UE over the direct link, where each PC5 QoS flow description is a set of parameters as described in clause 5.6 of 3GPP TS 23.304 [2].

The PC5 QoS flow descriptions is a type 6 information element with a minimum length of 6 octets. The maximum length for the information element is 65538 octets.

The PC5 QoS flow descriptions information element is coded as shown in figure 11.3.5.1, figure 11.3.5.2, figure 11.3.5.3, figure 11.3.5.4, and table 11.3.5.1.

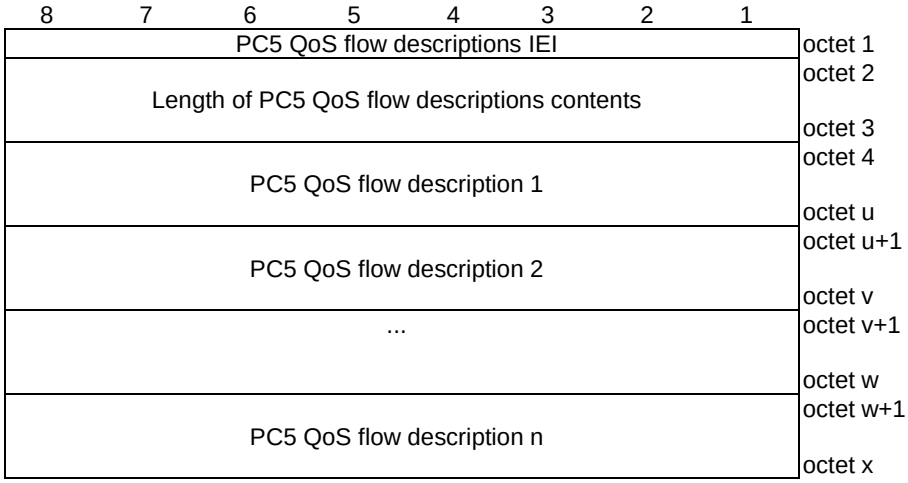

Figure 11.3.5.1: PC5 QoS flow descriptions information element

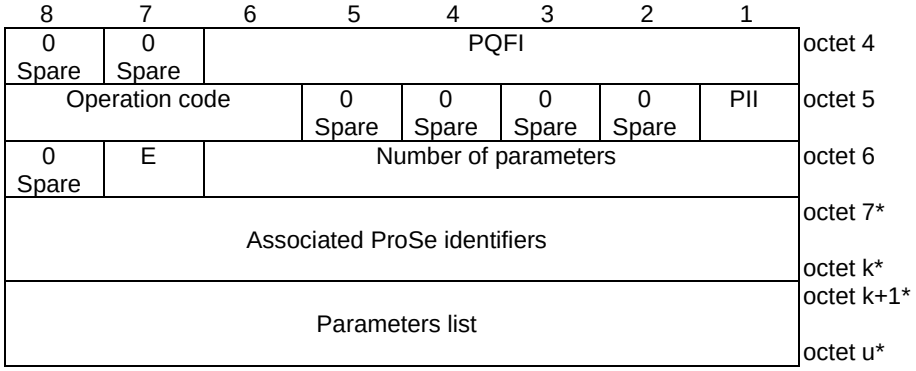

Figure 11.3.5.2: PC5 QoS flow description

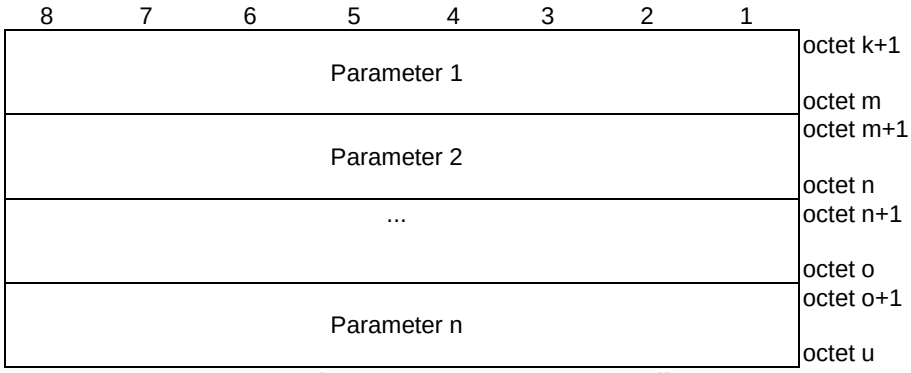

Figure 11.3.5.3: Parameters list

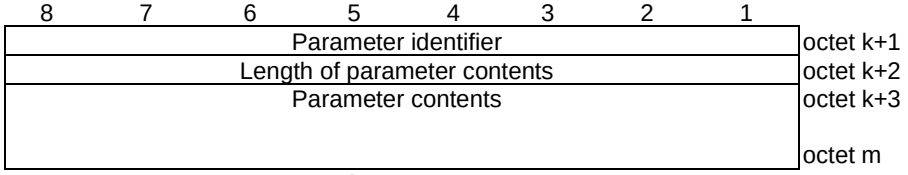

Figure 11.3.5.4: Parameter

Table 11.3.5.1: PC5 QoS flow descriptions information element

PC5 QoS flow identifier (PQFI) (bits 6 to 1 of octet 4)
PQFI field contains the PC5 QoS flow identifier.
Bits
6 5 4 3 2 1
0 0 0 0 0 1PQFI 1
to
1 1 1 1 1 1PQFI 63
The UE shall not set the PQFI value to 0.

ProSe identifiers indication (PII) (bit 1 of octet 5)
The PII indicates whether the Associated ProSe identifiers field is included
Bit
1
0 Associated ProSe identifiers field is not included
1 Associated ProSe identifiers field is included

Operation code (bits 8 to 6 of octet 5)
Bits
8 7 6
0 0 1 Create new PC5 QoS flow description
0 1 0 Delete existing PC5 QoS flow description
0 1 1 Modify existing PC5 QoS flow description
All other values are reserved.

E bit (bit 7 of octet 6)
For the "create new PC5 QoS flow description" operation, the E bit is encoded as follows:
Bit
7
0 reserved
1 parameters list is included

For the "Delete existing PC5 QoS flow description" operation, the E bit is encoded as follows:
Bit
7
0 parameters list is not included
1 reserved

For the "modify existing PC5 QoS flow description" operation, the E bit is encoded as follows:
Bit
7
0 extension of previously provided parameters
1 replacement of all previously provided parameters

If the E bit is set to "parameters list is not included", the number of parameters field has zero value. If the E bit is set to "parameters list is included", the number of parameters field has non-zero value. If the E bit is set to "extension of previously provided parameters" or "replacement of all previously provided parameters", the number of parameters field has non-zero value. If the E bit is set to "extension of previously provided parameters" and one of the parameters in the new parameters list already exists in the previously provided parameters, the parameter shall be set to the new value.

Number of parameters (bits 6 to 1 of octet 6)
The number of parameters field contains the binary coding for the number of parameters in the parameters list field. The number of parameters field is encoded in bits 6 through 1 of octet 6 where bit 6 is the most significant and bit 1 is the least significant bit.

Associated ProSe identifiers (octet 7 to k)
The associated ProSe identifiers field contains a variable number of ProSe identifiers associated with the PC5 QoS flow. Associated ProSe identifiers field is coded as the length and value part of ProSe identifier information element as specified in clause 11.3.3 starting with the second octet.

Parameters list (octets k+1 to u)
The parameters list contains a variable number of parameters.

Each parameter included in the parameters list is of variable length and consists of:
- a parameter identifier (1 octet);
- the length of the parameter contents (1 octet); and
- the parameter contents itself (variable amount of octets).

The parameter identifier field is used to identify each parameter included in the parameters list and it contains the hexadecimal coding of the parameter identifier. Bit 8 of the parameter identifier field contains the most significant bit and bit 1 contains the least significant bit. In this version of the protocol, the following parameter identifiers are specified:
- 01H (PQI);
- 02H (GFBR); (see NOTE)
- 03H (MFBR); (see NOTE)
- 04H (Averaging window) ;
- 05H (Resource type);
- 06H (Default priority level);
- 07H (Packet delay budget);
- 08H (Packet error rate);
- 09H (Default maximum data burst volume).

If the parameters list contains a parameter identifier that is not supported by the receiving entity the corresponding parameter shall be discarded.

The length of parameter contents field contains the binary coded representation of the length of the parameter contents field. The first bit in transmission order is the most significant bit.

When the parameter identifier indicates PQI, the parameter contents field contains the binary representation of PQI that is one octet in length.

PQI:
Bits
8 7 6 5 4 3 2 1
0 0 0 0 0 0 0 0 Reserved
0 0 0 0 0 0 0 1
to Spare
0 0 0 1 0 1 0 0
0 0 0 1 0 1 0 1 PQI 21
0 0 0 1 0 1 1 0 PQI 22
0 0 0 1 0 1 1 1 PQI 23
0 0 0 1 1 0 0 0 PQI 24
0 0 0 1 1 0 0 1 PQI 25
0 0 0 1 1 0 1 0 PQI 26
0 0 0 1 1 0 1 1
to Spare
0 0 1 1 0 1 1 0
0 0 1 1 0 1 1 1 PQI 55
0 0 1 1 1 0 0 0 PQI 56
0 0 1 1 1 0 0 1 PQI 57
0 0 1 1 1 0 1 0 PQI 58
0 0 1 1 1 0 1 1 PQI 59
0 0 1 1 1 1 0 0 PQI 60
0 0 1 1 1 1 0 1 PQI 61
0 0 1 1 1 1 1 0
to Spare
0 1 0 1 1 0 0 1
0 1 0 1 1 0 1 0 PQI 90
0 1 0 1 1 0 1 1 PQI 91
0 1 0 1 1 1 0 0 PQI 92
0 1 0 1 1 1 0 1 PQI 93
0 1 0 1 1 1 1 0
to Spare
0 1 1 1 1 1 1 1
1 0 0 0 0 0 0 0
to Operator-specific PQIs
1 1 1 1 1 1 1 0
1 1 1 1 1 1 1 1 Reserved

The UE shall consider all other values not explicitly defined in this version of the protocol as unsupported.

When the parameter identifier indicates "GFBR", the parameter contents field contains one octet indicating the unit of the guaranteed flow bit rate followed by two octets containing the value of the guaranteed flow bit rate.
Unit of the guaranteed flow bit rate (octet 1)
Bits
8 7 6 5 4 3 2 1
0 0 0 0 0 0 0 0 value is not used
0 0 0 0 0 0 0 1 value is incremented in multiples of 1 Kbps
0 0 0 0 0 0 1 0 value is incremented in multiples of 4 Kbps
0 0 0 0 0 0 1 1 value is incremented in multiples of 16 Kbps
0 0 0 0 0 1 0 0 value is incremented in multiples of 64 Kbps
0 0 0 0 0 1 0 1 value is incremented in multiples of 256 Kbps
0 0 0 0 0 1 1 0 value is incremented in multiples of 1 Mbps
0 0 0 0 0 1 1 1 value is incremented in multiples of 4 Mbps
0 0 0 0 1 0 0 0 value is incremented in multiples of 16 Mbps
0 0 0 0 1 0 0 1 value is incremented in multiples of 64 Mbps
0 0 0 0 1 0 1 0 value is incremented in multiples of 256 Mbps
0 0 0 0 1 0 1 1 value is incremented in multiples of 1 Gbps
0 0 0 0 1 1 0 0 value is incremented in multiples of 4 Gbps
0 0 0 0 1 1 0 1 value is incremented in multiples of 16 Gbps
0 0 0 0 1 1 1 0 value is incremented in multiples of 64 Gbps

0 0 0 0 1 1 1 1 value is incremented in multiples of 256 Gbps
0 0 0 1 0 0 0 0 value is incremented in multiples of 1 Tbps
0 0 0 1 0 0 0 1 value is incremented in multiples of 4 Tbps
0 0 0 1 0 0 1 0 value is incremented in multiples of 16 Tbps
0 0 0 1 0 0 1 1 value is incremented in multiples of 64 Tbps
0 0 0 1 0 1 0 0 value is incremented in multiples of 256 Tbps
0 0 0 1 0 1 0 1 value is incremented in multiples of 1 Pbps
0 0 0 1 0 1 1 0 value is incremented in multiples of 4 Pbps
0 0 0 1 0 1 1 1 value is incremented in multiples of 16 Pbps
0 0 0 1 1 0 0 0 value is incremented in multiples of 64 Pbps
0 0 0 1 1 0 0 1 value is incremented in multiples of 256 Pbps
Other values shall be interpreted as multiples of 256 Pbps in this version of the protocol.

Value of the guaranteed flow bit rate (octets 2 and 3)
Octets 2 and 3 represent the binary coded value of the guaranteed flow bit rate in units defined by the unit of the guaranteed flow bit rate.

When the parameter identifier indicates "GFBR downlink", the parameter contents field contains one octet indicating the unit of the guaranteed flow bit rate for downlink followed by two octets containing the value of the guaranteed flow bit rate for downlink.

When the parameter identifier indicates "MFBR ", the parameter contents field contains the one octet indicating the unit of the maximum flow bit rate followed by two octets containing the value of maximum flow bit rate.

Unit of the maximum flow bit rate (octet 1)
The coding is identical to that of the unit of the guaranteed flow bit rate.

Value of the maximum flow bit rate (octets 2 and 3)
Octets 2 and 3 represent the binary coded value of the maximum flow bit rate in units defined by the unit of the maximum flow bit rate.

When the parameter identifier indicates "averaging window", the parameter contents field contains the binary representation of the averaging window for both uplink and downlink in milliseconds and the parameter contents field is two octets in length.

When the parameter identifier indicates "resource type", the parameter contents field contains the binary representation of the resource type that is one octet in length.

Resource type:
Bits
8 7 6 5 4 3 2 1
0 0 0 0 0 0 0 0 Reserved
0 0 0 0 0 0 0 1 Non-GBR
0 0 0 0 0 0 1 0 GBR
0 0 0 0 0 0 1 1 Delay critical GBR
0 0 0 0 0 1 0 0
to Spare
1 1 1 1 1 1 1 1

When the parameter identifier indicates "default priority level", the parameter contents field contains the binary representation of the default priority level that is one octet in length.

Default priority level:
Bits
8 7 6 5 4 3 2 1
0 0 0 0 0 0 0 0 Reserved
0 0 0 0 0 0 0 1 1
0 0 0 0 0 0 1 0 2
0 0 0 0 0 0 1 1 3
0 0 0 0 0 1 0 0 4
0 0 0 0 0 1 0 1 5
0 0 0 0 0 1 1 0 6
0 0 0 0 0 1 1 1 7
0 0 0 0 1 0 0 0 8
0 0 0 0 1 0 0 1
to Spare
1 1 1 1 1 1 1 1

When the parameter identifier indicates "packet delay budget", the parameter contents field contains the binary representation of the packet delay budget for both uplink and downlink in milliseconds and the parameter contents field is two octets in length.

When the parameter identifier indicates "packet error rate", the parameter contents field contains the binary representation of the power of 10^{-1} for both uplink and downlink and the parameter contents field is one octet in length.

When the parameter identifier indicates "default maximum data burst volume", the parameter contents field contains the binary representation of the default maximum data burst volume for both uplink and downlink in bytes and the parameter contents field is two octets in length.

NOTE: The GFBR and MFBR apply to both directions of the 5G ProSe direct link.

11.3.6 IP address configuration

The purpose of the IP address configuration information element is to indicate the configuration options for IP address used by the UE over this direct link.

The IP address configuration is a type 3 information element with the length of 2 octets.

The IP address configuration information element is coded as shown in figure 11.3.6.1 and table 11.3.6.1.

8	7	6	5	4	3	2	1	
IP address configuration IEI								octet 1
IP address configuration content								octet 2

Figure 11.3.6.1: IP address configuration information element

Table 11.3.6.1: IP address configuration information element

IP address configuration value (octet 2) Bits **4 3 2 1**	
0 0 0 1	IPv6 Router
0 0 1 0	address allocation not supported
0 0 1 1	DHCPv4 server
0 1 0 0	DHCPv4 server & IPv6 Router
All other values are reserved.	
Bit 5 to 8 of octet 2 are spare and shall be coded as zero.	

11.3.7 Link local IPv6 address

The purpose of the Link local IPv6 address information element is to indicate the link local IPv6 address.

The Link local IPv6 address is a type 3 information element with the length of 17 octets.

The Link local IPv6 address information element is coded as shown in figure 11.3.7.1 and table 11.3.7.1.

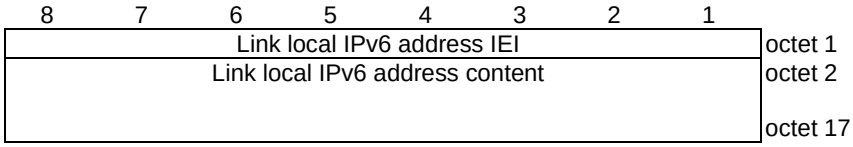

Figure 11.3.7.1: Link local IPv6 address information element

Table 11.3.7.1: Link local IPv6 address information element

Link local IPv6 address value (octet 2 to 17) This contains the 128-bit IPv6 address. This IPv6 address is encoded as a 128-bit address according to IETF RFC 4291 [15].

11.3.8 PC5 signalling protocol cause

The purpose of the PC5 signalling protocol cause information element is to indicate the cause used in the PC5 signalling protocol procedures.

The PC5 signalling protocol cause is a type 3 information element with a length of 2 octets.

The PC5 signalling protocol cause information element is coded as shown in figure 11.3.8.1 and table 11.3.8.1.

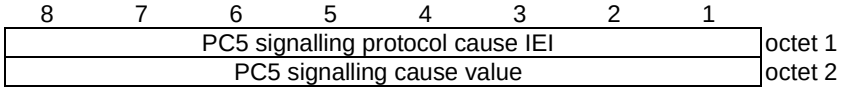

Figure 11.3.8.1: PC5 signalling protocol cause information element

Table 11.3.8.1: PC5 signalling protocol cause information element

PC5 signalling cause value (octet 2) Bits **8 7 6 5 4 3 2 1**	
0 0 0 0 0 0 0 1	Direct communication to the target UE not allowed
0 0 0 0 0 0 1 0	Direct communication to the target UE no longer needed
0 0 0 0 0 0 1 1	Conflict of layer-2 ID for unicast communication is detected
0 0 0 0 0 1 0 0	Direct connection is not available anymore
0 0 0 0 0 1 0 1	Lack of resources for 5G ProSe direct link
0 0 0 0 0 1 1 0	Authentication failure
0 0 0 0 0 1 1 1	Integrity failure
0 0 0 0 1 0 0 0	UE security capabilities mismatch
0 0 0 0 1 0 0 1	LSB of $K_{NRP-sess}$ ID conflict
0 0 0 0 1 0 1 0	UE PC5 unicast signalling security policy mismatch
0 0 0 0 1 0 1 1	Required service not allowed
0 0 0 0 1 1 0 0	Security policy not aligned
0 0 0 0 1 1 0 1	Congestion situation
0 1 1 0 1 1 1 1	Protocol error, unspecified
Any other value received by the UE shall be treated as 0110 1111, "protocol error, unspecified".	

11.3.9 Key establishment information container

The Key establishment information container information element contains information for 5G ProSe direct link key establishment.

The Key establishment information container is a type 6 information element with a minimum length of 4 octets.

The Key establishment information container information element is coded as shown in figure 11.3.9.1 and table 11.3.9.1.

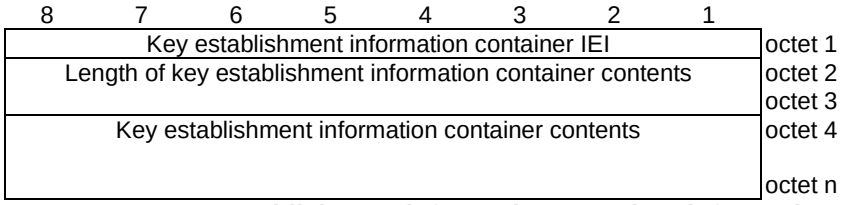

Figure 11.3.9.1: Key establishment information container information element

Table 11.3.9.1: Key establishment information container information element

Key establishment information container contents (octet 4 to n) This field contains the key establishment information container.

11.3.10 Nonce

The Nonce information element contains a 128-bit nonce used during 5G ProSe direct link security establishment.

The Nonce information element is a type 3 information element, with a length of 17 octets.

The Nonce information element is coded as shown in figure 11.3.10.1 and table 11.3.10.1.

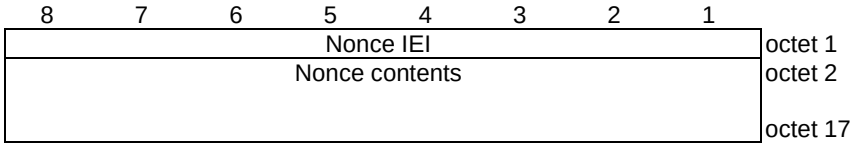

Figure 11.3.10.1: Nonce information element

Table 11.3.10.1: Nonce information element

Nonce contents (octet 2 to 17) This field contains the 128-bit nonce value.

11.3.11 UE security capabilities

The UE security capabilities information element is used to indicate which security algorithms are supported by the UE.

The UE security capabilities is a type 4 information element with a minimum length of 4 octets and a maximum length of 10 octets.

The UE security capabilities information element is coded as shown in figure 11.3.11.1 and table 11.3.11.1.

8	7	6	5	4	3	2	1	
UE security capabilities IEI								octet 1
Length of UE security capabilities contents								octet 2
5G-EA0	128-5G-EA1	128-5G-EA2	128-5G-EA3	5G-EA4	5G-EA5	5G-EA6	5G-EA7	octet 3
5G-IA0	128-5G-IA1	128-5G-IA2	128-5G-IA3	5G-IA4	5G-IA5	5G-IA6	5G-IA7	octet 4
0	0	0	0	0	0	0	0	
Spare								octet 5* -10*

Figure 11.3.11.1: UE security capabilities information element

Table 11.3.11.1: UE security capabilities information element

5GS encryption algorithms supported (octet 3)

5GS encryption algorithm 5G-EA0 supported (octet 3, bit 8)
0 5GS encryption algorithm 5G-EA0 not supported
1 5GS encryption algorithm 5G-EA0 supported

5GS encryption algorithm 128-5G-EA1 supported (octet 3, bit 7)
0 5GS encryption algorithm 128-5G-EA1 not supported
1 5GS encryption algorithm 128-5G-EA1 supported

5GS encryption algorithm 128-5G-EA2 supported (octet 3, bit 6)
0 5GS encryption algorithm 128-5G-EA2 not supported
1 5GS encryption algorithm 128-5G-EA2 supported

5GS encryption algorithm 128-5G-EA3 supported (octet 3, bit 5)
0 5GS encryption algorithm 128-5G-EA3 not supported
1 5GS encryption algorithm 128-5G-EA3 supported

5GS encryption algorithm 5G-EA4 supported (octet 3, bit 4)
0 5GS encryption algorithm 5G-EA4 not supported
1 5GS encryption algorithm 5G-EA4 supported

5GS encryption algorithm 5G-EA5 supported (octet 3, bit 3)
0 5GS encryption algorithm 5G-EA5 not supported
1 5GS encryption algorithm 5G-EA5 supported

5GS encryption algorithm 5G-EA6 supported (octet 3, bit 2)
0 5GS encryption algorithm 5G-EA6 not supported
1 5GS encryption algorithm 5G-EA6 supported

5GS encryption algorithm 5G-EA7 supported (octet 3, bit 1)
0 5GS encryption algorithm 5G-EA7 not supported
1 5GS encryption algorithm 5G-EA7 supported

5GS integrity algorithms supported (octet 4)

5GS integrity algorithm 5G-IA0 supported (octet 4, bit 8)
0 5GS integrity algorithm 5G-IA0 not supported
1 5GS integrity algorithm 5G-IA0 supported

5GS integrity algorithm 128-5G-IA1 supported (octet 4, bit 7)
0 5GS integrity algorithm 128-5G-IA1 not supported
1 5GS integrity algorithm 128-5G-IA1 supported

5GS integrity algorithm 128-5G-IA2 supported (octet 4, bit 6)
0 5GS integrity algorithm 128-5G-IA2 not supported
1 5GS integrity algorithm 128-5G-IA2 supported

5GS integrity algorithm 128-5G-IA3 supported (octet 4, bit 5)
0 5GS integrity algorithm 128-5G-IA3 not supported
1 5GS integrity algorithm 128-5G-IA3 supported

5GS integrity algorithm 5G-IA4 supported (octet 4, bit 4)
0 5GS integrity algorithm 5G-IA4 not supported
1 5GS integrity algorithm 5G-IA4 supported

5GS integrity algorithm 5G-IA5 supported (octet 4, bit 3)
0 5GS integrity algorithm 5G-IA5 not supported
1 5GS integrity algorithm 5G-IA5 supported

5GS integrity algorithm 5G-IA6supported (octet 4, bit 2)
0 5GS integrity algorithm 5G-IA6 not supported
1 5GS integrity algorithm 5G-IA6 supported

5GS integrity algorithm 5G-IA7 supported (octet 4, bit 1)
0 5GS integrity algorithm 5G-IA7 not supported
1 5GS integrity algorithm 5G-IA7 supported

11.3.12 UE PC5 unicast signalling security policy

The purpose of the UE PC5 unicast signalling security policy information element is to indicate the UE's configuration for integrity protection and ciphering of PC5 signalling messages.

The UE PC5 unicast signalling security policy is a type 3 information element with a length of 2 octets.

The UE PC5 unicast signalling security policy information element is coded as shown in figure 11.3.12.1.1 and table 11.3.12.1.

8	7	6	5	4	3	2	1	
UE PC5 unicast signalling security policy IEI								octet 1
0 spare	Signalling ciphering policy			0 spare	Signalling integrity protection policy			octet 2

Figure 11.3.12.1: UE 5G ProSe direct signalling security policy information element

Table 11.3.12.1: UE PC5 unicast signalling security policy information element

Signalling integrity protection policy (octet 2, bit 1 to 3)

Bits

3	**2**	**1**	
0	0	0	Signalling integrity protection not needed
0	0	1	Signalling integrity protection preferred
0	1	0	Signalling integrity protection required
0	1	1	
	to		Spare
1	1	0	
1	1	1	Reserved

If the UE receives a signalling integrity protection policy value that the UE does not understand, the UE shall interpret the value as 010 "Signalling integrity protection required".

Signalling ciphering policy (octet 2, bit 5 to 7)

Bits

7	**6**	**5**	
0	0	0	Signalling ciphering not needed
0	0	1	Signalling ciphering preferred
0	1	0	Signalling ciphering required
0	1	1	
	to		Spare
1	1	0	
1	1	1	Reserved

If the UE receives a signalling ciphering policy value that the UE does not understand, the UE shall interpret the value as 010 "Signalling ciphering required".

Bit 4 and 8 of octet 2 are spare and shall be coded as zero.

11.3.13 MSB of $K_{NRP\text{-}sess}$ ID

The purpose of the MSB of $K_{NRP\text{-}sess}$ ID information element is to carry the 8 most significant bits of the $K_{NRP\text{-}sess}$ ID.

The MSB of $K_{NRP\text{-}sess}$ ID information element is a type 3 information element with a length of 2 octets.

The MSB of $K_{NRP\text{-}sess}$ ID information element is coded as shown in figure 11.3.13.1 and table 11.3.13.1.

8	7	6	5	4	3	2	1	
MSB of $K_{NRP\text{-}sess}$ ID IEI								octet 1
MSB of $K_{NRP\text{-}sess}$ ID contents								octet 2

Figure 11.3.13.1: MSB of $K_{NRP\text{-}sess}$ ID information element

Table 11.3.13.1: MSB of $K_{NRP-sess}$ ID information element

MSB of $K_{NRP-sess}$ ID contents (octet 2) This field contains the 8 most significant bits of $K_{NRP-sess}$ ID.

11.3.14 K_{NRP} ID

The purpose of the K_{NRP} ID information element is to carry the identity of the K_{NRP} held by a UE.

The K_{NRP} ID is a type 3 information element with a length of 5 octets.

The K_{NRP} ID information element is coded as shown in figure 11.3.14.1 and table 11.3.14.1

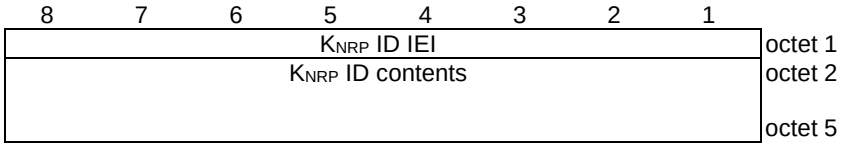

Figure 11.3.14.1: K_{NRP} ID information element

Table 11.3.14.1: K_{NRP} ID information element

K_{NRP} ID contents (octet 2 to 5) This field contains the 32-bit identifier of a K_{NRP}.

11.3.15 LSB of $K_{NRP-sess}$ ID

The purpose of the LSB of $K_{NRP-sess}$ ID information element is to carry the 8 least significant bits of the $K_{NRP-sess}$ ID.

The LSB of $K_{NRP-sess}$ ID is a type 3 information element with a length of 2 octets.

The LSB of $K_{NRP-sess}$ ID information element is coded as shown in figure 11.3.15.1 and table 12.3.15.1.

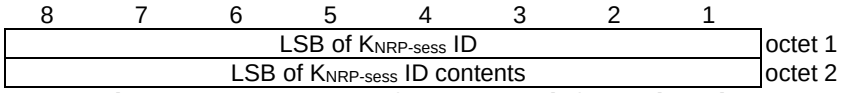

Figure 11.3.15.1: LSB of $K_{NRP-sess}$ ID information element

Table 11.3.15.1: LSB of $K_{NRP-sess}$ ID information element

LSB of $K_{NRP-sess}$ ID contents (octet 2) This field contains the 8 least significant bits of $K_{NRP-sess}$ ID.

11.3.16 MSBs of K_{NRP} ID

The purpose of the MSBs of K_{NRP} ID information element is to carry the 16 most significant bits of the K_{NRP} ID.

The MSBs of K_{NRP} ID is a type 3 information element with a length of 3 octets.

The MSBs of K_{NRP} ID information element is coded as shown in figure 11.3.16.1 and table 11.3.16.1.

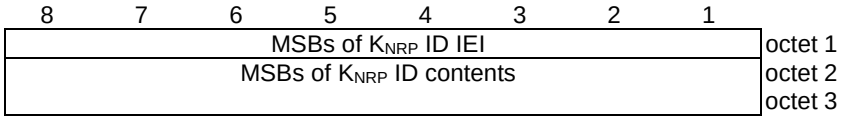

Figure 11.3.16.1: MSBs of K_{NRP} ID information element

Table 11.3.16.1: MSBs of K_{NRP} ID information element

MSBs of K_{NRP} ID contents (octet 2 to 3) This field contains the 16 most significant bits of K_{NRP} ID.

11.3.17 LSBs of K_{NRP} ID

The purpose of the LSBs of K_{NRP} ID information element is to carry the 16 least significant bits of the K_{NRP} ID.

The LSBs of K_{NRP} ID is a type 3 information element with a length of 3 octets.

The LSBs of K_{NRP} ID information element is coded as shown in figure 11.3.17.1 and table 11.3.17.1.

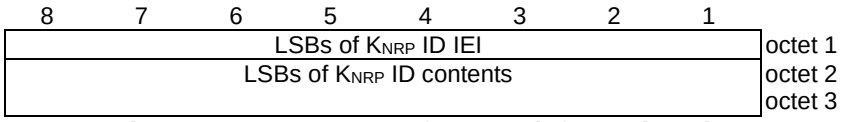

Figure 11.3.17.1: LSBs of K_{NRP} ID information element

Table 11.3.17.1: LSBs of K_{NRP} ID information element

LSBs of K_{NRP} ID contents (octet 2 to 3) This field contains the 16 least significant bits of K_{NRP} ID.

11.3.18 Configuration of UE PC5 unicast user plane security protection

The purpose of the configuration of UE PC5 unicast user plane security protection information element is to indicate the agreed configuration for security protection of PC5 user plane data between UEs over the 5G ProSe direct link.

The configuration of UE PC5 unicast user plane security protection is a type 3 information element with a length of 2 octets.

The configuration of UE PC5 unicast user plane security protection information element is coded as shown in figure 11.3.18.1 and table 11.3.18.1.

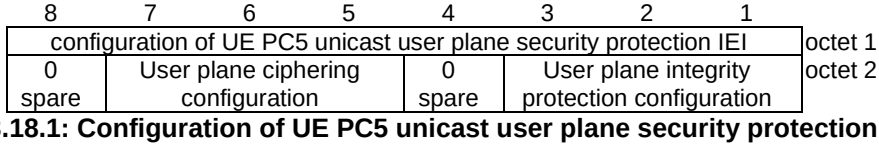

Figure 11.3.18.1: Configuration of UE PC5 unicast user plane security protection information element

Table 11.3.18.1: Configuration of UE PC5 unicast user plane security protection information element

User plane integrity protection configuration (octet 2, bit 1 to 3)			
Bits			
3	**2**	**1**	
0	0	0	Off
0	0	1	Off or On
0	1	0	On
0	1	1	
	to		Spare
1	1	0	
1	1	1	Reserved
User plane ciphering configuration (octet 2, bit 5 to 7)			
Bits			
7	**6**	**5**	
0	0	0	Off
0	0	1	Off or On
0	1	0	On
0	1	1	
	to		Spare
1	1	0	
1	1	1	Reserved
Bit 4 and 8 of octet 2 are spare and shall be coded as zero.			

11.3.19 Link modification operation code

The purpose of the Link modification operation code information element is to indicate what the operation of the 5G ProSe direct link modification procedure triggered by initiating UE is.

The Link modification operation code is a type 3 information element, with a length of 2 octets.

The Link modification operation code information element is coded as shown in figure 11.3.19.1 and table 11.3.19.1.

8	7	6	5	4	3	2	1	
Link modification operation code IEI								octet 1
Link modification operation code								octet 2

Figure 11.3.19.1: Link modification operation code information element

Table 11.3.19.1: Link modification operation code information element

Link modification operation code (octet 2)				
Bits				
4	**3**	**2**	**1**	
0	0	0	1	void
0	0	1	0	void
0	0	1	1	Add new PC5 QoS flow(s) to the existing 5G ProSe direct link
0	1	0	0	Modify PC5 QoS parameters of the existing PC5 QoS flow(s)
0	1	0	1	Remove existing PC5 QoS flow(s) from the existing 5G ProSe direct link
0	1	1	0	Associate new ProSe application(s) with existing PC5 QoS flow(s)
0	1	1	1	Remove ProSe application(s) from existing PC5 QoS flow(s)
1	0	0	0	
	to			Spare
1	1	1	0	
1	1	1	1	Reserved
Bit 5 to 8 of octet 2 are spare and shall be coded as zero.				

11.3.20 Keep-alive counter

The purpose of the Keep-alive counter information element is to indicate the keep-alive counter which is a 32-bit counter used for the 5G ProSe direct link keep-alive procedure.

The Keep-alive counter is a type 3 information element with a length of 5 octets.

The Keep-alive counter information element is coded as shown in figure 11.3.20.1 and table 11.3.20.1.

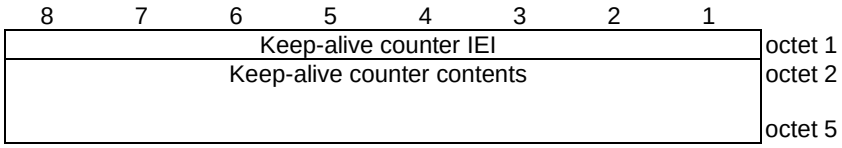

Figure 11.3.20.1: Keep-alive counter information element

Table 11.3.20.1: Keep-alive counter information element

Keep-alive counter contents (octet 2 to 5) This field contains the 32-bit keep-alive counter.

11.3.21 Maximum inactivity period

The purpose of the Maximum inactivity period information element is to indicate the maximum inactivity period of the initiating UE during a 5G ProSe direct link keep-alive procedure.

The Maximum inactivity period is a type 3 information element, with a length of 5 octets.

The Maximum inactivity period information element is coded as shown in figure 11.3.21.1 and table 11.3.21.1.

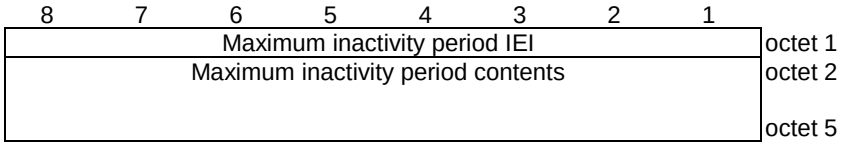

Figure 11.3.21.1: Maximum inactivity period information element

Table 11.3.21.1: Maximum inactivity period information element

Maximum inactivity period contents (octet 2 to 5) This field contains the binary encoding of the maximum inactivity period expressed in units of seconds.

11.3.22 Selected security algorithms

The purpose of the Selected security algorithms information element is to indicate the algorithms to be used for ciphering and integrity protection.

The Selected security algorithms is a type 3 information element with a length of 2 octets.

The Selected security algorithms information element is coded as shown in figure 11.3.22.1 and table 11.3.22.1.

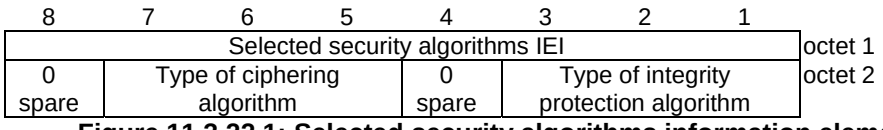

Figure 11.3.22.1: Selected security algorithms information element

Table 11.3.22.1: Selected security algorithms information element

Type of integrity protection algorithm (octet 2, bit 1 to 3) Bits **3 2 1** 0 0 0 5GS integrity algorithm 5G-IA0 (null integrity protection algorithm) 0 0 1 5GS integrity algorithm 128-5G-IA1 0 1 0 5GS integrity algorithm 128-5G-IA2 0 1 1 5GS integrity algorithm 128-5G-IA3 1 0 0 5GS integrity algorithm 5G-IA4 1 0 1 5GS integrity algorithm 5G-IA5 1 1 0 5GS integrity algorithm 5G-IA6 1 1 1 5GS integrity algorithm 5G-IA7 Type of ciphering algorithm (octet 2, bit 5 to 7) Bits **7 6 5** 0 0 0 5GS encryption algorithm 5G-EA0 (null ciphering algorithm) 0 0 1 5GS encryption algorithm 128-5G-EA1 0 1 0 5GS encryption algorithm 128-5G-EA2 0 1 1 5GS encryption algorithm 128-5G-EA3 1 0 0 5GS encryption algorithm 5G-EA4 1 0 1 5GS encryption algorithm 5G-EA5 1 1 0 5GS encryption algorithm 5G-EA6 1 1 1 5GS encryption algorithm 5G-EA7 Bit 4 and 8 of octet 2 are spare and shall be coded as zero.

11.3.23 UE PC5 unicast user plane security policy

The purpose of the UE PC5 unicast user plane security policy information element is to indicate the UE's configuration for integrity protection and ciphering of PC5 user plane data.

The UE PC5 unicast user plane security policy is a type 3 information element with a length of 2 octets.

The UE PC5 unicast user plane security policy information element is coded as shown in figure 11.3.23.1 and table 11.3.23.1.

8	7	6	5	4	3	2	1	
UE PC5 unicast user plane security policy IEI								octet 1
0 spare	User plane ciphering policy			0 spare	User plane integrity protection policy			octet 2

Figure 11.3.23.1: UE PC5 unicast user plane security policy information element

Table 11.3.23.1: UE PC5 unicast user plane security policy information element

User plane integrity protection policy (octet 2, bit 1 to 3) Bits **3 2 1** 0 0 0 User plane integrity protection not needed 0 0 1 User plane integrity protection preferred 0 1 0 User plane integrity protection required 0 1 1 to Spare 1 1 0 1 1 1 Reserved If the UE receives a user plane integrity protection policy value that the UE does not understand, the UE shall interpret the value as 010 "user plane integrity protection required". User plane ciphering policy (octet 2, bit 5 to 7) Bits **7 6 5** 0 0 0 User plane ciphering not needed 0 0 1 User plane ciphering preferred 0 1 0 User plane ciphering required 0 1 1 to Spare 1 1 0 1 1 1 Reserved If the UE receives a user plane ciphering protection policy value that the UE does not understand, the UE shall interpret the value as 010 "user plane ciphering protection required". Bit 4 and 8 of octet 2 are spare and shall be coded as zero.

11.3.24 Re-authentication indication

The purpose of the Re-authentication indication information element is to indication that K_{NRP} needs to be refreshed.

The Re-authentication indication information element is a type 3 information element, with a length of 2 octets.

The Re-authentication indication information element is coded as shown in figure 11.3.24.1 and table 11.3.24.1.

8	7	6	5	4	3	2	1	
Re-authentication indication IEI								octet 1
Re-authentication indication contents								octet 2

Figure 11.3.24.1: Re-authentication indication information element

Table 11.3.24.1: Re-authentication indication information element

Re-authentication indication contents (octet 2) Bits **1** 0 Reserved 1 K_{NRP} is requested to be refreshed Bits 2 to 8 of octet 2 are spare and shall be coded as zero.

11.3.25 Layer-2 ID

The purpose of the layer-2 ID information element is to indicate the layer-2 ID that is used by UE.

The layer-2 ID is a type 3 information element with a length of 4 octets.

The layer-2 ID information element is coded as shown in figure 11.3.25.1 and table 11.3.25.1.

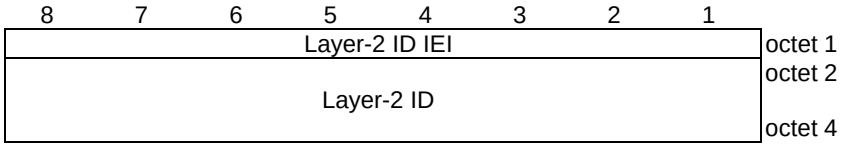

Figure 11.3.25.1: Layer-2 ID information element

Table 11.3.25.1: Layer-2 ID information element

Layer-2 ID (octet 2 to 4) This field contains the 24-bit layer-2 ID.

11.3.26 Relay service code

The purpose of the relay service code information element is to identify a connectivity service the UE-to-Network relay provides.

The relay service code information element is coded as shown in figure 11.3.26.1 and table 11.3.26.1.

The relay service code is a type 3 information element with a length of 4 octets.

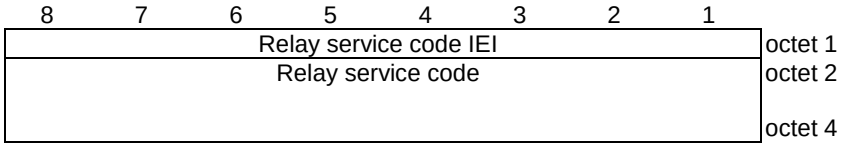

Figure 11.3.26.1: Relay service code information element

Table 11.3.26.1: Relay service code information element

Relay service code value (octet 2 to 4) This contains the 24-bit relay service code.

11.3.27 GPRS timer

See clause 10.5.7.3 in 3GPP TS 24.008 [31].

11.3.28 NCGI announcement request refresh timer T5106

This parameter is used to carry the value of NCGI announcement request refresh timer. It is an integer in the 1-1440 range representing the timer value in unit of minutes.

The NCGI announcement request refresh timer T5106 is a type 3 information element with a length of 2 octets.

The NCGI announcement request refresh timer T5106 IE is coded as shown in figure 11.3.28.1 and table 11.3.28.1.

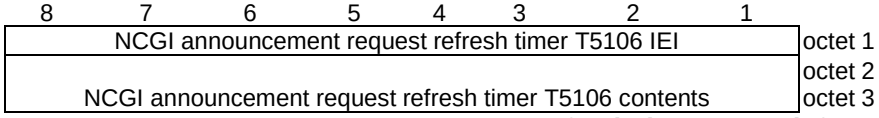

Figure 11.3.28.1: NCGI announcement request refresh timer T5106 information element

Table 11.3.28.1: NCGI announcement request refresh timer T5106 information element

NCGI announcement request refresh timer T5106 (octet 1 to 2) This field contains the 16-bit NCGI announcement request refresh timer T5106.

11.3.29 PC5 QoS rules

The purpose of the PC5 QoS rules information element is to indicate a set of PC5 QoS rules to be used by the UE over the direct link, where each PC5 QoS rule is a set of parameters as described in clause 5.6.1 of 3GPP TS 23.304 [2].

The PC5 QoS rules information element is a type 6 information element with a minimum length of 7 octets. The maximum length for the information element is 65538 octets.

The PC5 QoS flow rules information element is coded as shown in figure 11.3.29.1, figure 11.3.29.2, figure 11.3.29.3, figure 11.3.29.4, and table 11.3.29.1.

8	7	6	5	4	3	2	1	
PC5 QoS rules IEI								octet 1
Length of PC5 QoS rules IE								octet 2 octet 3
PC5 QoS rule 1								octet 4 octet u
PC5 QoS rule 2								octet u+1 octet v
…								octet v+1 octet w
PC5 QoS rule n								octet w+1 octet x

Figure 11.3.29.1: PC5 QoS rules information element

8	7	6	5	4	3	2	1	
PC5 QoS rule identifier								octet 4
Length of PC5 QoS rule								octet 5 octet 6
Rule operation code			DQR bit	Number of packet filters				octet 7
Packet filter list								octet 8* octet a*
PC5 QoS rule precedence								octet a+1*
0 Spare	0 Spare	PC5 QoS flow identifier (PQFI)						octet a+2*
ProSe identifier								octet a+3* octet b*

Figure 11.3.29.2: PC5 QoS rule (u=a+2 or u=b)

8	7	6	5	4	3	2	1	
0	0	0	0	Packet filter identifier 1				octet 8
Spare								
0	0	0	0	Packet filter identifier 2				octet 9
Spare								
…								
0	0	0	0	Packet filter identifier N				octet N+7
Spare								

Figure 11.3.29.3: Packet filter list when the rule operation is "modify existing PC5 QoS rule and delete packet filters" (m=N+7)

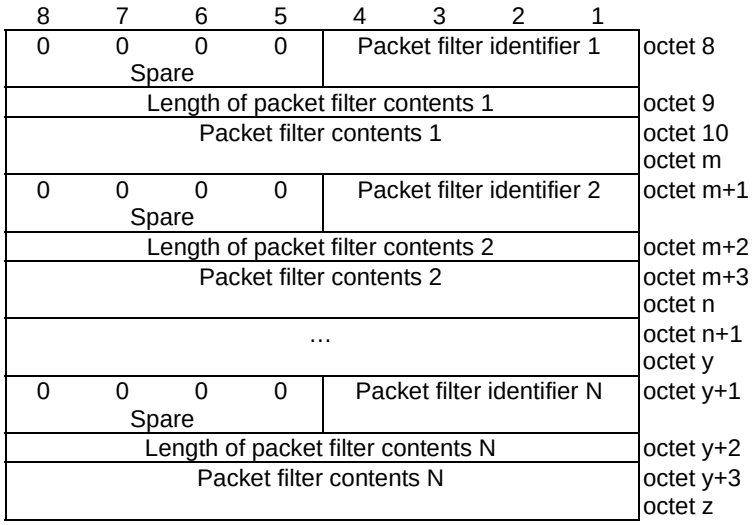

Figure 11.3.29.4: Packet filter list when the rule operation is "create new PC5 QoS rule", or "modify existing PC5 QoS rule and add packet filters" or "modify existing PC5 QoS rule and replace all packet filters"

Table 11.3.29.1: PC5 QoS rules information element

PC5 QoS rule identifier (octet 4)
The PC5 QoS rule identifier field is used to identify the PC5 QoS rule.
Bits
8 7 6 5 4 3 2 1
0 0 0 0 0 0 0 0 no PC5 QoS rule identifier assigned
0 0 0 0 0 0 0 1 PQRI 1
to
1 1 1 1 1 1 1 1 PQRI 255
The target UE shall not set the PQRI value to 0.

PC5 QoS rule precedence (octet a+1)
The PC5 QoS rule precedence field is used to specify the precedence of the PC5 QoS rule among all PC5 QoS rules associated with the PC5 direct link of the PC5 QoS flow. This field includes the binary coded value of the PC5 QoS rule precedence in the range from 0 to 255 (decimal). The higher the value of the PC5 QoS rule precedence field, the lower the precedence of that PC5 QoS rule is. For the "delete existing PC5 QoS rule" operation, the PC5 QoS rule precedence value field shall not be included. For the "create new PC5 QoS rule" operation, the PC5 QoS rule precedence value field shall be included.

PC5 QoS flow identifier (PQFI) (bits 6 to 1 of octet a+2) (see NOTE 1)
The PC5 QoS flow identifier (PQFI) field contains the PC5 QoS flow identifier.
Bits
6 5 4 3 2 1
0 0 0 0 0 0no PC5 QoS flow identifier assigned
0 0 0 0 0 1PQFI 1
to
1 1 1 1 1 1PQFI 63
The target shall not set the PQFI value to 0.
For the "delete existing PC5 QoS rule" operation, the PC5 QoS flow identifier value field shall not be included. For the "create new PC5 QoS rule" operation, the PC5 QoS flow identifier value field shall be included.

DQR bit (bit 5 of octet 7)
The DQR bit indicates whether the PC5 QoS rule is the default PC5 QoS rule and it is encoded as follows:
Bit
5
0 the PC5 QoS rule is not the default PC5 QoS rule.
1 the PC5 QoS rule is the default PC5 QoS rule.

Rule operation code (bits 8 to 6 of octet 7)
Bits
8 7 6
0 0 0 Reserved
0 0 1 Create new PC5 QoS rule
0 1 0 Delete existing PC5 QoS rule
0 1 1 Modify existing PC5 QoS rule and add packet filters
1 0 0 Modify existing PC5 QoS rule and replace all packet filters
1 0 1 Modify existing PC5 QoS rule and delete packet filters
1 1 0 Modify existing PC5 QoS rule without modifying packet filters
1 1 1 Reserved

ProSe identifier (octets a+3 to b) (NOTE 2)
The ProSe identifier field is used to carry the identifier of a ProSe application and shall be encoded as defined in clause 11.3.3.

Number of packet filters (bits 4 to 1 of octet 7)
The number of packet filters contains the binary coding for the number of packet filters in the packet filter list. The number of packet filters field is encoded in bits 4 through 1 of octet 7 where bit 4 is the most significant and bit 1 is the least significant bit. For the "delete existing PC5 QoS rule" operation and for the "modify existing PC5 QoS rule without modifying packet filters" operation, the number of packet filters shall be coded as 0. For the "create new PC5 QoS rule" operation and the "modify existing PC5 QoS rule and replace all packet filters" operation, the number of packet filters shall be greater than or equal to 0 and less than or equal to

15. For all other operations, the number of packet filters shall be greater than 0 and less than or equal to 15.

Packet filter list (octets 8 to m)
The packet filter list contains a variable number of packet filters.

For the "delete existing PC5 QoS rule" operation, the length of PC5 QoS rule field is set to one.

For the "delete existing PC5 QoS rule" operation and the "modify existing PC5 QoS rule without modifying packet filters" operation, the packet filter list shall be empty.

For the "modify existing PC5 QoS rule and delete packet filters" operation, the packet filter list shall contain a variable number of packet filter identifiers. This number shall be derived from the coding of the number of packet filters field in octet 7.

For the "create new PC5 QoS rule" operation and for the "modify existing PC5 QoS rule and replace all packet filters" operation, the packet filter list shall contain 0 or a variable number of packet filters. This number shall be derived from the coding of the number of packet filters field in octet 7.

For the "modify existing PC5 QoS rule and add packet filters" operation, the packet filter list shall contain a variable number of packet filters. This number shall be derived from the coding of the number of packet filters field in octet 7.

Each packet filter is of variable length and consists of
- a packet filter identifier (4 bits);
- the length of the packet filter contents (1 octet); and
- the packet filter contents itself (variable amount of octets).

The packet filter identifier field is used to identify each packet filter in a PC5 QoS rule. The least significant 4 bits are used. When the UE requests to "create new PC5 QoS rule", "modify existing PC5 QoS rule and replace all packet filters" or "modify existing PC5 QoS rule and add packet filters", the packet filter identifier values shall be set to 0.

The length of the packet filter contents field contains the binary coded representation of the length of the packet filter contents field of a packet filter. The first bit in transmission order is the most significant bit.

The packet filter contents field is of variable size and contains a variable number (at least one) of packet filter components. Each packet filter component shall be encoded as a sequence of a one octet packet filter component type identifier and a fixed length packet filter component value field. The packet filter component type identifier shall be transmitted first.

In each packet filter, there shall not be more than one occurrence of each packet filter component type. Among the "IPv4 remote address type" and "IPv6 remote address/prefix length type" packet filter components, only one shall be present in one packet filter. Among the "IPv4 local address type" and "IPv6 local address/prefix length type" packet filter components, only one shall be present in one packet filter. Among the "single local port type" and "local port range type" packet filter components, only one shall be present in one packet filter. Among the "single remote port type" and "remote port range type" packet filter components, only one shall be present in one packet filter. If the "match-all type" packet filter component is present in the packet filter, no other packet filter component shall be present in the packet filter and the length of the packet filter contents field shall be set to one. If the "Ethertype type" packet filter component is present in the packet filter and the "Ethertype type" packet filter component value is neither "0x0800" (for IPv4) nor "0x86DD" (for IPv6), no IP packet filter component shall be present in the packet filter.

The term "IP packet filter component" refers to "IPv4 remote address type", "IPv4 local address type", "IPv6 remote address/prefix length type", "IPv6 local address/prefix length type", "Protocol identifier/Next header type", "Single local port type", "Local port range type", "Single remote port type", "Remote port range type",

"Security parameter index type", "Type of service/Traffic class type" and "Flow label type".

The term local refers to the initiating UE. The term remote refers to an external network entity if the initiating UE is acting as a 5G ProSe layer-3 UE-to-network relay UE. Otherwise, the term remote refers to the peer UE of the 5G ProSe direct link.

Packet filter component type identifier

Bits	
8 7 6 5 4 3 2 1	
0 0 0 0 0 0 0 1	Match-all type
0 0 0 1 0 0 0 0	IPv4 remote address type
0 0 0 1 0 0 0 1	IPv4 local address type
0 0 1 0 0 0 0 1	IPv6 remote address/prefix length type
0 0 1 0 0 0 1 1	IPv6 local address/prefix length type
0 0 1 1 0 0 0 0	Protocol identifier/Next header type
0 1 0 0 0 0 0 0	Single local port type
0 1 0 0 0 0 0 1	Local port range type
0 1 0 1 0 0 0 0	Single remote port type
0 1 0 1 0 0 0 1	Remote port range type
0 1 1 0 0 0 0 0	Security parameter index type
0 1 1 1 0 0 0 0	Type of service/Traffic class type
1 0 0 0 0 0 0 0	Flow label type
1 0 0 0 0 0 0 1	Destination MAC address type
1 0 0 0 0 0 1 0	Source MAC address type
1 0 0 0 0 0 1 1	802.1Q C-TAG VID type
1 0 0 0 0 1 0 0	802.1Q S-TAG VID type
1 0 0 0 0 1 0 1	802.1Q C-TAG PCP/DEI type
1 0 0 0 0 1 1 0	802.1Q S-TAG PCP/DEI type
1 0 0 0 0 1 1 1	Ethertype type
1 0 0 0 1 0 0 0	Destination MAC address range type
1 0 0 0 1 0 0 1	Source MAC address range type
1 0 0 0 1 0 1 0	ProSe identifier (NOTE 2)
1 0 0 0 1 0 1 1	Source layer-2 ID
1 0 0 0 1 1 0 0	Destination layer-2 ID
1 0 0 0 1 1 0 1	Application layer ID

All other values are reserved.

The description and valid combinations of packet filter component type identifiers in a packet filter are defined in clause 7.2.7.

For "match-all type", the packet filter component shall not include the packet filter component value field.

For "IPv4 remote address type", the packet filter component value field shall be encoded as a sequence of a four octet IPv4 address field and a four octet IPv4 address mask field. The IPv4 address field shall be transmitted first.

For "IPv4 local address type", the packet filter component value field shall be encoded as defined for "IPv4 remote address type".

For "IPv6 remote address/prefix length type", the packet filter component value field shall be encoded as a sequence of a sixteen octet IPv6 address field and one octet prefix length field. The IPv6 address field shall be transmitted first.

For "IPv6 local address/prefix length type", the packet filter component value field shall be encoded as defined for "IPv6 remote address /prefix length".

For "protocol identifier/Next header type", the packet filter component value field shall be encoded as one octet which specifies the IPv4 protocol identifier or Ipv6 next header.

For "single local port type" and "single remote port type", the packet filter component value field shall be encoded as two octets which specify a port number.

For "local port range type" and "remote port range type", the packet filter component value field shall be encoded as a sequence of a two octet port range low limit field and a two octet port range high limit field. The port range low limit field shall be transmitted first.

For "security parameter index", the packet filter component value field shall be encoded as four octets which specify the IPSec security parameter index.

For "type of service/traffic class type", the packet filter component value field shall be encoded as a sequence of a one octet type-of-service/traffic class field and a one octet type-of-service/traffic class mask field. The type-of-service/traffic class field shall be transmitted first.

For "flow label type", the packet filter component value field shall be encoded as three octets which specify the IPv6 flow label. The bits 8 through 5 of the first octet shall be spare whereas the remaining 20 bits shall contain the IPv6 flow label.

For "destination MAC address type" and "source MAC address type", the packet filter component value field shall be encoded as 6 octets which specify a MAC address. When the packet filter direction field indicates "bidirectional", the destination MAC address is the remote MAC address and the source MAC address is the local MAC address.

For "802.1Q C-TAG VID type", the packet filter component value field shall be encoded as two octets which specify the VID of the customer-VLAN tag (C-TAG). The bits 8 through 5 of the first octet shall be spare whereas the remaining 12 bits shall contain the VID.

For "802.1Q S-TAG VID type", the packet filter component value field shall be encoded as two octets which specify the VID of the service-VLAN tag (S-TAG). The bits 8 through 5 of the first octet shall be spare whereas the remaining 12 bits shall contain the VID. If there are more than one S-TAG in the Ethernet frame header, the outermost S-TAG is evaluated.

For "802.1Q C-TAG PCP/DEI type", the packet filter component value field shall be encoded as one octet which specifies the 802.1Q C-TAG PCP and DEI. The bits 8 through 5 of the octet shall be spare, the bits 4 through 2 contain the PCP and bit 1 contains the DEI.

For "802.1Q S-TAG PCP/DEI type", the packet filter component value field shall be encoded as one octet which specifies the 802.1Q S-TAG PCP. The bits 8 through 5 of the octet shall be spare, the bits 4 through 2 contain the PCP and bit 1 contains the DEI. If there are more than one S-TAG in the Ethernet frame header, the outermost S-TAG is evaluated.

For "Ethertype type", the packet filter component value field shall be encoded as two octets which specify an ethertype.

For "destination MAC address range type", the packet filter component value field shall be encoded as a sequence of a 6 octet destination MAC address range low limit field and a 6 octet destination MAC address range high limit field. The destination MAC address range low limit field shall be transmitted first. When the packet filter direction field indicates "bidirectional", the destination MAC address range is the remote MAC address range.

For "source MAC address range type", the packet filter component value field shall be encoded as a sequence of a 6 octet source MAC address range low limit field and a 6 octet source MAC address range high limit field. The source MAC address range low limit field shall be transmitted first. When the packet filter direction field indicates "bidirectional", the source MAC address is the local MAC address range.

For "ProSe identifier", the packet filter component value field shall be encoded as defined in clause 11.3.3.

For "source layer-2 ID" and "destination layer-2 ID", the packet filter component value field shall be encoded as defined in clause 11.3.25.

For "application layer ID", the packet filter component value field shall be encoded as defined in clause 11.3.4.
NOTE 1: Octet a+2 shall not be included without octet a+1. NOTE 2: ProSe identifier (octets a+3 to b) can exist only when there is no packet filter including the ProSe identifier packet filter component.

11.3.30 5GS mobile identity

See clause 9.11.3.4 in 3GPP TS 24.501 [11] with Type of identity set to "SUCI".

Editor's note: It is FFS if other types of the UE identity are supported or new IEs are introduced based on whether the security for 5G ProSe layer-3 relay uses the security procedure over control plane or the security procedure over user plane as specified in 3GPP TS 33.503 [34].

11.4 5G ProSe direct discovery message over PC3a formats

11.4.1 Data types format in XML schema

To exchange structured information over the transport protocol, XML text format/notation is introduced.

The corresponding XML data types for the data types used in ProSe messages are provided in table 11.4.1.1.

Table 11.4.1.1: Primitive or derived types for ProSe parameter type

ProSe parameter type	Type in XML schema
Integer	xs:integer
String	xs:string
Boolean	xs:boolean
Binary	xs:hexBinary
Bit string	xs:hexBinary
Time	xs:dateTime

For complex data types described in clause 11.4.2, an XML "complexType" can be used.

Message construction shall be compliant with W3C REC-xmlschema-2-20041028: "XML Schema Part 2: Datatypes" [29]

11.4.2 Parameters in 5G ProSe direct discovery messages over PC3a

11.4.2.1 Transaction ID

This parameter is used to uniquely identify a PC3a control protocol for ProSe direct discovery transaction when it is combined with other PC3a control protocol for ProSe direct discovery transactions in the same transport message. The UE shall set this parameter to a new number for each outgoing new discovery request. The transaction ID is an integer in the 0-255 range.

11.4.2.2 Command

This parameter is used to indicate the type of discovery request (announce, monitor, query, or response) contained in a DISCOVERY_REQUEST message. It is an integer in the 0-255 range encoded in table 11.4.2.2.1.

Table 11.4.2.2.1: Command

0	Reserved
1	Announce
2	Monitor
3	Query
4	Response
5	Metadata_update
6-255	Unused

11.4.2.3 UE identity

This parameter is used to indicate the requesting UE's identity and is set to the SUPI. The coding of SUPI is defined in 3GPP TS 23.003 [12].

11.4.2.4 Prose application ID

This parameter is used to carry an identity used for open 5G ProSe direct discovery, identifying application related information for the ProSe-enabled UE. It is coded as specified in 3GPP TS 23.003 [12].

11.4.2.5 Application identity

This parameter is used to identify the particular application that triggers the DISCOVERY_REQUEST message. The format of the Application Identity consists of two parts:

a) OS ID: operating system identifier. The format of the OS ID is a Universally Unique IDentifier (UUID) as specified in IETF RFC 4122 [30]; and

b) OS App ID: a string containing the OS specific application identifier.

NOTE: Further definition of the format of OS App ID is beyond the scope of this specification.

11.4.2.6 ProSe application code

This parameter is used to contain a ProSe application code. The format of the ProSe application code is as follows:

a) if the ProSe application code is included in a MATCH_REPORT message and application-controlled extension is used, the ProSe application code is encoded as a 184 bitstring composed of:

   1) the ProSe application code Prefix; and

   2) the ProSe application code Suffix; or

b) in all other cases, the ProSe application is encoded as a 184 bitstring as defined in 3GPP TS 23.003 [12].

11.4.2.7 Validity timer T5060

This parameter is used to carry the value of validity timer T5060 associated with a ProSe application code. It is an integer in the 1-525600 range representing the timer value in unit of minutes.

11.4.2.8 PC3a control protocol cause value

This parameter is used to indicate the particular reason why a DISCOVERY_REQUEST or MATCH_REPORT message from the UE has been rejected by the 5G DDNMF. It is an integer in the 0-255 range encoded in table 11.4.2.8.1.

Table 11.4.2.8.1: PC3a control protocol cause value

0 Reserved
1 Invalid Application
2 Unknown ProSe application ID
3 UE authorisation failure
4 Unknown ProSe application code
5 Invalid MIC
6 Invalid UTC-based counter
7 Invalid message format
8 Scope violation in ProSe application ID
9 Unknown RPAUID
10 Unknown or invalid discovery entry ID
11 Invalid discovery target
12 UE unauthorised for discovery with application-controlled extension
13 UE unauthorised for on-demand announcing
14 Missing application level container
15 Invalid data in application level container
16 Invalid match event
17 No valid ProSe application code
18 Invalid UE Identity
19-255Unused

11.4.2.9 Discovery filter

The elements in the discovery filter parameter are listed below.

a) ProSe application code: The ProSe application code is used by a monitoring UE for full or partial matching of PROSE PC5 DISCOVERY messages received on the PC5 interface (see clause 10.2.1). Only one code is allowed in a discovery filter;

b) ProSe application mask: a bitmask provided by the 5G DDNMF in order to allow the monitoring UE to perform a full matching or partial matching of PROSE PC5 DISCOVERY messages received on the PC5 interface. A ProSe application mask with all bits set to "1" is used for full matching. One or more ProSe application masks may be included in a discovery filter. The length of the ProSe application mask is as same as the length of ProSe application code; and

c) TTL Timer T5064: time-to-live duration for which the associated discovery filter is valid, after which it shall not be used. It is an integer in the 1-525600 range representing the timer value in unit of minutes.

11.4.2.10 Monitored PLMN ID

This parameter is used to indicate the PLMN ID of the PLMN in which the PROSE PC5 DISCOVERY message containing a ProSe application code for which there was a match event was received. It is coded as specified in 3GPP TS 23.003 [12].

11.4.2.11 VPLMN ID

This parameter is used to indicate the PLMN ID of the PLMN in which the requesting UE is registered. It is coded as specified in 3GPP TS 23.003 [12].

11.4.2.12 UTC-based counter

This parameter is used to indicate the UTC time associated with the discovery transmission opportunity in which a PROSE PC5 DISCOVERY message is sent. It is expressed in unit of seconds and coded in binary format as the 32 least significant bits of the coordinated universal time as defined in 3GPP TS 38.331 [13].

11.4.2.13 Validity timer T5072

This parameter is used to carry the value of validity timer T5072 associated with a ProSe application code for which there was a match event. It is an integer in the 1-525600 range representing the timer value in unit of minutes.

11.4.2.14 Metadata flag

This parameter is used to indicate whether the UE wishes to receive the latest metadata information associated with the ProSe application ID or RPAUID in the MATCH_REPORT_ACK from the 5G DDNMF. It is a Boolean value coded as follows:

a) False: the UE does not wish to receive the latest metadata information associated with the ProSe application ID or RPAUID in the MATCH_REPORT_ACK from the 5G DDNMF; or

b) True: the UE wishes to receive the latest metadata information associated with the ProSe application ID or RPAUID in the MATCH_REPORT_ACK message from the 5G DDNMF.

11.4.2.15 Metadata

This parameter is used to carry the metadata that is associated with the ProSe application ID contained in the MATCH_REPORT_ACK message. The purpose of the metadata is to carry additional application-layer information associated with a particular ProSe application ID. Examples of such information are postal address, phone number, URL etc. The length and contents of the metadata are out of scope of 3GPP. The format of the metadata is a UTF8-encoded string.

11.4.2.16 Current time

This parameter is used to carry the current UTC-based time at the 5G DDNMF. The format of this parameter follows the XML data type defined in table 11.4.1.1 for ProSe parameter type "Time".

11.4.2.17 Max offset

This parameter is used to indicate the maximum time difference between the time on the UE's ProSe clock and the UTC-based counter associated with the discovery slot in seconds, as specified in 3GPP TS 33.503 [34]. The Max offset is an integer in the 1-32 range.

11.4.2.18 Discovery type

This parameter is used to indicate the type of ProSe direct discovery contained in the DISCOVERY_REQUEST message or MATCH_REPORT message. It is an integer in the 0-3 range encoded as table 11.4.2.18.1.

Table 11.4.2.18.1: Discovery type

0	Reserved
1	Open discovery
2	Restricted discovery
3	Unused

11.4.2.19 Match report refresh timer T5074

This parameter is used to carry the value of match report refresh timer T5074 associated with a ProSe application code for which there was a match event. It is an integer in the 1-525600 range representing the timer value in unit of minutes.

11.4.2.20 Requested timer

During the announce request procedure for open 5G ProSe direct discovery or restricted 5G ProSe direct discovery model A, the requested timer element is used to carry the length of validity timer associated with the ProSe application code or the ProSe restricted code that the UE expects to receive from the 5G DDNMF. When the procedure is to inform

the 5G DDNMF that the UE wants to stop announcing a ProSe application code or a ProSe restricted code before the associated valid timer expires, the requested timer shall be set to 0.

During the monitor request procedure for open 5G ProSe direct discovery or restricted 5G ProSe direct discovery model A, the requested timer element is only used to inform the 5G DDNMF that the UE wants to stop monitoring using discovery filter(s) or restricted discovery filter(s). The requested timer shall be set to 0.

It is an integer in the 0-525600 range representing the timer value in unit of minutes.

11.4.2.21 DDNMF transaction ID

This parameter is used to uniquely identify a PC3a control protocol for ProSe direct discovery transaction when it is combined with other PC3a control protocol for ProSe direct discovery transactions in the same transport message. The 5G DDNMF shall set this parameter to a new number for each outgoing new request. The DDNMF transaction ID is an integer in the 0-255 range.

11.4.2.22 Update info

This parameter is used to carry the following:

a) the updated information for an announcing UE in restricted discovery with a new ProSe restricted code to replace the old one in the discovery entry and the corresponding validity timer. In this case the parameter shall contain the following:

   1) ProSe restricted code: See clause 11.4.2.27; and

   2) validity timer T5062: See clause 11.4.2.32.

b) the updated information for a monitoring UE in restricted discovery with a new set of restricted discovery filters to be used for a given discovery entry. In this case the parameter shall contain one or more restricted discovery filters as defined in clause 11.4.2.30;

c) the updated information for an announcing UE in open discovery with a new ProSe application code to replace the old one in the discovery entry and the corresponding validity timer. In this case the parameter shall contain:

   1) ProSe application code: See clause 11.4.2.6; and

   2) validity timer T5060: See clause 11.4.2.7; or

d) the updated information for a monitoring UE in open discovery with a new set of discovery filters to be used for a given discovery entry. In this case the parameter shall contain one or more discovery filters defined in clause 11.4.2.9.

11.4.2.23 RPAUID

This parameter is used to carry the RPAUID, which is an identity used for restricted 5G ProSe direct discovery, identifying application related information for the 5G ProSe-enabled UE.

11.4.2.24 Announcing type

This parameter is used to indicate whether the UE requests on demand announcing in a DISCOVERY_REQUEST message. It is an integer in the 0-255 range encoded as table 11.4.2.24.1.

Table 11.4.2.24.1: Announcing type

0 Normal
1 On demand
2-225 Unused

11.4.2.25 Application level container

This parameter is used to carry the Application level container, which contains application-level data transparent to the 3GPP network transferred between the application client in the UE and the ProSe application server.

11.4.2.26 Discovery entry ID

This parameter is used to carry the discovery entry ID, which is an identity allocated by the 5G DDNMF to refer to a discovery entry in the UE's context as a result of a discovery request, either announcing or monitoring. It is an integer in the 0-65535 range.

11.4.2.27 ProSe restricted code

This parameter is used to contain a ProSe restricted code. The format of the ProSe restricted code is as follows:

a) if the ProSe restricted code is included in a MATCH_REPORT message and application-controlled extension is not used, the ProSe restricted code is encoded as a 184 bitstring composed of:

   1) the ProSe restricted code in the 64 most significant bits; and

   2) the remaining 120 bits set to zero;

b) if the ProSe restricted code is included in a MATCH_REPORT message and application-controlled extension is used, the ProSe restricted code is encoded as a 184 bitstring composed of

   1) the ProSe restricted code prefix in the 64 most significant bits;

   2) the ProSe restricted code suffix; and

   3) any remaining unused least significant bits set to zero; or

c) in all other cases, the ProSe restricted code is encoded as a 64 bitstring as defined in 3GPP TS 23.003 [12].

11.4.2.28 ProSe restricted code suffix range

This parameter is used to carry a range of consecutive ProSe restricted code suffixes, each of which can be appended by the UE to a ProSe restricted code prefix (see clause 11.4.2.27) for restricted 5G ProSe direct discovery with application-controlled extension. A ProSe restricted code suffix range includes a beginning suffix code and optionally an ending suffix code, as described below:

a) beginning suffix code: the bit-length of this bit string reflects the length of the suffix portion of the ProSe restricted code allocated by the ProSe application server for an RPAUID based on application configuration. The binary value of this code is the lowest value of the ProSe restricted code suffix range; and

b) ending suffix code: the binary value of this code is the highest value of the ProSe restricted code suffix range. The length of the ending suffix code shall be the same as that of the beginning suffix code.

If the ProSe restricted code suffix range contains only a single ProSe restricted code suffix, then that suffix is represented by the beginning suffix code, and the ending suffix code is omitted.

11.4.2.29 On demand announcing enabled indicator

This parameter is used to carry the on demand announcing enabled indicator, which is a Boolean value indicating whether on demand announcing is enabled or not in the 5G DDNMF.

11.4.2.30 Restricted discovery filter

This parameter is used to carry the discovery filter(s) used to monitor an individual target RPAUID in restricted 5G ProSe direct discovery model A. It contains one or more filters, TTL timer T5066, optionally an RPAUID parameter identifying the target RPAUID, optionally a metadata indicator, and optionally the corresponding metadata. The elements in the restricted discovery filter parameter are defined as below:

a) filter: a matching filter used for restricted 5G ProSe direct discovery Model A monitoring. It contains one code and one or more masks. The code is used by a monitoring UE for full or partial matching of PROSE PC5 DISCOVERY messages received on the PC5 interface with a ProSe restricted code (see clause 11.4.2.27). Only one code is allowed in a filter. The mask is a bitmask provided by the 5G DDNMF in order to allow the monitoring UE to perform a full matching or partial matching of PROSE PC5 DISCOVERY messages received on the PC5 interface. A mask with all bits set to "1" is used for full matching. One or more masks may be included in a filter. The length of the mask is the same as the length of the code;

b) TTL Timer T5066: time-to-live duration for which the associated restricted discovery filter is valid, after which it shall not be used. It is an integer in the 1-525600 range representing the timer value in unit of minutes;

c) RPAUID: identifier of the target RPAUID to be monitored;

d) metadata indicator: it contains the information element defined in clause 11.4.2.44; and

e) metadata: application-layer metadata associated with the monitoring target.

11.4.2.31 ACE enabled indicator

This parameter is used to indicate whether application-controlled extension for open 5G ProSe direct discovery or restricted 5G ProSe direct discovery is enabled. It is an integer value in the 0-255 range encoded as table 11.4.2.31.1.

Table 11.4.2.31.1: ACE enabled indicator

0 Reserved
1 Normal
2 Application-controlled extension enable
3-225 Unused

11.4.2.32 Validity timer T5062

This parameter is used to carry the value of validity timer T5062 associated with a ProSe restricted code or ProSe restricted code prefix. It is an integer in the 1-525600 range representing the timer value in unit of minutes.

11.4.2.33 Restricted code security material

This parameter is used as a container for the information necessary for security keys and algorithms protecting the sending or receiving of restricted 5G ProSe direct discovery messages over the PC5 interface. The elements in the restricted code security material parameter are listed below:

a) DUSK: an optional key which is allocated by the 5G DDNMF and is used by the UE for scrambling or unscrambling the PROSE PC5 DISCOVERY message containing the ProSe restricted code in restricted 5G ProSe direct discovery. The calculation of the DUSK is defined in 3GPP TS 33.503 [34];

b) DUIK: an optional key which is allocated by the 5G DDNMF and is used by the UE to compute the MIC that is included in the PROSE PC5 DISCOVERY message containing the ProSe restricted code in restricted 5G ProSe direct discovery. The calculation of the DUIK is defined in 3GPP TS 33.503 [34]; and

c) DUCK and associated encrypted bitmask: DUCK is an optional key which is allocated by the 5G DDNMF and is used by the UE to encrypt a portion of the PROSE PC5 DISCOVERY message containing the ProSe restricted code in restricted 5G ProSe direct discovery. The calculation of the DUCK is defined in 3GPP TS 33.503 [34]. The encrypted bitmask is a 184-bit bitmask which uses bit "1" to mark the positions of the bits for which the DUCK encryption is applied.

d) MIC-check-indicator: an optional indication which is provided by the 5G DDNMF and indicates whether to use match reports for MIC checking, used by the UE to decide whether to perform the required MIC check via the match report procedure for restricted 5G ProSe direct discovery. If this indication is included, the DUIK shall not be included in the restricted code security material parameter but provided as a separate parameter as specified in 3GPP TS 33.503 [34]. This indication is not used for 5G ProSe UE-to-network relay discovery and group member discovery.

11.4.2.34 Discovery model

This parameter is used to indicate the model of ProSe direct discovery contained in the DISCOVERY_REQUEST message. It is an integer in the 0-3 range encoded as table 11.4.2.34.1.

Table 11.4.2.34.1: Discovery model

0	Reserved
1	Model A
2	Model B
3	Unused

11.4.2.35 ProSe response code

This parameter is used to carry the ProSe response code. It is a bit string coded as specified in 3GPP TS 23.003 [12].

11.4.2.36 Discovery query filter

This parameter is used to carry the discovery query filter that is allocated by the 5G DDNMF in the HPLMN to the discoveree UE for restricted Model B discovery, for a particular RPAUID. The elements in the discovery query filter parameter are defined as below:

a) Code: the code is used by a discoveree UE for full or partial matching of PROSE PC5 DISCOVERY messages received on the PC5 interface containing a ProSe query code. Only one code is allowed in a discovery query filter; and

b) Mask: the mask is a bitmask provided by the 5G DDNMF in order to allow the discoveree UE to perform a full matching or partial matching of PROSE PC5 DISCOVERY messages received on the PC5 interface containing the ProSe query code. A mask with all bits set to "1" is used for full matching. One or more masks may be included in a filter. The length of the mask is the same as the length of the code.

11.4.2.37 Validity timer T5068

This parameter is used to carry the value of validity timer T5068 associated with a ProSe response code and corresponding discovery query filter(s). It is an integer in the 1-525600 range representing the timer value in unit of minutes.

11.4.2.38 Subquery result

This parameter is used to contain the information allocated by the 5G DDNMF related to one particular query target RPAUID which the discoverer UE intends to query with restricted 5G ProSe direct discovery model B. It contains one ProSe query code, one or more discovery response filter(s), validity timer T5070, an RPAUID parameter identifying the target RPAUID, restricted security and optionally the corresponding metadata. The elements in the subquery result parameter are defined as below:

a) ProSe query code: it is a ProSe restricted code allocated by the 5G DDNMF to a discoverer UE to solicit the response from a discoveree UE for a particular target RPAUID;

b) discovery response filter: it contains one code and one or more masks to be used to matching ProSe response code. The code is used by a discoverer UE to represent a targeted ProSe response code (see clause 11.4.2.35). The mask is a bitmask provided by the 5G DDNMF in order to allow the discoverer UE to perform a full matching or partial matching of PROSE PC5 DISCOVERY messages received on the PC5 interface containing the ProSe response code. A mask with all bits set to "1" is used for full matching. The length of the mask is the same as the length of the code;

c) validity timer T5070: it represents the validity time associated with a ProSe query code and corresponding discovery response filter(s). It is an integer in the 1-525600 range representing the timer value in unit of minutes;

d) code-sending security parameter: it contains the information element defined in clause 11.4.2.33;

e) code-receiving security parameter: it contains the information element defined in clause 11.4.2.33;

f) RPAUID: identifier of the target RPAUID to be monitored; and

g) metadata: application-layer metadata associated with the querying target.

11.4.2.39 Validity timer T5076

This parameter is used to carry the value of validity timer T5076 associated with a ProSe restricted code for which there was a match event. It is an integer in the 1-525600 range representing the timer value in unit of minutes.

11.4.2.40 Match report refresh timer T5077

This parameter is used to carry the value of match report refresh timer T5077 associated with a ProSe restricted Code for which there was a match event. It is an integer in the 1-525600 range representing the timer value in unit of minutes.

11.4.2.41 Metadata index mask

This parameter is a bitmask provided by the 5G DDNMF in order to indicate the portion used for the metadata index in the ProSe application code for the monitoring UE. The length of the metadata index mask is as same as the length of ProSe application code.

11.4.2.42 Network-initiated transaction method

This parameter is used to indicate the method enabling transport of PC3a messages for 5G DDNMF-initiated ProSe direct discovery procedures. It is an integer in the 0-255 range encoded as table 11.4.2.42.1.

Table 11.4.2.42.1: Network-initiated transaction method

0 Unused
1 HTTP long polling
2-255 Unused

11.4.2.43 Announcing PLMN ID

This parameter is used to indicate the PLMN ID of the PLMN operating the radio resources which the UE intends to use for transmitting a PROSE PC5 DISCOVERY message. It is coded as specified in 3GPP TS 23.003 [12].

11.4.2.44 Metadata Indicator

This parameter is used to indicate whether there is a metadata associated with the target RPAUID. It is an integer value in the 0-255 range encoded as table 11.4.2.44.1.

Table 11.4.2.44.1: Metadata indicator

0 No metadata associated
1 Metadata associated
2-255 Unused

11.4.2.45 ProSe application code prefix

This parameter is used to contain a ProSe application code prefix. Its length indicates the size in bits of the allocated prefix, which can take any value that is a multiple of 8 in the 32 to 176 range.

NOTE: The size of the prefix for a given application is determined by the ProSe application server and made known to the 5G DDNMF by means that are out of scope of 3GPP.

11.4.2.46 ProSe application code suffix

This parameter is used to contain a ProSe application code suffix. The ProSe application code suffix is used with a ProSe application code prefix to form a 184-bit ProSe application code for open 5G ProSe direct discovery with application-controlled extension.

11.4.2.47 ProSe application code ACE

This parameter is used to carry a set of ProSe application code(s) allocated for a corresponding ProSe application ID when application-controlled extension is used. It contains one ProSe application code Prefix, and one or more ProSe application code suffix range(s). The elements in the ProSe application code ACE parameter are defined as below:

a) ProSe application code prefix: as defined in clause 11.4.2.45; and

b) ProSe application code suffix range: this parameter is used to carry a range of consecutive ProSe application code suffixes (see clause 11.4.2.46). A ProSe application code suffix range includes a beginning suffix code and optionally an ending suffix code, as described below:

   1) beginning suffix code: the bit-length of this bit string reflects the length of the suffix portion of the ProSe application code allocated by the ProSe application server for a ProSe application ID based on application configuration. The binary value of this code is the lowest value of the ProSe application code suffix range; and

   2) ending suffix code: the binary value of this code is the highest value of the ProSe application code suffix range. The length of the ending suffix code shall be the same as that of the beginning suffix code.

   If the ProSe application code suffix range contains only a single ProSe application code suffix, then that suffix is represented by the beginning suffix code, and the ending suffix code is omitted.

11.4.2.48 Discovery key

This parameter is used to carry a Discovery key allocated by the 5G DDNMF. This key is used by the UE to compute the MIC that is included in the PROSE PC5 DISCOVERY message. The format of Discovery key is defined in 3GPP TS 33.303 [36].

11.4.2.49 PC5 security policies

This parameter is used to indicate the PC5 security policies as integer values, where the PC5 signalling security policies are defined in table 11.3.12.1 and the PC5 user plane security policies are defined in table 11.3.23.1.

11.5 Non-IP PDU format

The non-IP PDU is coded according to figure 11.5.1 and table 11.5.1.

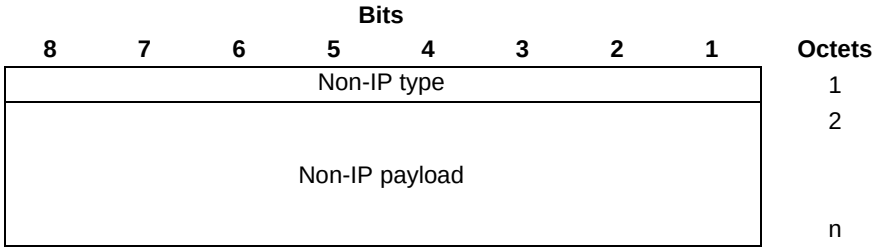

Figure 11.5.1: Non-IP PDU format

Table 11.5.1: Non-IP PDU values

Non-IP type (octet 1)								
Bits								
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**	
0	0	0	1	0	0	0	0	Ethernet
0	0	0	1	0	0	0	1	Address Resolution Protocol (see RFC 826 [32])
0	0	0	1	0	0	1	0	Unstructured
All other values are reserved.								
Octets 2 to n contain the non-IP payload field containing the data provided by the upper layer as indicated in Non-IP type.								

12 List of system parameters

12.1 Overview

The description of timers in the following tables should be considered a brief summary. The precise details are found in clauses 4 to 8, which should be considered the definitive descriptions.

12.2 Timers of provisioning of parameters for 5G ProSe configuration procedures

Timers of provisioning of parameters for 5G ProSe configuration are shown in table 12.2.1.

NOTE: Timer T5040 is defined in 3GPP TS 24.587 [18].

Table 12.2.1: Timers of provisioning of parameters for 5G ProSe configuration – UE side

TIMER NUM.	TIMER VALUE	CAUSE OF START	NORMAL STOP	ON EXPIRY
T5051	Validity timer value for UE policies for 5G ProSe direct discovery over PC5 (see clause 5.2), which is specified in 3GPP TS 24.555 [17] clause 5.3.	Start using the new UE policies for 5G ProSe direct discovery received in MANAGE UE POLICY COMMAND message	Stop using the old UE policies for 5G ProSe direct discovery	Initiate the UE-requested ProSeP provisioning procedure (NOTE 1)
T5052	Validity timer value for UE policies for 5G ProSe direct communication over PC5 (see clause 5.2), which is specified in 3GPP TS 24.555 [17] clause 5.4.	Start using the new UE policies for 5G ProSe direct communications received in MANAGE UE POLICY COMMAND message	Stop using the old UE policies for 5G ProSe direct communications	Initiate the UE-requested ProSeP provisioning procedure (NOTE 1)
T5053	Validity timer value for UE policies for 5G ProSe UE-to-network relay UE (see clause 5.2), which is specified in 3GPP TS 24.555 [17] clause 5.5.	Start using the new UE policies for 5G ProSe UE-to-network relay received in MANAGE UE POLICY COMMAND message	Stop using the old UE policies for 5G ProSe UE-to-network relay	Initiate the UE-requested ProSeP provisioning procedure (NOTE 1)
T5054	Validity timer value for UE policies for 5G ProSe remote UE (see clause 5.2), which is specified in 3GPP TS 24.555 [17] clause 5.6.	Start using the new UE policies for 5G ProSe Remote UE received in MANAGE UE POLICY COMMAND message	Stop using the old UE policies for 5G ProSe Remote UE	Initiate the UE-requested ProSeP provisioning procedure (NOTE 1)
NOTE 1: The timers expire only once.				

12.3 Timers of 5G ProSe direct link management procedures

NOTE: Timer T3346 is defined in 3GPP TS 24.008 [31].

Table 12.3.1: 5G ProSe direct link management timers

TIMER NUM.	TIMER VALUE	CAUSE OF START	NORMAL STOP	ON EXPIRY
T5080	8s NOTE 1	Upon sending a PROSE DIRECT LINK ESTABLISHMENT REQUEST message	Upon receiving a PROSE DIRECT LINK ESTABLISHMENT ACCEPT or PROSE DIRECT LINK ESTABLISHMENT REJECT message from the target UE if the Target user info is included in the PROSE DIRECT LINK ESTABLISHMENT REQUEST message	Retransmission of PROSE DIRECT LINK ESTABLISHMENT REQUEST message if the Target user info is included in the PROSE DIRECT LINK ESTABLISHMENT REQUEST message; or may abort the ongoing procedure if the Target user info is not included in the PROSE DIRECT LINK ESTABLISHMENT REQUEST message
T5081	5s	Upon sending a PROSE DIRECT LINK MODIFICATION REQUEST message	Upon receiving a PROSE DIRECT LINK MODIFICATION ACCEPT or PROSE DIRECT LINK MODIFICATION REJECT or PROSE DIRECT LINK RELEASE REQUEST message from the target UE	Retransmission of PROSE DIRECT LINK MODIFICATION REQUEST message
T5082	2s	Upon sending a PROSE DIRECT LINK IDENTIFIER UPDATE REQUEST message	Upon receiving a PROSE DIRECT LINK IDENTIFIER UPDATE ACCEPT or PROSE DIRECT LINK IDENTIFIER UPDATE REJECT or PROSE DIRECT LINK RELEASE REQUEST message from the target UE	Retransmission of the PROSE DIRECT LINK IDENTIFIER UPDATE REQUEST message
T5083	2s	Upon sending a PROSE DIRECT LINK IDENTIFIER UPDATE ACCEPT message	Upon receiving a PROSE DIRECT LINK IDENTIFIER UPDATE ACK message or PROSE DIRECT LINK RELEASE REQUEST message from the initiating UE	Retransmission of the PROSE DIRECT LINK IDENTIFIER UPDATE ACCEPT message
T5084	5s	Upon receiving a PC5 signalling message or PC5 user plane data	Upon 5G ProSe direct link release or upon initiating the 5G ProSe direct link keep-alive procedure	Initiate the 5G ProSe direct link keep-alive procedure
T5085	5s	Upon sending a PROSE DIRECT LINK KEEPALIVE REQUEST message	Upon receiving a PC5 signalling message or PC5 user plane data	Retransmission of the PROSE DIRECT LINK KEEPALIVE REQUEST message

TIMER NUM.	TIMER VALUE	CAUSE OF START	NORMAL STOP	ON EXPIRY
T5086	Default 10m NOTE 2	Upon receiving a Maximum inactivity period in a PROSE DIRECT LINK KEEPALIVE REQUEST message, receiving a PC5 signalling message or receiving PC5 user plane data	Upon receiving a PC5 signalling message or PC5 user plane data	Either initiate the 5G ProSe direct link keep-alive procedure or the 5G ProSe direct link release procedure
T5087	5s	Upon sending a PROSE DIRECT LINK RELEASE REQUEST message	Upon receiving a PROSE DIRECT LINK RELEASE ACCEPT message from the target UE	Retransmission of PROSE DIRECT LINK RELEASE REQUEST message
T5088	As described in clause 7.2.2.5 and clause 7.2.6.3	Upon receiving a PROSE DIRECT LINK ESTABLISHMENT REJECT message with PC5 signalling protocol cause value set to #13 "congestion situation" and a back-off timer value is provided in the message Upon receiving a PROSE DIRECT LINK RELEASE REQUEST message with PC5 signalling protocol cause value set to #13 "congestion situation" and a back-off timer value is provided in the message	Upon receiving PROSE PC5 DISCOVERY message from the same UE-to-network relay UE due to starting announcing UE procedure or discoveree UE procedure as described in clause 8.2.1.2.1.2 and clause 8.2.1.3.2.2 respectively	Take the peer UE onboard for UE-to-network relay UE discovery and selection
T5089	2s	Upon sending a PROSE DIRECT LINK SECURITY MODE COMMAND message	Upon receiving a PROSE DIRECT LINK SECURITY MODE COMPLETE or PROSE DIRECT LINK SECURITY MODE REJECT message from the target UE	Retransmission of PROSE DIRECT LINK SECURITY MODE COMMAND message
T5090	NOTE 2	Upon establishing a 5G ProSe direct link and at least one of ProSe identifiers for the 5G ProSe direct link satisfying the privacy requirements or upon completing a 5G ProSe direct link modification and at least one of ProSe identifiers for the 5G ProSe direct link satisfying the privacy requirements or upon completing the 5G ProSe direct link identifier update procedure	Upon completing a 5G ProSe direct link identifier update or upon accepting a PROSE DIRECT LINK IDENTIFIER UPDATE REQUEST message or upon a 5G ProSe direct link release	Transmission of PROSE DIRECT LINK IDENTIFIER UPDATE REQUEST message
T5091	8s	Upon sending a PROSE DIRECT LINK REKEYING REQUEST message	Upon receiving a PROSE DIRECT LINK REKEYING RESPONSE message or PROSE DIRECT LINK RELEASE REQUEST message from the target UE	Retransmission of PROSE DIRECT LINK REKEYING REQUEST message
T5092	2s	Upon sending a PROSE DIRECT LINK AUTHENTICATION REQUEST message	Upon receiving a PROSE DIRECT LINK AUTHENTICATION RESPONSE or DIRECT LINK AUTHENTICATION REJECT message from the target UE	Retransmission of PROSE DIRECT LINK AUTHENTICATION REQUEST message

TIMER NUM.	TIMER VALUE	CAUSE OF START	NORMAL STOP	ON EXPIRY
NOTE 1: If the Target user info is not included in the PROSE DIRECT LINK ESTABLISHMENT REQUEST message, then the initiating UE may keep the timer T5080 running upon receiving PROSE DIRECT LINK ESTABLISHMENT ACCEPT message. NOTE 2: The value of this timer is the privacy timer value which is one of the configuration parameters for 5G ProSe direct communication (see clause 5.2.4) and it is specified in 3GPP TS 24.555 [17] clause 5.4.				

12.4 Timers of 5G ProSe direct discovery procedures over PC3a

Table 12.4.1: Timers of 5G ProSe direct discovery procedures over PC3a – UE side

TIMER NUM.	TIMER VALUE	CAUSE OF START	NORMAL STOP	ON EXPIRY
T5060	NOTE 1	Upon receiving a ProSe application code with an associated T5060 timer in a DISCOVERY_RESPONSE message whose transaction ID contained in the <response-announce> element matches the value sent by the UE in a DISCOVERY_REQUEST message with the command set to "announce", as described in clause 6.2.2.4. Upon receiving a ProSe application code with an associated T5060 timer in the Update info in the <discovery-update-request> element in a DISCOVERY_UPDATE_REQUEST message and the discovery entry ID in the <discovery-update-request> element is known, as described in clause 6.2.11.3.	Upon receiving a new T5060 timer value for the same ProSe application code or receiving a new Timer associated with a new ProSe application code for the same ProSe application ID in a DISCOVERY_RESPONSE message. When the UE selects a new PLMN. Upon receiving a <discovery-update-request> element in a DISCOVERY_UPDATE_REQUEST message and the discovery entry ID in the <discovery-update-request> element is known, as described in clause 6.2.11.3.	Stop announcing the associated ProSe application code over the PC5 interface and re-initiate the announce request procedure if the request from upper layers to announce the ProSe application ID corresponding to the associated ProSe application code is still in place.

TIMER NUM.	TIMER VALUE	CAUSE OF START	NORMAL STOP	ON EXPIRY
T5062	NOTE 2	Upon receiving a ProSe restricted code or ProSe restricted code prefix with an associated T5062 timer in a DISCOVERY_RESPONSE message whose transaction ID contained in the <restricted-announce-response> element matches the value sent by the UE in a DISCOVERY_REQUEST message with the command set to "announce" and the discovery type set to "Restrict discovery", as described in clause 6.2.3.4. Upon receiving a ProSe restricted code with an associated T5062 timer in the Update info in the <discovery-update-request> element in a DISCOVERY_UPDATE_REQUEST message and the discovery entry ID in the <discovery-update-request> element is known, as described in clause 6.2.12.3.2.	Upon receiving a new T5062 timer value for the same ProSe restricted code or ProSe restricted code prefix, or upon receiving a new T5062 timer associated with a new ProSe restricted code or ProSe restricted code prefix for the same RPAUID in a DISCOVERY_RESPONSE message. When the UE selects a new PLMN. Upon receiving a ProSe restricted code with an associated T5062 timer in the Update info in the <discovery-update-request> element in a DISCOVERY_UPDATE_REQUEST message and the discovery entry ID in the <discovery-update-request> element is known, as described in clause 6.2.12.3.2.	Stop announcing the associated ProSe restricted code over the PC5 interface if the ProSe restricted code is already allocated; and re-initiate the announce request procedure if the request from upper layers to announce the RPAUID corresponding to the associated ProSe restricted code is still in place.
T5064	NOTE 3	Upon receiving a discovery filter with an associated T5064 timer in a DISCOVERY_RESPONSE message whose transaction ID contained in the <response-monitor> element matches the value sent by the UE in a DISCOVERY_REQUEST message with the command set to "monitor", as described in clause 6.2.4.4. Upon receiving a discovery filter in the Update info in the <discovery-update-request> element in a DISCOVERY_UPDATE_REQUEST message and the discovery entry ID in the <discovery-update-request> element is known, as described in clause 6.2.11.3.	Upon receiving a new T5064 timer value for the same discovery filter in a DISCOVERY_RESPONSE message. Upon receiving a <discovery-update-request> element in a DISCOVERY_UPDATE_REQUEST message and the discovery entry ID in the <discovery-update-request> element is known, as described in clause 6.2.11.3.	Stop using the associated discovery filter for ProSe direct discovery monitoring over the PC5 interface and re-initiate the monitor request procedure, if the request from upper layers to monitor the ProSe application ID corresponding to the associated discovery filter is still in place.

TIMER NUM.	TIMER VALUE	CAUSE OF START	NORMAL STOP	ON EXPIRY
T5066	NOTE 4	Upon receiving a Restricted discovery filter with an associated T5066 timer in a DISCOVERY_RESPONSE message whose transaction ID contained in the <restricted-monitor-response> element matches the value sent by the UE in a DISCOVERY_REQUEST message with the command set to "monitor" and the discovery type set to "Restrict discovery", as described in clause 6.2.5.4. Upon receiving a Restricted discovery filter in the Update info in the <discovery-update-request> element in a DISCOVERY_UPDATE_REQUEST message and the discovery entry ID in the <discovery-update-request> element is known, as described in clause 6.2.12.3.2.	Upon receiving one or more new T5066 timer values for the same discovery entry in a DISCOVERY_RESPONSE message. Upon receiving a Restricted discovery filter in the Update info in the <discovery-update-request> element in a DISCOVERY_UPDATE_REQUEST message and the discovery entry ID in the <discovery-update-request> element is known, as described in clause 6.2.12.3.2.	Stop using the associated Restricted discovery filter for restricted 5G ProSe direct discovery monitoring over the PC5 interface and re-initiate the monitor request procedure, if the request from upper layers to monitor the corresponding discovery target is still in place.
T5068	NOTE 5	Upon receiving a ProSe response code and discovery query filters with an associated T5068 timer in a DISCOVERY_RESPONSE message whose transaction ID contained in the < restricted-discoveree-response > element matches the value sent by the UE in a DISCOVERY_REQUEST message with the command set to "response" and the discovery type set to "Restrict discovery", as described in clause 6.2.6.4.	Upon receiving a new T5068 timer value for the same discovery entry in a DISCOVERY_RESPONSE message. When the UE selects a new PLMN.	Stop announcing the associated ProSe response code or monitoring with the associated discovery query filter(s) over the PC5 interface and re-initiate the discoveree request procedure if the request from upper layers to announce the RPAUID in Model B is still in place.
T5070	NOTE 6	Upon receiving a ProSe query code and discovery response filters with an associated T5070 timer in a DISCOVERY_RESPONSE message whose transaction ID contained in the < restricted-discoverer-response > element matches the value sent by the UE in a DISCOVERY_REQUEST message with the command set to "query" and the discovery type set to "Restrict discovery", as described in clause 6.2.7.4.	Upon receiving a new T5070 timer value for the same discovery entry in a DISCOVERY_RESPONSE message.	Stop announcing the associated ProSe query code or monitoring with the associated discovery response filter(s) over the PC5 interface and re-initiate the discoverer request procedure if the request from upper layers to query for the same targets in Model B is still in place.

TIMER NUM.	TIMER VALUE	CAUSE OF START	NORMAL STOP	ON EXPIRY
T5072	NOTE 7	Upon receiving a T5072 timer in a MATCH_REPORT_ACK message whose transaction ID contained in the <match-ack> element matches the value sent by the UE in a MATCH_REPORT message, as described in clause 6.2.8.4.	Upon receiving a new T5072 timer value for the same ProSe application code in a MATCH_REPORT_ACK message. Upon receiving a MATCH_REPORT_ACK message with a <match-reject> element containing PC3a control protocol cause value is #5.	The UE may inform the upper layers that the corresponding ProSe application ID is no longer matched.
T5074	NOTE 7	Upon receiving a T5074 timer in a MATCH_REPORT_ACK message whose transaction ID contained in the <match-ack> element matches the value sent by the UE in a MATCH_REPORT message, as described in clause 6.2.8.4.	Upon receiving a new T5074 timer value for the same ProSe application code in a MATCH_REPORT_ACK message. When the corresponding T5074 timer for the ProSe application code is stopped or expires.	The UE needs to send a Match Report on next instance it detects the corresponding ProSe application code.
T5076	NOTE 8	Upon receiving a T5076 timer in a MATCH_REPORT_ACK message whose transaction ID contained in the <restricted-match-ack> element matches the value sent by the UE in a MATCH_REPORT message, as described in clause 6.2.9.4 or 6.2.10.4.	Upon receiving a new T5076 timer value for the same ProSe restricted code or ProSe response code in a MATCH_REPORT_ACK message. Upon receiving a MATCH_REPORT_ACK message with a <match-reject> element containing PC3a control protocol cause value #5.	The UE may inform the upper layers that the corresponding RPAUID is no longer matched.
T5077	NOTE 8	Upon receiving a T5077 timer in a MATCH_REPORT_ACK message whose transaction ID contained in the <restricted-match-ack> element matches the value sent by the UE in a MATCH_REPORT message, as described in clause 6.2.9.4.	Upon receiving a new T5077 timer value for the same ProSe restricted code or ProSe response code in a MATCH_REPORT_ACK message. When the corresponding T5076 timer for the ProSe restricted code or ProSe response code is stopped or expires.	The UE needs to send a Match Report on next instance it detects the corresponding ProSe restricted code or ProSe response code.

TIMER NUM.	TIMER VALUE	CAUSE OF START	NORMAL STOP	ON EXPIRY

NOTE 1: The value of this timer is provided by the 5G DDNMF during the announce request and discovery update procedure for open 5G ProSe direct discovery.
NOTE 2: The value of this timer is provided by the 5G DDNMF during the announce request and discovery update procedure for restricted 5G ProSe direct discovery model A.
NOTE 3: The value of this timer is provided by the 5G DDNMF during the monitor request and discovery update procedure for open 5G ProSe direct discovery.
NOTE 4: The value of this timer is provided by the 5G DDNMF during the monitor request and discovery update procedure for restricted 5G ProSe direct discovery model A.
NOTE 5: The value of this timer is assigned by the 5G DDNMF during the discoveree request procedure for restricted 5G ProSe direct discovery model B.
NOTE 6: The value of this timer is assigned by the 5G DDNMF during the discoverer request procedure for restricted 5G ProSe direct discovery model B.
NOTE 7: The value of this timer is provided by the 5G DDNMF during the match report procedure for open 5G ProSe direct discovery.
NOTE 8: The value of this timer is provided by the 5G DDNMF during the match report procedure for restricted 5G ProSe direct discovery model A or match report procedure for restricted 5G ProSe direct discovery model B.

Table 12.4.2: Timers of 5G ProSe direct discovery procedures over PC3a – 5G DDNMF side

TIMER NUM.	TIMER VALUE	CAUSE OF START	NORMAL STOP	ON EXPIRY
T5061	NOTE 1	Upon assigning a ProSe application code with an associated T5060 value to the UE, as described in clause 6.2.2.3 and clause 6.2.11.2.	Upon receiving a new DISCOVERY_REQUEST message from the UE with the command set to "announce" for the same ProSe application ID.	Delete the association between the UE, the requested ProSe application ID and the corresponding ProSe application code allocated by the 5G DDNMF.
T5063	NOTE 3	Upon assigning a ProSe restricted code or ProSe restricted code prefix with an associated T5062 value to the UE, as described in clause 6.2.3.3 and clause 6.2.12.3.1.	Upon receiving a new DISCOVERY_REQUEST message from the UE with the command set to "announce" for the same RPAUID or discovery entry ID. Set to be the same as the discovery entry in which this timer is running.	Delete the association between the UE, the RPAUID and the corresponding ProSe restricted code or ProSe restricted code prefix allocated by the 5G DDNMF.
T5065	NOTE 2	Upon assigning a discovery filter with an associated T5064 value to the UE, as described in clause 6.2.4.3 and clause 6.2.11.2.	Upon receiving a new DISCOVERY_REQUEST message from the UE with the command set to "monitor" for the same ProSe application ID	Delete the association between the UE, the requested ProSe application ID and the corresponding discovery filter allocated by the 5G DDNMF.
T5067	NOTE 4	Upon assigning a Restricted discovery filter with an associated T5066 value to the UE, as described in clause 6.2.5.3 and clause 6.2.12.3.1.	Upon receiving a new DISCOVERY_REQUEST message from the UE with the command set to "monitor" and discovery entry ID set to be the same as the discovery entry in which this timer is running.	Delete the association between the UE, the RPAUID and the corresponding Restricted discovery filter allocated by the 5G DDNMF.
T5069	NOTE 5	Upon assigning a ProSe query code, ProSe response code and discovery query filter(s) with an associated T5068 value to the UE, as described in clause 6.2.6.3.	Upon receiving a new DISCOVERY_REQUEST message from the UE with the command set to "response" for the same RPAUID or discovery entry ID. Set to be the same as the discovery entry in which this timer is running.	Delete the discovery entry in discoveree UE context which contains association between the UE, the RPAUID and the corresponding ProSe query code, ProSe response code, discovery query filter(s) allocated by the 5G DDNMF.

TIMER NUM.	TIMER VALUE	CAUSE OF START	NORMAL STOP	ON EXPIRY
T5071	NOTE 6	Upon retrieving the ProSe query code, ProSe response code from discoveree UE context and assigning Discovery Response Filter(s) with an associated T5070 value to the UE, as described in clause 6.2.7.3.	Upon receiving a new DISCOVERY_REQUEST message from the UE with the command set to "query" and discovery entry ID set to be the same as the discovery entry in which this timer is running.	Delete the discovery entry in discoverer UE context which contains the association between the UE, the RPAUID and the corresponding Discovery Response Filter(s) allocated by the 5G DDNMF.
NOTE 1: The value of this timer is assigned by the 5G DDNMF during the announce request and discovery update procedure for open 5G ProSe direct discovery. NOTE 2: The value of this timer is assigned by the 5G DDNMF during the monitor request and discovery update procedure for open 5G ProSe direct discovery. NOTE 3: The value of this timer is assigned by the 5G DDNMF during the announce request and discovery update procedure for restricted 5G ProSe direct discovery model A. NOTE 4: The value of this timer is assigned by the 5G DDNMF during the monitor request and discovery update procedure for restricted 5G ProSe direct discovery model A. NOTE 5: The value of this timer is assigned by the 5G DDNMF during the discoveree request procedure for restricted 5G ProSe direct discovery model B. NOTE 6: The value of this timer is assigned by the 5G DDNMF during the discoverer request procedure for restricted 5G ProSe direct discovery model B.				

NOTE: Multiple timers T5061, T5063, T5065, T5067, T5069 and T5071 can run simultaneously in the 5G DDNMF.

12.5 Timers of broadcast mode 5G ProSe communication over PC5 interface

Table 12.5.1: timers of broadcast mode 5G ProSe communication over PC5

TIMER NUM.	TIMER VALUE	CAUSE OF START	NORMAL STOP	ON EXPIRY
T5100	Privacy timer value for source layer-2 ID of UE for 5G ProSe communication over PC5 (see clause 5.2), which is specified in 3GPP TS 24.555 [17] clause 5.4.	Upon initiating transmission of broadcast mode 5G ProSe communication over PC5, as described in clause 7.3.2.4. Upon receiving an indication from upper layers that the application layer identifier has been changed while performing transmission of broadcast mode 5G ProSe communication over PC5, as described in clause 7.3.2.4. Upon T5aaa expiration while performing transmission of broadcast mode 5G ProSe communication over PC5, as described in clause 7.3.2.4.	Upon stopping transmission of broadcast mode V2X communication over PC5, as described in clause 7.3.2.4.	Change the value of the source layer-2 ID self-assigned by the UE for broadcast mode ProSe communication over PC5. If the data unit(s) of a ProSe application contains IP data, change the value of the source IP address self-assigned by the UE for broadcast mode 5G ProSe communication over PC5.

12.6 Timers of groupcast mode 5G ProSe communication over PC5 interface

Table 12.6.1: timers of groupcast mode 5G ProSe direct communication over PC5

TIMER NUM.	TIMER VALUE	CAUSE OF START	NORMAL STOP	ON EXPIRY
T5200	Privacy timer value for source layer-2 ID of UE for 5G ProSe communication over PC5 (see clause 5.2), which is specified in 3GPP TS 24.555 [17] clause 5.4.	Upon initiating transmission of groupcast mode 5G ProSe communication over PC5, as described in clause 7.4.2.4. Upon receiving an indication from upper layers that the application layer identifier has been changed while performing transmission of groupcast mode 5G ProSe communication over PC5, as described in clause 7.4.2.4. Upon T5200 expiration while performing transmission of groupcast mode 5G ProSe communication over PC5, as described in clause 7.4.2.4.	Upon stopping transmission of groupcast mode 5G ProSe communication over PC5, as described in clause 7.4.2.4.	Change the value of the source Layer-2 ID self-assigned by the UE for groupcast mode ProSe communication over PC5. If the data unit(s) of a ProSe application contains IP data, change the value of the source IP address self-assigned by the UE for groupcast mode 5G ProSe communication over PC5.

12.7 Timers of 5G ProSe additional parameters announcement procedure

Table 12.7: 5G ProSe additional parameters announcement timers

TIMER NUM.	TIMER VALUE	CAUSE OF START	NORMAL STOP	ON EXPIRY
T5106	NOTE 1	Upon receiving a T5106 value in a PROSE ADDITIONAL PARAMETERS ANNOUNCEMENT RESPONSE message as described in clause 10.3.25.	Upon receiving one or more new T5106 timer values in a PROSE ADDITIONAL PARAMETERS ANNOUNCEMENT_ RESPONSE message.	Re-initiate the additional parameters announcement request procedure, if the upper layer application still needs to obtain NCGI or TAI of the cell serving the 5G ProSe layer-3 UE-to-network relay.
T5107	NOTE 2	Upon sending a PROSE ADDITIONAL PARAMETERS ANNOUNCEMENT RESPONSE message as described in clause 10.3.25.	Upon sending a new PROSE ADDITIONAL PARAMETERS ANNOUNCEMENT RESPONSE message.	Stop the cell ID or TAI announcement in the PROSE PC5 DISCOVERY message for relay discovery additional Information.
NOTE 1: The value of this timer is provided by the 5G ProSe layer-3 UE-to-network relay UE during the 5G ProSe additional parameters announcement procedure. NOTE 2: The value of this timer is assigned by the 5G ProSe layer-3 UE-to-network relay UE during the 5G ProSe additional parameters announcement procedure.				

Annex A (informative): Change history

Change history							
Date	**Meeting**	**TDoc**	**CR**	**Rev**	**Cat**	**Subject/Comment**	**New version**
2021-02	CT1#128e	C1-211183				Draft skeleton provided by the rapporteur.	0.0.0
2021-02	CT1#128e	C1-211184				Implementing the following p-CR agreed by CT1: C1-211184 Editorial change from the rapporteur.	0.1.0
2021-04	CT1#129e					Implementing the following p-CR agreed by CT1: C1-212046, C1-212274, C1-212275, C1-212276, C1-212383, C1-212384, C1-212385, C1-212468, C1-212469, C1-212470, C1-212472, C1-212474, C1-212475, C1-212477, C1-212488, C1-212495, C1-212498, C1-212505, C1-212507, C1-212531, C1-212572, C1-212574, C1-212579, C1-212586, C1-212587, C1-212588, C1-212589, C1-212590, C1-212591, C1-212592, C1-212594 Editorial change from the rapporteur. Correction from the rapporteur.	0.2.0
2021-05	CT1#130e					Implementing the following p-CR agreed by CT1: C1-213020, C1-213755, C1-213043, C1-213044, C1-213045, C1-213046, C1-213202, C1-213674, C1-213203, C1-213205, C1-213568, C1-213569, C1-213570, C1-213571, C1-213572, C1-213843, C1-213802, C1-213770, C1-213768, C1-213767, C1-213667, C1-213668, C1-213670, C1-213671, C1-213756 Editorial change from the rapporteur. Correction from the rapporteur.	0.3.0
2021-08	CT1#131e					Implementing the following p-CR agreed by CT1: C1-215037, C1-215038, C1-215119, C1-215036, C1-215039, C1-214813, C1-214794, C1-215127, C1-215060, C1-215113, C1-215140, C1-215058, C1-215110, C1-215107, C1-215141, C1-215072, C1-214597, C1-214951, C1-215069, C1-215066, C1-215067, C1-214334, C1-214469, C1-214313, C1-214595, C1-214312 Editorial change from the rapporteur. Correction from the rapporteur.	0.4.0
2021-10	CT1#132e					Implementing the following p-CR agreed by CT1: C1-216106 C1-216038, C1-216034, C1-216182, C1-216190, C1-216159, C1-215616, C1-216155, C1-216107, C1-215844, C1-215620, C1-216191, C1-216175, C1-216189, C1-216160, C1-216158, C1-216156, C1-216186, C1-216037, C1-216041, C1-216183, C1-215615, C1-216147, C1-216184, C1-216035, C1-216095, C1-216036, C1-216188, C1-215829 Editorial change from the rapporteur. Correction from the rapporteur.	0.5.0
2021-12	CT#94-e					Implementing the following p-CR agreed by CT1: C1-216701 C1-216704, C1-216776, C1-216896, C1-216990, C1-216991, C1-216992, C1-217005, C1-217119, C1-217145, C1-217148, C1-217149, C1-217164, C1-217193, C1-217194, C1-217270, C1-217362, C1-217363, C1-217364, C1-217391, C1-217394, C1-217398, C1-217403, C1-217408 Editorial change from the rapporteur. Correction from the rapporteur.	1.0.0
2022-01	CT1#133bis-e					Implementing the following p-CR agreed by CT1: C1-220489, C1-220494, C1-220497, C1-220498, C1-220499, C1-220500, C1-220601, C1-220633, C1-220634, C1-220635, C1-220636, C1-220637, C1-220638, C1-220639, C1-220686, C1-220688, C1-220745, C1-220746, C1-220752, C1-220775, C1-220777, C1-220779, C1-220781, C1-220782, C1-220789, C1-220791, C1-220794, C1-220803, C1-220805, C1-220807 Editorial change from the rapporteur. Correction from the rapporteur.	1.1.0
2022-02	CT1#134e					Implementing the following p-CR agreed by CT1: C1-221149, C1-221154, C1-221158, C1-221163, C1-221312, C1-221492, C1-221494, C1-221495, C1-221496, C1-221499, C1-221501, C1-221506, C1-221508, C1-221509, C1-221570, C1-221571, C1-221572, C1-221574, C1-221782, C1-221783, C1-221837, C1-221863, C1-221864, C1-221873, C1-221875, C1-221877, C1-221879, C1-221880, C1-221949 Editorial change from the rapporteur. Correction from the rapporteur.	1.2.0
2022-03	CT#95e					TS 24.554 v2.0.0 presented to TSG for approval	2.0.0
2022-03	CT-95e					TS 24.554 v17.0.0 created by MCC after CT#95e	17.0.0

History

Document history		
V17.0.0	May 2022	Publication