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to ProSe function protocol aspects;
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Contents

Foreword

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

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1 Scope

The present document specifies the protocols for Proximity-based Services (ProSe) between:

- the ProSe-enabled UE and the ProSe Function (over the PC3 interface); and
- two ProSe-enabled UEs (over the PC5 interface).

The present document defines the associated procedures for ProSe service authorisation, ProSe direct discovery, EPC-level ProSe discovery and ProSe direct communication.

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

The present document is applicable to:

- the ProSe-enabled UE; and
- the ProSe Function.

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 23.303: "Proximity-based services (ProSe); Stage 2".

[3] 3GPP TS 29.344: "Proximity-services (Prose) Function to Home Subscriber Server (HSS) aspects; Stage 3".

[4] 3GPP TS 23.003: "Numbering, addressing and identification".

[5] 3GPP TS 29.345: "Inter-Proximity-services (Prose) Function signalling aspects; Stage 3".

[6] 3GPP TS 33.303: "Proximity-based Services (ProSe); Security aspects".

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

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

[9] 3GPP TS 24.333: "Proximity-services (ProSe) Management Objects (MO)".

[10] IETF RFC 1035: "DOMAIN NAMES - IMPLEMENTATION AND SPECIFICATION".

[11] 3GPP TS 24.301: "Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3".

[12] 3GPP TS 36.331: "Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification".

[13] Wi-Fi Alliance Technical Committee P2P Task Group, "Wi-Fi Peer-to-Peer (P2P) Technical Specification", Version 1.1.

[14] IEEE Std 802.11-2012: "IEEE Standard for Information technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements - Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications".

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

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

[17] 3GPP TS 31.102: "Characteristics of the Universal Subscriber Identity Module (USIM) application".

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

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

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

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

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

[23] 3GPP TS 36.304: "Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) procedures in idle mode".

[24] 3GPP TS 23.122: "Non-Access-Stratum (NAS) functions related to Mobile Station (MS) in idle mode".

[25] IETF RFC 3023: "XML Media Types".

[26] IETF RFC 4288: "Media Type Specifications and Registration Procedures".

[27] 3GPP TS 32.277: "Proximity-based Services (ProSe) charging".

[28] IETF RFC 1166: "Internet Numbers".

[29] IETF RFC 5952: "A Recommendation for IPv6 Address Text Representation".

[30] 3GPP TS 24.008: "Mobile Radio Interface Layer 3 specification; Core Network Protocols; Stage 3".

[31] 3GPP TS 29.343: "Proximity-services (ProSe) function to ProSe application server aspects (PC2); Stage 3".

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

[33] IETF RFC 4861: "Neighbor Discovery for IP version 6 (IPv6)".

[34] 3GPP TS 23.401: "General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access".

[35] 3GPP TS 23.221: "Architectural requirements".

[36] IETF RFC 4291: "IP Version 6 Addressing Architecture".

[37] 3GPP TS 36.323: "Packet Data Convergence Protocol (PDCP) specification".

[38] 3GPP TS 23.179: "Functional architecture and information flows to support mission critical communication services".

[39] IETF RFC 6507: "Elliptic Curve-Based Certificateless Signatures for Identity-Based Encryption (ECCSI)".

[40] IETF RFC 6508: "Sakai-Kasahara Key Encryption (SAKKE)".

[41] 3GPP TS 33.102: "3G Security; Security architecture".

[42] 3GPP TS 33.233: "Generic Authentication Architecture (GAA); Generic Bootstrapping Architecture (GBA) Push function".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions 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].

ProSe Function CTF (ADF): Accounting Data Forwarding (ADF) function block of the Charging Trigger Function (CTF) in the ProSe Function.

Usage information report: usage information related to one collection period.

Usage information report list: one or more usage information report(s) and associated with a UE identity.

Not served by E-UTRAN: the UE is either:

- outside of E-UTRAN coverage;
- within E-UTRAN coverage but not camped on any cell;
- within E-UTRAN coverage but camped on a non-E-UTRAN cell; or
- camped on an E-UTRAN cell not operating on the carrier frequency provisioned for ProSe direct service.

Open ProSe direct discovery: a type of ProSe direct discovery without explicit permission from the ProSe-enabled UE being discovered.

Restricted ProSe direct discovery: a type of ProSe direct discovery that only takes place with explicit permission from the ProSe-enabled UE being discovered.

For the purposes of the present document, the following terms and definitions given in 3GPP TS 23.303 [2] apply:

Local PLMN
ProSe-enabled UE
Geographical area
ProSe Query Code
ProSe Response Code
Discovery Query Filter
Discovery Response Filter
Restricted ProSe Application User ID
ProSe Discovery UE ID
Discovery Entry ID
ProSe Restricted Code
Relay Service Code
User Info ID
Discovery Group ID
ProSe Per-Packet Priority
ProSe Layer 2 Group ID
ProSe UE-to-Network Relay
Remote UE
Application Layer Group ID

For the purposes of the present document, the following terms and definitions given in 3GPP TS 23.003 [4] apply:

ECGI
TMGI

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].

ACE	Application-Controlled Extension
ADF	Accounting Data Forwarding function block
CTF	Charging Trigger Function
DUCK	Discovery User Confidentiality Key
DUIK	Discovery User Integrity Key
DUSK	Discovery User Scrambling Key
ECCSI	Elliptic Curve-based Certificateless Signatures for Identity-based Encryption
ECGI	E-UTRAN Cell Global Identification
FQDN	Fully Qualified Domain Name
GPI	GBA Push Information
MBMS	Multimedia Broadcast/Multicast Service
MIC	Message Integrity Check
MIME	Multi-Purpose Internet Mail Extensions
PDUID	ProSe Discovery UE ID
ProSe	Proximity-based Services
PRUK	ProSe Relay User Key
RPAUID	Restricted ProSe Application User ID
SAI	Service Area Identifier
SAKKE	Sakai-Kasahara Key Encryption
TMGI	Temporary Mobile Group Identity
TTL	Time To Live
UUID	Universally Unique IDentifier

4 General

4.1 Overview

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 ProSe include the following functions:

- ProSe direct discovery;
- ProSe direct communication;
- EPC-level ProSe discovery; and
- EPC support for WLAN direct discovery and communication.

Among the above functions, ProSe direct discovery and EPC-level ProSe Discovery is applicable for both Public Safety UE and non-Public Safety UE. ProSe direct communication is applicable for Public Safety UE only.

In this release of the document, the stand-alone procedure for EPC support for WLAN direct discovery and communication is not supported.

The communication security over the PC3 interface is specified in 3GPP TS 33.303 [6]. The communication security over the PC3ch interface is the same as communication security over the PC3 interface specified in 3GPP TS 33.303 [6].

5 ProSe service authorisation and authorisation update procedure

5.1 Service authorisation and authorisation update for ProSe direct discovery and ProSe direct communication

5.1.1 General

The service authorisation for ProSe direct discovery and ProSe direct communication determines whether the UE is authorised to use ProSe direct discovery and ProSe direct communication, in a particular PLMN or when not served by E-UTRAN. In this release of the specification, ProSe direct communication is supported only for Public Safety ProSe-enabled UE. The service authorisation is either:

1) pre-configured in the UE. The pre-configured service authorisation may be stored in the ME, or in the USIM as specified in 3GPP TS 31.102 [17], or in both the ME and the USIM. If both the ME and the USIM contain the same parameters, the values stored in the USIM shall take precedence. The UE shall not use the pre-configured service authorisation if the contents of the USIM indicate that the UE is not authorised to use them (see 3GPP TS 31.102 [17]); or

2) transferred between the UE and the ProSe Function over the PC3 interface with the ProSe Direct Services Provisioning Management Object or the ProSe Public Safety Direct Services Provisioning Management Object as specified in 3GPP TS 24.333 [9].

When using option 2) above, the UE shall request service authorisation to use ProSe direct discovery or ProSe direct communication or both from the ProSe Function of the HPLMN. As specified in 3GPP TS 29.345 [5], the ProSe Function of the HPLMN contacts the ProSe Function of each local PLMN or VPLMN to obtain the service authorisation, merges it with its own service authorisation and sends the merged service authorisation to the UE.

NOTE 1: How the Prose Function in the HPLMN merges the authorisation policy is implementation dependent.

The service authorisation provided by the ProSe Function of the HPLMN for ProSe direct discovery for non-public safety use contains a list of PLMNs in which the UE is authorised to use ProSe direct discovery.

The service authorisation provided by the ProSe Function of the HPLMN for ProSe direct discovery for public safety use indicates:

- the list of PLMNs in which the UE is authorised to use ProSe direct discovery for public safety use when served by E-UTRAN;

- whether the UE is authorised to perform ProSe direct discovery for public safety use when not served by E-UTRAN, and if so, the required radio parameters to be used for ProSe direct discovery for public safety use when not served by E-UTRAN;

- the group member discovery related parameters; and

- the ProSe UE-to-network relay related parameters.

The service authorisation provided by the ProSe Function of the HPLMN for ProSe direct communication indicates:

- whether the UE is authorised to perform ProSe direct communication when not served by E-UTRAN, and if so, the required radio parameters to be used for ProSe direct communication when not served by E-UTRAN;

- the ProSe direct communication policy parameters;

- the list of PLMNs in which the UE is authorised to use direct communication when served by E-UTRAN; and

- the usage information reporting configuration.

Alternatively, the ProSe direct communication policy parameters, the group member discovery related parameters and certain ProSe UE-to-network relay related parameters (i.e. items a, c and f in the parameters related to ProSe UE-to-network relaying in subclause 5.1.3) mentioned above can be provided by the third party public safety provider

application server, using mechanisms that are out of scope of the present specification. If the UE receives the same parameters associated with the same Application Layer Group ID from the third party public safety provider application server as those which had been previously transferred between the UE and the ProSe Function over the PC3 interface with the ProSe Public Safety Direct Services Provisioning Management Object, the UE shall use the parameters provided by the third party public safety provider application server for ProSe direct communication.

The UE discovers the IP address of the ProSe Functions of the HPLMN as specified in subclause 5.1.2.

Optionally, the operator can configure the UE with configuration parameters for establishment of the PDN connection for reaching the HPLMN ProSe Function. If the UE is configured with the configuration parameters for establishment of the PDN connection for reaching the HPLMN ProSe Function (see 3GPP TS 24.333 [9]):

a) if a PDN connection for reaching the HPLMN ProSe Function is not established yet, the UE shall establish the PDN connection for reaching the HPLMN ProSe Function according to the UE configuration and shall send the HTTP request message via the PDN connection for reaching the HPLMN ProSe Function; and

b) if a PDN connection for reaching the HPLMN ProSe Function is already established either due to other ProSe feature or due to other application, the UE shall send the HTTP request message via the PDN connection for reaching the HPLMN ProSe Function.

After the UE is authorised to use ProSe direct discovery or ProSe direct communication or both, the ProSe Function of the HPLMN shall update the service authorisation:

a) when the ProSe Function of the HPLMN is informed the ProSe related subscription data is updated at the HSS;

b) when the ProSe Function of the HPLMN decides to revoke the authorisation for ProSe direct service;

c) when the ProSe Function of the HPLMN is informed the ProSe Function of the VPLMN or local PLMN decides to revoke the authorisation for ProSe direct service; or

d) when the ProSe Function of the HPLMN decides to update the ProSe Discovery UE ID of the UE before the timer T4018 expires.

The ProSe Function of the HPLMN sends the updated authorisation for ProSe direct service to the UE, e.g. by sending an OMA push message. If the update of service authorisation is triggered to revoke the authorisation for ProSe direct service, the updated authorization for ProSe direct service does not include:

a) the authorization for ProSe direct service (discovery or communication or both) which is to be revoked; and

b) the PLMN ID of the PLMN in which the service authorisation is to be revoked.

If the update of service authorisation is triggered to update the ProSe Discovery UE ID of the UE, the updated authorisation for ProSe direct service includes the new ProSe Discovery UE ID assigned to the UE and the associated validity timer T4015. The UE then sends the new ProSe Discovery UE ID to the ProSe Application Server, using mechanisms that are out of scope of the present specification.

NOTE 2: The ProSe Function of the HPLMN can send the updated authorisation for ProSe direct service to the UE immediately or wait for the next time when the UE communicates with the ProSe Function of the HPLMN based on operator's policy; in the latter case, the UE is allowed to use ProSe direct services until the next time that it will communicate with the ProSe Function of the HPLMN.

5.1.2 ProSe Function discovery

The IP address of the ProSe function in the HPLMN may be pre-configured in the UE and in this case, the UE may use the pre-configured IP address. Alternatively, the FQDN of the ProSe Function in the HPLMN may be self-constructed by the UE, i.e. derived from the PLMN ID of the HPLMN. The UE may perform DNS lookup as specified in IETF RFC 1035 [10].

5.1.3 Service authorisation from ProSe Function

The UE shall initiate the service authorisation procedure to the ProSe Function of the HPLMN:

a) when the UE receives a request from upper layer to perform open ProSe direct discovery announcing or monitoring, restricted ProSe direct discovery model A announcing or monitoring, restricted ProSe direct

discovery model B discoverer operation or discoveree operation, or direct communication and has no valid service authorisation;

b) when the UE is performing open ProSe direct discovery announcing or monitoring, restricted ProSe direct discovery model A announcing or monitoring, restricted ProSe direct discovery model B discoverer operation or discoveree operation, or direct communication and changes its registered PLMN to a PLMN which is not included in the list of PLMNs in which the UE is authorised to perform the corresponding service, and the request from upper layer to perform the corresponding service is still in place in the new registered PLMN;

c) when timer T4005 associated with a valid service authorisation policy expires and the request from upper layer to perform open ProSe direct discovery announcing or monitoring, restricted ProSe direct discovery model A announcing or monitoring, restricted ProSe direct discovery model B discoverer operation or discoveree operation, or direct communication in the corresponding PLMN is still in place; or

d) when timer T4015 associated with a ProSe Discovery UE ID expires and the request from upper layer to perform restricted ProSe direct discovery model A announcing or monitoring, restricted ProSe direct discovery model B discoverer operation or discoveree operation is still in place.

NOTE 1: In order to ensure continuity of ProSe direct discovery service or ProSe direct communication service, the UE can request service authorisation from the ProSe Function of the HPLMN before the timer T4005 associated with a service authorisation policy in a PLMN expires or the timer 4015 associated with a ProSe Discovery UE ID expires.

The UE shall obtain the service authorisation from the ProSe Function of the HPLMN over the PC3 interface by requesting the ProSe Direct Services Provisioning Management Object or the ProSe Public Safety Direct Services Provisioning MO as specified in 3GPP TS 24.333 [9]. The UE waits for an implementation dependent time for an answer from the ProSe Function. If the ProSe Function does not respond within that time, the UE may retry the service authorisation procedure. The number of retries performed by the UE is implementation dependent. Unless the UE receives a response from the ProSe function for service authorisation, the UE shall not consider that the request has been authorised.

The ProSe direct discovery service authorisation from the ProSe Function of the HPLMN may include:

a) the PLMNs in which the UE is authorised to perform open ProSe direct discovery monitoring, and for each PLMN a timer T4005 indicating for how long the monitoring authorisation policy in that PLMN is valid;

b) the PLMNs in which the UE is authorised to perform open ProSe direct discovery announcing , and for each PLMN, it indicates:

   1) a timer T4005 indicating for how long the announcing authorisation policy in that PLMN is valid; and

   2) the authorised announcing range (short/medium/long).

c) void;

d) void;

e) void;

f) void;

g) the PLMNs in which the UE is authorised to perform restricted ProSe direct discovery model A monitoring, and for each PLMN a timer T4005 indicating for how long the monitoring authorisation policy in that PLMN is valid;

h) the PLMNs in which the UE is authorised to perform restricted ProSe direct discovery model A announcing, and for each PLMN, it indicates:

   1) a timer T4005 indicating for how long the announcing authorisation policy in that PLMN is valid; and

   2) the authorised announcing range (short/medium/long).

i) the PLMNs in which the UE is authorised to perform restricted ProSe direct discovery model B discoverer operation, and for each PLMN, it indicates:

1) a timer T4005 indicating for how long the discoverer operation authorisation policy in that PLMN is valid; and

2) the authorised discoverer operation range (short/medium/long).

j) the PLMNs in which the UE is authorised to perform restricted ProSe direct discovery model B discoveree operation, and for each PLMN, it indicates:

1) a timer T4005 indicating for how long the discoveree operation authorisation policy in that PLMN is valid; and

2) the authorised discoveree operation range (short/medium/long).

k) the ProSe Discovery UE ID assigned to the UE for restricted ProSe direct discovery with an associated timer T4015 indicating for how long this ProSe Discovery UE ID is valid.

The ProSe direct discovery for public safety use service authorisation from the ProSe Function of the HPLMN may include:

a) the PLMNs in which the UE is authorised to perform ProSe direct discovery for public safety use announcing, and for each PLMN, it indicates:

1) a timer T4005 indicating for how long the authorisation policy for that operation is valid; and

2) the authorised announcing range (short/medium/long);

b) whether the UE is authorised to perform ProSe direct discovery for public safety use announcing when the UE is not served by E-UTRAN;

c) the PLMNs in which the UE is authorised to perform ProSe direct discovery for public safety use monitoring, and for each PLMN, a timer T4005 indicating for how long the authorisation policy for that operation is valid;

d) whether the UE is authorised to perform ProSe direct discovery for public safety use monitoring when the UE is not served by E-UTRAN;

e) the PLMNs in which the UE is authorised to perform ProSe direct discovery for public safety use discoverer operation, and for each PLMN, it indicates:

1) a timer T4005 indicating for how long the authorisation policy for that operation is valid; and

2) the authorised discoveree operation range (short/medium/long);

f) whether the UE is authorised to perform ProSe direct discovery for public safety use discoverer operation when the UE is not served by E-UTRAN;

g) the PLMNs in which the UE is authorised to perform ProSe direct discovery for public safety use discoveree operation, and for each PLMN, it indicates;

1) a timer T4005 indicating for how long the authorisation policy for that operation is valid; and

2) the authorised discoverer operation range (short/medium/long);

h) whether the UE is authorised to perform ProSe direct discovery for public safety use discoveree operation when the UE is not served by E-UTRAN; and

i) the radio parameters to be used for ProSe direct discovery for public safety use when not served by E-UTRAN and the geographical area(s) in which the UE is allowed to use these radio parameters.

The ProSe direct discovery for public safety use service authorisation from the ProSe Function of the HPLMN may include the following parameters related to ProSe UE-to-network relaying:

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

b) the PLMNs in which the UE is authorised to act as a UE-to-network relay when the UE is served by E-UTRAN, and for each PLMN:

1) whether the relay needs to report the IMEI/IMEISV of the remote UE(s) connected to or disconnected from the relay; and

2) a timer T4005 indicating for how long the authorisation policy for that operation is valid;

c) for each connectivity service provided by a UE-to-network relay:

1) the Relay Service Code identifying the connectivity service;

2) optionally the PDN type to be used for the relayed traffic of the connectivity service. If the PDN type is not provisioned, the IPv4v6 is used for the relayed traffic of the connectivity service;

3) optionally the APN to be used for the relayed traffic of the connectivity service. If the APN is not provisioned, the default APN is used for the relayed traffic of the connectivity service;

4) the ProSe Relay UE ID; and

5) the address of the ProSe Key Management Function that the UE shall use to obtain security contents;

d) whether the UE is authorised to act as a remote UE towards a UE-to-network relay;

e) void;

f) for each connectivity service authorised to be accessed by the remote UE:

1) the Relay Service Code identifying the connectivity service;

2) the IP version(s) to be used for the traffic of the connectivity service;

3) optionally the User Info ID of the UE-to-network relay providing the connectivity service; and

4) the address of the ProSe Key Management Function that the UE shall use to obtain security contents; and

g) mapping rules between the QCI of EPS bearer and the ProSe Per-Packet Priority for downlink unicast traffic relayed over the PC5 interface.

The ProSe direct discovery for public safety use service authorisation from the ProSe Function of the HPLMN may include the following parameters related to group member discovery, for each application layer group:

a) the User Info ID for the group member discovery;

b) the Discovery Group ID identifying the discovery group;

c) the Application Layer Group ID identifying an application layer group that the UE belongs to; and

d) the address of the ProSe Key Management Function that the UE shall use to obtain security contents.

The one-to-many ProSe direct communication service authorisation from the ProSe Function of the HPLMN may include:

a) whether the UE is authorised to perform one-to-many ProSe direct communication when not served by E-UTRAN;

b) the radio parameters to be used for one-to-many ProSe direct communication when not served by E-UTRAN as defined in 3GPP TS 36.331 [12] and the geographical area(s) in which the UE is allowed to use these radio parameters;

c) the PLMNs in which the UE is authorised to perform one-to-many ProSe direct communication when served by E-UTRAN, and for each PLMN a timer T4005 indicating for how long the one-to-many direct communication authorisation policy in that PLMN is valid; and

d) the one-to-many ProSe Direct communication policy parameters, consisting of, for each application layer group:

1) the ProSe Layer-2 Group ID;

2) the ProSe Group IP multicast address;

3) whether the UE should use IPv4 or IPv6 for that group;

4) an IPv4 address to be used by the UE as a source address in case IPv4 is used;

5) the address of the ProSe Key Management Function that the UE shall use to obtain group-related security contents; and

6) the Application Layer Group ID identifying an application layer group that the UE belongs to; and

e) the usage information reporting configuration, including:

1) the address of the server to which the UE shall upload the usage information reports;

2) the collection period;

3) the reporting window;

4) whether or not the UE shall report the Group Parameters in the usage information;

5) whether or not the UE shall report the time stamps of the first transmission/reception during the collection period in the usage information;

6) whether or not the UE shall report the amount of data transmitted during the collection period in the usage information, and whether with location information;

7) whether or not the UE shall report the amount of data received during the collection period in the usage information, and whether with location information;

8) whether or not the UE shall report the time stamps when it went in and out of E-UTRAN coverage during the collection period in the usage information;

9) whether or not the UE shall report the list of locations of the UE when in E-UTRAN coverage during the reporting period in the usage information; and

10) whether or not the UE shall report the radio parameters used for ProSe direct communication (i.e. indicator of which radio resources used and radio frequency used) during the reporting period in the usage information.

The one-to-one ProSe direct communication service authorisation from the ProSe Function of the HPLMN may include:

a) whether the UE is authorised to perform one-to-one ProSe direct communication when not served by E-UTRAN;

b) the radio parameters to be used for one-to-one ProSe direct communication when not served by E-UTRAN as defined in 3GPP TS 36.331 [12] and the geographical area(s) in which the UE is allowed to use these radio parameters;

c) the PLMNs in which the UE is authorised to perform one-to-one ProSe direct communication when served by E-UTRAN, and for each PLMN a timer T4005 indicating for how long the one-to-one direct communication authorisation policy in that PLMN is valid; and

d) the one-to-one ProSe direct communication policy parameters, consisting of:

- the ProSe Per-Packet Priority value for PC5 signalling messages; and
- for each application layer group,

1) the Layer 2 ID used for unicast communication;

2) void;

3) the address of the Key Management Server that the UE shall use to obtain security contents; and

4) the Application Layer Group ID identifying an application layer group that the UE belongs to.

NOTE 2: ProSe communication operation is not applicable to local PLMNs.

The ProSe Function of the HPLMN is allowed to take the serving PLMN of the UE into account when including the authorised PLMNs in the service authorisation to the UE.

The UE shall start the timer(s) T4005 with the values included in this service authorisation. The UE shall consider that an authorisation policy is valid in the associated PLMN until the corresponding the timer T4005 expires or is stopped.

6 ProSe direct discovery

6.1 Overview

This clause describes the PC3 Control Protocol procedures between the UE and the ProSe Function for ProSe direct discovery announcing and monitoring. It also describes the ProSe Protocol procedures at the UE for ProSe direct discovery of other ProSe-enabled UEs over the PC5 interface.

6.1.1 Transport protocol for PC3 Control Protocol messages for ProSe direct discovery

The UE and ProSe Function shall use HTTP 1.1 as specified in IETF RFC 7230 [18] and IETF RFC 7231 [19] as the transport protocol for ProSe messages over the PC3 interface. The ProSe messages described here shall be included in the body of either an HTTP request message or an HTTP response message. The following rules apply:

6.1.2 Handling of UE-initiated procedures

The following rules apply for UE-initiated procedures:

- The UE initiates ProSe transactions with an HTTP request message containing the PC3 request(s);
- The ProSe Function responds to the requests with an HTTP response message containing the PC3 response(s) for the PC3 request(s); and
- HTTP POST methods are used for PC3 direct discovery procedures.

Optionally, the operator can configure the UE with configuration parameters for establishment of the PDN connection for reaching the HPLMN ProSe Function. If the UE is configured with the configuration parameter for establishment of the PDN connection for reaching the HPLMN ProSe Function (see 3GPP TS 24.333 [9]):

a) if a PDN connection for reaching the HPLMN ProSe Function is not established yet, the UE shall establish the PDN connection for reaching the HPLMN ProSe Function according to the UE configuration and shall send the HTTP request message via the PDN connection for reaching the HPLMN ProSe Function; and

b) if a PDN connection for reaching the HPLMN ProSe Function is already established (e.g. either due to other ProSe feature or due to other application), the UE shall send the HTTP request message via the PDN connection for reaching the HPLMN ProSe Function;

6.1.3 Handling of ProSe Function-initiated procedures

6.1.3.1 General

The ProSe Function-initiated messages for ProSe direct discovery over the PC3 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 ProSe Function shall support OMA Push for network initiated procedures. Optionally the UE and ProSe Function 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 ProSe Function.

Upon receiving a DISCOVERY_REQUEST message containing a Network-Initiated Transaction Method set to "HTTP long polling", if the ProSe Function supports the HTTP long polling and wants to use the HTTP long polling for network initiated procedures, the ProSe Function shall include a Network-Initiated Transaction Method set to "HTTP long polling" in the DISCOVERY_RESPONSE message. Otherwise the ProSe Function shall not include a Network-Initiated Transaction Method 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 ProSe Function uses OMA Push for network initiated procedures.

6.1.3.2 HTTP long polling

The HTTP long polling method involves 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 PC3 interface;

b) the ProSe Function defers its response to the UE's request until;

   i) one ore more network-initiated PC3 message(s) for the UE are available. The ProSe Function encloses the message(s) in an HTTP response message and send it to the UE; or

   ii) a particular timeout for HTTP polling has occurred. The ProSe Function then sends an empty HTTP response message as the polling response to the UE.

c) After receiving the response from the ProSe Function, the UE may keep polling after some waiting period if:

   i) the UE receives an empty polling response; or

   ii) the UE receives prose function-initiated message(s) from the ProSe Function 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 PC3 message to the ProSe Function while it has a pending HTTP polling request, the UE shall open another HTTP connection to the ProSe Function 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 involves the following steps:

a) if one or more network-initiated PC3 message(s) for the UE are available, the ProSe Function 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 [22]. The URL is linked to the PC3 message(s) to be sent to the UE. The ProSe Function (performing OMA Push Proxy Gateway functionality) generates a Push Message as specified in OMA-WAP-TS-PushOTA-V2_1-20110405-A [21] with the PDU set according to WAP-168-ServiceLoad-20010731-a [20]. 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 ProSe Function with this URL; and

c) the ProSe Function sends an HTTP response message containing the PC3 message(s) to the UE.

6.2 Procedures

6.2.1 Types of ProSe direct discovery procedures

The following PC3 Control Protocol procedures are defined:

- announce request;
- monitor request;
- match report; and
- network initiated direct discovery update.

In the following descriptions of PC3 Control Protocol procedures, the terms "request" and "response" refer to the corresponding PC3 Control Protocol messages, not to the HTTP request or response. The following procedure descriptions use a single PC3 Control Protocol message for illustration purposes.

NOTE: A single HTTP request message can contain multiple PC3 Control Protocol requests and a single HTTP response message can contain multiple PC3 Control Protocol responses.

6.2.2 Announce request procedure for open ProSe direct discovery

6.2.2.1 General

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

- 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 23.303 [2];
- to inform the ProSe Function that the UE wants to stop announcing a ProSe Application Code as defined in 3GPP TS 23.303 [2]; or
- to upload metadata associated with a ProSe Application ID to the ProSe Function as defined in 3GPP TS 23.303 [2].

The UE shall be authorised for open ProSe direct discovery announcing in the registered PLMN or the local PLMN based on the service authorisation 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 PC5_DISCOVERY message and passes the 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 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 authorised to perform open 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 T4000 assigned by the ProSe Function 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 authorised for open 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; or

e) when the UE needs to inform the ProSe Function 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 ProSe Function.

When the UE selects a new PLMN while announcing a ProSe Application Code and the UE is not yet authorised for open ProSe direct discovery announcing in the new PLMN, the UE shall initiate an announce request procedure only after the UE is authorised for open 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 TTL timer T4000 assigned by the ProSe Function for a Prose Application Code expires.

The UE initiates the announce request procedure for open ProSe direct discovery by sending a DISCOVERY_REQUEST message with:

- a new transaction ID;
- the ProSe Application ID set to the ProSe Application ID received from upper layers;
- 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 ProSe Function, otherwise set to "announce";
- the UE identity set to the UE's IMSI;
- the Application Identity set to the Application Identity of the upper layer application that requested the announcing;
- the Discovery Entry ID set to 0 when this is a new request or set to the Discovery Entry ID received from the ProSe Function if the announce request is to update a previously sent announce request;
- 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;
- 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 ProSe Function;
- optionally the Metadata set to the metadata received from upper layers associated with the ProSe Application ID; and
- 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 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 ProSe Function 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 ProSe Function in the announce request procedure.

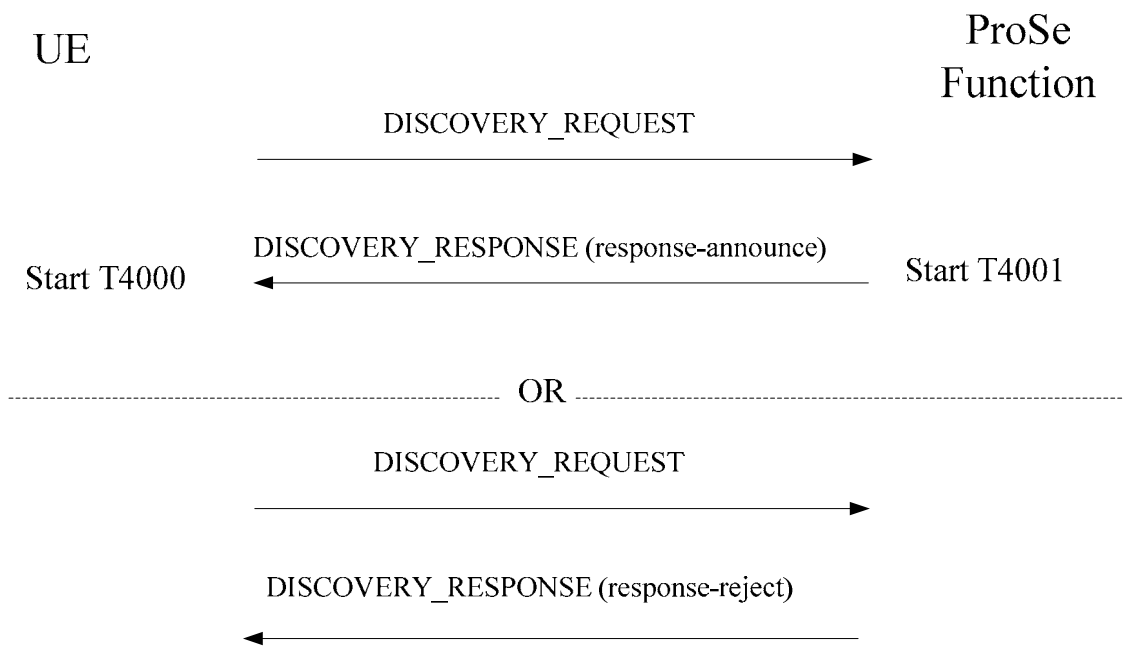

Figure 6.2.2.2.1: Announce request procedure

6.2.2.3 Announce request procedure accepted by the ProSe Function

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 ProSe Function 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 ProSe Function shall inform the ProSe Function in the announcing PLMN to remove the corresponding discovery entry as specified in 3GPP TS 29.345 [5] when the announcing PLMN is not the same as that of the PLMN to which the ProSe Function belongs and remove the discovery entry identified by the Discovery Entry ID from the UE's context. Then the ProSe Function shall send a DISCOVERY_RESPONSE message containing a <response-announce> element with:

- the transaction ID set to the value of the transaction ID received in the DISCOVERY_REQUEST message, and
- 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 ProSe Function shall perform the following procedure.

The ProSe Function shall check that the application corresponding to the Application Identity contained in the DISCOVERY_REQUEST message is authorised for open ProSe direct discovery announcing. If the application is authorised for open ProSe direct discovery announcing, the ProSe Function 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 ProSe Function skips the check of the ProSe Application ID, the ProSe Function 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 ProSe Function checks with the HSS whether the UE is authorised for open ProSe direct discovery announcing as described in 3GPP TS 29.344 [3]. If the check indicates that the UE is authorised then:

- the ProSe Function shall check whether the UE is authorised to announce the ProSe Application ID contained in the DISCOVERY_REQUEST message;

- if the UE is authorised 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 ProSe Function shall check whether the UE is authorised to use ACE. If the UE is authorised for ACE, the ProSe Function shall invoke the procedure described in 3GPP TS 29.343 [31] to check whether the UE is authorised to announce the requested ProSe Application ID with application-defined suffix(es), and obtain suffix-related information from the ProSe Application Server. The ProSe Function shall then allocate one ProSe Application Code Prefix and a value for validity timer T4000 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 29.343 [31]. The ProSe Function may take into account the Requested Timer if contained in the DISCOVERY_REQUEST message;

- if the UE is authorised 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 ProSe Function shall allocate the corresponding ProSe Application Code(s) and a value for validity timer T4000. The ProSe Function may take into account the Requested Timer if contained in the DISCOVERY_REQUEST message;

- if the UE is authorised 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 ProSe Function shall check whether the UE is authorised to use ACE. If the UE is authorised for ACE, the ProSe Function shall invoke the procedure described in 3GPP TS 29.343 [31] to check whether the UE is authorised to announce the requested ProSe Application ID with application-defined suffix(es), and obtain suffix-related information from the ProSe Application Server. The ProSe Function shall then allocate one ProSe Application Code Prefix and a value for validity timer T4000 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 29.343 [31]. The ProSe Function may take into account the Requested Timer if contained in the DISCOVERY_REQUEST message;

- if the UE is authorised 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 ProSe Function shall allocate the corresponding ProSe Application Code(s) and a value for validity timer T4000. The ProSe Function may take into account the Requested Timer if contained in the DISCOVERY_REQUEST message; and

- if the UE is authorised to announce the ProSe Application ID and the ACE Enabled Indicator is not included in the DISCOVERY_REQUEST message, the ProSe Function shall allocate the corresponding ProSe Application Code(s) and a value for validity timer T4000. The ProSe Function may take into account the Requested Timer if contained in the DISCOVERY_REQUEST message.

NOTE 1: A UE implementing a previous release of the protocol will not include the ACE Enabled Indicator in the DISCOVERY_REQUEST message.

NOTE 2: The ProSe Function 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 subclause 24.2.2 of 3GPP TS 23.003 [4].

If the requested ProSe Application ID is country-specific or global as described in subclause 24.2 of 3GPP TS 23.003 [4], the ProSe Function shall allocate the corresponding ProSe Application Code(s) or ProSe Application Code Prefix according to subclause 24.3 of 3GPP TS 23.003 [4]. 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 subclause 24.3 of 3GPP TS 23.003 [4]. The ProSe Function shall use the MCC and MNC of the PLMN ID of this ProSe Function 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 ProSe Function 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 HSS, and starts timer T4001. The HSS also provides to the ProSe Function 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 T4001 shall be longer than timer T4000. By default, the value of timer T4001 is 4 minutes greater than the value of timer T4000.

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

If the Metadata is included in the DISCOVERY_REQUEST message, the ProSe Function 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 ProSe Function, the ProSe Function shall update the metadata in the UE context by using the received Medadata 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 ProSe Function 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 T4001.

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 ProSe Function shall either update the discovery entry with a new validity timer T4000, or allocate new ProSe Application Code(s) or ProSe Application Code Prefix for the requested ProSe Application ID with a new validity timer T4000, and restart timer T4001. The ProSe Function may take into account 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 ProSe Function checks with the ProSe Function of the VPLMN or the local PLMN identified by the Announcing PLMN ID whether the UE is authorised for open ProSe direct discovery announcing as described in 3GPP TS 29.345 [5].

If the check indicates that the UE is authorised then the ProSe Function shall send a DISCOVERY_RESPONSE message containing a <response-announce> element with:

- the transaction ID set to the value of the transaction ID received in the DISCOVERY_REQUEST message from the UE;
- either the ProSe Application Code(s) set to the ProSe Application Code(s) allocated by the ProSe Function, or the ProSe Application Code ACE parameter set to include the ProSe-Application Code- Prefix allocated by the ProSe Function, 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;
- Validity Timer T4000 set to the T4000 timer value assigned by the ProSe Function to the ProSe Application Code(s):
- if the ACE Enabled Indicator was included by the UE in the DISCOVERY_REQUEST message, 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;
- the Discovery Entry ID set to the identifier associated with the corresponding discovery entry; and
- the Discovery Key set to a value provided by the ProSe Function.

If timer T4001 expires, the ProSe Function 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:

- stop the validity timer T4000 corresponding to the ProSe Application Code(s) or ProSe Application Code Prefix in the discovery entry identified by the Discovery Entry ID;
- remove the discovery entry identified by the Discovery Entry ID included; and
- 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 T4000 if running and start the validity timer T4000 with the received value. Otherwise the UE shall discard the DISCOVERY_RESPONSE message and shall not perform the procedures below.

For any one of the received ProSe Application Codes or ProSe Application Code Prefix in this discovery entry, the UE may perform open ProSe direct discovery announcing as described below.

The UE requests the parameters from the lower layers for Prose direct discovery announcing (see 3GPP TS 36.331 [12]). The UE shall perform direct discovery announcing only if the lower layers indicate that ProSe direct discovery is supported by the network. If the UE in EMM-IDLE mode has to request resources for ProSe direct discovery announcing as specified in 3GPP TS 36.331 [12], the UE shall perform a service request procedure or tracking area update procedure as specified in 3GPP TS 24.301 [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 subclause 12.2.2.18. 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 Discovery Key contained in the <response-announce> element of the DISCOVERY_RESPONSE message to compute the MIC field for the PC5_DISCOVERY message as described in 3GPP TS 33.303 [6].

The UE shall either use the ProSe Application Code received in the DISCOVERY_RESPONSE message, 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 as announced ProSe Application Code, along with the MIC and the four least significant bits of the UTC-based counter, in order to construct a PC5_DISCOVERY message, according to the format defined in subclause 11.2.5.

NOTE: The UE can use different codes formed based on different ProSe Application Code Suffixes to announce, without having to send a new DISCOVERY_REQUEST message to the ProSe Function, as long as the validity timer T4000 of the ProSe Application Code Prefix has not expired.

The UE then passes the PC5_DISCOVERY message, along with the PLMN ID of the intended announcing PLMN, to the lower layers for transmission if:

- the UE is currently authorised to perform open direct discovery announcing in the registered PLMN or the local PLMN operating the radio resources that the UE intends to use;
- the validity timer T4000 for the corresponding discovery entry allocated ProSe Application Code or ProSe Application Code Prefix has not expired; and
- a request from upper layers to announce the ProSe Application ID associated with both the ProSe Application Code or ProSe Application Code Prefix and the authorised Application Identity is still in place.

The UE shall ensure that it keeps on passing PC5_DISCOVERY messages to the lower layers for transmission until the validity timer T4000 of the ProSe Application Code or ProSe Application 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 eNodeB and the UE is in EMM-CONNECTED mode, the UE shall trigger the corresponding procedure in lower layers as specified in 3GPP TS 36.331 [12].

6.2.2.5 Announce request procedure not accepted by the ProSe Function

If the DISCOVERY_REQUEST message cannot be accepted by the ProSe Function, the ProSe Function sends a DISCOVERY_RESPONSE message containing a <response-reject> element to the UE including an appropriate PC3 Control Protocol cause value.

If the application corresponding to the Application Identity contained in the DISCOVERY_REQUEST message is not authorised for open ProSe direct discovery announcing, the ProSe Function shall send the DISCOVERY_RESPONSE message containing a <response-reject> element with PC3 Control Protocol cause value #1 "Invalid application".

If the ProSe Application ID contained in the DISCOVERY_REQUEST message is unknown to the ProSe Function, the ProSe Function shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3 Control Protocol cause value #2 "Unknown ProSe Application ID".

If the UE is not authorised for open ProSe direct discovery announcing, the ProSe Function shall send the DISCOVERY_RESPONSE message containing a <response-reject> element with PC3 Control Protocol cause value #3 "UE authorisation failure".

If the UE is not authorised to use the ProSe Application ID contained in the DISCOVERY_REQUEST message, the ProSe Function shall send the DISCOVERY_RESPONSE message containing a <response-reject> element with PC3 Control Protocol cause value #3 "UE authorisation 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 ProSe Function has not authorized the UE to announce in that country, the ProSe Function shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3 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 ProSe Function has no agreement to access the country-wide ProSe Application ID database of that country, the ProSe Function shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3 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 ProSe Function and the Requested Timer is set to zero, the ProSe Function shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3 Control Protocol cause value # 10 "Unknown or invalid Discovery Entry ID".

If the UE is not authorised to use ACE, but the DISCOVERY_REQUEST message contains the ACE Enabled Indicator set to "application-controlled extension enabled", the ProSe Function shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3 Control Protocol cause value #12 "UE unauthorised 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 ProSe Function shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3 Control Protocol cause value #14 "Missing Application Level Container".

If the ProSe Application Server indicates to the ProSe Function that the Application Level Container in the DISCOVERY REQUEST message contains invalid information, the ProSe Function shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3 Control Protocol cause value #15 "Invalid Data in Application Level Container".

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 ProSe Function shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3 Control Protocol cause value #14 "Missing 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 ProSe Function shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3 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 ProSe Function, establish a new secure connection and then restart the announce request procedure.

b) No response from the ProSe Function 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 ProSe Function 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:

- included a Requested Timer which is set to 0; or
- included an Announcing PLMN ID;

the UE shall acknowledge the DISCOVERY_RESPONSE message received from the ProSe Function but discard its content and then abort the procedure.

6.2.2.6.2 Abnormal cases in the ProSe Function

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 ProSe Function shall abort the procedure, and stop any associated timer(s) T4001, if running.

6.2.2A Announce request procedure for restricted ProSe direct discovery model A

6.2.2A.1 General

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

- to obtain a ProSe Restricted Code corresponding to the Restricted ProSe Application User ID (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 23.303 [2]; or

- to inform the ProSe Function that the UE wants to stop announcing a ProSe Restricted Code as defined in 3GPP TS 23.303 [2].

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

The UE includes the ProSe Restricted Code obtained as a result of a successful announce request procedure in a PC5_DISCOVERY message and passes the PC5_DISCOVERY message to the lower layers for transmission over the PC5 interface.

6.2.2A.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 authorisation 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 authorised to perform restricted 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 T4007 assigned by the ProSe Function 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 authorised for restricted 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 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 authorised for restricted ProSe direct discovery model A announcing in the new PLMN, the UE shall initiate an announce request procedure only after the UE is authorised for restricted 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 T4007 assigned by the ProSe Function for a ProSe Restricted Code expires.

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

- a new transaction ID not used in any other direct discovery procedures in PC3 interface;

- the RPAUID set to the RPAUID received from upper layers;

- the command set to "announce";

- the UE identity set to the UE's IMSI;

- the Application Identity set to the Application Identity of the upper layer application that requested the announcing;

- the Discovery Type set to "Restricted discovery";

- 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;
- 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;
- 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 ProSe Function;
- 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 ProSe Function if the announcing request is to update a previously sent announcing request; and
- 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 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 ProSe Function 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 6.2.2A.2.1 illustrates the interaction of the UE and the ProSe Function in the announce request procedure.

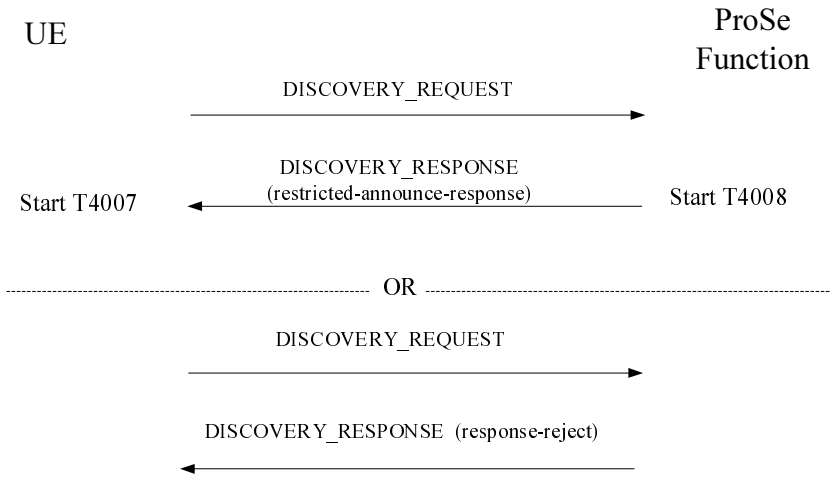

Figure 6.2.2A.2.1: Announce request procedure for restricted ProSe direct discovery model A

6.2.2A.3 Announce request procedure accepted by the ProSe Function

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 ProSe Function 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 ProSe Function shall inform the ProSe Function in the announcing PLMN to remove the corresponding discovery entry as specified in 3GPP TS 29.345 [5] when the announcing PLMN is not the

same as that of the PLMN to which the ProSe Function belongs and remove the discovery entry identified by the Discovery Entry ID from the UE's context. Then the ProSe Function shall send a DISCOVERY_RESPONSE message containing a <restricted-announce-response> element with:

- the transaction ID set to the value of the transaction ID received in the DISCOVERY_REQUEST message, and
- 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" 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 ProSe Function shall perform the following procedure.

The ProSe Function shall check that the application corresponding to the Application Identity contained in the DISCOVERY_REQUEST message is authorised for restricted ProSe direct discovery model A announcing. If the application is authorised for restricted ProSe direct discovery model A announcing, the ProSe Function shall check whether there is an existing context for the UE.

If there is no associated UE context, the ProSe Function checks with the HSS whether the UE is authorised for restricted ProSe direct discovery model A announcing as described in 3GPP TS 29.344 [3]. If the check indicates that the UE is authorised, the ProSe Function creates a UE context that contains the UE's subscription parameters obtained from the HSS. The HSS also provides to the ProSe Function the PLMN ID of the PLMN in which the UE is currently registered. If the UE context exists, the ProSe Function shall then check whether the UE is authorised for restricted ProSe direct discovery model A announcing 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 authorised and the Discovery Entry ID included in the DISCOVERY_REQUEST message is set to 0 then:

- the ProSe Function 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 29.343 [31] to obtain the binding between the RPAUID and PDUID, and then verifying that the PDUID belongs to the requesting UE;
- if the UE is authorised 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 ProSe Function shall check whether the UE is authorized to use ACE. If the UE is authorized for ACE, the ProSe Function shall invoke the procedure described in 3GPP TS 29.343 [31] to check whether the UE is authorised to announce the requested RPAUID with application-defined suffix(es), and obtain suffix-related information from the ProSe Application Server. The ProSe Function shall then allocate a ProSe Restricted Code Prefix and a value for validity timer T4007 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 29.343 [31]. The ProSe Function may take into account the Requested Timer if contained in the DISCOVERY_REQUEST message when allocating validity timer T4007;
- if the UE is authorised 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 ProSe Function shall allocate the corresponding ProSe Restricted Code and a value for validity timer T4007. The ProSe Function may take into account the Requested Timer if contained in the DISCOVERY_REQUEST message when allocating validity timer T4007;
- if the UE is authorised 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 ProSe Function shall check whether the UE is authorized to use ACE. If the UE is authorized for ACE, the ProSe Function shall invoke the procedure described in 3GPP TS 29.343 [31] to check whether the UE is authorised to announce the requested RPAUID with application-defined suffix(es), and obtain suffix-related information from the ProSe Application Server. The ProSe Function shall then allocate a ProSe Restricted Code Prefix and a value for validity timer T4007 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 29.343 [31] The ProSe Function may take into account the Requested Timer if contained in the DISCOVERY_REQUEST message when allocating validity timer T4007.
- if the UE is authorised 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 ProSe Function shall allocate the corresponding ProSe Restricted Code and a value for validity timer T4007. The ProSe Function may take into account the Requested Timer if contained in the DISCOVERY_REQUEST message when allocating validity timer T4007; and

- the ProSe Function associates the allocated ProSe Restricted Code or ProSe Restricted Code Prefix with a new discovery entry in the UE's context, and starts timer T4008. The HSS also provides to the ProSe Function the PLMN ID of the PLMN in which the UE is currently registered. For a given ProSe Restricted Code, timer T4008 shall be longer than timer T4007. By default, the value of timer T4008 is 4 minutes greater than the value of timer T4007.

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 ProSe Function shall either update the discovery entry with a new validity timer T4007, or allocate a new ProSe Restricted Code or ProSe Restricted Code Prefix for the requested RPAUID with a new validity timer T4007, restart timer T4008, and clear any existing on demand announcing enabled indicator. The ProSe Function may take into account the Requested Timer if contained in the DISCOVERY_REQUEST message when allocating validity timer T4007.

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 ProSe Function, the ProSe Function shall behave as if the Discovery Entry ID included in the DISCOVERY_REQUEST message was set to 0, and the ProSe Function 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 ProSe Function shall check if "on demand" announcing is authorised and enabled based on the Application Identity and the operator's policy. If "on demand" announcing is authorised and enabled, and there is no ongoing monitoring request for this RPAUID, then the ProSe Function 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 ProSe Function checks with the ProSe function of the VPLMN or the local PLMN represented by the Announcing PLMN ID whether the UE is authorised for restricted ProSe direct discovery model A announcing as described in 3GPP TS 29.345 [5].

The ProSe Function shall then send a DISCOVERY_RESPONSE message containing a <restricted-announce-response> element with:

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

- 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 ProSe Function, and optionally one or more ProSe Restricted Code Suffix Ranges which contain the suffix(es) for the RPAUID received in the DISCOVERY_REQUEST message;

- a Validity Timer T4007 set to the T4007 timer value assigned by the ProSe Function to the ProSe Restricted Code;

- 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;

- the Restricted Security set to a value containing the security-related information for restricted discovery provided by the ProSe Function;

- 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; and

- the Discovery Entry ID set to the ID of the discovery entry associated with this announce request in the UE's context.

If timer T4008 expires, the ProSe Function shall remove the discovery entry associated with the corresponding RPAUID from the UE's context.

6.2.2A.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:

- stop the validity timer T4007 for the discovery entry corresponding to the Discovery Entry ID received in the DISCOVERY_RESPONSE message;
- remove the discovery entry identified by the Discovery Entry ID included; and
- 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 T4007, if running, for the discovery entry corresponding to the Discovery Entry ID received in the DISCOVERY_RESPONSE message, and start the validity timer T4007 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.

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 ProSe Function of the HPLMN before starting to perform restricted ProSe direct discovery model A announcing. Otherwise, the UE may perform restricted ProSe direct discovery model A announcing as described below.

The UE requests the parameters from the lower layers for restricted Prose direct discovery model A announcing (see 3GPP TS 36.331 [12]). The UE shall perform restricted 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 EMM-IDLE mode has to request resources for ProSe direct discovery announcing as specified in 3GPP TS 36.331 [12], the UE shall perform a service request procedure or tracking area update procedure as specified in 3GPP TS 24.301 [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 subclause 12.2.2.18. 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 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 as announced ProSe Restricted Code, along with the eight least significant bits of the UTC-based counter, in order to construct a PC5_DISCOVERY message, according to the format defined in subclause 11.2.5.

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 ProSe Function, as long as the validity timer T4007 of the ProSe Restricted Code Prefix has not expired.

The UE shall then apply one or more of the DUIK, DUSK or DUCK with the associated Encrypted Bitmask, whichever received in the Restricted Code Security Material parameter of the DISCOVERY_RESPONSE message, along with the UTC-based counter to the PC5_DISCOVERY message, to e.g. generate a MIC value, scramble the message contents or provide confidentiality protection, as specified in 3GPP TS 33.303 [6].

The UE then passes the resulting PC5_DISCOVERY message, along with the PLMN ID of the intended announcing PLMN, to the lower layers for transmission if:

- the UE is currently authorised to perform restricted ProSe direct discovery model A announcing in the registered PLMN or the local PLMN operating the radio resources that the UE intends to use;
- the validity timer T4007 for the corresponding discovery entry allocated ProSe Restricted Code or ProSe Restricted Code Prefix has not expired; and

- a request from upper layers to announce the RPAUID associated with both the ProSe Restricted Code or ProSe Restricted Code Prefix, and the authorised Application Identity, is still in place.

The UE shall ensure that it keeps on passing PC5_DISCOVERY messages to the lower layers for transmission until the validity timer T4007 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 eNodeB and the UE is in EMM-CONNECTED mode, the UE shall trigger the corresponding procedure in lower layers as specified in 3GPP TS 36.331 [12].

6.2.2A.5 Announce request procedure not accepted by the ProSe Function

If the DISCOVERY_REQUEST message cannot be accepted by the ProSe Function, the ProSe Function sends a DISCOVERY_RESPONSE message containing a <response-reject> element to the UE including an appropriate PC3 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 announcing, the ProSe Function shall send the DISCOVERY_RESPONSE message containing a <response-reject> element with PC3 Control Protocol cause value #1 "Invalid application".

If the RPAUID contained in the DISCOVERY_REQUEST message is unknown to the ProSe Function or ProSe Application Server, the ProSe Function shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3 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 ProSe Function shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3 Control Protocol cause value #10 "Unknown or Invalid Discovery Entry ID".

If the UE is not authorised for restricted ProSe direct discovery model A announcing, the ProSe Function shall send the DISCOVERY_RESPONSE message containing a <response-reject> element with PC3 Control Protocol cause value #3 "UE authorisation failure".

If the UE is not authorised for restricted "on demand" restricted ProSe direct discovery model A announcing, the ProSe Function shall send the DISCOVERY_RESPONSE message containing a <response-reject> element with PC3 Control Protocol cause value #13 "UE unauthorised 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 ProSe Function shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3 Control Protocol cause value #3 "UE authorisation 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 ProSe Function shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3 Control Protocol cause value #12 "UE unauthorised 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 ProSe Function shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3 Control Protocol cause value #14 "Missing Application Level Container".

If the ProSe Application Server indicates to the ProSe Function that the Application Level Container in the DISCOVERY REQUEST message contains invalid information, the ProSe Function shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3 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 ProSe Function and the Requested Timer is set to zero, the ProSe Function shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3 Control Protocol cause value # 10 "Unknown or invalid Discovery Entry ID".

6.2.2A.6 Abnormal cases

6.2.2A.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 ProSe Function, establish a new secure connection and then restart the announce request procedure.

b) No response from the ProSe Function 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 ProSe Function 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.

6.2.2A.6.2 Abnormal cases in the ProSe Function

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 ProSe Function shall abort the procedure, and stop any associated timer(s) T4008, if running.

6.2.2B Discoveree request procedure for restricted ProSe direct discovery model B

6.2.2B.1 General

The purpose of the discoveree request procedure for restricted 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 Restricted ProSe Application User ID (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 23.303 [2].

Before initiating the discoveree request procedure, the UE shall be authorised for restricted 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 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).

6.2.2B.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 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 authorised to perform restricted 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 T4011 assigned by the ProSe Function 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 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 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 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 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 T4011 assigned by the ProSe Function for a ProSe Response Code expires.

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

- a new transaction ID not used in any other direct discovery procedures in PC3 interface;
- the RPAUID set to the RPAUID received from upper layers;
- the command set to "response";
- the UE identity set to the UE's IMSI;
- the Application Identity set to the Application Identity of the upper layer application that requested the announcing;
- the Discovery Type set to "Restricted discovery";
- the Discovery Model set to "Model B";
- 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 ProSe Function if the discoveree request is to update a previously sent discoveree request; and
- 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 6.2.2B.2.1 illustrates the interaction of the UE and the ProSe Function in the discoveree request procedure.

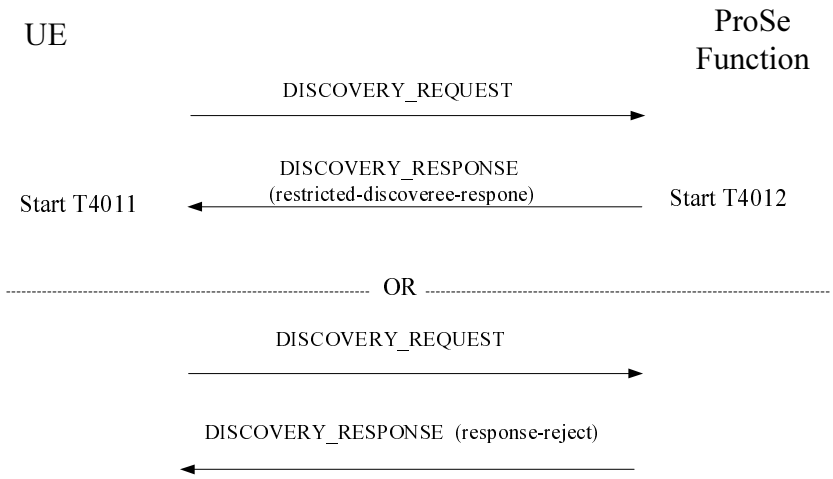

Figure 6.2.2B.2.1: Discoveree request procedure for restricted ProSe direct discovery model B

6.2.2B.3 Discoveree request procedure accepted by the ProSe Function

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

If there is no associated UE context, the ProSe Function checks with the HSS whether the UE is authorised for restricted ProSe direct discovery model B discoveree operation as described in 3GPP TS 29.344 [3]. If the check indicates that the UE is authorised, the ProSe Function creates a UE context that contains the UE's subscription parameters obtained from the HSS. The HSS also provides to the ProSe Function the PLMN ID of the PLMN in which the UE is currently registered.

If the UE context exists, the ProSe Function shall check whether the UE is authorized for restricted 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:

- the ProSe Function 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 29.343 [31] to obtain the binding between the RPAUID and PDUID, and then verifying that the PDUID belongs to the requesting UE;

- if the UE is authorised to announce the RPAUID, the ProSe Function 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 T4011, which is associated with the ProSe Response Code, PorSe Query Code and Discovery Query Filter(s).

- the ProSe Function 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 T4012. For a given ProSe Response

Code, timer T4012 shall be longer than timer T4011. By default, the value of timer T4012 is 4 minutes greater than the value of timer T4011.

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 ProSe Function shall either update the discovery entry with a new validity timer T4011, 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 T4011, restart timer T4012.

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 ProSe Function, the ProSe Function shall behave as if the Discovery Entry ID included in the DISCOVERY_REQUEST message was set to 0, and the ProSe Function 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 ProSe Function checks with the ProSe function of the VPLMN or the local PLMN identified by the Announcing PLMN ID whether the UE is authorised for restricted ProSe direct discovery model B discoveree operation as described in 3GPP TS 29.345 [5].

The ProSe Function shall then send a DISCOVERY_RESPONSE message containing a <restricted-discoveree-response> element with:

- the transaction ID set to the value of the transaction ID received in the DISCOVERY_REQUEST message from the UE;
- the ProSe Response Code set to the ProSe Response Code allocated for the RPAUID received in the DISCOVERY_REQUEST message;
- one or more ProSe Query Filters set to the ProSe Query Filter(s) used to match a query for the RPAUID received in the DISCOVERY_REQUEST message;
- a Validity Timer T4011 set to the T4011 timer value assigned by the ProSe Function to the ProSe Response Code and the Discovery Query Filter(s);
- the Restricted Security set to a value containing the security-related information for restricted discovery provided by the ProSe Function;
- the Discovery Entry ID set to the ID of the discovery entry associated with this disoveree request in the UE context.

If timer T4012 expires, the ProSe Function shall remove the discovery entry associated with the corresponding RPAUID from the UE's context.

6.2.2B.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 T4011 if running and start the validity timer T4011 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 below.

The UE may apply the received Discovery Query Filter(s) 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 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.

When applying a Discovery Query Filter to a received PC5_DISCOVERY message for the above-mentioned bitwise AND operation, the UE shall use the DUSK, if received as part of the filter in the DISCOVERY_RESPONSE message, and the UTC-based counter generated during the monitoring operation described below, to unscramble the PC5_DISCOVERY message as described in 3GPP TS 33.303 [6]. Then, if a DUCK is included as part of the filter, the

UE shall use the DUCK and the UTC-based counter to decrypt the message-specific confidentiality protected portion identified by the Encrypted Bitmask, as described in 3GPP TS 33.303 [6];

NOTE 1: 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.

If a DUIK is received as part of the filter, the UE shall use the DUIK and the UTC-based counter to verify the MIC field in the unscrambled PC5_DISCOVERY message.

NOTE 2: The UE needs to verify the MIC field because the match report procedure is not used for checking the MIC of a PC5_DISCOVERY message containing a ProSe Query Code by the ProSe Function.

The UE may instruct the lower layers to start monitoring with Discovery Query Filter(s) and prepare announcing the ProSe Response Code if all of the following conditions are met:

- the UE is currently authorized to perform restricted ProSe direct discovery model B discoveree operation in the registered PLMN or the local PLMN operating the radio resources that the UE intends to use;

- the UE has obtained the ProSe Response Code and Discovery Query Filter(s) and the respective validity timer T4011 for the corresponding discovery entry has not expired; and

- a request from upper layers to perform discoveree operation for the RPAUID associated with an authorised Application Identity is still in place.

During the discoveree operation, if one of the above conditions is no longer met, the UE may instruct the lower layers to stop the discoveree operation. When the UE stops discoveree operation, if the lower layers indicate that the UE is required to send a discovery indication to the eNodeB and the UE is in EMM-CONNECTED mode, the UE shall trigger the corresponding procedure in lower layers as specified in 3GPP TS 36.331 [12].

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 36.331 [12]. This shall be done only if the lower layers indicate that ProSe direct discovery is supported by the network. If the UE in EMM-IDLE mode has to request resources for ProSe direct discovery announcing as specified in 3GPP TS 36.331 [12], the UE shall perform a service request procedure or tracking area update procedure as specified in 3GPP TS 24.301 [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 subclause 12.2.2.18. 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 ProSe Response Code received in the DISCOVERY_RESPONSE message, along with the eight least significant bits of the UTC-based counter, in order to construct a PC5_DISCOVERY message, according to the format defined in subclause 11.2.5.

The UE shall then apply one or more of the DUIK, DUSK or DUCK with the associated Encrypted Bitmask, whichever received in the Restricted Code Security Material parameter of the DISCOVERY_RESPONSE message, along with the UTC-based counter to the PC5_DISCOVERY message, to e.g. generate a MIC value, scramble the message contents or provide confidentiality protection, as specified in 3GPP TS 33.303 [6].

The UE then passes the resulting PC5_DISCOVERY message, along with the PLMN ID of the intended announcing PLMN, to the lower layers for transmission.

For each match event with the Discovery Query Filter(s), the UE shall at least pass PC5_DISCOVERY message once to the lower layers for transmission. The UE shall ensure that it keeps on passing 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 T4011 expires. How this is achieved is left up to UE implementation.

6.2.2B.5 Discoveree request procedure not accepted by the ProSe Function

If the DISCOVERY_REQUEST message cannot be accepted by the ProSe Function, the ProSe Function sends a DISCOVERY_RESPONSE message containing a <response-reject> element to the UE including an appropriate PC3 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 ProSe Function shall send the

DISCOVERY_RESPONSE message containing a <response-reject> element with PC3 Control Protocol cause value #1 "Invalid application".

If the RPAUID contained in the DISCOVERY_REQUEST message is unknown to the ProSe Function or ProSe Application Server, the ProSe Function shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3 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 ProSe Function shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3 Control Protocol cause value #10 "Unknown or Invalid Discovery Entry ID".

If the UE is not authorised for restricted ProSe direct discovery model B discoveree operation, the ProSe Function shall send the DISCOVERY_RESPONSE message containing a <response-reject> element with PC3 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 ProSe Function shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3 Control Protocol cause value #3 "UE authorisation Failure".

6.2.2B.6 Abnormal cases

6.2.2B.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 ProSe Function, establish a new secure connection and then restart the discoveree request procedure.

b) No response from the ProSe Function 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 ProSe Function 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 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.

6.2.2B.6.2 Abnormal cases in the ProSe Function

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 ProSe Function shall abort the procedure, and stop any associated timer(s) T4012, if running.

6.2.3 Monitor request procedure for open ProSe direct discovery

6.2.3.1 General

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

- to receive and process PC5_DISCOVERY messages upon a request for monitoring from upper layers as defined in 3GPP TS 23.303 [2]; or
- to inform the ProSe Function that the UE wants to stop using Discovery Filters for direct discovery monitoring as defined in 3GPP TS 23.303 [2].

The UE shall only initiate the monitor request procedure if it has been authorised for open ProSe direct discovery monitoring at least in one PLMN based on the service authorisation 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 T4002 for each Discovery Filter indicating the time during which the filter is valid.

6.2.3.2 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 authorised to perform open 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 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 T4002 assigned by the ProSe Function 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 ProSe Function 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 T4002 assigned by the ProSe Function for a Discovery Filter expires.

The UE initiates the monitor request procedure for open ProSe direct discovery by sending a DISCOVERY_REQUEST message with:

- a new transaction ID;

  the ProSe Application ID set to the ProSe Application ID received from upper layers;

- the command set to "monitor"
- the UE identity set to the UE's IMSI;
- the Application Identity set to the Application Identity of the upper layer application that requested the monitoring;
- 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;
- the Discovery Entry ID set to 0 if this is a new request or set to the Discovery Entry ID received from the ProSe Function if the monitor request is to update a previously sent monitor request; and
- optionally, the Requested Timer set to 0 only when the UE wants to stop using Discovery Filters for direct discovery monitoring.

If open 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 6.2.3.2.1 illustrates the interaction between the UE and the ProSe Function in the monitor request procedure.

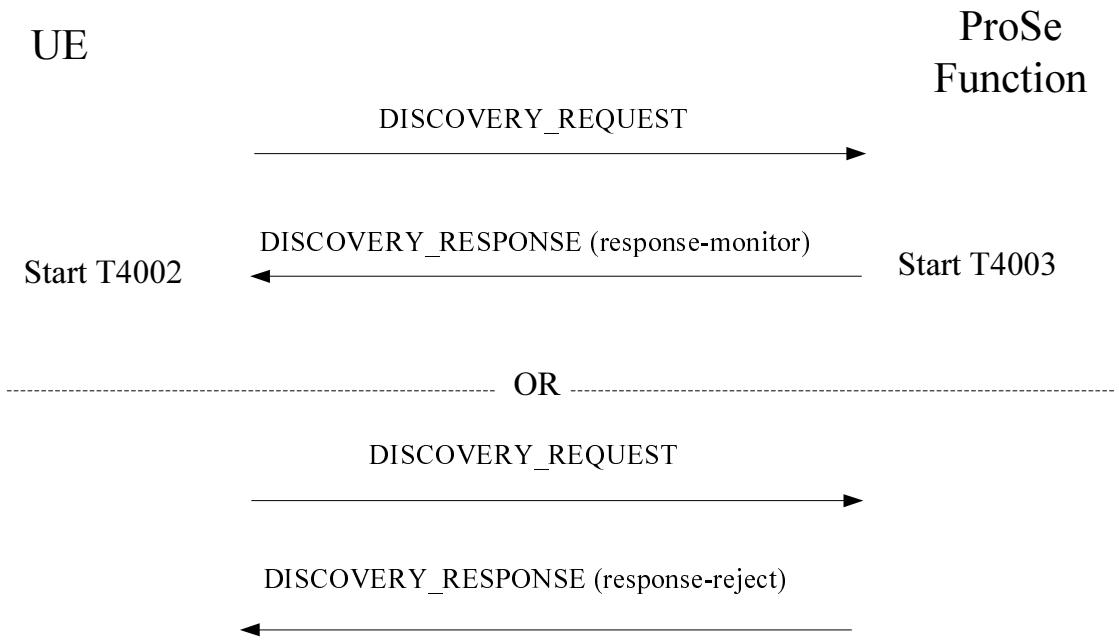

Figure 6.2.3.2.1: Monitor request procedure

6.2.3.3 Monitor request procedure accepted by the ProSe Function

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 ProSe Function 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 ProSe Function 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 ProSe Function belongs, the ProSe Function shall inform the ProSe Function in the PLMN indicated by the ProSe Application ID to remove the corresponding discovery entry as specified in 3GPP TS 29.345 [5]. Then the ProSe Function shall send a DISCOVERY_RESPONSE message containing a <response-monitor> element with:

- the transaction ID set to the value of the transaction ID received in the DISCOVERY_REQUEST message, and
- 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 ProSe Function shall perform the following procedure.

The ProSe Function shall check that the application corresponding to the Application Identity contained in the DISCOVERY_REQUEST message is authorised for open ProSe direct discovery monitoring. If the application is authorised for open ProSe direct discovery monitoring, the ProSe Function 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 ProSe Function checks with the HSS whether the UE is authorised for open ProSe direct discovery monitoring as described in 3GPP TS 29.344 [3]. The HSS provides to the ProSe Function the PLMN ID of the PLMN in which the UE is currently registered. If the subscription check indicates that the UE is authorised, the ProSe Function 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 ProSe Function shall check whether the UE is authorised to use ACE. If the UE is authorised for ACE, the ProSe Function shall also use the procedure described in 3GPP TS 29.343 [31] 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 ProSe Function belongs, then the ProSe Function executes the procedures defined in 3GPP TS 29.345 [5] to obtain the Discovery Filter(s) for the ProSe Application ID. Otherwise, the ProSe Function shall allocate one or more Discovery Filters for the requested ProSe Application ID if it is known to the ProSe Function.and at least one corresponding valid ProSe Application Code or ProSe Application Code Prefix is available in the ProSe Function. Each Discovery Filter consists of a ProSe Application Code, one or more ProSe Application Masks, and a TTL timer T4002. If application-controlled extension is used, the allocated Discovey 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 subclause 24.2 of 3GPP TS 23.003 [4], the ProSe Function 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 subclause 24.3 of 3GPP TS 23.003 [4]. If the requested ProSe Application ID is PLMN-specific, the ProSe Function 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 ProSe Function then associates the Discovery Filters with the new discovery entry in the UE context and starts timer T4003 assigned for each Discovery Filter. For a given Discovery Filter timer T4003 shall be longer than timer T4002. By default, the value of timer T4003 is 4 minutes greater than the value of timer T4002.

If there is an existing context for the UE that contains the UE's subscription parameters obtained from the HSS, but no discovery entry identified by the Discovery Entry ID contained in the DISCOVERY_REQUEST message, the ProSe Function shall check whether the UE is authorised for ProSe direct discovery monitoring. If the UE is authorised, the ProSe Function shall allocate the Discovery Filter as specified above.

After the Discovery Filter is allocated, the ProSe Function 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 T4003 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 ProSe Function updates the content of Discovery Filter(s), associate the discovery entry with the updated Discovery Filter(s) and restart timer T4003 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 ProSe Function shall send a DISCOVERY_RESPONSE message containing a <response-monitor> element with:

- the transaction ID set to the value of the transaction ID received in the DISCOVERY_REQUEST message from the UE;
- the Discovery Entry ID set to the identifier associated with the discovery entry; and
- if the ACE Enabled Indicator was included by the UE in the DISCOVERY_REQUEST message, 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; and

- one or more Discovery Filters allocated by the ProSe Function(s) for the ProSe Application ID received in the DISCOVERY_REQUEST message from the UE.

If timer T4003 expires, the ProSe Function shall remove the UE's association with the corresponding Discovery Filter. Furthermore, the ProSe Function shall remove the discovery entry from the UE's context if there is no Discovery Filter corresponding to the ProSe Application ID.

6.2.3.4 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:

- stop TTL timer T4002 for each Discovery Filter in the discovery entry identified by the Discovery Entry ID;
- remove the discovery entry identified by the Discovery Entry ID; and
- 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 ProSe Function, stop TTL timer T4002 if running and start TTL timer T4002 with the received value. Otherwise the UE shall discard the DISCOVERY_RESPONSE message and shall not perform the procedures below.

The UE may perform open ProSe direct discovery monitoring for discovery messages received over the PC5 interface as described below.

For a ProSe Application ID requested by the monitoring UE, the ProSe Function 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. In case of a match event, the UE shall consider that the ProSe Application ID it seeks to monitor has been discovered. A match event for open ProSe direct discovery is defined as follows:

There is a match event 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 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: A ProSe Application Mask with all bits set to "1" is assigned by the ProSe Function for full matching.

The UE may instruct the lower layers to start monitoring if all of the following conditions are met:

- the UE is currently authorized to perform open ProSe direct discovery monitoring in at least one PLMN;
- the UE has obtained at least one Discovery Filter and their respective TTL timer T4002(s) have not expired; and
- a request from upper layers to monitor for the ProSe Application ID associated with an authorised Application Identity is still in place.

If the UE is in EMM-CONNECTED mode, the monitoring UE shall also trigger the corresponding procedure in lower layers as specified in 3GPP TS 36.331 [12].

During the monitoring operation, the UE receives all PC5_DISCOVERY messages and associated UTC times from the lower layers. The UE shall generate the UTC-based counter corresponding to the UTC time associated with a PC5_DISCOVERY message and only process the PC5_DISCOVERY message if the UTC-based counter is within Max Offset of the time shown by the clock used for ProSe by the UE.

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 EMM-CONNECTED mode, the UE shall trigger the corresponding procedure in lower layers as specified in 3GPP TS 36.331 [12].

6.2.3.5 Monitor request procedure not accepted by the ProSe Function

If the DISCOVERY_REQUEST message is not accepted by the ProSe Function, the ProSe Function shall send a DISCOVERY_RESPONSE message containing a <response-reject> element to the UE including an appropriate PC3 Control Protocol cause value.

If the application corresponding to the Application Identity contained in the DISCOVERY_REQUEST message is not authorised for open ProSe direct discovery monitoring, the ProSe Function shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3 Control Protocol cause value #1 "Invalid application".

If the ProSe Application ID contained in the DISCOVERY_REQUEST message is unknown to the ProSe Function, the ProSe Function shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3 Control Protocol cause value #2 "Unknown ProSe Application ID".

If the UE is not authorised for open ProSe direct discovery monitoring, the ProSe Function shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3 Control Protocol cause value #3 "UE authorisation 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 ProSe Function has not authorized the UE to monitor in that country, it shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3 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 ProSe Function has no agreement to access the country-specific ProSe Application ID database of that country, the ProSe Function shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3 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 ProSe Function and the Requested Timer is set to 0, the ProSe Function shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3 Control Protocol cause value #10 "Unknown or invalid Discovery Entry ID ".

If the ProSe Function cannot retrieve a valid ProSe Application Code corresponding to the ProSe Application ID contained in the DISCOVERY_REQUEST message, the ProSe Function shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3 Control Protocol cause value #17 "No Valid ProSe Application Code".

If the UE is not authorised to use ACE, but the DISCOVERY_REQUEST message contains the ACE Enabled Indicator set to "application-controlled extension enabled", the ProSe Function shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3 Control Protocol cause value #12 "UE unauthorised 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 ProSe Function shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3 Control Protocol cause value #1 "Invalid Application".

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 ProSe Function, establish a new secure connection and then restart the monitor request procedure.

b) No response from the ProSe Function 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 ProSe Function 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.

6.2.3.6.2 Abnormal cases in the ProSe Function

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 ProSe Function shall abort the procedure, and stop any associated timer(s) T4003, if running.

6.2.3A Monitor request procedure for restricted ProSe direct discovery model A

6.2.3A.1 General

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

- to allow a UE participating in restricted ProSe direct discovery model A to receive and process PC5_DISCOVERY messages upon a request for monitoring from upper layers as defined in 3GPP TS 23.303 [2]; or

- to inform the ProSe Function that the UE wants to stop using Restricted Discovery Filter(s) for direct discovery monitoring as defined in 3GPP TS 23.303 [2].

The UE shall only initiate the restricted ProSe direct discovery model A monitor request procedure if it has been authorised for restricted ProSe direct discovery model A monitoring in at least in one PLMN based on the service authorisation 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 T4009 for each Restricted Discovery Filter indicating the time during which the filter is valid.

6.2.3A.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 authorisation 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 authorised 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 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 T4009 assigned by the ProSe Function 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 T4009 assigned by the ProSe Function for a Restricted Discovery Filter expires.

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

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

- a new transaction ID;
- the RPAUID set to the RPAUID received from upper layers;
- the command set to "monitor";
- the Discovery Type set to "Restricted discovery"
- the UE identity set to the UE's IMSI;
- the Application Identity set to the Application Identity of the upper layer application that requested the monitoring;
- 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;
- the Application Level Container set to the target RPAUIDs to monitor;
- 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 ProSe Function if the monitoring request is to update a previously sent monitoring request; and
- 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 6.2.3A.2.1 illustrates the interaction between the UE and the ProSe Function in the monitor request procedure.

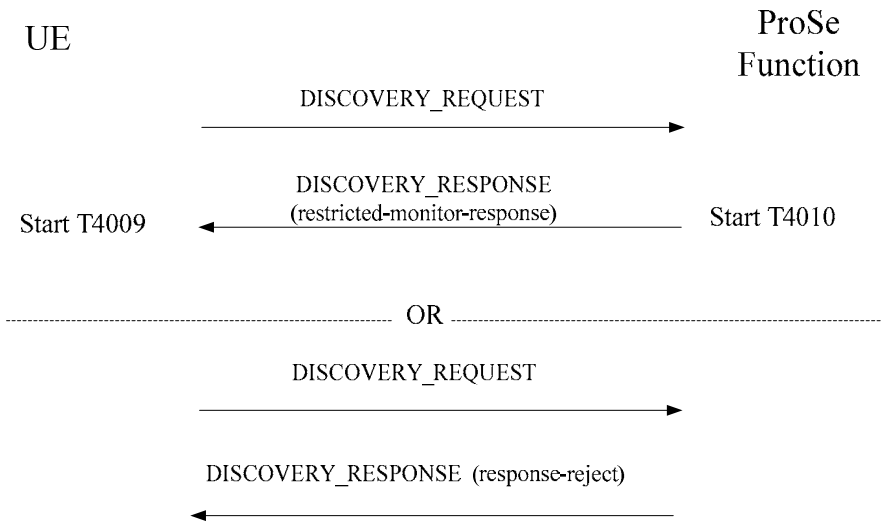

Figure 6.2.3A.2.1: Monitor request procedure for restricted ProSe direct discovery model A

6.2.3A.3 Monitor request procedure accepted by the ProSe Function

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 ProSe Function 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 ProSe Function 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 ProSe Function belongs, the ProSe Function shall inform the ProSe Function in the PLMN indicated by the PDUID to remove the corresponding discovery entry as specified in 3GPP TS 29.345 [5]. Then the ProSe Function shall send a DISCOVERY_RESPONSE message containing a <restricted-monitor-response> element with:

- the transaction ID set to the value of the transaction ID received in the DISCOVERY_REQUEST message, and
- 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" and the Discovery Type set to "Restricted discovery", if the Requested Timer is not included in the DISCOVERY_REQUEST message, the ProSe Function shall perform the following procedure.

The ProSe Function shall check that the application corresponding to the Application Identity contained in the DISCOVERY_REQUEST message is authorised for ProSe direct discovery model A monitoring. If the application is authorised for restricted ProSe direct discovery model A monitoring, the ProSe Function shall check whether there is an existing UE context.

If there is no associated UE context, the ProSe Function checks with the HSS whether the UE is authorised for restricted ProSe direct discovery model A monitoring as described in 3GPP TS 29.344 [3]. The HSS provides to the ProSe Function the PLMN ID of the PLMN in which the UE is currently registered. If the subscription check indicates that the UE is authorised, the ProSe Function creates a new UE context containing the UE's subscription parameters obtained from the HSS.

If the Discovery Entry ID included in the DISCOVERY_REQUEST is set to 0 then:

- the ProSe Function shall use the procedure described in 3GPP TS 29.343 [31] 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 authorised target RPAUID(s) from the ProSe Application Server;

- 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 ProSe Function shall check whether the UE is authorized to use ACE. If the UE is authorized for ACE, the ProSe Function shall also use the procedure described in 3GPP TS 29.343 [31] 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 are authorised by the ProSe Application Server.

- for each of the PDUIDs corresponding to an authorised target RPAUID, if the PLMN ID of the PDUID is not the same as that of the PLMN to which the ProSe Function belongs, then the ProSe Function executes the procedures defined in 3GPP TS 29.345 [5] 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 ProSe Function 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 ProSe Function or ProSe Application Server for this application, the ACE configuration in the ProSe Function 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 T4009, optionally the target RPAUID, optionally a metadata indicator and optionally metadata associated with this RPAUID;

- the ProSe Function associates the Restricted Discovery Filters with a new discovery entry in the UE's context; and

- the ProSe Function starts timer T4010 assigned for each Restricted Discovery Filter. For a given Restricted Discovery Filter, timer T4010 shall be longer than timer T4009. By default, the value of timer T4010 is 4 minutes greater than the value of timer T4009.

NOTE 2: For each target RPAUID, the ProSe Function 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 ProSe Function shall check whether the UE is authorised for restricted ProSe direct discovery model A monitoring. If the UE is authorised, the ProSe Function 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 T4010(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 29.345 [5].

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 ProSe Function, the ProSe Function shall behave as if the Discovery Entry ID included in the DISCOVERY_REQUEST message was set to 0, and the ProSe Function shall allocate a new non-zero Discovery Entry ID for this entry.

Then the ProSe Function shall send a DISCOVERY_RESPONSE message containing a <restricted-monitor-response> element with:

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

- one or more Restricted Discovery Filter(s) allocated by the ProSe Function(s) for the authorised target RPAUID(s);

- 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;

- the Discovery Entry ID set to the ID of the discovery entry associated with this monitor request; and

- the Application Level Container set to the application-level data received from the ProSe Application Server.

If T4010 expires, the ProSe Function 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 ProSe Function shall delete the discovery entry from the UE's context.

6.2.3A.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:

- stop TTL timer T4009 for each Restricted Discovery Filter in the discovery entry identified by the Discovery Entry ID;
- remove the discovery entry identified by the Discovery Entry ID; and
- 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:

- If the DISCOVERY_RESPONSE creates a new discovery entry, start the TTL timer T4009 with the received value for each Restricted Discovery Filter information element received in the DISCOVERY_RESPONSE message.
- If the DISCOVERY_RESPONSE updates an existing discovery entry, the UE shall
  - stop the T4009 timer(s) of any Restricted Discovery Filter in this discovery entry which are no longer authorized by the ProSe Function, ask lower layers to stop using those filters in monitoring operation, and remove the corresponding Restricted Discovery Filter from the discovery entry;
  - restart the T4009 timer(s) for those remain eligible; and
  - start the T4009 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 may perform monitoring for discovery messages received over the PC5 interface as described below.

The UE provides the Application Level Container, which contains the authorised Target RPAUID(s), to the upper layer applications. For each authorised target RPAUID , the ProSe Function 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. In case of a match event, the UE shall consider that the target RPAUID it seeks to monitor has been discovered. A match event is defined as follows:

There is match event 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 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: In a Restricted Discovery Filter, a mask with all bits set to "1" is assigned by the ProSe Function for full matching of a ProSe Restricted Code.

When applying a Restricted Discovery Filter to a received PC5_DISCOVERY message for the above-mentioned bitwise AND operation, the UE shall use the DUSK, if received as part of the filter in the DISCOVERY_RESPONSE message, and the UTC-based counter generated during the monitoring operation, to unscramble the PC5_DISCOVERY message as described in 3GPP TS 33.303 [6]. Then, if a DUCK is included as part of the filter, the UE shall use the DUCK and the UTC-based counter to decrypt the message-specific confidentiality protected portion identified by the Encrypted Bitmask, as described in in 3GPP TS 33.303 [6];

NOTE: 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.

If a DUIK is received as part of the filter, the UE shall use the DUIK and the UTC-based counter to verify the MIC field in the unscrambled PC5_DISCOVERY message. If a MIC Check Indicator parameter is included instead, the UE shall use the match report procedure described in subclause 6.2.4A to trigger checking of the MIC of the PC5_DISCOVERY message containing the ProSe Restricted Code by the ProSe Function.

The UE may instruct the lower layers to start monitoring if all of the following conditions are met:

- the UE is currently authorized to perform restricted ProSe direct discovery model A monitoring in at least one PLMN;
- the UE has obtained at least one Restricted Discovery Filter and their respective TTL timer T4009(s) have not expired; and
- a request from upper layers to monitor for the RPAUID(s) associated with an authorised Application Identity is still in place.

If the UE is in EMM-CONNECTED mode, the monitoring UE shall also trigger the corresponding procedure in lower layers as specified in 3GPP TS 36.331 [12].

During the monitoring operation, the UE receives all PC5_DISCOVERY messages and associated UTC times from the lower layers. The UE shall generate the UTC-based counter corresponding to the UTC time associated with a PC5_DISCOVERY message and only process the PC5_DISCOVERY message if the UTC-based counter is within Max Offset of the time shown by the clock used for ProSe by the UE.

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 EMM-CONNECTED mode, the UE shall trigger the corresponding procedure in lower layers as specified in 3GPP TS 36.331 [12].

6.2.3A.5 Monitor request procedure not accepted by the ProSe Function

If the DISCOVERY_REQUEST message is not accepted by the ProSe Function, the ProSe Function shall send a DISCOVERY_RESPONSE message containing a <response-reject> element to the UE including an appropriate PC3 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 monitoring, the ProSe Function shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3 Control Protocol cause value #1 "Invalid application".

If the RPAUID contained in the DISCOVERY_REQUEST message is unknown to the ProSe Application Server, the ProSe Function shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3 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 ProSe Function shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3 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 ProSe Function shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3 Control Protocol cause value #10 "Unknown or Invalid Discovery Entry ID".

If the UE is not authorised for restricted ProSe direct discovery monitoring, the ProSe Function shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3 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 ProSe Function shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3 Control Protocol cause value #3 "UE authorisation 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 ProSe Function shall send a DISCOVERY_RESPONSE message

containing a <response-reject> element with PC3 Control Protocol cause value #12 "UE unauthorised for discovery with Application-Controlled Extension".

If the Discovery Entry ID contained in the DISCOVERY_REQUEST message is unknown to the ProSe Function and the Requested Timer is set to 0, the ProSe Function shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3 Control Protocol cause value #10 "Unknown or invalid Discovery Entry ID".

6.2.3A.6 Abnormal cases

6.2.3A.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 ProSe Function, establish a new secure connection and then restart the monitor request procedure.

b) No response from the ProSe Function 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 ProSe Function 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.

6.2.3A.6.2 Abnormal cases in the ProSe Function

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 ProSe Function shall abort the procedure, and stop any associated timer(s) T4010, if running.

6.2.3B Discoverer request procedure for restricted ProSe direct discovery model B

6.2.3B.1 General

The purpose of the discoverer request procedure for restricted 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 23.303 [2].

Before initiating the discoverer request procedure, the UE shall be authorised for restricted 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 PC5_DISCOVERY message and passes the 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.

6.2.3B.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 may 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 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 T4013 assigned by the ProSe Function 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 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 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 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 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 T4013 assigned by the ProSe Function for a ProSe Query Code expires.

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

- a new transaction ID not used in any other direct discovery procedures in PC3 interface;
- the RPAUID set to the RPAUID received from upper layers;
- the Application Level Container set to contain the application-layer information, e.g., target RPAUID(s) to discover;
- the command set to "query";
- the UE identity set to the UE's IMSI;
- the Application Identity set to the Application Identity of the upper layer application that requested the announcing;
- the Discovery Type set to "Restricted discovery";
- the Discovery Model set to "Model B";
- 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 ProSe Function if the discoverer request is to update a previously sent discoverer request; and

- 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 6.2.3B.2.1 illustrates the interaction of the UE and the ProSe Function in the discoverer request procedure.

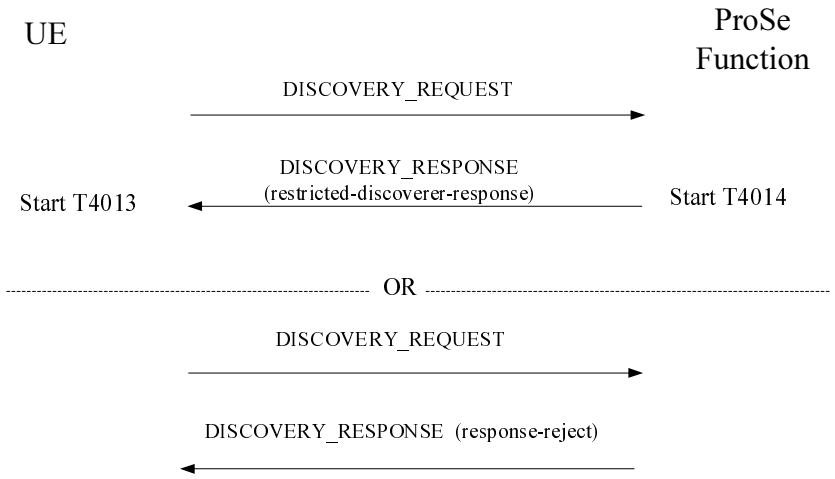

Figure 6.2.3B.2.1: Discoverer request procedure for restricted ProSe direct discovery model B

6.2.3B.3 Discoverer request procedure accepted by the ProSe Function

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

If there is no associated UE context, the ProSe Function checks with the HSS whether the UE is authorised for restricted ProSe direct discovery model B discoverer operation as described in 3GPP TS 29.344 [3]. If the check indicates that the UE is authorised, the ProSe Function creates a UE context that contains the UE's subscription parameters obtained from the HSS. The HSS also provides to the ProSe Function the PLMN ID of the PLMN in which the UE is currently registered.

If the UE context exists, the ProSe Function shall check whether the UE is authorized for restricted 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:

- the ProSe Function shall use the procedure described in 3GPP TS 29.343 [31] 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;

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

    - if the PLMN ID of the PDUID is not the same as that of the PLMN to which the ProSe Function belongs, then the ProSe Function executes the procedures defined in 3GPP TS 29.345 [5] to obtain the ProSe Query Code, the ProSe Response Code, the associated validity timer T4012, and optionally metadata associated

with this target RPAUID. Otherwise, the ProSe Function shall locate the discoveree UE context and retrieve the corresponding ProSe Query Code and ProSe Response Code and the validity timer T4012, and optionally metadata associated with this RPAUID. Then, the ProSe Function 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 T4013 based on the remaining value of T4012.

NOTE 1: If the ProSe Function 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 ProSe Function can skip the processing of this target RPAUID.

NOTE 2: The ProSe Function can choose the value of T4013 to be longer than the remaining value of T4012, 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 ProSe Function.

- the ProSe Function 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

- the ProSe Function starts timer T4014 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 T4014 shall be longer than timer T4013. By default, the value of timer T4014 is 4 minutes greater than the value of timer T4013.

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 ProSe Function 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 ProSe Function, the ProSe Function shall behave as if the Discovery Entry ID included in the DISCOVERY_REQUEST message was set to 0, and the ProSe Function 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 ProSe Function checks with the ProSe Function of the VPLMN or the local PLMN indicated by the Announcing PLMN ID whether the UE is authorised for restricted ProSe direct discovery model B discoverer operation as described in 3GPP TS 29.345 [5].

The ProSe Function shall then send a DISCOVERY_RESPONSE message containing a <restricted-discoverer-response> element with:

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

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

  - a target RPAUID;

  - the ProSe Query Code set to the ProSe Query Code for the target RPAUID;

  - one or more the Discovery Response Filters IE which are set to include the Discovery Response Filter(s) used to match a potential ProSe Response Code responding to the ProSe Query Code.;

  - a validity timer T4013 set to the T4013 timer value assigned by the ProSe Function to the ProSe Query Code and the Discovery Response Filter(s); and

  - optionally, the metadata associated with the target RPAUID;

  - the Restricted Security IE containing the security key(s) needed to be used with Discovery Response Filter(s) for restricted discovery monitoring ;

- the Discovery Entry ID set to the ID of the discovery entry associated with this announce request in the UE context.

If T4014 expires, the ProSe Function shall remove the corresponding ProSe Query Code and ProSe Response Filter(s) from the discovery entry associated with the discoverer UE's context.

6.2.3B.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:

- If the DISCOVERY_RESPONSE creates a new discovery entry, start the validity timer T4013 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;

- If the DISCOVERY_RESPONSE updates an existing discovery entry, the UE shall

  - stop the timer T4013 of any ProSe Query Code(s) and Discovery Response Filter(s) in this discovery entry which are no longer authorized by the ProSe Function, 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;

  - restart the T4013 timer(s) for those remain eligible;

  - start the T4013 timer(s) for any new ProSe Query Codes and their corresponding Discovery Response Filter(s); and

  - 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 procedures below.

For each ProSe Query Code in this discovery entry, the UE requests the lower layers to announce the ProSe Query Code in the PC5 interface, as specified in 3GPP TS 36.331 [12]. This shall be done only if the lower layers indicate that ProSe direct discovery is supported by the network. If the UE in EMM-IDLE mode has to request resources for ProSe direct discovery announcing as specified in 3GPP TS 36.331 [12], the UE shall perform a service request procedure or tracking area update procedure as specified in 3GPP TS 24.301 [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 subclause 12.2.2.18. 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 for each ProSe Query Code in this discovery entry, use the ProSe Query Code to construct a PC5_DISCOVERY message, according to the format defined in subclause 11.2.5.

The UE shall then apply one or more of the DUIK, DUSK or DUCK with the associated Encrypted Bitmask, whichever received in the Restricted Code Security Material parameter of the DISCOVERY_RESPONSE message, along with the UTC-based counter to the PC5_DISCOVERY message, to e.g. generate a MIC value, scramble the message contents or provide confidentiality protection, as specified in 3GPP TS 33.303 [6].

The UE then passes the resulting PC5_DISCOVERY message, along with the PLMN ID of the intended announcing PLMN stored for this discovery entry, to the lower layers for transmission and instruct the lower layers to start monitoring if:

- the UE is currently authorised to perform restricted ProSe direct discovery model B discoverer operation in the registered PLMN or the local PLMN operating the radio resources that the UE intends to use;

- the validity timer T4013 for the ProSe Query Code and corresponding ProSe Response Filter(s) has not expired; and

- a 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 still in place.

During the discoverer operation, if one of the above conditions is no longer met, the UE may instruct the lower layers to stop the discoverer operation. When the UE stops discoverer operation, if the lower layers indicate that the UE is required to send a discovery indication to the eNodeB and the UE is in EMM-CONNECTED mode, the UE shall trigger the corresponding procedure in lower layers as specified in 3GPP TS 36.331 [12].

The UE shall ensure that it keeps on passing PC5_DISCOVERY messages to the lower layers for transmission until the validity timer T4013 of the ProSe Query Code expires. How this is achieved is left up to UE implementation.

The UE may apply the received Discovery Response Filter(s) 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 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.

When applying a Discovery Response Filter to a received PC5_DISCOVERY message for the bitwise AND operation, the UE shall use the DUSK, if received as part of the filter in the DISCOVERY_RESPONSE message, and the UTC-based counter generated during the monitoring operation, to unscramble the PC5_DISCOVERY message as described in 3GPP TS 33.303 [6]. Then, if a DUCK is included as part of the filter, the UE shall use the DUCK and the UTC-based counter to to decrypt the message-specific confidentiality protected portion identified by the Encrypted Bitmask, as described in 3GPP TS 33.303 [6];

NOTE: 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.

If a DUIK is received as part of the filter, the UE shall use the DUIK and the UTC-based counter to verify the MIC field in the unscrambled PC5_DISCOVERY message. If a MIC Check Indicator parameter is included instead, the UE shall use the match report procedure described in subclause 6.2.4B to trigger checking of the MIC of the PC5_DISCOVERY message containing the ProSe Response Code by the ProSe Function.

The UE may notify the upper layer application about the match event of restricted ProSe direct discovery Model B with the corresponding target RPAUID and metadata, if the RPAUID and meta-data are included in the Subquery Result element in the DISCOVERY_RESPONSE message.

6.2.3B.5 Discoverer request procedure not accepted by the ProSe Function

If the DISCOVERY_REQUEST message cannot be accepted by the ProSe Function, the ProSe Function sends a DISCOVERY_RESPONSE message containing a <response-reject> element to the UE including an appropriate PC3 Control Protocol cause value.

If the application corresponding to the Application Identity contained in the DISCOVERY_REQUEST message is not authorised for restricted ProSe direct discovery Model B discoverer operation, the ProSe Function shall send the DISCOVERY_RESPONSE message containing a <response-reject> element with PC3 Control Protocol cause value #1 "Invalid application".

If the RPAUID contained in the DISCOVERY_REQUEST message is unknown to the ProSe Function or ProSe Application Server, the ProSe Function shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3 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 ProSe Function shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3 Control Protocol cause value #10 "Unknown or Invalid Discovery Entry ID".

If the UE is not authorised for restricted ProSe direct discovery model B discoverer operation, the ProSe Function shall send the DISCOVERY_RESPONSE message containing a <response-reject> element with PC3 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 ProSe Function shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3 Control Protocol cause value #3 "UE authorisation Failure".

If the ProSe Function fails to retrieve any valid target PDUIDs from ProSe Application Server based on the Application Level Container contained in the DISCOVERY_REQUEST message, the ProSe Function shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3 Control Protocol cause value #11 "Invalid discovery target".

If the ProSe Function 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 ProSe Function shall send a DISCOVERY_RESPONSE message containing a <response-reject> element with PC3 Control Protocol cause value #11 "Invalid discovery target".

6.2.3B.6 Abnormal cases

6.2.3B.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 ProSe Function, establish a new secure connection and then restart the discoverer request procedure.

b) No response from the ProSe Function 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 ProSe Function 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 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.

6.2.3B.6.2 Abnormal cases in the ProSe Function

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 ProSe Function shall abort the procedure, and stop any associated timer(s) T4014, if running.

6.2.4 Match report procedure for open ProSe direct discovery

6.2.4.1 General

The purpose of the Match report procedure for open 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 authorised for open ProSe direct discovery monitoring in the monitored PLMN based on the service authorisation 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.

6.2.4.2 Match report procedure initiation

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

- a request from upper layers to monitor for the ProSe Application ID, which resulted in the matched ProSe Application Code, is still in place;

- 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

- the TTL timer T4002 associated with the Discovery Filter, which resulted in a match event of the ProSe Application Code, has not expired.

If the UE is authorised to perform open 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 T4004 of the ProSe Application Code 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 T4006 of the ProSe Application Code has expired; or

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.

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

- the UE shall set the ProSe Application Code to the ProSe Application Code for which there was a match event;

- the UE shall set the UE identity to the UE's IMSI;

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

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

    1) the first counter composed of:

       - 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 PC5_DISCOVERY message that contained the ProSe Application Code for which there was a match event encoded as specified in subclause 12.2.2.18;

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

       - 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 PC5_DISCOVERY message that contained the ProSe Application Code for which there was a match event, as specified in 3GPP TS 33.303 [6]; and

    2) the second counter composed of:

       - 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 PC5_DISCOVERY message that contained the ProSe Application Code for which there was a match event encoded as specified in subclause 12.2.2.18;

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

       - 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 PC5_DISCOVERY message that contained the ProSe Application Code for which there was a match event, as specified in 3GPP TS 33.303 [6]; and

  - 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 PC5_DISCOVERY message that contained the ProSe Application Code for which there was a match event encoded as specified in subclause 12.2.2.18, and set the UTC-based counter in the MATCH_REPORT message to that counter;

- the UE shall set the MIC to the MIC of the PC5_DISCOVERY message that contained the ProSe Application Code for which there was a match event;

- the UE shall set the Message Type to the value of Message Type field of the PC5_DISCOVERY message that contained the ProSe Application Code for which there was a match event;
- the UE shall set the Monitored PLMN ID to the PLMN ID of the PLMN where the PC5_DISCOVERY message was received, as provided by the lower layers;
- 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
- 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 ProSe Function.

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 6.2.4.2.1 illustrates the interaction between the UE and the ProSe Function in the match report procedure.

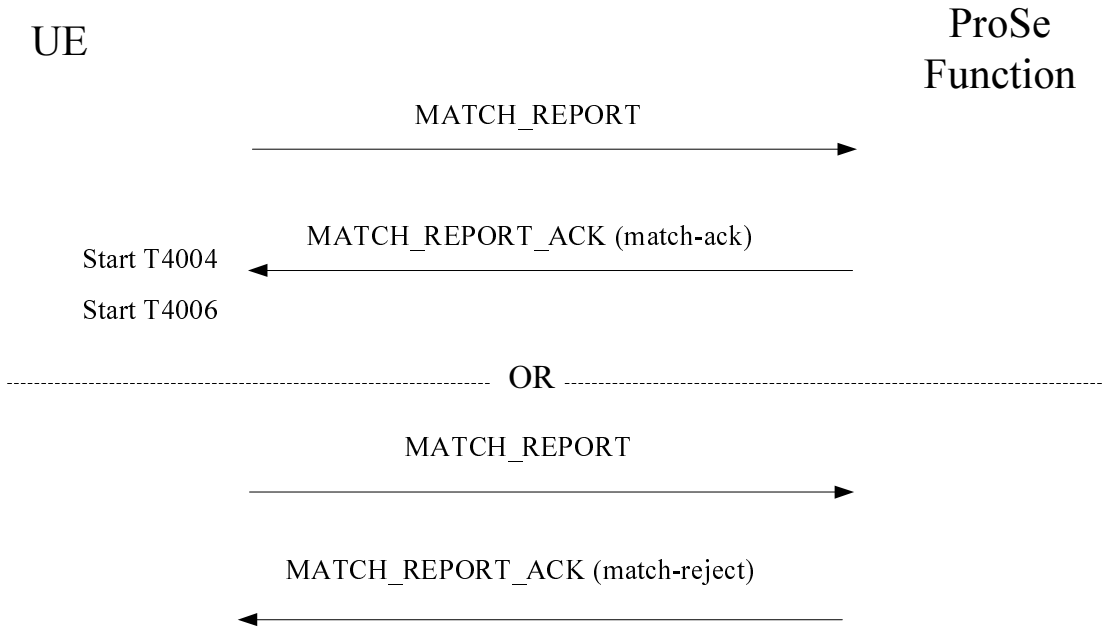

Figure 6.2.4.2.1: Match report procedure

6.2.4.3 Match report procedure accepted by the ProSe Function

Upon receiving a MATCH_REPORT message, the ProSe Function shall check whether there is an existing context for the UE identified by its IMSI. If there is no associated UE context, the ProSe Function checks with the HSS whether the UE is authorised for open ProSe direct discovery monitoring as described in 3GPP TS 29.344 [3].

The ProSe Function 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 ProSe Function belongs, the ProSe Function shall execute the procedures defined in 3GPP TS 29.345 [5]. Otherwise, the ProSe Function shall check whether the received ProSe Application Code is authorised 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 ProSe Function shall verify if the PLMN ID in the ProSe Application Code is the same as the PLMN of the ProSe Function. If so, the ProSe Function 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 subclause 24.3 of 3GPP TS 23.003 [4], the ProSe Function shall check whether the MCC of the PLMN ID part of the ProSe Application Code corresponds to the country of the ProSe Function. If so, the ProSe Function 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 subclause 24.3 of 3GPP TS 23.003 [4], the ProSe Function 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 ProSe Function maps the ProSe Application Code Prefix to the corresponding ProSe Application ID.

The ProSe Function shall analyse the ProSe Application Code received from the UE and determine the validity of the ProSe Application Code.

NOTE: This might require the ProSe Function to execute procedures defined in 3GPP TS 29.345 [5].

The ProSe Function shall check if the MIC value and its corresponding UTC-based counter are valid, as defined in 3GPP TS 33.303 [6].

If the VPLMN ID is included in the MATCH_REPORT message, the ProSe Function uses it for charging purposes as specified in 3GPP TS 32.277 [27].

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

- the transaction ID set to the value of the transaction ID received in the MATCH_REPORT message from the UE;
- the ProSe Application ID set to the ProSe Application ID provided by the ProSe Function and corresponding to the ProSe Application Code contained in the MATCH_REPORT message;
- the Validity Timer T4004 set to indicate for how long this ProSe Application Code is valid; and
- the Match Report Refresh Timer T4006 set to indicate for how long the UE will wait before sending a new Match Report for this ProSe Application Code.

If the UE has set the Metadata Flag to indicate that it wishes to receive metadata information associated with the ProSe Application ID, the ProSe Function shall set the Metadata 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 ProSe Function for the ProSe Application Code received in the MATCH_REPORT message.

6.2.4.4 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 T4004 and T4006, 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 PC3 Control Protocol cause value is #5 "Invalid MIC", as specified in subclause 6.2.4.5, the UE shall stop timer T4004 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 T4004 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 T4004 of the corresponding ProSe Application Code is stopped upon receiving MATCH_REPORT_ACK message with a <match-reject> element with PC3 Control Protocol cause value #5 "Invalid MIC".

6.2.4.5 Match report procedure not accepted by the ProSe Function

If the MATCH_REPORT message is not accepted by the ProSe Function, the ProSe Function sends a MATCH_REPORT_ACK message with a <match-reject> element to the UE including an appropriate PC3 Control Protocol cause value.

If the ProSe Application Code contained in the MATCH_REPORT message is unknown by the ProSe Function, the ProSe Function shall send the MATCH_REPORT_ACK message with a <match-reject> element with PC3 Control Protocol cause value #4 "Unknown ProSe Application Code".

If the check of the MIC contained in the MATCH_REPORT message fails, the ProSe Function shall send the MATCH_REPORT_ACK message with a <match-reject> element with PC3 Control Protocol cause value #5 "Invalid MIC".

If the check of the UTC-based counter contained in the MATCH_REPORT message fails, the ProSe Function shall send the MATCH_REPORT_ACK message with a <match-reject> element with PC3 Control Protocol cause value #6 "Invalid UTC-based counter".

If the UE is not authorised for open ProSe direct discovery monitoring in the monitored PLMN contained in the MATCH_REPORT message, the ProSe Function shall send the MATCH_REPORT_ACK message with a <match-reject> element with PC3 Control Protocol cause value #3 "UE authorisation failure".

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 MATCH_REPORT message (e.g. after TCP retransmission timeout)

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

b) No response from the ProSe Function 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 T4002 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.

6.2.4A Match report procedure for restricted ProSe direct discovery model A

6.2.4A.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 authorised for restricted ProSe direct discovery monitoring model A in the monitored PLMN based on the service authorisation 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.

6.2.4A.2 Match report procedure initiation

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

- a request from upper layers to monitor for the target RPAUID, which resulted in the matched ProSe Restricted Code, is still in place;
- the lower layers have provided UTC time information, along with the discovery message containing the ProSe Restricted Code; and
- the TTL timer T4009 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 authorised to perform restricted 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 T4016 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 T4017 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 T4017 for this ProSe Restricted Code and the UE is directed by the ProSe Function to perform the required MIC check via the match report procedure.

NOTE 1: The ProSe Function 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:

- the RPAUID set to the UE's RPAUID which has requested the corresponding monitoring operation that resulted this match event;
- the ProSe Restricted Code set to the ProSe Restricted Code for which there was a match event;
- the UE identity set to the UE's IMSI;
- the Discovery Type set to "Restricted discovery";
- the Application Identity set to the Application Identity of the upper layer application that triggered the monitoring operation;
- optionally, the UTC-based counter set as follows if the MIC is checked via the match report procedure:
  - the UE shall generate two UTC-based counters with:
    1) the first counter composed of:
       - 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 PC5_DISCOVERY message that contained the ProSe Restricted Code for which there was a match event encoded as specified in subclause 12.2.2.18;
       - the 24th most significant bit of the UTC-based counter set to '0'; and

- 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 PC5_DISCOVERY message that contained the ProSe Restricted Code for which there was a match event, as specified in 3GPP TS 33.303 [6]; and

2) the second counter composed of:

- 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 PC5_DISCOVERY message that contained the ProSe Restricted Code for which there was a match event encoded as specified in subclause 12.2.2.18;

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

- 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 PC5_DISCOVERY message that contained the ProSe Restricted Code for which there was a match event, as specified in 3GPP TS 33.303 [6]; and

- 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 PC5_DISCOVERY message that contained the ProSe Restricted Code for which there was a match event encoded as specified in subclause 12.2.2.18, and set the UTC-based counter in the MATCH_REPORT message to that counter;

- optionally, the Message Type set to the value of Message Type field of the 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;

- optionally, the MIC set to the MIC of the 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

- 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 ProSe Function.

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 6.2.4A.2.1 illustrates the interaction between the UE and the ProSe Function in the match report procedure.

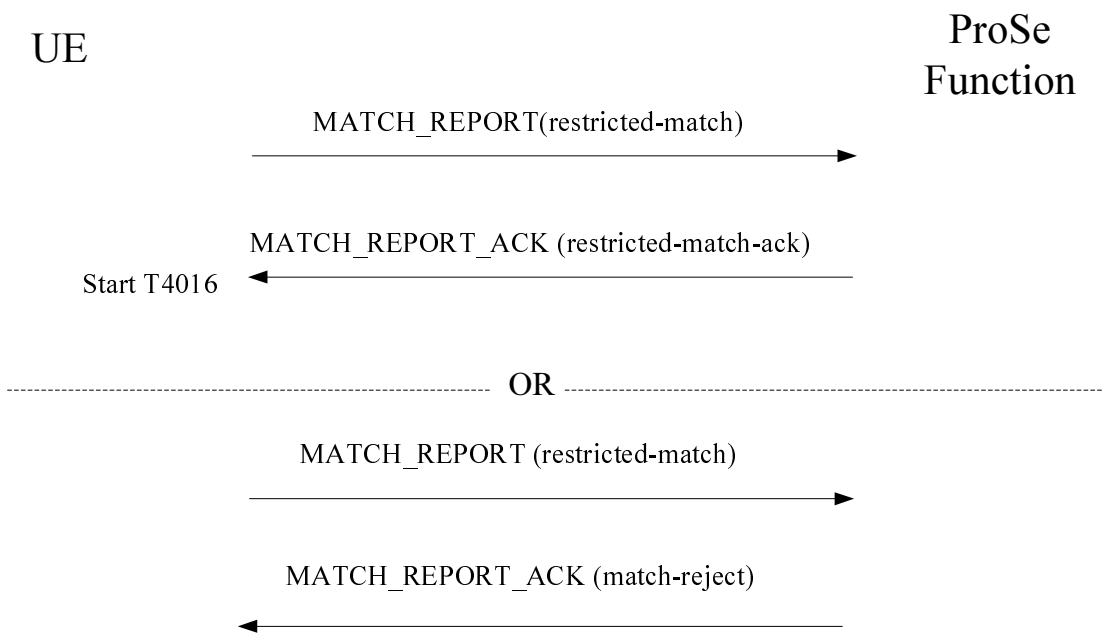

Figure 6.2.4A.2.1: Match report procedure for restricted discovery model A

6.2.4A.3 Match report procedure accepted by the ProSe Function

Upon receiving a MATCH_REPORT message, the ProSe Function shall check whether there is an existing context for the UE identified by its IMSI.

The ProSe Function shall analyse 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 ProSe Function shall check whether the MIC value and the UTC-based counter are valid and within the acceptable range respectively as defined in 3GPP TS 33.303 [6]. The ProSe Function 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 ProSe Function may further invoke the procedure defined in 3GPP TS 29.343 [31] 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 ProSe Function does not have the latest metadata.

If the outcome of the above processing is successful, the ProSe Function shall send a MATCH_REPORT_ACK message containing a <restricted-match-ack> element with the transaction ID set to the value of the transaction ID received in the MATCH_REPORT message from the UE, the RPAUID set to the target RPAUID retrieved from the UE context at the ProSe Function which corresponds to the ProSe Restricted Code contained in the MATCH_REPORT message, and the Validity Timer T4016 set to indicate for how long this ProSe Restricted Code is valid. The ProSe Function shall set the Match Report Refresh Timer T4017 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. If there exists metadata information associated with this target RPAUID and the Metadata Flag is set to "True" in the MATCH_REPORT message, the ProSe Function shall set the Metadata to the associated metadata information.

If the corresponding PDUID of the target RPAUID does not belong to the HPLMN of the requesting UE, the ProSe Function may optionally invoke the procedure defined in 3GPP TS 29.345 [5] to inform the ProSe Function of the announcing UE about the match event.

6.2.4A.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 T4016 and T4017, 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 PC3 Control Protocol cause value is #5 "Invalid MIC", as specified in subclause 6.2.4A.5, the UE shall stop timer T4016 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 T4016 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 T4016 of the corresponding ProSe Restricted Code is stopped upon receiving MATCH_REPORT_ACK message with a <match-reject> element with PC3 Control Protocol cause value #5 "Invalid MIC".

6.2.4A.5 Match report procedure not accepted by the ProSe Function

If the MATCH_REPORT message is not accepted by the ProSe Function, the ProSe Function sends a MATCH_REPORT_ACK message with a <match-reject> element to the UE including an appropriate PC3 Control Protocol cause value.

If there is no associated UE context for the IMSI contained in the MATCH_REPORT message, the ProSe Function shall send the MATCH_REPORT_ACK message with a <match-reject> element with PC3 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 ProSe Function shall send the MATCH_REPORT_ACK message with a <match-reject> element with PC3 Control Protocol cause value #16 "Invalid Match Event".

If the check of the MIC contained in the MATCH_REPORT message fails, the ProSe Function shall send the MATCH_REPORT_ACK message with a <match-reject> element with PC3 Control Protocol cause value #5 "Invalid MIC".

If the check of the UTC-based counter contained in the MATCH_REPORT message fails, the ProSe Function shall send the MATCH_REPORT_ACK message with a <match-reject> element with PC3 Control Protocol cause value #6 " Invalid UTC-based counter".

If the UE is not authorised for restricted ProSe direct discovery monitoring, the ProSe Function shall send the MATCH_REPORT_ACK message with a <match-reject> element with PC3 Control Protocol cause value #3 "UE authorisation failure".

6.2.4A.6 Abnormal cases

6.2.4A.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 ProSe Function, establish a new secure connection and then restart the match report procedure.

b) No response from the ProSe Function 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 T4009 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.

6.2.4B Match report procedure for restricted ProSe direct discovery model B

6.2.4B.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 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 authorised for restricted ProSe direct discovery model B discoverer operation in the monitored PLMN based on the service authorisation 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.

6.2.4B.2 Match report procedure initiation

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

- 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;
- the lower layers have provided UTC time information, along with the discovery message containing the ProSe Response Code; and
- the TTL timer T4013 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 authorised to perform restricted 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 T4016 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 T4017 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 T4017 for this ProSe Response Code and the UE is directed by the ProSe Function to perform the required MIC check via the match report procedure.

NOTE 1: The ProSe Function 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:

- the RPAUID set to the UE's RPAUID which has requested the corresponding restricted discovery model B discoverer operation that resulted this match event;
- the ProSe Response Code set to the ProSe Response Code for which there was a match event;

- the UE identity set to the UE's IMSI;
- the Discovery Type set to "Restricted discovery";
- the Application Identity set to the Application Identity of the upper layer application that triggered the restricted direct discovery Model B discoverer operation;
- optionally, the UTC-based counter set as follows if the MIC is checked via the match report procedure:
  - the UE shall generate two UTC-based counters with:
    1) the first counter composed of:
       - 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 PC5_DISCOVERY message that contained the ProSe Response Code for which there was a match event encoded as specified in subclause 12.2.2.18;
       - the 24th most significant bit of the UTC-based counter set to '0'; and
       - 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 PC5_DISCOVERY message that contained the ProSe Response Code for which there was a match event, as specified in 3GPP TS 33.303 [6]; and
    2) the second counter composed of:
       - 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 PC5_DISCOVERY message that contained the ProSe Response Code for which there was a match event encoded as specified in subclause 12.2.2.18;
       - the 24th most significant bit of the UTC-based counter set to '1'; and
       - 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 PC5_DISCOVERY message that contained the ProSe Response Code for which there was a match event, as specified in 3GPP TS 33.303 [6]; and
  - 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 PC5_DISCOVERY message that contained the ProSe Response Code for which there was a match event encoded as specified in subclause 12.2.2.18, and set the UTC-based counter in the MATCH_REPORT message to that counter;
- optionally, the Message Type set to the value of Message Type field of the 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;
- optionally, the MIC to the MIC of the 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
- 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 ProSe Function.

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 6.2.4B.2.1 illustrates the interaction between the UE and the ProSe Function in the match report procedure.

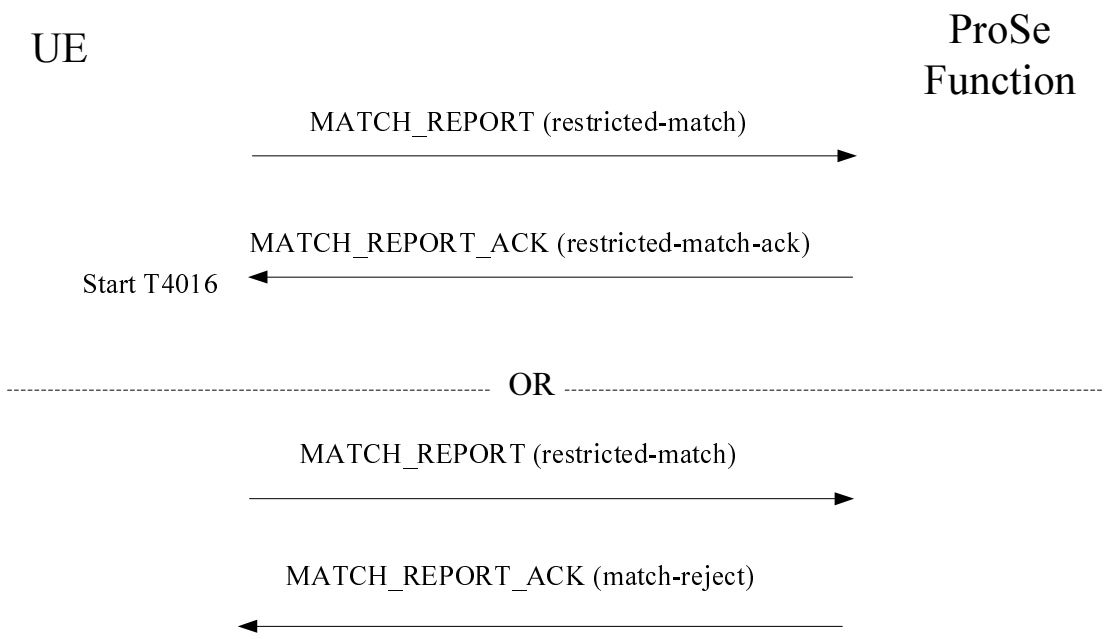

Figure 6.2.4A.2.1: Match report procedure for restricted discovery model B

6.2.4B.3 Match report procedure accepted by the ProSe Function

Upon receiving a MATCH_REPORT message, the ProSe Function shall check whether there is an existing discoverer UE context for the UE identified by its IMSI.

The ProSe Function shall analyse 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 ProSe Function shall check whether the MIC value and the UTC-based counter are valid and within the acceptable range respectively, as defined in 3GPP TS 33.303 [6]. The ProSe Function 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 ProSe Function may further invoke the procedure defined in 3GPP TS 29.343 [31] 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 ProSe Function does not have the latest metadata.

If the outcome of the above processing is successful, the ProSe Function shall send a MATCH_REPORT_ACK message containing a <restricted-match-ack> element with the transaction ID set to the value of the transaction ID received in the MATCH_REPORT message from the UE, the RPAUID set to the target RPAUID retrieved from the UE context at the ProSe Function which corresponds to the ProSe Response Code contained in the MATCH_REPORT message, the Validity Timer T4016 set to indicate for how long this ProSe Response Code is valid. The ProSe Function shall set the Match Report Refresh Timer T4017 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. If there exists metadata information associated with this target RPAUID, the ProSe Function shall set the Metadata to the associated metadata information.

If the corresponding PDUID of the target RPAUID does not belong to the HPLMN of the requesting UE, the ProSe Function may optionally invoke the procedure defined in 3GPP TS 29.345 [5] to inform the ProSe Function of the discoveree UE about the match event.

6.2.4B.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 T4016 and T4017, 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 PC3 Control Protocol cause value is #5 "Invalid MIC", as specified in subclause 6.2.4A.5, the UE shall stop timer T4016 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 T4016 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 T4016 of the corresponding ProSe Response Code is stopped upon receiving MATCH_REPORT_ACK message with a <match-reject> element with PC3 Control Protocol cause value #5 "Invalid MIC".

6.2.4B.5 Match report procedure not accepted by the ProSe Function

If the MATCH_REPORT message is not accepted by the ProSe Function, the ProSe Function sends a MATCH_REPORT_ACK message with a <match-reject> element to the UE including an appropriate PC3 Control Protocol cause value.

If there is no associated UE context for the IMSI contained in the MATCH_REPORT, the ProSe Function shall send the MATCH_REPORT_ACK message with a <match-reject> element with PC3 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 ProSe Function shall send the MATCH_REPORT_ACK message with a <match-reject> element with PC3 Control Protocol cause value #16 "Invalid Match Event".

If the check of the MIC contained in the MATCH_REPORT message fails, the ProSe Function shall send the MATCH_REPORT_ACK message with a <match-reject> element with PC3 Control Protocol cause value #5 "Invalid MIC".

If the check of the UTC-based counter contained in the MATCH_REPORT message fails, the ProSe Function shall send the MATCH_REPORT_ACK message with a <match-reject> element with PC3 Control Protocol cause value #6 " Invalid UTC-based counter".

If the UE is not authorised for restricted ProSe direct discovery model B discoverer operation, the ProSe Function shall send the MATCH_REPORT_ACK message with a <match-reject> element with PC3 Control Protocol cause value #3 "UE authorisation failure".

6.2.4B.6 Abnormal cases

6.2.4B.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 ProSe Function, establish a new secure connection and then restart the match report procedure.

b) No response from the ProSe Function 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 T4013 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.

6.2.5 Direct discovery time synchronisation by the Prose Function

To ensure time synchronisation as specified in 3GPP TS 33.303 [6], the ProSe Function shall include timing-related information in parameters Current Time and Max Offset as defined in subclause 12.2.2.23 and subclause 12.2.2.24 in the DISCOVERY_RESPONSE message. It shall also include Current Time in MATCH_REPORT_ACK message.

After receiving the Current Time parameter in a DISCOVERY_RESPONSE or MATCH_REPORT_ACK message, the UE shall set the clock used for ProSe to the value of Current Time. After receiving the Max Offset parameter in a DISCOVERY_RESPONSE message, the UE shall store the Max Offset parameter and overwrite any previous value.

6.2.6 Discovery Update

6.2.6.1 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 23.303 [2].

6.2.6.2 Revocation of Restricted Discovery Filters

6.2.6.2.1 Restricted Discovery filters revocation procedure initiation

The ProSe Function in the HPLMN initiates the restricted discovery filters revocation procedure by sending the DISCOVERY_UPDATE_REQUEST to the UE with:

- a new ProSe Function transaction ID not used in any other direct discovery procedures in PC3 interface;
- the UE identity set to the UE's IMSI;
- 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
- Optionally Update Info containing the restricted discovery filters that replace the existing ones, if the ProSe Function decides to remove only certain filter(s) and not others.

NOTE: The ProSe Function 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 6.2.6.2.1.1 illustrates the interaction of the UE and the ProSe Function in the restricted discovery filters revocation procedure.

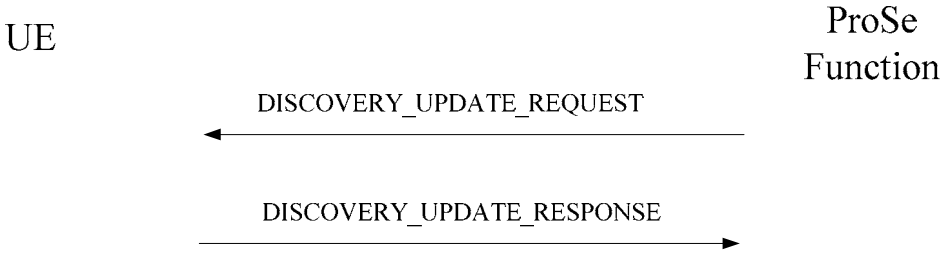

Figure 6.2.6.2.1.1: Restricted Discovery filters revocation procedure

6.2.6.2.2 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 IMSI of the UE. If the UE identity is the IMSI 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 ProSe Function with:

- the ProSe Function transaction ID set to the value of the ProSe Function transaction ID received in the DISCOVERY_UPDATE_REQUEST message; and
- Discovery Entry ID set to the value of the Discovery Entry ID received in the DISCOVERY_UPDATE_REQUEST message.

6.2.6.2.3 Restricted Discovery filters revocation procedure completion by the ProSe Function

Upon receipt of the DISCOVERY_UPDATE_ RESPONSE message by the ProSe Function, if the ProSe Function transaction ID contained in the <response-update> element does not match the value sent by the ProSe Function in a DISCOVERY_UPDATE_REQUEST message, the ProSe Function shall discard the DISCOVERY_UPDATE_RESPONSE message. Upon receipt of the DISCOVERY_UPDATE_ RESPONSE message by the ProSe Function, if the ProSe Function transaction ID contained in the <response-update> element matches the value sent by the ProSe Function in a DISCOVERY_UPDATE_REQUEST message, the restricted discovery filters revocation procedure is complete.

6.2.6.2.4 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 ProSe Function including an appropriate PC3 Control Protocol cause value.

If the UE identity contained in the DISCOVERY_UPDATE_REQUEST message is not the IMSI of the UE, the UE shall send a DISCOVERY_UPDATE_RESPONSE message containing a <response-reject> element with PC3 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".

6.2.6.2.5 Abnormal cases

6.2.6.2.5.1 Abnormal cases in the ProSe Function

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 ProSe Function 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 ProSe Function shall retransmit the DISCOVERY_UPDATE_REQUEST message.

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

6.2.6.2.5.2 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.

6.2.6.3 Allocation of new ProSe Restricted Code

6.2.6.3.1 New ProSe Restricted Code allocation procedure initiation

The ProSe Function in the HPLMN initiates the ProSe restricted code allocation procedure by sending the DISCOVERY_UPDATE_REQUEST to the UE with:

- a new ProSe Function transaction ID not used in any other direct discovery procedures in PC3 interface;
- the UE identity set to the UE's IMSI;
- the Discovery Entry ID set to the Discovery Entry ID of the corresponding Discovery Entry that contains the ProSe Restricted Code to be replaced;
- Update Info containing the ProSe Restricted Code set to the ProSe Restricted Code to be replaced and a Validity Timer T4007 set to the T4007 timer value assigned by the ProSe Function to the ProSe Restricted Code.

Figure 6.2.6.3.1.1 illustrates the interaction of the UE and the ProSe Function in the ProSe restricted code allocation procedure.

NOTE: The ProSe function 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.

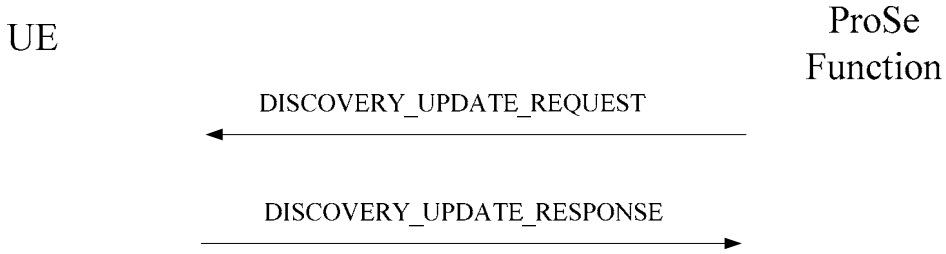

Figure 6.2.6.3.1.1: New ProSe Restricted Code allocation procedure

6.2.6.3.2 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 IMSI of the UE. If the UE identity is the IMSI 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 T4007 if running and start the validity timer T4007 with the received value. Then the UE shall send a DISCOVERY_UPDATE_RESPONSE message to the ProSe Function with:

- the ProSe Function transaction ID set to the value of the ProSe Function transaction ID received in the DISCOVERY_UPDATE_REQUEST message; and
- Discovery Entry ID set to the value of the Discovery Entry ID received in the DISCOVERY_UPDATE_REQUEST message.

6.2.6.3.3 ProSe Restricted Code allocation procedure completion by the ProSe Function

Upon receipt of the DISCOVERY_UPDATE_ RESPONSE message by the ProSe Function, if the ProSe Function transaction ID contained in the <response-update> element does not match the value sent by the ProSe Function in a DISCOVERY_UPDATE_REQUEST message, the ProSe function shall discard the DISCOVERY_UPDATE_RESPONSE message. Upon receipt of the DISCOVERY_UPDATE_ RESPONSE message by the ProSe Function, if the Prose Function transaction ID contained in the <response-update> element matches the value sent by the ProSe Function in a DISCOVERY_UPDATE_REQUEST message, the ProSe Restricted Code allocation procedure is complete.

6.2.6.3.4 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 ProSe Function including an appropriate PC3 Control Protocol cause value.

If the UE identity contained in the DISCOVERY_UPDATE_REQUEST message is not the IMSI of the UE, the UE shall send a DISCOVERY_UPDATE_RESPONSE message containing a <response-reject> element with PC3 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".

6.2.6.3.5 Abnormal cases

6.2.6.3.5.1 Abnormal cases in the ProSe Function

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 ProSe Function 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 ProSe Function shall retransmit the DISCOVERY_UPDATE_REQUEST message.

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

6.2.6.3.5.2 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.

6.2.7 Direct discovery update procedure for open discovery

6.2.7.1 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 23.303 [2].

6.2.7.2 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 ProSe Function in the HPLMN sends a DISCOVERY_UPDATE_REQUEST message to the UE with:

- a new ProSe Function transaction ID not used in any other direct discovery procedures in PC3 interface;
- the UE identity set to the UE's IMSI; and
- 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 ProSe function in the HPLMN shall allocate a new ProSe Application Code for the ProSe Application ID with a new validity timer T4000, associate the discovery entry with the new ProSe Application Code and restart timer T4001.Then the ProSe Function sends a DISCOVERY_UPDATE_REQUEST message to the UE with:

- a new ProSe Function transaction ID not used in any other direct discovery procedures in PC3 interface;
- the UE identity set to the UE's IMSI;
- 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
- the Update Info containing the ProSe Application Code set to the new ProSe Application Code allocated by the ProSe Function and a Validity Timer T4000 set to the T4000 timer value assigned by the ProSe Function to the new ProSe Application Code.

When triggered to update Discovery Filter(s) for a monitoring UE, the ProSe Function in the HPLMN updates the content of Discovery Filter(s), associate the discovery entry with the updated Discovery Filter(s) and restart timer T4003 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 ProSe Function sends a DISCOVERY_UPDATE_REQUEST message to the UE with:

- a new ProSe Function transaction ID not used in any other direct discovery procedures in PC3 interface;
- the UE identity set to the UE's IMSI;
- 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
- the Update Info containing the Discovery Filter(s) set to the new Discovery Filter(s) allocated by the ProSe Function.

NOTE 1: The ProSe Function 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 6.2.7.2.1 illustrates the interaction of the UE and the ProSe Function in the direct discovery update procedure.

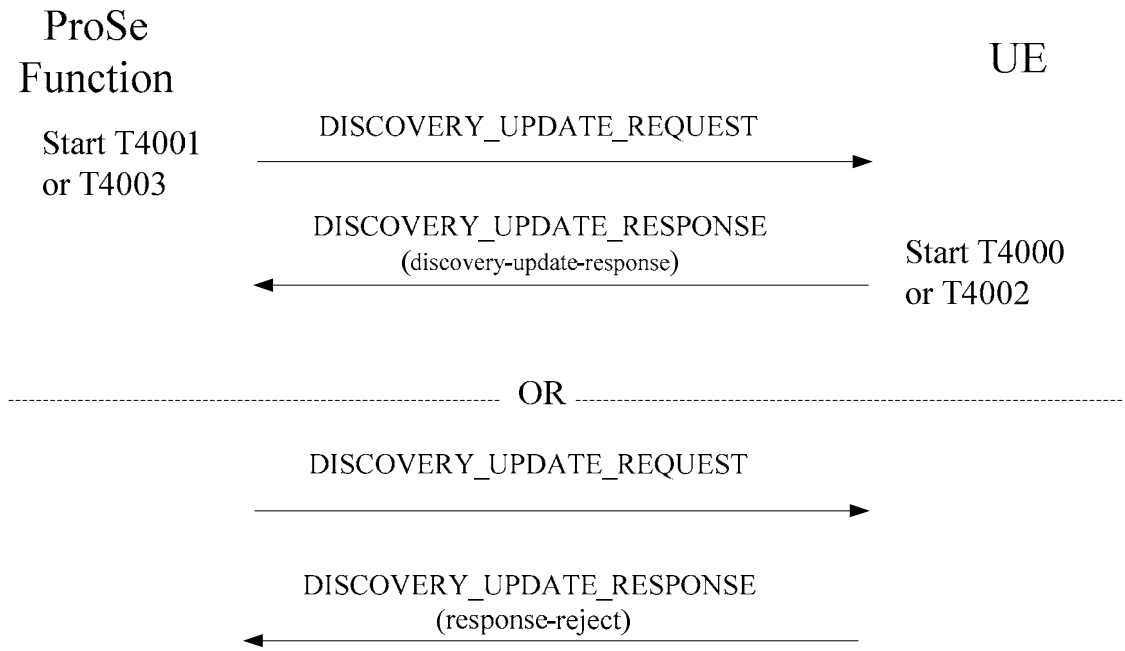

Figure 6.2.7.2.1: Direct discovery update procedure for open discovery

NOTE 2: In the figure 6.2.7.2.1, 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.

6.2.7.3 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 IMSI of the UE. If the UE identity is the IMSI 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 take any appropriate action.

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 T4000 and start the validity timer T4000 with the received value for the new ProSe Application Code. The monitoring UE shall stop TTL timer T4002 and start TTL timer T4002 with the received value for the each new Discovery Filter(s).

Then the UE shall send a DISCOVERY_UPDATE_RESPONSE message containing a <response-update> element with:

- the ProSe Function transaction ID set to the value of the ProSe Function transaction ID received in the DISCOVERY_UPDATE_REQUEST message; and
- the Discovery Entry ID set to the value of the Discovery Entry ID received in the DISCOVERY_UPDATE_REQUEST message.

6.2.7.4 Direct discovery update procedure completed by the ProSe Function

Upon receiving a DISCOVERY_UPDATE_RESPONSE message, if the ProSe Function transaction ID contained in the <response-update> element does not match the value sent by the ProSe Function in a DISCOVERY_UPDATE_REQUEST message, the ProSe Function shall discard the DISCOVERY_UPDATE_RESPONSE message. Otherwise, the ProSe Function 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 ProSe Function shall execute the procedures defined in 3GPP TS 29.345 [5] to inform the ProSe Function 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 ProSe Function belongs, the ProSe Function executes the procedures defined in 3GPP TS 29.345 [5] to inform the ProSe Function 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 ProSe Function shall delete the discovery entry indicated by the Discovery Entry ID from the UE's context and release the associated resources.

6.2.7.5 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 ProSe Function including an appropriate PC3 Control Protocol cause value.

If the UE identity contained in the DISCOVERY_UPDATE_REQUEST message is not the IMSI of the UE, the UE shall send a DISCOVERY_UPDATE_RESPONSE message containing a <response-reject> element with PC3 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 PC3 Control Protocol cause value # 10 "Unknown or Invalid Discovery Entry ID".

6.2.7.6 Abnormal cases

6.2.7.6.1 Abnormal cases in the ProSe Function

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 ProSe Function 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 ProSe Function shall retransmit the DISCOVERY_UPDATE_REQUEST message.

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

6.2.7.6.2 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.

6.2.8 Announcing Alert procedure

6.2.8.1 General

The purpose of the Announcing Alert procedure is for the ProSe Function in HPLMN to send to the announcing UE the ProSe Restricted Code generated in the announce request procedure for restricted ProSe direct discovery model A as specified in clause 6.2.2A.

Before initiating the Announcing Alert procedure, the ProSe Function 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 PC5_DISCOVERY message and passes the 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.

6.2.8.2 Announcing Alert procedure initiation

If the UE has initiated an announce request procedure for restricted ProSe direct discovery model A before as specified in clause 6.2.2A and the On Demand Announcing Enabled Indicator associated with the RPAUID in the announcing UE context is set to 1, the ProSe Function shall initiate an Announcing Alert procedure:

a) when the ProSe Function receives a pair of Target PDUID -Target RPAUID from the ProSe Application Server as described in 3GPP TS 29.343[31], the Target RPAUID is the same as the RPAUID stored in the announcing UE context, and ProSe Function determines the monitoring UE is in the vicinity of the announcing UE; or

b) when the ProSe Function receives a pair of Target PDUID -Target RPAUID from other ProSe Functions as described in 3GPP TS 29.345[5], the Target RPAUID is the same as the RPAUID stored in the announcing UE context and the ProSe Function determines the monitoring UE is in the vicinity of the announcing UE.

NOTE: How the ProSe Function 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 ProSe Function.

The ProSe Function initiates the Announce Alert procedure by sending an ANNOUNCING_ALERT_REQUEST message with:

- a new ProSe Function transaction ID;
- the UE identity set to the UE's IMSI;
- the RPAUID set to the Target RPAUID received from ProSe Application Server as specified in 3GPP TS 29.343[31] or from other ProSe Functions as specified in 3GPP TS 29.345[5];
- 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

- the Discovery Entry ID set to the identifier associated with the corresponding discovery entry in the UE's context.

Figure 6.2.8.2.1 illustrates the interaction of the ProSe Function and the UE in the Announce Alert procedure.

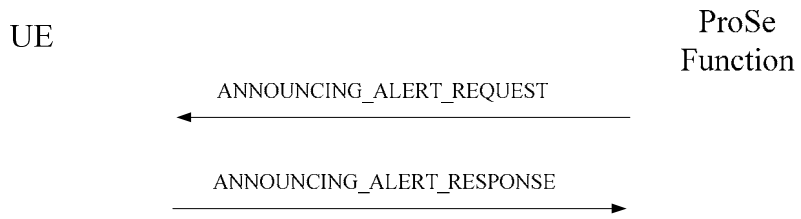

Figure 6.2.8.2.1: Announcing Alert procedure

6.2.8.3 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 IMSI of the UE. If the UE identity is the IMSI 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 ProSe Function with a ProSe Function transaction ID set to the value of the ProSe Function transaction ID received in the ANNOUNCING_ALERT_REQUEST message.

Then, the UE may perform restricted ProSe direct discovery model A announcing as described below.

The UE requests the parameters from the lower layers for restricted Prose direct discovery model A announcing (see 3GPP TS 36.331 [12]). The UE shall perform restricted 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 EMM-IDLE mode has to request resources for ProSe direct discovery announcing as specified in 3GPP TS 36.331 [12], the UE shall perform a service request procedure or tracking area update procedure as specified in 3GPP TS 24.301 [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 subclause 12.2.2.18. 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 to compute the MIC field for the PC5_DISCOVERY message as described in 3GPP TS 33.303 [6].

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 PC5_DISCOVERY message, according to the format defined in subclause 11.2.5.

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 ProSe Function, as long as the validity timer T4007 of the ProSe Restricted Code Prefix has not expired.

The UE then passes the PC5_DISCOVERY message to the lower layers for transmission if:

- the UE is currently authorised to perform restricted ProSe direct discovery model A announcing in the registered PLMN or the local PLMN operating the radio resources that the UE intends to use;

- the validity timer T4007 for the corresponding discovery entry allocated ProSe Restricted Code or ProSe Restricted Code Prefix has not expired; and

- a request from upper layers to announce the RPAUID associated with both the ProSe Restricted Code or ProSe Restricted Code Prefix, and the authorised Application Identity, is still in place.

The UE shall ensure that it keeps on passing PC5_DISCOVERY messages to the lower layers for transmission until the validity timer T4007 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 eNodeB and the UE is in EMM-CONNECTED mode, the UE shall trigger the corresponding procedure in lower layers as specified in 3GPP TS 36.331 [12].

6.2.8.4 Announcing Alert procedure completion by the ProSe Function

Upon receipt of the ANNOUNCE_ALERT_RESPONSE message with a ProSe Function transaction ID set to the value of the ProSe Function Transaction ID included in the ANNOUNCING_ALERT_REQUEST message, the ProSe Function will set the associated On Demand Announcing Enabled Indicator to 0. Then the Announcing Alert procedure is successfully completed.

6.2.8.4A Announcing Alert procedure not accepted by the UE

If the ANNOUNCING_ALERT_REQUEST message cannot be accepted by the UE, the UE sends a ANNOUNCING_ALERT_RESPONSE message containing a <response-reject> element to the ProSe Function including an appropriate PC3 Control Protocol cause value.

If the UE identity contained in the ANNOUNCING_ALERT_REQUEST message is not the IMSI of the UE, the UE shall send a ANNOUNCING_ALERT_RESPONSE message containing a <response-reject> element with PC3 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 PC3 Control Protocol cause value #10"Unknown or Invalid Discovery Entry ID".

6.2.8.5 Abnormal cases

6.2.8.5.1 Abnormal cases in the ProSe Function

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 ProSe Function 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 ProSe Function shall retransmit the ANNOUNCING_ALERT_REQUEST message.

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

6.2.8.5.2 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.

7 EPC-level ProSe discovery

7.1 Overview

This clause describes the PC3 Control Protocol procedures between the UE and the ProSe Function for EPC-level ProSe discovery.

7.1.1 Transport protocol for PC3 Control Protocol messages for EPC-level ProSe discovery

The UE and the ProSe Function shall use HTTP 1.1 as specified in IETF RFC 7230 [18] and IETF RFC 7231 [19] as the transport protocol for EPC-level ProSe discovery messages over the PC3 interface. The ProSe messages described here shall be included in the body of either an HTTP request message or an HTTP response message.

7.1.2 Handling of UE-initiated procedures

The following rules apply for UE-initiated procedures:

- The UE initiates ProSe transactions with an HTTP request message containing the PC3 request(s); and
- The ProSe Function responds to the requests with an HTTP response message containing the PC3 response(s) for the PC3 request(s).

Optionally, the operator can configure the UE with configuration parameters for establishment of the PDN connection for reaching the HPLMN ProSe Function. If the UE is configured with the configuration parameter for establishment of the PDN connection for reaching the HPLMN ProSe Function (see 3GPP TS 24.333 [9]):

a) if a PDN connection for reaching the HPLMN ProSe Function is not established yet, the UE shall establish the PDN connection for reaching the HPLMN ProSe Function according to the UE configuration and shall send the HTTP request message via the PDN connection for reaching the HPLMN ProSe Function; and

b) if a PDN connection for reaching the HPLMN ProSe Function is already established (e.g. either due to other ProSe feature or due to other application), the UE shall send the HTTP request message via the PDN connection for reaching the HPLMN ProSe Function;

7.1.3 Handling of network-initiated procedures

The network-initiated messages for EPC-level ProSe discovery over the PC3 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 ProSe Function shall support OMA Push for network initiated procedures. Optionally the UE and ProSe Function should support long polling as well for network initiated procedures.

During the UE registration procedure, the UE and the ProSe Function decide which method to use. If the UE supports long polling method, the UE indicates that to the ProSe Function in the UE-registration request with a "Method for server-initiated transaction" IE. If the ProSe Function supports long polling method as well and if it prefers to use the long polling method for network initiated procedures, then it checks if UE can also support long polling method via the "Method for server-initiated transaction" IE included in the registration request message and indicates the use of long-polling in the registration response message. If the ProSe Function supports OMA Push only or if it chooses to use OMA Push then it ignores the "Method for server-initiated transaction"IE in UE registration request.

7.1.3.1 HTTP long polling

The HTTP long polling method involves 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 PC3 interface;

b) the ProSe Function defers its response to the UE"s request until;

i) one ore more network-initiated PC3 message(s) for the UE are available. The ProSe Function will enclose the message(s) in an HTTP response message and send it to the UE; or

ii) a particular timeout for HTTP polling has occurred. The ProSe Function then sends an empty HTTP response message as the polling response to the UE.

c) After receiving the response from the ProSe Function, the UE may keep polling after some waiting period if:

i) the UE receives an empty polling response; or

ii) the UE receives network-initiated message(s) from the ProSe Function 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 PC3 message to the ProSe Function while it has a pending HTTP polling request, the UE shall open another HTTP connection to the ProSe Function to send this new request. Alternately the UE may always use a separate dedicated HTTP connection for polling.

7.1.3.2 OMA Push

The OMA Push method involves the following steps:

a) if one or more network-initiated PC3 message(s) for the UE are available, the ProSe Function 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 [22]. The URL is linked to the PC3 message(s) to be sent to the UE. The ProSe Function (performing OMA Push Proxy Gateway functionality) generates a Push Message as specified in OMA-WAP-TS-PushOTA-V2_1-20110405-A [21] with the PDU set according to WAP-168-ServiceLoad-20010731-a [20]. 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 ProSe Function with this URL; and

c) the ProSe Function sends an HTTP response message containing the PC3 message(s) to the UE.

7.2 Procedures

7.2.1 Types of EPC-level ProSe discovery procedures

The following PC3 Control Protocol procedures are defined:

- UE registration;
- application registration;
- proximity request;
- proximity request validation;
- proximity alert;
- UE deregistration; and
- proximity request cancellation.

EPC support for WLAN direct discovery and communication may be requested as part of the EPC-level ProSe discovery procedure.

7.2.2 UE registration procedure

7.2.2.1 General

The purpose of the UE registration procedure is for the UE to register with the ProSe Function to obtain EPC-level ProSe discovery services as defined in 3GPP TS 23.303 [2]. The UE registers with the ProSe Function residing in the HPLMN.

7.2.2.2 UE registration procedure initiation

Based on pre-configuration, if the UE is authorised to perform EPC-level ProSe discovery in the registered PLMN, it shall initiate the UE registration procedure when the UE is triggered by upper layers to obtain EPC-level ProSe discovery services and the UE has no corresponding EPC ProSe User ID.

The UE initiates the UE registration procedure by sending a UE_REGISTRATION_REQUEST message with the UE identity set to the UE's IMSI. If the UE intends to use EPC support for WLAN direct discovery and communication and if the UE uses a permanent WLAN link layer identifier, then the UE also includes the WLAN link layer identifier in the UE_REGISTRATION_REQUEST message. If the UE supports long polling method for network initiated procedures then the UE also includes a "Method for server-initiated transaction" parameter indicating to the ProSe Function that it support long polling method.

Figure 7.2.2.2.1 illustrates the interaction of the UE and the ProSe Function in the UE registration procedure.

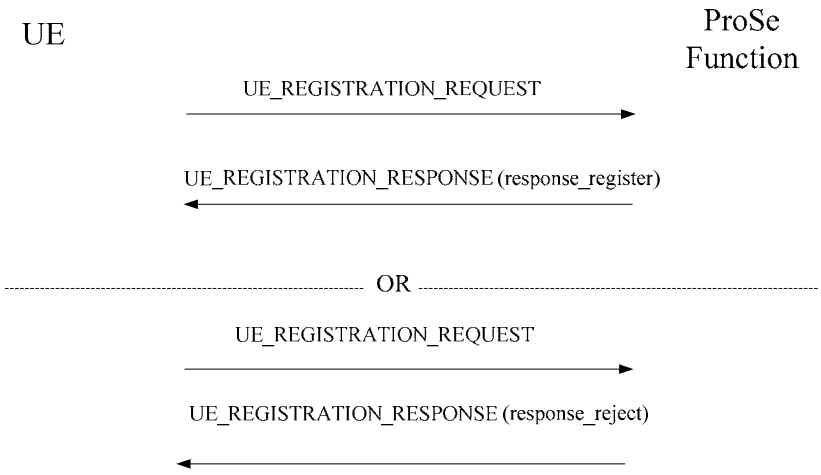

Figure 7.2.2.2.1: UE registration procedure

7.2.2.3 UE registration procedure accepted by the ProSe Function

Upon receiving a UE_REGISTRATION_REQUEST message, the ProSe Function interacts with the HSS as described in 3GPP TS 29.344 [3] in order to authenticate the user and check whether the user is authorised to use EPC-level ProSe discovery services corresponding to the IMSI contained in the UE_REGISTRATION_REQUEST message in the registered PLMN.

If the ProSe Function contains all the settings related to authentication and authorisation for the user corresponding to the IMSI contained in the UE_REGISTRATION_REQUEST message then the ProSe function need not interact with the HSS and the ProSe Function checks locally if the user is authorised to use EPC-level ProSe discovery services.

If the UE is authorised to use EPC-level ProSe discovery services, the ProSe Function generates an EPC ProSe User ID corresponding to the IMSI contained in the UE_REGISTRATION_REQUEST message and shall send a UE_REGISTRATION_RESPONSE message containing a <response-register> element to the UE with the EPC ProSe User ID. The EPC ProSe User ID is a number generated by the ProSe Function that is unique within the ProSe Function on a per UE basis. The <response-register> element shall also contain a server-initiated method configuration parameter indicating to the UE which method to use to handle server-initiated procedures.

7.2.2.4 UE registration procedure completion by the UE

Upon receipt of the UE_REGISTRATION_RESPONSE message containing a <response-register> element the UE stores the EPC ProSe User ID and may start the application registration procedure. The UE shall use the method configured in UE_REGISTRATION_RESPONSE message to handle server-initiated procedures.

7.2.2.5 UE registration procedure not accepted by the ProSe Function

If the UE_REGISTRATION_REQUEST message is not accepted by the ProSe Function, the ProSe Function shall send a UE_REGISTRATION _RESPONSE message containing a <response-reject> element to the UE including an appropriate PC3 EPC Control Protocol cause value.

If the UE is not authorised for EPC-level ProSe discovery, the ProSe Function shall send the UE_REGISTRATION_RESPONSE message containing a <response-reject> element with PC3 EPC Control Protocol cause value #2 "UE authorisation failure".

7.2.3 Application registration procedure

7.2.3.1 General

The purpose of the application registration procedure is for the UE to activate EPC-level Prose discovery for a specific application as defined in 3GPP TS 23.303 [2]. The UE registers the specific application with the ProSe Function residing in the HPLMN.

7.2.3.2 Application registration procedure initiation

When the user uses applications on the UE, an Application ID is used to identify the corresponding application server platform. When the user registers an application with the application server, the user is designated an Application Layer User ID. If the application requires EPC-level ProSe discovery, the UE is configured with the data structure of the Application IDs and the Application Layer User ID. This step is performed using mechanisms outside of the scope of 3GPP. The user may have multiple Application Layer User IDs for an application, but may choose to register only one of these to activate EPC-level ProSe discovery. The UE shall initiate the application registration procedure after successfully completing the UE registration procedure.

If the UE is authorised to perform EPC-level ProSe discovery in the registered PLMN, it shall initiate the application registration procedure when the UE is triggered by upper layers to activate EPC-level Prose discovery for a specific application and the application is not registered.

The UE initiates the application registration procedure by sending an APPLICATION_REGISTRATION_REQUEST message by including a new transaction ID, the UE's EPC ProSe User ID, the Application ID for the application that is to be registered and the user's Application Layer User ID for the application that is to be registered.

NOTE: A UE can include one or multiple transactions in one APPLICATION_REGISTRATION_REQUEST message for different Application IDs, and receive corresponding <response-register> element or <response-reject> element in the APPLICATION_REGISTRATION_RESPONSE message for each respective transaction. In the following description of the application registration procedure, only one transaction is included.

Figure 7.2.3.2.1 illustrates the interaction of the UE and the ProSe Function in the application registration procedure.

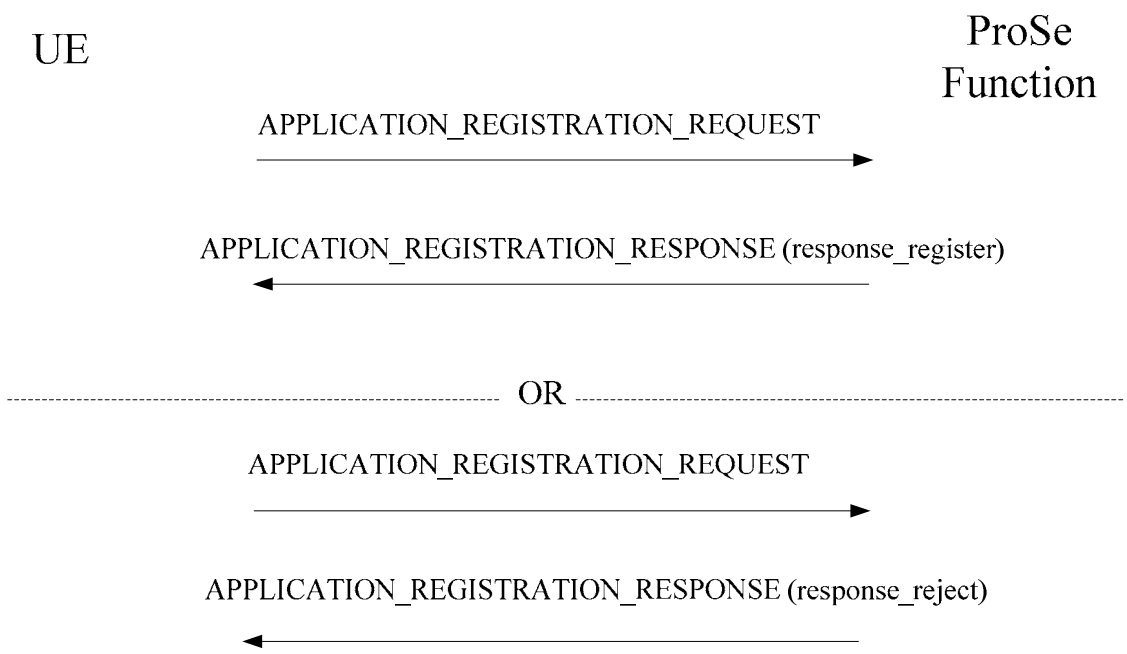

Figure 7.2.3.2.1: Application registration procedure

7.2.3.3 Application registration procedure accepted by the ProSe Function

Upon receiving an APPLICATION_REGISTRATION_REQUEST message, the ProSe Function retrieves the user profile based on the UE's EPC ProSe User ID included in the APPLICATION_REGISTRATION_REQUEST message. The ProSe Function then checks if the list of authorised applications in the user's profile includes the requested application based on the Application ID in the APPLICATION_REGISTRATION_REQUEST message.

If the check is successful then the ProSe Function sends a request to the application server so that the user of this application identified by Application Layer User ID in the APPLICATION_REGISTRATION_REQUEST message can use EPC-level ProSe discovery for that application.

If the user is authorised to use EPC-level ProSe discovery for the specified application, the ProSe Function generates one or more allowed range classes corresponding to the Application ID contained in the APPLICATION_REGISTRATION_REQUEST message. The ProSe Function shall send an APPLICATION_REGISTRATION_RESPONSE message containing a <response-register> element to the UE with transaction ID set to the value of the transaction ID received in the APPLICATION_REGISTRATION_REQUEST message from the UE and the set of allowed range classes. The set of allowed range classes for each Application ID is stored in the ProSe Function.

7.2.3.4 Application registration procedure completion by the UE

Upon receipt of the UE_REGISTRATION_RESPONSE message, if the transaction ID contained in the <response-register> element matches the value sent by the UE in an APPLICATION_REGISTRATION_REQUEST message the UE stores the set of allowed range classes for this Application ID and may start the proximity request procedure.

7.2.3.5 Application registration procedure not accepted by the ProSe Function

If the APPLICATION_REGISTRATION_REQUEST message is not accepted by the ProSe Function, the ProSe Function shall send an APPLICATION_REGISTRATION_RESPONSE message containing a <response-reject> element to the UE including an appropriate PC3 EPC Control Protocol cause value.

If the application corresponding to the Application ID contained in the APPLICATION_REGISTRATION_REQUEST message is not authorised for EPC-level ProSe Discovery in the registered PLMN, the ProSe Function shall send the APPLICATION_REGISTRATION_RESPONSE message containing a <response-reject> element with PC3 EPC Control Protocol cause value #1 "Invalid Application".

If the UE is not authorised for EPC-level ProSe Discovery, the ProSe Function shall send the APPLICATION_REGISTRATION_RESPONSE message containing a <response-reject> element with PC3 EPC Control Protocol cause value #2 "UE authorisation failure".

If the Application Layer User ID contained in the APPLICATION_REGISTRATION_REQUEST message is unknown to the Application Server, the ProSe Function shall send the APPLICATION_REGISTRATION_RESPONSE message containing a <response-reject> element with PC3 EPC Control Protocol cause value #10 "Invalid Application Layer User ID".

7.2.4 Proximity request procedure

7.2.4.1 General

The purpose of the proximity request procedure is to allow a UE (UE A) to request to be alerted when it enters in proximity with a targeted UE (UE B) as defined in 3GPP TS 23.303 [2]. UE A performs the proximity request procedure with the ProSe Function residing in the HPLMN.

7.2.4.2 Proximity request procedure initiation

Before initiating the proximity request procedure, UE A needs to register the user's Application Layer User ID A with ProSe Function A as described in subclause 7.2.3. UE A shall initiate the proximity request procedure when triggered by upper layers to activate EPC-level Prose discovery for a specific application and for a specific targeted user identified via its Application Layer User ID B.

UE A initiates the proximity request procedure by sending a PROXIMITY_REQUEST message to ProSe Function A by including a new transaction ID, UE A's EPC ProSe User ID, the Application ID for the application for which the request is made, UE A's Application Layer User ID (Application Layer User ID A), the Application Layer User ID of UE B (Application Layer User ID B), a requested range class value selected from the set of allowed range classes for this application, UE A's Current Location with the best known accuracy and a Time Window indicating the time interval during which the request is valid.

NOTE: A UE can include one or multiple transactions in one PROXIMITY_REQUEST message for different Application IDs, and receives corresponding <response-accept> element or <response-reject> element in the PROXIMITY_REQUEST_RESPONSE message for each respective transaction. In the following description of the Proximity Request procedure, only one transaction is included.

If UE A, subsequent to successful proximity detection with UE B, wishes to engage in WLAN direct discovery and communication, UE A also includes a WLAN Indication in the PROXIMITY_REQUEST message.

Figure 7.2.4.2.1 illustrates the interaction of the UE and the ProSe Function in the proximity request procedure.

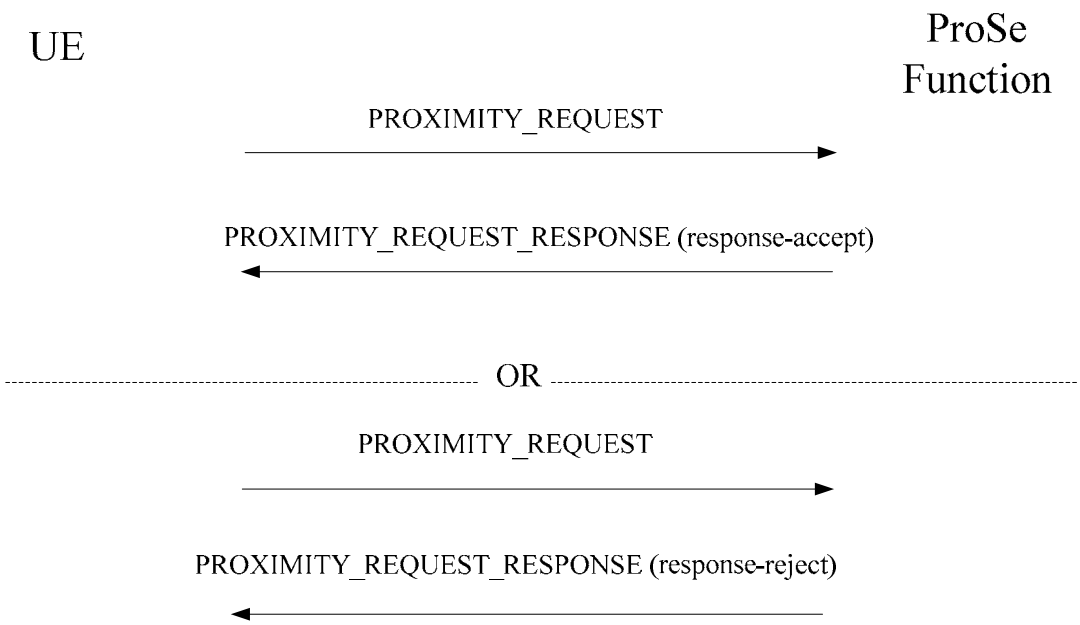

Figure 7.2.4.2.1: Proximity request procedure

7.2.4.3 Proximity request procedure accepted by the ProSe Function

Upon receiving a PROXIMITY_REQUEST message from UE A, ProSe Function A retrieves the user profile based on the UE's EPC ProSe User ID included in the PROXIMITY_REQUEST message. ProSe Function A then checks that UE A has previously registered the application identified with the Application ID in the PROXIMITY_REQUEST message and that the requested range class value belongs to the set of allowed range classes for this application.

If the check is successful then ProSe Function A interacts with the Application Server to obtain the identifier of ProSe Function B that owns the user profile of the targeted user, as well as its EPC ProSe User ID (EPC ProSe User ID B). ProSe Function A then propagates the proximity request to ProSe Function B on the targeted UE side (the B-side). The Current Location of UE A included in the PROXIMITY_REQUEST message may be used by ProSe Function B to determine whether the proximity request is accepted or not.

NOTE: The mechanism used by ProSe Function B to determine acceptance or non-acceptance of PROXIMITY_REQUEST messages is outside the scope of this specification.

If the proximity request is accepted by the B-side, ProSe Function A stores Application Layer User ID A, Application Layer User ID B, EPC ProSe User ID B, requested range class and Time Window in the UE A's context identified with EPC ProSe User ID A. The WLAN Indication is also stored, if it was included in the PROXIMITY_REQUEST message. Then ProSe Function A shall initiate location reporting for UE A and send a PROXIMITY_REQUEST_RESPONSE message containing a <response-accept> element to UE A with transaction ID set to the value of the transaction ID received in the PROXIMITY_REQUEST message from UE A.

7.2.4.4 Proximity request procedure completion by the UE

Upon receipt of the PROXIMITY_REQUEST_RESPONSE message, if the transaction ID contained in the <response-accept> element matches the value sent by the UE in a PROXIMITY_REQUEST message, the proximity request procedure is successfully completed.

7.2.4.5 Proximity request procedure not accepted by the ProSe Function

If the PROXIMITY_REQUEST message is not accepted by the ProSe Function, the ProSe Function shall send a PROXIMITY_REQUEST_RESPONSE message containing a <response-reject> element to the UE including an appropriate PC3 EPC Control Protocol cause value.

If the application corresponding to the Application ID contained in the PROXIMITY_REQUEST message is not authorised for EPC-level ProSe discovery, the ProSe Function shall send the PROXIMITY_REQUEST_RESPONSE message containing a <response-reject> element with PC3 EPC Control Protocol cause value #1 "Invalid Application".

If the application corresponding to the Application ID contained in the PROXIMITY_REQUEST message has not been registered for EPC-level ProSe discovery, the ProSe Function shall send the PROXIMITY_REQUEST_RESPONSE message containing a <response-reject> element with PC3 EPC Control Protocol cause value #4 "Application not registered".

If the requested Range Class value is not allowed for this application, the ProSe Function shall send the PROXIMITY_REQUEST_RESPONSE message containing a <response-reject> element with PC3 EPC Control Protocol cause value #5 "Range Class not allowed for this application".

If based on the Current Location the B-side determines that UE A and targeted UE B are unlikely to enter proximity within the requested Time Window, the ProSe Function shall send the PROXIMITY_REQUEST_RESPONSE message containing a <response-reject> element with PC3 EPC Control Protocol cause value #6 "Proximity detection unlikely within requested time window".

If the ProSe Function determines that the targeted UE has not registered the application identified with Application ID, the ProSe Function shall send the PROXIMITY_REQUEST_RESPONSE message containing a <response-reject> element with PC3 EPC Control Protocol cause value #7 "Targeted user not registered for this application".

If the B-side rejects to validate the proximity request, the ProSe Function shall send the PROXIMITY_REQUEST_RESPONSE message containing a <response-reject> element with PC3 EPC Control Protocol cause value #8 "Proximity validation rejected by B side".

7.2.5 Proximity alert procedure

7.2.5.1 General

The purpose of the proximity alert procedure is to inform the UE (UE A) that it has been determined to be in proximity with the targeted UE (UE B) as defined in 3GPP TS 23.303 [2]. If UE A has indicated in the proximity request procedure that it wishes to engage in WLAN direct discovery and communication with UE B, the proximity alert procedure is also used to provide Assistance Information that expedites the WLAN direct discovery and communication to both UE A and UE B. The proximity alert procedure is initiated by the ProSe Function residing in the HPLMN.

7.2.5.2 Proximity alert procedure initiation by the network

When ProSe Function A on the A-side determines that UE A and UE B are in proximity, it cancels the location reporting for UE A with the SUPL Location Platform and sends a PROXIMITY_ALERT message to UE A including the Application ID, Application Layer User ID A and Application Layer User ID B.

UE A may have registered multiple proximity requests for applications with different Application IDs. In this case the ProSe Function may combine the multiple alerts for each of the different Application IDs and send a combined PROXIMITY_ALERT message to the UE.

If UE A's context contains a WLAN Indication, the ProSe Function generates Assistance Information for WLAN direct discovery and communication according to the underlying WLAN technology, includes the Assistance Information in the PROXIMITY ALERT message and forwards the alert towards the B-side.

If the context of UE A does not contain WLAN Indication then ProSe Function A sends a cancellation request towards ProSe Function B.

After transmitting the PROXIMITY_ALERT message to UE A and alerting (or sending a cancellation request to) the B-side, the ProSe Function deletes the information related to this specific Proximity Request in UE A's context.

NOTE: If UE A has signalled a permanent WLAN Link Layer ID during UE Registration procedure as described in subclause 7.2.2, the WLAN Link Layer ID for UE A is retrieved from UE A's context; otherwise a random WLAN Link Layer ID is generated for UE A by the ProSe Function. Similarly, if during the Proximity Request procedure the ProSe Function has received a permanent WLAN Link Layer ID for UE B, the WLAN Link Layer ID for UE B is retrieved from UE A's context; otherwise a random WLAN Link Layer ID is generated for UE B by the ProSe Function.

When ProSe Function B is alerted that UE A and UE B are in proximity, it cancels the location reporting for UE B and shall send a PROXIMITY_ALERT message to UE B including the Application ID, Application Layer User ID A and Application Layer User ID B.

Figure 7.2.5.2.1 illustrates the interaction of the UE and the ProSe Function in the proximity alert procedure.

Figure 7.2.5.2.1: Proximity alert procedure

7.2.5.3 Proximity alert procedure completion by the UE

Upon receipt of the PROXIMITY_ALERT message the UE shall inform the application identified via the Application ID in the PROXIMITY_ALERT message including Application Layer User ID A and Application Layer User ID B. If the Assistance Information for WLAN direct discovery and communication is included in the PROXIMITY_ALERT message, the UE uses this information to engage in WLAN direct discovery and communication with the peer UE.

7.2.6 UE deregistration procedure

7.2.6.1 General

The UE deregistration procedure is used to deregister the UE for EPC-level ProSe discovery services. It can be initiated at any time by the UE or by the ProSe Function residing in the HPLMN.

7.2.6.2 UE-initiated UE deregistration procedure

7.2.6.2.1 UE-initiated UE deregistration procedure initiation

When the UE decides to deregister for EPC-level ProSe discovery services, it shall send the UE_DEREGISTRATION_REQUEST message to the ProSe Function residing in the HPLMN. The message includes the EPC ProSe User ID.

Figure 7.2.6.2.1.1 illustrates the interaction of the UE and the ProSe Function in the UE-initiated UE deregistration procedure.

Figure 7.2.6.2.1.1: UE-initiated UE deregistration procedure

7.2.6.2.2 UE-initiated UE deregistration procedure accepted by the ProSe Function

Upon receiving the UE_DEREGISTRATION_REQUEST message, the ProSe Function retrieves the user profile based on the UE's EPC ProSe User ID included in the UE_DEREGISTRATION_REQUEST message, cancels any ongoing proximity alert procedures for this UE, clears the UE context and shall send a UE_DEREGISTRATION_RESPONSE message to the UE.

7.2.6.2.3 UE-initiated UE deregistration procedure completion by the UE

Upon receipt of the UE_DEREGISTRATION_RESPONSE message by the UE, the UE deregistration procedure is complete.

7.2.6.3 Network-initiated UE deregistration procedure

7.2.6.3.1 Network-initiated UE deregistration procedure initiation

When the ProSe Function residing in the HPLMN decides to deregister the UE for EPC-level ProSe discovery services, it shall send the UE_DEREGISTRATION_REQUEST to the UE.

Figure 7.2.6.3.1.1 illustrates the interaction of the UE and the ProSe Function in the network-initiated UE deregistration procedure.

Figure 7.2.6.3.1.1: Network-initiated UE deregistration procedure

7.2.6.3.2 Network-initiated UE deregistration procedure in the UE

Upon receiving a UE_DEREGISTRATION_REQUEST message, the UE deletes all context information related to EPC-level ProSe discovery and shall send a UE_DEREGISTRATION_RESPONSE message to the network.

7.2.6.3.3 Network-initiated UE deregistration procedure completion by the network

Upon receipt of the UE_DEREGISTRATION_RESPONSE message by the ProSe Function the UE deregistration procedure is complete.

7.2.7 Proximity request cancellation procedure

7.2.7.1 General

The proximity request cancellation procedure is used by the UE or ProSe Function to cancel an ongoing proximity request that was sent earlier as defined in 3GPP TS 23.303 [2]. The UE initiates the proximity request cancellation procedure due to occurrence of certain event (e.g.termination of the corresponding application). The ProSe Function initiates the proximity request cancellation procedure (e.g. due to excess of time window).

7.2.7.2 UE initiated proximity request cancellation procedure

7.2.7.2.1 Initiation of UE initiated proximity request cancellation procedure

The UE initiates the proximity request cancellation procedure by sending a CANCEL_PROXIMITY_REQUEST message to the ProSe Function including a new transaction ID, the UE's EPC ProSe User ID, the Application ID for the application for which the cancellation is being made and the targeted user's Application Layer User ID B.

NOTE: A UE can include one or multiple transactions in one CANCEL_PROXIMITY_REQUEST message for different Application IDs, and receive corresponding CANCEL_PROXIMITY_RESPONSE message for each respective transaction. In the following description of the proximity request cancellation procedure, only one transaction is included.

Figure 7.2.7.2.1.1 illustrates the interaction of the UE and the ProSe Function in the UE initiated proximity request cancellation procedure.

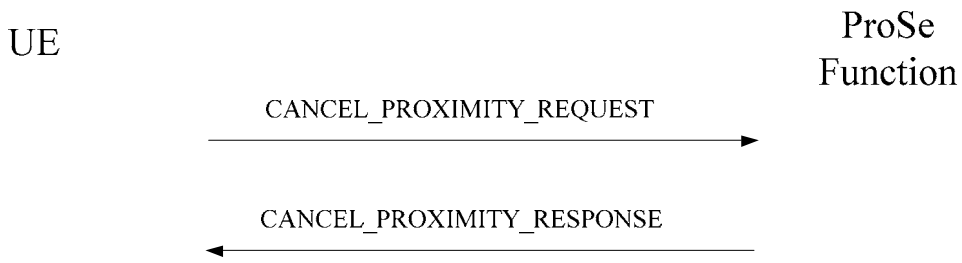

Figure 7.2.7.2.1.1: UE initiated proximity request cancellation procedure

7.2.7.2.2 UE initiated proximity request cancellation procedure handling by the ProSe Function

Upon receiving a CANCEL_PROXIMITY_REQUEST message from UE A, ProSe Function A retrieves the user profile of UE A based on UE A's EPC ProSe User ID included in the CANCEL_PROXIMITY_REQUEST message. ProSe Function A then uses the Application ID and Application Layer User ID B to identify the ProSe Function identifier of ProSe Function B which owns the context of the targeted user and forwards the cancellation request towards ProSe Function B as defined in 3GPP TS 29.345 [5].

The ProSe Function A shall send a CANCEL_PROXIMITY_RESPONSE message to UE A with transaction ID set to the value of the transaction ID received in the CANCEL_PROXIMITY_REQUEST message from UE A. If UE A has no other ongoing proximity requests then ProSe Function A cancels the location reporting for UE A.

7.2.7.2.3 UE initiated proximity request cancellation procedure completion by the UE

Upon receipt of the CANCEL_PROXIMITY_RESPONSE message with transaction ID set to the value of the transaction ID received in the CANCEL_PROXIMITY_REQUEST message, the UE A shall abort the proximity request procedure and the UE initiated proximity request cancellation procedure is complete.

7.2.7.3 ProSe Function initiated proximity request cancellation procedure

7.2.7.3.1 Initiation of ProSe Function initiated proximity request cancellation procedure

The ProSe Function initiates the proximity request cancellation procedure by retrieving the user profile of UE A based on UE A's EPC ProSe User ID included in the PROXIMITY_REQUEST message sent by UE A earlier.

The ProSe Function A shall send a CANCEL_PROXIMITY_REQUEST message to UE A with transaction ID set to the value of the transaction ID received in the PROXIMITY_REQUEST message from UE A, the UE A's EPC ProSe User ID, the Application ID for the application for which the cancellation is being made and the targeted user's

Application Layer User ID B. If UE A has no other ongoing proximity requests then ProSe Function A cancels the location reporting for UE A.

NOTE: A ProSe Function can include one or multiple transactions in one CANCEL_PROXIMITY_REQUEST message for each respective transaction. In the following description of the proximity request cancellation procedure, only one transaction is included.

Figure 7.2.7.3.1.1 illustrates the ProSe Function initiated proximity request cancellation procedure.

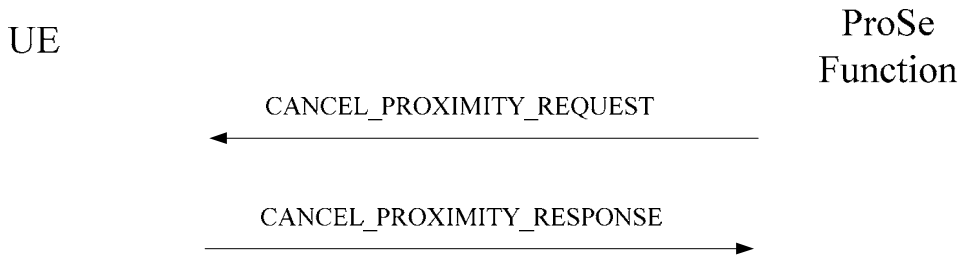

Figure 7.2.7.3.1.1: ProSe Function initiated proximity request cancellation procedure

7.2.7.3.2 ProSe initiated proximity request cancellation procedure handling by the UE

Upon receiving a CANCEL_PROXIMITY_REQUEST message from ProSe Function A, the UE A shall abort the proximity request procedure and send a CANCEL_PROXIMITY_RESPONSE message to ProSe Function A with transaction ID set to the value of the transaction ID received in the CANCEL_PROXIMITY_REQUEST message from ProSe Function A.

7.2.7.3.3 ProSe Function initiated proximity request cancellation procedure completion by the ProSe Function

Upon receipt of the CANCEL_PROXIMITY_RESPONSE message by ProSe Function A, the ProSe Function initiated proximity request cancellation procedure is complete.

7.2.8 Proximity request Validation procedure

7.2.8.1 General

If the targeted UE's profile indicates that the proximity requests for the UE need to be explicitly validated then the network uses the proximity request validation procedure to request the targeted UE (UE B) to confirm permission for the proximity requests (e.g. user B may have temporarily disabled the ProSe functionality on UE B). It is initiated by the ProSe Function residing in the HPLMN as part of the overall proximity request procedure defined in 3GPP TS 23.303 [2].

7.2.8.2 Initiation of the proximity request validation procedure

Upon reception of a proximity request from UE A, the ProSe Function on the targeted UE side (B-side) retrieves the stored profile of UE B. If UE B's profile indicates that the proximity requests for UE B need to be explicitly validated, ProSe Function B shall send the PROXIMITY_REQUEST_VALIDATION message to UE B including the Application ID of the application for which the proximity request is being validated.

Figure 7.2.8.2.1 illustrates the interaction of the targeted UE and the ProSe Function in the proximity request validation procedure.

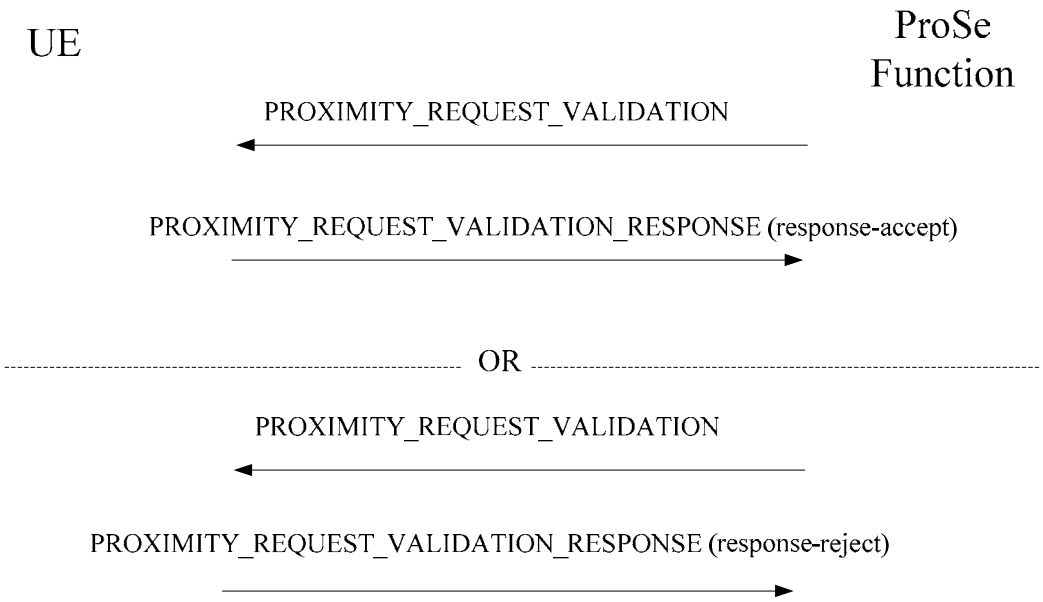

Figure 7.2.8.2.1: Proximity request validation procedure

7.2.8.3 Proximity request validation procedure in the UE

Upon receiving a PROXIMITY_REQUEST_VALIDATION message, UE B checks whether the application corresponding to the Application ID included in the message is ready for accepting a proximity request from other users.

If the application corresponding to the Application ID contained in the PROXIMITY_REQUEST_VALIDATION message is ready for accepting proximity requests from other users, the targeted UE shall send the PROXIMITY_REQUEST_VALIDATION_ACCEPT message to the ProSe Function.

If the application corresponding to the Application ID contained in the PROXIMITY_REQUEST_VALIDATION message is not ready for accepting proximity requests from other users, the targeted UE shall send the PROXIMITY_REQUEST_VALIDATION_RESPONSE message with PC3 EPC Control Protocol cause value #9 "Application disabled temporarily".

7.2.8.4 Proximity request validation procedure completion by the network

Upon receipt of the PROXIMITY_REQUEST_VALIDATION_RESPONSE message containing a <response-accept> element, ProSe Function B initiates location reporting for UE B and acknowledges the proximity request towards ProSe Function A.

Upon receipt of the PROXIMITY_REQUEST_VALIDATION_RESPONSE message containing a <response-reject> element, ProSe Function B forwards an indication towards ProSe Function A that the proximity request is rejected.

7.2.9 Abnormal cases

7.2.9.1 Abnormal cases in the UE

In case of the messages listed below:

- UE_REGISTRATION_REQUEST;
- APPLICATION_REGISTRATION_REQUEST;
- PROXIMITY_REQUEST;

- UE_DEREGISTRATION_REQUEST;
- CANCEL_PROXIMITY_REQUEST; and
- PROXIMITY_REQUEST_VALIDATION.

the following abnormal cases can be identified.

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

The UE shall close the existing connection to the ProSe Function, establish a new connection and then restart the appropriate procedure.

b) No response from the ProSe Function after a message has been successfully delivered (e.g. TCP ACK has not been received)

The UE shall retransmit the message.

7.2.9.2 Abnormal cases in the ProSe Function

In case of the messages listed below:

- UE_REGISTRATION_RESPONSE;
- APPLICATION_REGISTRATION_RESPONSE;
- PROXIMITY_REQUEST_RESPONSE;
- PROXIMITY_ALERT;
- UE_DEREGISTRATION_RESPONSE;
- CANCEL_PROXIMITY_RESPONSE; and
- PROXIMITY_REQUEST_VALIDATION_RESPONSE.

the following abnormal cases can be identified.

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

After receiving an indication from lower layer that a message has not been successfully acknowledged (e.g. TCP ACK is not received), the ProSe Function shall abort the procedure.

8 EPC support for WLAN direct discovery and communication

In this release of the document, the stand-alone procedure for EPC support for WLAN direct discovery and communication is not supported.

9 Handling of unknown, unforeseen, and erroneous protocol data

9.1 General

The procedures specified in the present document apply to those PC3 or PC5 messages which pass the checks described in this subclause.

This subclause 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 subclause 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 PC5 interface

9.2.1 Message too short

When a message is received that is too short to contain a complete message type parameter, that message shall be ignored.

9.2.2 Unknown or unforeseen message type

If the UE receives a PC5_DISCOVERY message with Message Type not defined as in subclause 12.2.2.10, it shall discard the whole PC5_DISCOVERY message.

If the UE receives a PC5_DISCOVERY message with Message Type indicating a discovery model or discovery type that is not supported by the UE, it shall discard the whole PC5_DISCOVERY message.

9.3 Handling of unknown, unforeseen, and erroneous protocol data in messages sent over the PC3 interface

9.3.1 Invalid XML

The protocol data over PC3 interface are encapsulated as XML contents, which may contain one or more PC3 messages. The XML content shall be validated with the XML schema defined in subclause 11.2.3.

When the UE receives an invalid XML content, it shall discard the whole XML content. When the ProSe Function receives an invalid XML content, it shall discard the whole XML document and send an HTTP response message containing a "400 Bad Request" error code to the UE.

9.3.2 Unforeseen message type

If the UE receives a PC3 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. For example, if a UE not authorised for EPC-level ProSe discovery receives messages specified for EPC-level ProSe discovery procedures in subclause 7, the UE shall discard the message.

If the ProSe Function receives a PC3 message whose message type indicates that this is a ProSe discovery mechanism the sending UE is not authorised to support, the ProSe Function shall discard the message.

10 ProSe direct communication

10.1 General

This clause describes the procedures at the UE, and between UEs, for ProSe direct communication over the PC5 interface.

When served by E-UTRAN, the UE shall be authorised for ProSe direct communication in the registered PLMN based on the service authorisation procedure as specified in clause 5, before initiating ProSe direct communication.

When not served by E-UTRAN, the UE shall be authorised for ProSe direct communication for "not served by E-UTRAN" based on the service authorisation procedure as specified in subclause 5, before initiating ProSe direct communication.

10.2 One-to-many ProSe direct communication

10.2.1 General

One-to-many ProSe direct communication is applicable only to ProSe-enabled Public Safety UEs. One-to-many ProSe direct communication can only apply when the UE is:

a) served by E-UTRAN and authorised for ProSe direct communication in the registered PLMN;

b) not served by E-UTRAN, and authorised for ProSe direct communication for "not served by E-UTRAN"; or

c) in EMM-IDLE mode and in limited service state as specified in 3GPP TS 23.122 [24] and authorised for ProSe direct communication when "not served by E-UTRAN", 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 36.304 [23];

   ii) the UE received an ATTACH REJECT message or a TRACKING AREA UPDATE REJECT message or a SERVICE REJECT message with the EMM cause #11 "PLMN not allowed" as specified in 3GPP TS 24.301 [11] or a LOCATION UPDATING REJECT message or a GPRS ATTACH REJECT message or ROUTING AREA UPDATE REJECT message or SERVICE REJECT message with cause #11 "PLMN not allowed" as specified in 3GPP TS 24.008 [30]; or

   iii) the UE received an ATTACH REJECT message or a TRACKING AREA UPDATE REJECT message or a SERVICE REJECT message with the EMM cause #7 "EPS services not allowed" as specified in 3GPP TS 24.301 [11] or a LOCATION UPDATING REJECT message or a GPRS ATTACH REJECT message or ROUTING AREA UPDATE REJECT message or SERVICE REJECT message with cause #7 "GPRS services not allowed" as specified in 3GPP TS 24.008 [30].

Upon receiving a request from upper layers to send or receive data for ProSe direct communication in a given group, the UE shall initiate the procedure for ProSe direct communication. For case a, the UE shall perform ProSe direct communication procedures specified in subclause 10.2.2. For case b and c, the UE shall perform ProSe direct communication procedures specified in subclause 10.2.3.

If the UE is camped on an E-UTRAN cell not operating on the carrier frequency provisioned for ProSe direct communication which indicates that ProSe direct communication is supported by the network, the UE can perform either ProSe direct communication procedures specified in subclause 10.2.2 or ProSe direct communication procedures specified in subclause 10.2.3.

The UE shall obtain the ProSe direct communication policy parameters for that group as specified in subclause 5, except for the eMBMS content to be relayed by one-to-many ProSe direct communication as specified in subclause 10.2.4.2.

If the ProSe direct communication policy parameters indicate that the UE is configured to use IPv6 for that group, the UE shall auto-configures a link local IPv6 Address following procedures defined in RFC 4862 [15]. This address can only be used as the source IP address for one-to-many ProSe direct communication.

If the ProSe Direct communication policy parameters group indicate that the UE is configured to use IPv4 for that group, then the UE shall:

- use the configured IPv4 address for that group as source address; or
- if there is no configured IPv4 address for that group, use Dynamic Configuration of IPv4 Link-Local Addresses as specified in IETF RFC 3927 [16].

10.2.2 ProSe direct communication facilitated by serving E-UTRAN

When the UE is served by E-UTRAN and intends to use the ProSe radio resources (i.e. carrier frequency) provided by an E-UTRAN cell, the UE requests the parameters from the lower layers for transmitting or receiving ProSe direct communication (see 3GPP TS 36.331 [12]). The UE shall perform direct communication only if the lower layers indicate that ProSe direct communication is supported by the network. If the UE in EMM-IDLE mode has to request resources for ProSe direct communication as specified in 3GPP TS 36.331 [12], the UE shall perform a service request procedure or tracking area update procedure as specified in 3GPP TS 24.301 [11]. Once the radio resources for transmitting or receiving ProSe direct communication are provided by eNodeB as specified in 3GPP TS 36.331 [12], the UE shall start ProSe direct communication.

10.2.3 Procedure for UE to use provisioned radio resources

When the UE is not served by E-UTRAN, the UE shall select the radio parameters to be used for ProSe direct communication as follows:

- 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
- in all other cases, the UE shall not initiate ProSe direct communication.

NOTE 1: It is out of scope of the present specification to define how the UE can locate itself in a specific Geographical Area. When the UE is in coverage of a 3GPP RAT it can for example use information derived from the serving PLMN. When the UE is not in coverage of a 3GPP RAT it can use other techniques as determined by local regulations.

Before initiating ProSe direct 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 36.331 [12], and:

- if the lower layers indicate that the usage would not cause any interference, the UE shall initiate ProSe direct communication; or

NOTE 2: 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 ProSe direct communication in this PLMN, the UE can use the radio parameters indicated by the cell as specified in 3GPP TS 36.331 [12].

- else if the lower layers report that one or more PLMNs operate in the provisioned radio resources (i.e. carrier frequency) then:

  a) if the following conditions are met:

     1) none of the PLMNs reported by the lower layers is the registered PLMN or equivalent to the registered PLMN; and

     2) at least one of the PLMNs reported by the lower layers is in the list of authorised PLMNs for ProSe direct communication and provides radio resources for ProSe direct communication as specified in 3GPP TS 36.331 [12];

     then the UE shall:

     1) if in EMM-IDLE mode, perform PLMN selection triggered by ProSe direct communication as specified in 3GPP TS 23.122 [24]; or

     2) else if in EMM-CONNECTED mode, either:

i) perform a detach procedure as specified in 3GPP TS 24.301 [11] and then perform PLMN selection triggered by ProSe direct communication as specified in 3GPP TS 23.122 [24]; or

ii) not initiate ProSe direct communication.

Whether the UE performs i) or ii) above is left up to UE implementation; or

b) else the UE shall not initiate ProSe direct communication.

If the registration to the selected PLMN is successful, the UE shall proceed with the procedure to initiate ProSe direct communication as specified in subclause 10.2.2.

If the UE is performing ProSe direct communication using radio parameters associated with a geographical area and moves out of that geographical area, the UE shall stop performing ProSe direct communication and then:

- if the UE is not served by E-UTRAN or the UE intends to use radio resources for ProSe other than those operated by the serving E-UTRAN cell, the UE shall select appropriate radio parameters for the new geographical area as specified above; or
- if the UE is served by E-UTRAN and intends to use radio resources for ProSe operated by the serving E-UTRAN cell, the UE shall proceed with the procedure to initiate ProSe direct communication when served by E-UTRAN.

10.2.4 One-to-many ProSe direct communication transmission

10.2.4.1 General

When receiving user data from upper layers to be sent to a given group, the transmitting UE shall tag each outgoing protocol data unit with the following information before passing it to the lower layers for transmission:

- a Layer-3 protocol data unit type (see 3GPP TS 36.323 [37]) set to:

  a) IP packet; or

  b) Address Resolution Protocol packet;

- the Source Layer-2 ID set to the ProSe UE ID assigned from the ProSe Key Management Function or self-assigned by the UE;
- the Destination Layer-2 ID set to the ProSe Layer-2 Group ID; and
- the ProSe Per-Packet Priority associated with the protocol data unit.

The UE shall choose from a range of eight possible values to indicate the required ProSe Per-Packet Priority related to the lower layer handling of this packet data unit. The ProSe Per-Packet Priority is selected by the application layer based on criteria that are outside the scope of this specification, and is independent of the ProSe Layer-2 Group ID, which is used as the Layer 2 destination address for this packet data unit.

10.2.4.2 eMBMS traffic relay

A ProSe UE-to-network relay UE acting as an eMBMS traffic relay shall use one-to-many ProSe direct communication to broadcast the eMBMS traffic received from the network only if the following conditions are met:

- the ProSe UE-to-network relay UE has detected the TMGI value which it has been requested to monitor during the TMGI monitoring request procedure as specified in subclause 10.5; and
- the ProSe UE-to-network relay UE has announced the PC5_DISCOVERY message for Relay Discovery Additional Information, which includes the detected TMGI value and the corresponding ProSe Layer 2 Group ID to be used for the one-to-many communication packets carrying the relayed eMBMS traffic associated with this TMGI value.

For eMBMS traffic relayed by the ProSe UE-to-network relay UE, the ProSe UE-to-network relay UE uses the ProSe Per-Packet Priority that is included in TMGI_MONITORING_REQUEST message to determine the ProSe Per-Packet

Priority value to be applied for the one-to-many communication packets corresponding to that TMGI when they are relayed over PC5.

NOTE: It is assumed that the remote UE receives the QCI associated with the TMGI at the application layer along with an associated priority value that the application layer in the remote UE maps into a ProSe Per-Packet Priority.

For eMBMS traffic relayed by the ProSe UE-to-network relay UE, bearer-level security mechanisms specified in 3GPP TS 33.303 [6] shall not be applied.

The ProSe UE-to-network relay UE acting as an eMBMS traffic relay shall stop the one-to-many ProSe direct communication, if any of the following conditions is met:

- the TMGI value corresponding to the relayed eMBMS traffic can no longer be detected by the ProSe UE-to-network relay UE; or
- There is no longer any remote UE requesting to monitor the TMGI value corresponding to the relayed eMBMS traffic, i.e., the T4105 timer for this TMGI (see subclause 10.5) expires.

10.3 PC3ch Control Protocol for ProSe direct communication

10.3.1 Transport protocol for PC3ch Control Protocol for ProSe direct communication

The UE and ProSe Function CTF (ADF) shall use HTTP 1.1 as specified in IETF RFC 7230 [18] and IETF RFC 7231 [19] as the transport protocol for messages transmitted over the PC3ch interface. The ProSe messages described here shall be included in the body of either an HTTP request message or an HTTP response message. The following rules apply:

a) The UE initiates ProSe transactions with an HTTP request message containing the PC3ch request(s).

b) The ProSe Function CTF (ADF) responds to the requests with an HTTP response message containing the PC3ch response(s) for the PC3ch request(s); and

c) HTTP POST methods are used for PC3ch procedures.

Optionally, the operator can configure the UE with configuration parameters for establishment of the PDN connection for reaching the HPLMN ProSe Function. If the UE is configured with the configuration parameter for establishment of the PDN connection for reaching the HPLMN ProSe Function (see 3GPP TS 24.333 [9]):

a) if a PDN connection for reaching the HPLMN ProSe Function is not established yet, the UE shall establish the PDN connection for reaching the HPLMN ProSe Function according to the UE configuration and shall send the HTTP request message via the PDN connection for reaching the HPLMN ProSe Function; and

b) if a PDN connection for reaching the HPLMN ProSe Function is already established (e.g. either due to other ProSe feature or due to other application), the UE shall send the HTTP request message via the PDN connection for reaching the HPLMN ProSe Function;

10.3.2 Procedures for PC3ch Control Protocol for ProSe direct communication

10.3.2.1 Usage information report list sending procedure

10.3.2.1.1 General

The purpose of the usage information report list sending procedure is to enable a ProSe-enabled Public Safety UE to provide information necessary for composing of charging events related to the ProSe direct communication as defined in 3GPP TS 32.277 [27].

The UE shall perform the usage information report list sending procedure with the Accounting Data Forwarding (ADF) function block of the Charging Trigger Function (CTF) in the ProSe Function (ProSe Function CTF (ADF)) residing in the HPLMN.

The UE shall construct the usage information report based on the policy described in subclause 5.1.3.

10.3.2.1.2 Usage information report list sending procedure initiation

The UE shall perform the usage information report list sending procedure if the UE is in E-UTRAN coverage and if:

a) the following is true:

   1) if a usage information report list sending procedure was already performed after beginning of ProSe direct communication, the configured collection period has elapsed since the end of the previous usage information report list sending procedure;

   2) if a usage information report list sending procedure was not performed yet after beginning of ProSe direct communication, the configured collection period has elapsed since beginning of ProSe direct communication;

   3) the configured reporting window has not elapsed after the configured collection period elapsed;

   4) the UE is in the RRC CONNECTED mode; and

   5) the UE has usage information for at least one collection period; or

b) the following is true:

   1) if a usage information report list sending procedure was already performed after beginning of ProSe direct communication, the configured collection period has elapsed since the end of the previous usage information report list sending procedure;

   2) if a usage information report list sending procedure was not performed yet after beginning of ProSe direct communication, the configured collection period has elapsed since beginning of ProSe direct communication;

   3) the configured reporting window has elapsed after the configured collection period elapsed; and

   4) the UE has usage information for at least one collection period.

The UE shall initiate the usage information report list sending procedure by sending a USAGE_INFORMATION_REPORT_LIST message to the ProSe Function CTF (ADF).

If the UE is configured with the IP address of the ProSe Function CTF (ADF), the UE shall send the USAGE_INFORMATION_REPORT_LIST message to the configured IP address of the ProSe Function CTF (ADF). If the UE is not configured with the IP address of the ProSe Function CTF (ADF), the UE shall send the USAGE_INFORMATION_REPORT_LIST message to the IP address of the ProSe Function discovered as described in subclause 5.1.2.

In the USAGE_INFORMATION_REPORT_LIST message, the UE:

a) shall include a new transaction ID;

b) shall include the UE identity set to the UE's IMSI;

c) for each collection period:

   1) shall include a sequence number of the usage information report;

   2) if the UE is configured to report the time stamps when it went in and out of E-UTRAN coverage during the collection period in the usage information, for each going in or out of E-UTRAN coverage:

      A) shall include information whether the UE was in or out of E-UTRAN coverage;

      B) shall include the time stamp of the move; and

C) if the UE was in E-UTRAN coverage and the UE is configured to report the list of locations of the UE when in E-UTRAN coverage during the collection period in the usage information, for each camping on a cell or usage of a cell in the EMM-CONNECTED mode:

i) shall include the E-UTRAN cell global identification of the cell; and

ii) shall include the time stamp of beginning of the camping on the cell or of beginning of the usage of the cell in the EMM-CONNECTED mode;

3) if the UE is configured to report the group parameters in the usage information, for each group:

A) shall include the ProSe Layer-2 Group ID;

B) shall include the ProSe Group IP multicast address;

C) if the UE transmitted data during the collection period and the UE is configured to report the time stamps of the first transmission/reception during the collection period in the usage information, shall include the time stamp of the first transmission to the ProSe Group IP multicast address in the collection period;

D) if the UE received data during the collection period and the UE is configured to report the time stamps of the first transmission/reception during the collection period in the usage information, shall include the time stamp of the first reception from the ProSe Group IP multicast address in the collection period;

E) shall include an IP address used by the UE as a source address;

F) shall include the ProSe UE ID;

G) for each transmitter in one-to-many ProSe direct communication, shall include the Source L2 ID and IP address of the transmitter;

H) if the UE is configured to report the amount of data transmitted during the collection period with location information in the usage information, per each in or out of E-UTRAN coverage period and per each E-UTRAN cell used when in E-UTRAN coverage:

i) shall indicate whether the data are sent in or out of E-UTRAN coverage;

ii) if the UE transmitted data in an E-UTRAN cell during an in E-UTRAN coverage period:

- shall include the E-UTRAN cell global identification of the E-UTRAN cell;

- shall include amount of the data transmitted in the E-UTRAN cell;

- if the UE is configured to report the time stamps of the first transmission/reception during the collection period in the usage information, shall include time stamp of the first transmission in the E-UTRAN cell; and

- if the UE is configured to report the radio parameters used for ProSe direct communication (i.e. indicator of which radio resources used and radio frequency used) during the reporting period in the usage information, shall include the indicator of which radio resources were used;

iii) if the UE transmitted data during out of E-UTRAN coverage period:

- shall include amount of the data transmitted during the out of E-UTRAN coverage period; and

- if the UE is configured to report the time stamps of the first transmission/reception during the collection period in the usage information, shall include time stamp of the first transmission during the out of E-UTRAN coverage period; and

iv) if the UE is configured to report the radio parameters used for ProSe direct communication (i.e. indicator of which radio resources used and radio frequency used) during the reporting period in the usage information, shall include the used radio frequency; and

I) if the UE is configured to report the amount of data transmitted during the collection period without location information in the usage information, per each in or out of E-UTRAN coverage period:

i) shall indicate whether the data are sent in or out of E-UTRAN coverage;

ii) if the UE transmitted data during in E-UTRAN coverage period:

- shall include amount of the data transmitted during the in E-UTRAN coverage period;
- if the UE is configured to report the time stamps of the first transmission/reception during the collection period in the usage information, shall include time stamp of the first transmission during the in E-UTRAN coverage period; and
- if the UE is configured to report the radio parameters used for ProSe direct communication (i.e. indicator of which radio resources used and radio frequency used) during the reporting period in the usage information, shall include the indicator of which radio resources were used;

iii) if the UE transmitted data during out of E-UTRAN coverage period:

- shall include amount of the data transmitted during the out of E-UTRAN coverage period; and
- if the UE is configured to report the time stamps of the first transmission/reception during the collection period in the usage information, shall include time stamp of the first transmission during the out of E-UTRAN coverage period; and

iv) if the UE is configured to report the radio parameters used for ProSe direct communication (i.e. indicator of which radio resources used and radio frequency used) during the reporting period in the usage information, shall include the used radio frequency; and

J) if the UE is configured to report the amount of data received during the collection period with location information in the usage information, per each in or out of E-UTRAN coverage period and per each E-UTRAN cell used when in E-UTRAN coverage:

i) shall indicate whether the data are sent in or out of E-UTRAN coverage;

ii) if the UE received data in an E-UTRAN cell during an in E-UTRAN coverage period:

- shall include the E-UTRAN cell global identification of the E-UTRAN cell;
- shall include amount of the data received in the E-UTRAN cell;
- if the UE is configured to report the time stamps of the first transmission/reception during the collection period in the usage information, shall include time stamp of the first reception in the E-UTRAN cell; and
- if the UE is configured to report the radio parameters used for ProSe direct communication (i.e. indicator of which radio resources used and radio frequency used) during the reporting period in the usage information, shall include the indicator of which radio resources were used;

iii) if the UE received data during out of E-UTRAN coverage period:

- shall include amount of the data received during the out of E-UTRAN coverage period; and
- if the UE is configured to report the time stamps of the first transmission/reception during the collection period in the usage information, shall include time stamp of the first reception during the out of E-UTRAN coverage period; and

iv) if the UE is configured to report the radio parameters used for ProSe direct communication (i.e. indicator of which radio resources used and radio frequency used) during the reporting period in the usage information, shall include the used radio frequency; and

K) if the UE is configured to report the amount of data received during the collection period without location information in the usage information, per each in or out of E-UTRAN coverage period:

i) shall indicate whether the data are sent in or out of E-UTRAN coverage;

ii) if the UE received data during in E-UTRAN coverage period:

- shall include amount of the data received during the in E-UTRAN coverage period;

- if the UE is configured to report the time stamps of the first transmission/reception during the collection period in the usage information, shall include time stamp of the first reception during the in E-UTRAN coverage period; and

- if the UE is configured to report the radio parameters used for ProSe direct communication (i.e. indicator of which radio resources used and radio frequency used) during the reporting period in the usage information, shall include the indicator of which radio resources were used;

iii) if the UE received data during out of E-UTRAN coverage period:

- shall include amount of the data received during the out of E-UTRAN coverage period; and

- if the UE is configured to report the time stamps of the first transmission/reception during the collection period in the usage information, shall include time stamp of the first reception during the out of E-UTRAN coverage period; and

iv) if the UE is configured to report the radio parameters used for ProSe direct communication (i.e. indicator of which radio resources used and radio frequency used) during the reporting period in the usage information, shall include the used radio frequency; and

4) if configured radio parameters for the ProSe direct communication applicable in the geographical area of the UE were used during the collection period, shall include the configured radio parameters for the ProSe direct communication applicable in the geographical area of the UE; and

d) for each application specific data received from upper layers during the collection period, shall include the received application specific data.

Figure 10.3.2.1.2.1 illustrates the interaction of the UE and the ProSe Function CTF (ADF) in the usage information report list sending procedure.

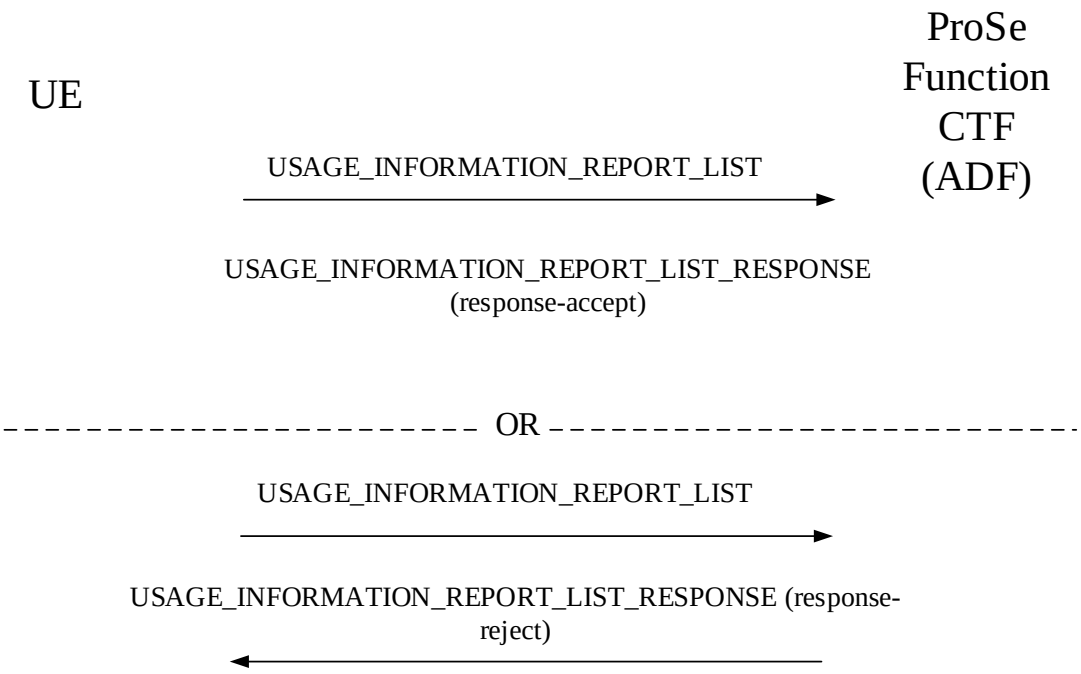

Figure 10.3.2.1.2.1: Usage information report list sending procedure

10.3.2.1.3 Usage information report list sending procedure accepted by the ProSe Function

Upon receiving a USAGE_INFORMATION_REPORT_LIST message from UE, the ProSe Function CTF (ADF) triggers one or more charging data requests according to 3GPP TS 32.277 [27].

If the USAGE_INFORMATION_REPORT_LIST message is accepted by the ProSe Function CTF (ADF), the ProSe Function CTF (ADF) shall send a USAGE_INFORMATION_REPORT_LIST_RESPONSE message to the UE, containing a <response-accept> element with transaction ID set to the value of the transaction ID included in the USAGE_INFORMATION_REPORT_LIST message.

10.3.2.1.4 Usage information report list sending procedure successful completion by the UE

Upon receipt of the USAGE_INFORMATION_REPORT_LIST_RESPONSE message containing a <response-accept> element with transaction ID set to the value of the transaction ID included in the USAGE_INFORMATION_REPORT_LIST message, the usage information report list sending procedure is successfully completed.

10.3.2.1.5 Usage information report list sending procedure not accepted by the ProSe Function

If the USAGE_INFORMATION_REPORT_LIST message is not accepted by the ProSe Function CTF (ADF), the ProSe Function CTF (ADF) shall send a USAGE_INFORMATION_REPORT_LIST_RESPONSE message to the UE. In the USAGE_INFORMATION_REPORT_LIST_RESPONSE message, the ProSe Function CTF (ADF):

1) shall include a <response-reject> element with transaction ID set to the value of the transaction ID included in the USAGE_INFORMATION_REPORT_LIST message; and

2) shall include appropriate cause value.

10.3.2.1.6 Usage information report list sending procedure unsuccessful completion by the UE

Upon receipt of the USAGE_INFORMATION_REPORT_LIST_RESPONSE message containing a <response-reject> element with transaction ID set to the value of the transaction ID included in the USAGE_INFORMATION_REPORT_LIST message, the usage information report list sending procedure is unsuccessfully completed.

If the USAGE_INFORMATION_REPORT_LIST_RESPONSE message contains the cause value set to #3 "Invalid Message Format", the UE shall not perform the usage information report list sending procedure until the UE powers off and powers on again or the USIM is removed.

10.4 One-to-one ProSe direct communication

10.4.1 Overview

This clause describes the PC5 Signalling Protocol procedures between two ProSe-enabled UEs for one-to-one ProSe direct communication.The following PC5 Signalling Protocol procedures are defined:

- direct link setup;
- direct link keepalive;
- direct link release; and
- direct link authentication.

10.4.1A Radio resource selection

The UE shall be authorised for one-to-one ProSe direct communication and obtain the ProSe direct communication policy parameters based on the service authorisation procedure as specified in clause 5 before initiating or participating in any PC5 Signalling Protocol procedures for one-to-one ProSe direct communication.

The UE shall select the radio resources for one-to-one ProSe direct communication as described for one-to-many ProSe direct communication in subclauses 10.2.1, 10.2.2 and 10.2.3.

For one-to-one communication between a remote UE and a ProSe UE-to-network relay UE, if the remote UE receives a lower layers indication that using radio resources for relay communication is not allowed as specified in 3GPP TS 36.331 [12], the remote UE shall abort any ongoing procedures involving a relay (i.e., PC5 signalling Protocol procedures and data transmission/reception) and start an implementation specific timer with value T. While this timer is running, the remote UE shall not initiate any procedures involving a relay. If the remote UE receives lower layers indication that using radio resources for relay communication is allowed as specified in 3GPP TS 36.331 [12], the remote UE shall stop the implementation specific timer and can resume any procedures involving a relay. Otherwise, after the implementation specific timer expires, the remote UE shall release all direct links used for communication with relay(s) locally.

NOTE: The length of T is UE implementation specific.

10.4.2 Direct link setup procedure

10.4.2.1 General

The direct link setup procedure is used to establish a secure direct link between two ProSe-enabled UEs. The UE sending the request message is called the "initiating UE"and the other UE is called the "target UE".

If the direct link setup is for isolated one-to-one ProSe direct communication, i.e. when none of the two UEs is a ProSe UE-to-network relay, both UEs are required to have fetched in advance the public key of the KMS (Key Management Server), and a set of credentials associated with the UE's identity (as defined in IETF RFC 6507 [39] and IETF RFC 6508 [40]), as specified by 3GPP TS 33.303 [6].

10.4.2.2 Direct link setup procedure initiation by initiating UE

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

- a request from upper layers to establish a direct link with the target UE is received and there is no existing link between the initiating UE and that target UE;
- 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);
- the link layer identifier for the target UE (i.e., Layer 2 ID used for unicast communication) is available to the initiating UE (e.g., pre-configured or obtained via ProSe direct discovery); and
- the initiating UE is either authorised for ProSe direct communication in the serving PLMN, or has a valid authorization for ProSe direct communication when not served by E-UTRAN.

The initiating UE initiates the direct link setup procedure by generating a DIRECT_COMMUNICATION_REQUEST message with:

- the User Info set to:
  - the initiating UE"s User Info received from upper layers if the target UE is not a ProSe UE-to-network relay UE;
  - the PRUK ID received from the PKMF if the target UE is a ProSe UE-to-network relay UE, the initiating UE has received a PRUK from the PKMF for this relay, and an attempt to connect to this relay has not been rejected due to the PRUK ID not being recognised;
  - the initiating UE"s IMSI if the target UE is a ProSe UE-to-network relay UE and the initiating UE has not received a PRUK from the PKMF for this relay; or
  - the initiating UE"s IMSI if the target UE is a ProSe UE-to-network relay UE and the initiating UE has received a PRUK from the PKMF for this relay but an attempt to connect to this relay has been rejected due to the PRUK ID not being recognised;
- an IP Address Config IE set to one of the following values:
  - "DHCPv4 Server" if only IPv4 address allocation mechanism is supported by the initiating UE, i.e., acting as a DHCPv4 Server;

- "IPv6 Router" if only IPv6 address allocation mechanism is supported by the initiating UE, i.e., acting as an IPv6 Router;

- "DHCPv4 Server & IPv6 Router" if both IPv4 and IPv6 address allocation mechanisms are supported by the initiating UE; or

- "address allocation not supported" if neither IPv4 nor IPv6 address allocation mechanism is supported by the initiating UE;

- a Link Local IPv6 Address IE formed locally based on IETF RFC 4862 [15] if the IP Address Config IE is set to "address allocation not supported" and the link is setup for isolated one-to-one communication;

NOTE 1: the UE can reuse a Link Local IPv6 IP address for multiple isolated one-to-one communication links.

- a Maximum Inactivity Period IE to indicate the maximum inactivity period of the requesting UE over this direct link;

NOTE 2: The value of Maximum Inactivity Period IE can be calculated based on UE's local settings, such as keepalive timer T4102 (see 10.4.3), retransmission timer T4101 (see 10.4.3), and maximum number of allowed retransmissions for DIRECT_COMMUNICATION_KEEPALIVE message.

- a Nonce_1 IE set to the 128-bit nonce value generated by the initiating UE for the purpose of session key establishment over this direct link;

- a UE Security Capabilities IE set to indicate the list of algorithms that the initiating UE supports for the security establishment of this direct link;

- an MSB of $K_{D\text{-}sess}$ ID IE set to the most significant 8 bits of the $K_{D\text{-}sess}$ ID; and

- Optionally, a K_D ID IE set to the known ID of K_D which was previously established if the initiating UE has an existing K_D with the target UE.

If the direct link setup is for isolated one-to-one ProSe direct communication, the DIRECT_COMMUNICATION_REQUEST message shall also include the following parameters:

- the Signature IE set to the ECCSI signature calculated with the following information elements, as specified in 3GPP TS 33.303 [6]:

  - User Info; and

  - Nonce_1.

Else if the link setup for remote UE to ProSe UE-to-network relay ProSe direct communication, the DIRECT_COMMUNICATION_REQUEST message shall also include the Relay Service Code IE set to the Relay Service Code of the target relay.

After the DIRECT_COMMUNICATION_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 T4100. The UE shall not send a new DIRECT_COMMUNICATION_REQUEST message to the same target UE while timer T4100 is running.

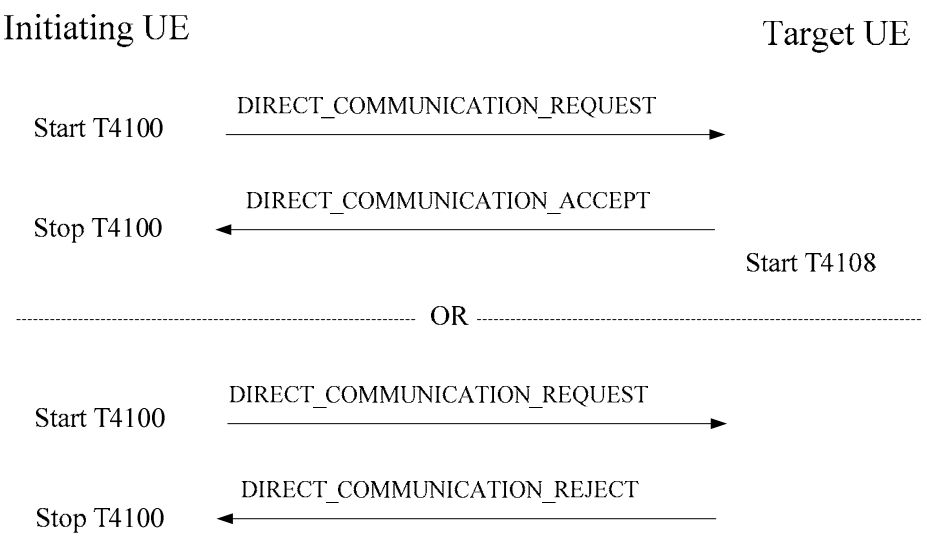

Figure 10.4.2.2.1: Direct link setup procedure

10.4.2.3 Direct link setup procedure accepted by the target UE

Upon receiving a DIRECT_COMMUNICATION_REQUEST message, the target UE shall store the pair of Layer 2 IDs (for unicast communication) used in the transport of this message provided by the lower layers and associate them with a direct link context.

The target UE then checks the User Info IE included in the DIRECT_COMMUNICATION_REQUEST message and determines whether this request can be accepted or not. Then, the target UE examines the IP Address Config IE to see whether there is at least one common IP address configuration option supported by both the initiating UE and the target UE. If the above check is successful, the target UE shall invoke the direct security mode control procedure as specified in subclause 10.4.5 to establish a security association between the target UE and the initiating UE. Only after the completion of link authentication procedure and a successful establishment of the security association, the target UE shall send a DIRECT_COMMUNICATION_ACCEPT message to the initiating UE.

The target UE shall include an IP Address Config IE set to one of the following values:

- "DHCPv4 Server" if only IPv4 address allocation mechanism is supported by the target UE and the target UE is able to act as DHCP server;
- "IPv6 Router" if only IPv6 address allocation mechanism is supported by the target UE and the target UE is able to act as IPv6 Router;
- "DHCPv4 Server & IPv6 Router" if both IPv4 and IPv6 address allocation mechanisms are supported by the target UE; or
- "address allocation not supported" if neither IPv4 nor IPv6 address allocation is supported by the target UE.

If the IP Address Config IE is set to "address allocation not supported" and the received DIRECT_COMMUNICATION_REQUEST message included a Link Local IPv6 Address IE, the target UE shall include a Link Local IPv6 Address IE set to the link-local IPv6 address formed locally.

NOTE: the UE can reuse a Link Local IPv6 IP address for multiple isolated one-to-one communication links.

A ProSe UE-to-network relay UE shall support at least one of the IP address allocation mechanisms.

If the target UE acts as a ProSe UE-to-network relay UE and PDN connection for relaying associated with the ProSe relay UE ID is not established yet or additional PDN connection used for relaying is needed when the ProSe UE-to-network relay UE sends the DIRECT_COMMUNICATION_ACCEPT message to the remote UE, the ProSe UE-to-network relay UE shall initiate the UE requested PDN connectivity procedure by sending the PDN CONNECTIVITY

REQUEST message including the APN which is associated with the ProSe Relay UE ID as specified in 3GPP TS 24.301 [11].

If the target UE is a ProSe-UE-to-network relay UE, the target UE shall create an inactivity timer T4108 with the value provided in the Maximum Inactivity Period IE included in the DIRECT_COMMUNICATION_REQUEST message, and start the timer T4108 when it has no more messages to send over the link to be established. Once the timer T4108 is started, if any communication activity occurs before the timer T4108 expires, the UE shall stop the timer T4108 and reset it with the initial value, unless a new value is provided in a Maximum Inactivity Period IE in a DIRECT_COMMUNICATION_KEEPALIVE message.

If the target UE is a ProSe-UE-to-network relay UE, and it has been configured by the serving PLMN to report the IMEI or IMEISV of the remote UE(s) served by the relay based on the service authorisation procedure as specified in clause 5, the ProSe UE-to-network relay UE shall initiate a remote UE information request procedure (as specified in subclause 10.7.2) to request the IMEI or IMEISV of the remote UE upon successful direct link establishment.

10.4.2.4 Direct link setup procedure completion by the initiating UE

Upon receipt of the DIRECT_COMMUNICATION_ACCEPT message, the initiating UE shall stop timer T4100. From this time onward the initiating UE shall use the established link for all one-to-one communication (including additional PC5 Signalling messages) to the target UE.

10.4.2.5 Direct link setup procedure not accepted by the target UE

If the direct link setup request cannot be accepted, the target UE shall send a DIRECT_COMMUNICATION_REJECT message. The DIRECT_COMMUNICATION_REJECT message contains a PC5 Signalling Protocol cause value set to one of the following cause values:

#1 Direct communication to target UE not allowed;

#2 Authentication failure;

#3 Conflict of Layer 2 ID for unicast communication is detected;

#4 Lack of resources for proposed link;

#5 IP version mismatch; or.

#6 Link setup failure due to other errors.

If the target UE is not allowed to accept this request.e.g. based on operator policy or service authorisation provisioning, the target UE shall send a DIRECT_COMMUNICATION_REJECT message containing PC5 Signalling Protocol cause value #1 "Direct communication to target UE not allowed".

If verification of the signature parameter included in the DIRECT_COMMUNICATION_REQUEST message fails at the target UE (see subclause 10.4.5), the target UE shall send a DIRECT_COMMUNICATION_REJECT message containing PC5 Signalling Protocol cause value #2 "Authentication failure".

If the direct link setup fails due to the problems in direct link authentication procedure (see 10.4.5), the target UE shall send a DIRECT_COMMUNICATION_REJECT message containing PC5 Signalling Protocol cause value #2 "Authentication failure".

For a received DIRECT_COMMUNICATION_REQUEST message from a Layer 2 ID (for unicast communication), if the target UE already has an existing link established to the UE known to use this Layer 2 ID or is currently processing a DIRECT_COMMUNICATION_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 DIRECT_COMMUNICATION_REJECT message containing PC5 Signalling Protocol cause value #3 "Conflict of Layer 2 ID for unicast communication is detected".

If the direct link setup fails due to the congestion problems or other temporary lower layer problems causing resource constraints, the target UE shall send a DIRECT_COMMUNICATION_REJECT message containing PC5 Signalling Protocol cause value #4 "Lack of resources for proposed link".

In case of ProSe UE-to-network relay UE, if the remote UE intends to use the ProSe UE-to-network relay UE for mission critical communication (e.g. MCPTT), but the ProSe UE-to-network relay UE does not support IPv6 address

allocation scheme as a router, the target UE (i.e. ProSe UE-to-network relay UE) shall reject the request with DIRECT_COMMUNICATION_REJECT message containing PC5 Signalling Protocol cause value #5 "IP version mismatch".

NOTE 1: To determine if remote UE intends to use the ProSe UE-to-network relay UE for mission critical communication (e.g. MCPTT), the target UE can examine the Layer 2 destination address of the transport of DIRECT_COMMUNICATION_REQUEST message to check whether it matches the ProSe Relay UE ID which has been associated to mission critical communication (e.g. MCPTT) or examine the User Info included in the DIRECT_COMMUNICATION_REQUEST message.

For other reasons that causing the failure of link establishment, the target UE shall send a DIRECT_COMMUNICATION_REJECT message containing PC5 Signalling Protocol cause value #6 "Link setup failure due to other errors".

Upon receipt of the DIRECT_COMMUNICATION_REJECT message, the initiating UE shall stop timer T4100 and abort the direct link setup procedure. If the cause value in the DIRECT_COMMUNICATION_REJECT message is #1 "Direct communication to target UE not allowed" or #4 "Lack of resources for proposed link", then the UE shall not attempt to start direct link setup with the same target UE at least for a time period T, and if the initiating UE is a remote UE requesting link setup to a ProSe UE-to-network relay UE, it shall initiate the relay reselection procedure as specified in subclause 10A.2.13.

NOTE 2: 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 target UE not allowed" or when the UE receives cause value #4 "Lack of resources for proposed link".

10.4.2.6 Abnormal cases

10.4.2.6.1 Abnormal cases at the initiating UE

If timer T4100 expires, the initiating UE shall retransmit the DIRECT_COMMUNICATION_REQUEST message and restart timer T4100. After reaching the maximum number of allowed retransmissions, the initiating UE shall abort the direct link setup procedure, may notify the upper layer that the target UE is unreachable, and if the initiating UE is a remote UE requesting link setup to a ProSe UE-to-network relay UE, it shall initiate the relay reselection procedure as specified in subclause 10A.2.4.

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.

10.4.2.6.2 Abnormal cases at the target UE

For a received DIRECT_COMMUNICATION_REQUEST message from a Layer 2 ID (for unicast communication), if the target UE already has an existing link established to the UE known to use this Layer 2 ID and the new request contains an identical User Info as the known user, the UE shall process the new request. However, the target UE shall only delete the existing link context after the new link setup procedure succeeds, or the link keepalive procedure as described in subclause 10.4.3 fails.

If the inactivity timer T4108 expires, if the target UE is a ProSe UE-to-network relay UE, it shall initiate the direct link release procedure specified in subclause 10.4.4 with the release reason #3 "Direct connection is not available any more". Otherwise, the target UE may:

A) initiate is own keepalive procedure to check the link; or

B) initiate the direct link release procedure specified in subclause 10.4.4 with the release reason #3 "Direct connection is not available any more".

Whether the UE chooses A or B is left to UE implementation.

10.4.3 Direct link keepalive procedure

10.4.3.1 General

The direct link keepalive procedure is used to maintain the direct link between two ProSe-enabled UEs, i.e., check that the link between the two UEs is still viable. The procedure can be initiated by only one UE or both of the UEs in the established direct link. If the direct link is used for one-to-one communication between a remote UE and a ProSe UE-to-network relay UE, only the remote UE shall initiate the link keepalive procedure.

In this procedure, the UE sending the DIRECT_COMMUNICATION_KEEPALIVE message is called the "requesting UE" and the other UE is called the "peer UE".

10.4.3.2 Direct link keepalive procedure initiation by the requesting UE

The requesting UE manages a keepalive timer T4102 and a keepalive counter for this procedure. The keepalive timer T4102 is used to trigger the periodic initiation of the procedure. It is started or restarted whenever the UE receives a PC5 Signalling message or PC5 user plane data from the peer UE over this link. The keepalive counter is set to an initial value of zero after link establishment.

The requesting UE may initiate the procedure if:

- a request from upper layers to check the viability of the direct link is received; or
- the keepalive timer T4102 for this link expires.

The requesting UE initiates the procedure by stopping timer T4102 if it is still running and generating a DIRECT_COMMUNICATION_KEEPALIVE message with a Keepalive Counter IE that contains the value of the keepalive counter for this link. Optionally, the initiating UE may include a Maximum Inactivity Period IE to indicate the maximum inactivity period of the requesting UE over this direct link. When a remote UE sends DIRECT_COMMUNICATION_KEEPALIVE message to the ProSe UE-to-network relay UE, this IE shall be included.

After the DIRECT_COMMUNICATION_KEEPALIVE message is generated, the requesting UE shall pass this message to the lower layers for transmission along with the requesting UE"s Layer 2 ID (for unicast communication) and the peer UE's Layer 2 ID (for unicast communication), and start retransmission timer T4101.

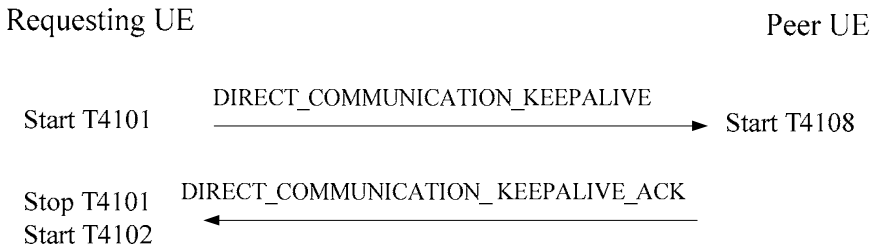

Figure 10.4.3.2.1: Direct link keepalive procedure

10.4.3.3 Direct link keepalive procedure accepted by the peer UE

Upon receiving a DIRECT_COMMUNICATION_KEEPALIVE message, the peer UE shall respond with a DIRECT_COMMUNICATION_KEEPALIVE_ACK message including the Keepalive Counter IE set to the same value as that received in the DIRECT_COMMUNICATION_KEEPALIVE message.

If a Maximum Inactivity Period IE is included in the DIRECT_COMMUNICATION_KEEPALIVE message, the peer UE shall stop the inactivity timer T4108 if it is running, and restart the timer T4108 with the value provided in the IE, If any communication activity occurs in this direct link before the timer T4108 expires, the UE shall stop the timer T4108 and reset it with the initial value.

10.4.3.4 Direct link keepalive procedure completed by the requesting UE

Upon receiving a DIRECT_COMMUNICATION_KEEPALIVE_ACK message, the requesting UE shall stop retransmission timer T4101, start keepalive timer T4102 and increment the keepalive counter for this link.

10.4.3.5 Abnormal cases

10.4.3.5.1 Abnormal cases at the requesting UE

If retransmission timer T4101 expires, the requesting UE shall initiate the transmission of the DIRECT_COMMUNICATION_KEEPALIVE message again with the last used keepalive counter value and restart timer T4101. If no response is received from the peer UE after reaching the maximum number of allowed retransmissions, the requesting UE shall abort the link keepalive procedure and initiate the direct link release procedure (see subclasue 10.4.4) instead, and if the requesting UE is a remote UE, it shall initiate the relay reselection procedure as specified in subclause 10A.2.13.

NOTE: The maximum number of allowed retransmissions is UE implementation specific.

If the need to use this direct link no longer exists before the direct link keepalive procedure is completed, the requesting UE shall abort the procedure and start a direct link release procedure (see subcaluse 10.4.4) instead.

10.4.3.5.2 Abnormal cases at the peer UE

If the inactivity timer T4108 expires, if the peer UE is a ProSe UE-to-network relay UE, it shall initiate the direct link release procedure specified in 10.4.4 with the release reason #3 "Direct connection is not available any more". Otherwise, the peer UE may:

A) initiate is own keepalive procedure to check the link; or

B) initiate the direct link release procedure specified in 10.4.4 with the release reason #3 "Direct connection is not available any more".

Whether the UE chooses A or B is left to UE implementation.

10.4.4 Direct link release procedure

10.4.4.1 General

The Direct link release procedure is used to release a secure direct link between two ProSe-enabled UEs. The link can be released from either end points. The UE sending the DIRECT_COMMUNICATION_RELEASE message is called the "releasing UE"and the other UE is called the "peer UE".

When the direct link between a remote UE and a ProSe UE-to-network relay UE is released, the ProSe-UE-to-network relay UE shall perform the Remote UE report procedure as specified in 3GPP TS 24.301 [11].

10.4.4.2 Direct link release procedure initiation by the releasing UE

The releasing UE shall initiate the procedure if:

- a request from upper layers to release a direct link with the peer UE which uses a known Layer 2 ID (for unicast communication) is received and there is an existing link between those two UEs; or
- the peer UE has been non-responsive, e.g., unable to complete the direct link keepalive procedure.

The releasing UE initiates the direct link release procedure by generating a DIRECT_COMMUNICATION_RELEASE message with a Release Reason IE indicating one of the following cause values:

#1 Direct Communication to peer UE no longer needed;

#2 Direct communication with the peer UE is no longer allowed; or

#3 Direct connection is not available any more.

After the DIRECT_COMMUNICATION_RELEASE message is generated, the releasing UE shall pass this message to the lower layers for transmission along with the releasing UE's Layer 2 ID (for unicast communication) and the peer UE's Layer 2 ID (for unicast communication). The releasing UE shall release the direct link locally if the release reason is #3 "Direct connection is not available any more". Otherwise, the releasing UE shall start timer T4103.

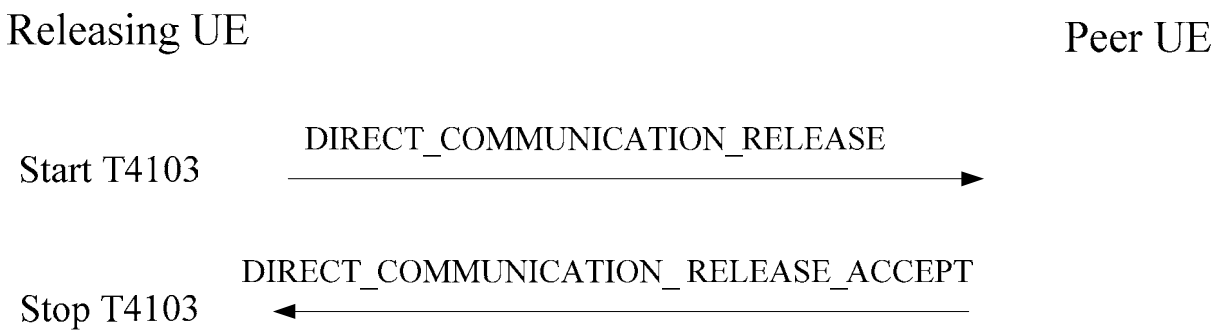

Figure 10.4.4.2.1: Direct link release procedure

10.4.4.3 Direct link release procedure accepted by the peer UE

Upon receiving a DIRECT_COMMUNICATION_RELEASE message, the peer UE shall stop timer T4101, timer T4102 or timer T4103 for this link, if any of those timers is running, and abort any other ongoing PC5 Signalling Protocol procedures on this link. The peer UE shall respond with a DIRECT_COMMUNICATION_RELEASE_ACCEPT message. After the message is sent, the peer UE shall remove the context of this direct link and no longer send or receive any messages via this link.

If the cause value in the DIRECT_COMMUNICATION_RELEASE message is "Direct communication with the peer UE is no longer allowed", then the UE shall not attempt to start direct link setup with the releasing UE at least for the time period T and if the initiating UE is a remote UE requesting link setup to a ProSe UE-to-network relay UE, it shall initiate the relay reselection procedure as specified in subclause 10A.2.13.

NOTE: The length of time period T is UE implementation specific.

10.4.4.4 Direct link release procedure completion by the releasing UE

Upon receipt of the DIRECT_COMMUNICATION_RELEASE_ACCEPT message, the releasing UE shall stop timer T4103. From this time onward the releasing UE shall no longer send or receive any messages via this link.

10.4.4.5 Abnormal cases

10.4.4.5.1 Abnormal cases at the releasing UE

If retransmission timer T4103 expires, the releasing UE shall initiate the transmission of the DIRECT_COMMUNICATION_RELEASE message again and restart timer T4103. If no response is received from the peer UE after reaching the maximum number of allowed retransmissions, the releasing UE shall release the direct link locally. From this time onward the releasing UE shall no longer send or receive any messages via this link.

NOTE: The maximum number of allowed retransmissions is UE implementation specific.

10.4.5 Direct security mode control procedure

10.4.5.1 General

Security association for a direct link between two ProSe-Enabled UEs is established during the direct link setup procedure or direct link rekeying procedure with the exchange of message contents related to direct security mode establishment. After successful completion of the direct security mode control procedure, the selected security

algorithms and keys are used to integrity protect and cipher all PC5 Signalling messages exchanged between the UEs; and are also used to cipher all data plane traffic exchanged between the UEs.

In the rest of this subclause, the UE sending the DIRECT_SECURITY_MODE_COMMAND message is called the "commanding UE"and the other UE is called the "peer UE".

10.4.5.2 Direct security mode control procedure initiation by the commanding UE

A commanding UE may initiate the direct security mode control procedure in response to receiving a DIRECT_COMMUNICATION_REQUEST or a DIRECT_REKEYING_REQUEST message.

If the procedure takes place between a remote UE and a ProSe UE-to-network relay UE and is triggered by a DIRECT_REKEYING_REQUEST to only refresh $K_{D\text{-}sess}$ but not K_D, then either the ProSe UE-to-network relay UE or the remote UE can act as the commanding UE. Otherwise, if both keys are to be refreshed, the ProSe UE-to-network relay UE shall act as the commanding UE.

To initiate this procedure, the commanding UE shall either identify an existing K_D based on the K_D ID included in the DIRECT_COMMUNICATION_REQUEST or DIRECT_REKEYING_REQUEST message, or derive a new K_D if it either does not share a known K_D with the peer UE or wishes to derive a new K_D, as specified in 3GPP TS 33.303 [6]. In the latter case, the commanding UE shall generate the MSB of K_D ID to ensure that the resultant K_D ID will be unique in the commanding UE. Then, it shall generate a LSB of $K_{D\text{-}sess}$ ID such that the $K_{D\text{-}sess}$ ID formed by combining with the MSB of $K_{D\text{-}sess}$ ID (received in the DIRECT_COMMUNICATION_REQUEST or DIRECT_REKEYING_REQUEST that triggered the direct security mode procedure) is unique within the commanding UE.

Following this, the commanding UE shall generate a 128-bit Nonce_2 value. With K_D, Nonce_2 and Nonce_1 received in the DIRECT_COMMUNICATION_REQUEST or DIRECT_REKEYING_REQUEST message, the commanding UE shall derive $K_{D\text{-}sess}$ as specified in 3GPP TS 33.303 [6].

Then, the UE shall construct a DIRECT_SECURITY_MODE_COMMAND message with the following:

- Nonce_2 IE set to Nonce_2;
- the LSB of $K_{D\text{-}sess}$ ID IE set to indicate the least significant 8-bits of $K_{D\text{-}sess}$ ID;
- the UE Security Capabilities IE set to the UE Security Capabilities received in the DIRECT_COMMUNICATION_REQUEST message or DIRECT_REKEYING_REQUEST; and
- the Chosen Algorithms IE set to the algorithms to be used for ciphering and integrity protection.

If the DIRECT_SECURITY_MODE_COMMAND message is used between a remote UE and a ProSe UE-to-network relay UE and the ProSe UE-to-network relay UE received the K_D Freshness parameter from the PKMF, then the ProSe UE-to-network relay UE shall include the following additional parameters in the DIRECT_SECURITY_MODE_COMMAND message to create a new K_D:

- the GPI IE containing the GPI payload if it was received from the ProSe Key Management Function (PKMF);
- the K_D Freshness IE set to the K_D Freshness parameter received from the PKMF; and
- the MSB of K_D ID IE set to the MSB of K_D ID of the new K_D.

If the DIRECT_SECURITY_MODE_COMMAND message is used for isolated one-to-one ProSe direct communication, then the commanding UE shall include the following additional parameters in the DIRECT_SECURITY_MODE_COMMAND message in order to create a new K_D:

- the User Info IE set to the User Info received from upper layers;
- the MSB of K_D ID IE set to the MSB of K_D ID of the new K_D; and
- the Signature IE set to the ECCSI signature value calculated with the following information elements, as specified in 3GPP TS 33.303 [6]:
  - User Info;
  - Nonce_1; and

- the Encrypted Payload IE set to the SAKKE payload generated as specified in 3GPP TS 33.303 [6].

The commanding UE shall select the integrity protection and ciphering algorithms that will be used and include these choices in the Chosen algorithms IE in the DIRECT SECURITY MODE COMMAND message. The UE shall include the received UE security capabilities that was present in the DIRECT_COMMUNICATION_REQUEST or a DIRECT_REKEYING_REQUEST message that triggered the DIRECT SECURITY MODE COMMAND message.

The commanding UE shall send the DIRECT SECURITY MODE COMMAND message unciphered, but shall integrity protect the message with the new security context. After sending the DIRECT_SECURITY_MODE_COMMAND message, the commanding UE shall start timer T4111 (see figure 10.4.5.2.1).

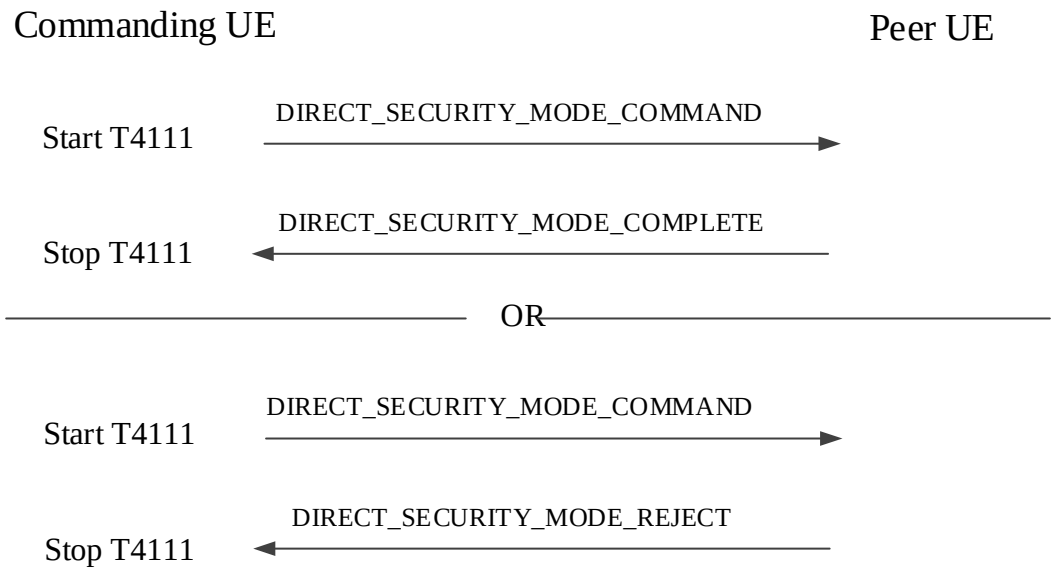

Figure 10.4.5.2.1: Direct Security mode control procedure

10.4.5.3 Direct security mode control procedure accepted by the peer UE

Upon receipt of the DIRECT_SECURITY_MODE_COMMAND message, the peer UE shall check whether the security mode command can be accepted or not. This is done by performing the integrity check of the message and by checking that the received UE security capabilities have not been altered compared to the latest values that the peer UE sent to the commanding UE in the DIRECT_COMMUNICATION_REQUEST or DIRECT_REKEYING_REQUEST message.

In order to check the integrity, the peer UE needs to create the security context as described in 3GPP TS 33.303 [6]. If the MSB of K_D ID were included in the DIRECT_SECURITY_MODE_COMMAND message then the peer UE shall take one of the following two actions:

- If performing isolated one-to-one ProSe direct communication, the peer UE shall first check the signature included in the SIGN IE of the DIRECT SECURITY MODE COMMAND and then obtain the new K_D from the Encrypted Payload IE; or

- If the peer UE is a remote UE that has received the DIRECT_SECURITY_MODE_COMMAND message from a ProSe UE-to-network relay UE, it shall first replace its PRUK ID and PRUK if a GPI IE was included in the DIRECT_SECURITY_MODE_COMMAND. Finally, the UE shall derive a new K_D, as described in 3GPP TS 33.303 [6].

If MSB of K_D ID was not included in the DIRECT_SECURITY_MODE_COMMAND, then the peer UE shall use either the existing K_D indicated by the K_D ID included in the DIRECT_COMMUNICATION_REQUEST or the currently used one.

The peer UE shall then derive the $K_{D\text{-}sess}$ based on the KD-$_{sess}$ ID in the same way as the commanding UE. Finally the peer UE shall use the algorithms indicated in the Chosen Algorithms IE.

If the DIRECT_SECURITY_MODE_COMMAND message can be accepted, the peer UE shall send a DIRECT_SECURITY_MODE_COMPLETE message ciphered and integrity protected with the new security context. The DIRECT_SECURITY_MODE_COMPLETE message shall include the 16 least significant bits of the K_D ID if the initiating UE included the MSB of K_D ID in the DIRECT_SECURITY_MODE_COMMAND message.

From this time onward the peer UE shall protect all signalling messages and user data with the new security context.

10.4.5.4 Direct security mode control procedure completion by the commanding UE

Upon receipt of the DIRECT_SECURITY_MODE_COMPLETE message, the commanding UE shall stop timer T4111. If an LSB of K_D ID IE was included in the message, the commanding UE uses this and the MSB of K_D ID it previously sent to form the K_D ID of the new K_D. From this time onwards the commanding UE shall protect all signalling messages and user data with the new security context.

10.4.5.5 Direct security mode control procedure not accepted by the peer UE

If the DIRECT_SECURITY_MODE_COMMAND message cannot be accepted, the peer UE shall send a DIRECT_SECURITY_MODE_REJECT message. The DIRECT_SECURITY_MODE_REJECT message contains a PC5 Signaling Protocol Cause Value IE indicating one of the following cause values:

#7: UE security capabilities mismatch;

#8: Unspecified error; or

#9: Authentication synchronisation error.

If the DIRECT_SECURITY_MODE_COMMAND message cannot be accepted due to a synchronisation error when processing the authentication vector contained in the GPI payload sent by the ProSe UE-to-network relay UE to the remote UE, then the peer UE shall include the RAND and AUTS parameters in the DIRECT_SECURITY_MODE_ REJECT message.

Upon receipt of the DIRECT_SECURITY_MODE_REJECT message, the commanding UE shall stop timer T4111. If the PC5 Signaling Protocol Cause Value IE indicates a synchronisation error and the message contained a RAND and an AUTS, then a ProSe UE-to-network relay may fetch a fresh K_D from the PKMF by sending a Key Request message including RAND and AUTS as specified in 3GPP TS 33.303 [6]. Otherwise the commanding UE shall abort the ongoing procedure that triggered the initiation of the direct security mode control procedure, as specified in subclauses 10.4.2 or 10.4.8.

10.4.5.6 Abnormal cases

10.4.5.6.1 Abnormal cases at the commanding UE

If timer T4111 expires, then

- if the direct security mode control procedure is triggered by a DIRECT_COMMUNICATION_REQUEST message, the commanding UE shall discard any derived keys with Nonce_1 and initiate the transmission of the DIRECT_COMMUNICATION_REJECT message with the PC5 Signaling Protocol Cause Value IE set to #10 "non-responsive peer during the direct security mode procedure"; or

- if the direct security mode control procedure is triggered by a DIRECT_REKEYING_REQUEST message, the commanding UE shall continue to use old keys until those keys are no longer valid.

10.4.5.6.2 Abnormal cases at the peer UE

If the DIRECT_SECURITY_MODE_COMMAND message is malformed, the peer UE shall discard the message.

10.4.6 IP Address configuration

10.4.6.1 General

The IP address configuration procedure is performed after the establishment of the direct link to enable IP connectivity between the UEs at each end of the direct link.

When the IP address configuration procedure for a remote UE completes, the ProSe UE-to-network relay UE shall perform the Remote UE report procedure as specified in 3GPP TS 24.301 [11].

10.4.6.2 Selection of IP version

When neither of the two UEs on the direct link acts as a ProSe UE-to-network relay, the two UEs shall select the IP version (IPv4 or IPv6) to be used based on the following rules:

- if the target UE in the direct link setup procedure (see subclause 10.4.2) has indicated "DHCPv4 Server" in the IP Address Config IE, then the initiating UE in the direct link setup procedure (see subclause 10.4.2) shall initiate the IPv4 address configuration with DHCPv4 procedure acting as a DHCP client;

- if the target UE in the direct link setup procedure has indicated "IPv6 Router" in the IP Address Config IE , then the initiating UE in the direct link setup procedure shall initiate the IPv6 address configuration with IPv6 stateless address auto-configuration acting as an IPv6 host;

- if the target UE in the direct link setup procedure has indicated "DHCPv4 Server & IPv6 Router" in the IP Address Config IE, then the initiating UE in the direct link setup procedure shall choose either IP version and initiate the address configuration procedure, acting as a client or host;

- if the target UE in the direct link setup procedure has indicated "address allocation not supported" in the IP Address Config IE and the initiating UE has indicated "DHCPv4 Server", "IPv6 Router" or "DHCPv4 Server & IPv6 Router" in the IP Address Config IE, then the target UE shall:

  a) initiate the IPv4 address configuration with DHCPv4 procedure acting as a DHCP client, if the initiating UE has indicated "DHCPv4 Server";

  b) initiate the IPv6 address configuration with IPv6 stateless address auto-configuration acting as an IPv6 host if the initiating UE has indicated "IPv6 Router"; and

  c) choose either IP version and initiate the corresponding IP address configuration procedure as a client or host, if if the other UE has indicated "DHCPv4 Server & IPv6 Router"; and

- if both of the UEs has indicated "address allocation not supported" in the IP Address Config IE, then the UEs shall use IPv6 link-local addresses formed locally as defined in RFC 4862 [15].

When one of the two UEs on the direct link acts as a ProSe UE-to-network relay, the two UEs shall select the IP version (IPv4 or IPv6) to be used based on the following rules

- if the ProSe UE-to-network relay UE has indicated "DHCPv4 Server" in the IP Address Config IE, the remote UE shall initiate the IPv4 address configuration with DHCPv4 procedure acting as a DHCP client;

- if the ProSe UE-to-network relay UE has indicated "IPv6 Router" in the IP Address Config IE, the remote UE shall initiate the IPv6 address configuration with IPv6 stateless address auto-configuration acting as an IPv6 host; and

- if the ProSe UE-to-network relay UE has indicated "DHCPv4 Server & IPv6 Router" in the IP Address Config IE, the remote UE shall choose the IP version and initiate the corresponding IP address configuration procedure as a client or host. Especially, if the remote UE intends to use the ProSe UE-to-network relay UE for mission critical communication (e.g. MCPTT), the remote UE shall initiate the IPv6 stateless address auto-configuration acting as an IPv6 host.

10.4.6.3 IPv4 address configuration with DHCPv4

The IPv4 address configuration with DHCPv4 shall be carried out as follow:

1. The DHCP client sends a DHCPDISCOVER message;
2. The DHCP server sends the DHCPOFFER message with the assigned IPv4 address for the client. The IPv4 address provided shall correspond to a local IPv4 address range configured in the DHCP server;
3. When the DHCP client receives the lease offer, it sends a DHCPREQUEST message containing the received IPv4 address.
4. The DHCP server sends a DHCPACK message to the client UE. This message includes the lease duration and any other configuration information that the client might have requested.
5. On receiving the DHCPACK message, the IPv4 address configuration is completed.

NOTE: The DHCPv4 client may skip the DHCPv4 Discovery phase, and send DHCPv4 Request message in broadcast as the first message in accordance with the DHCPv4 renewal process.

If the direct link is setup for one-to-one communication between a remote UE and a UE-to-network relay UE, after the remote UE releases the IPv4 address using DHCPv4 or the IPv4 address lease time expires, the ProSe UE-to-network relay UE shall wait for a relay implementation specific time before allocating the same IPv4 address to another remote UE.

10.4.6.4 IPv6 address configuration with IPv6 stateless address auto-configuration

The IPv6 stateless address auto-configuration protocol procedure shall be carried out as follow:

1. the UE acting as an IP Host shall send a Router Solicitation message in order to solicit a Router Advertisement message as specified in IETF RFC 4862 [15].
2. Upon receiving the Router Solicitation message, the other UE shall send an IPv6 Router Advertisement message as specified in IETF RFC 4862 [15], acting as an advertising interface as specified in IETF RFC 4861 [33]. The Router Advertisement messages shall contain an IPv6 prefix, which is to be combined with the interface identifier to form the IPv6 address.
3. The UE which receives the Router advertisement message retrieves the router's address from the Source IP address field of the message, and formed its own IP address with the prefix and the interface identifier as specified in IETF RFC 4862 [15].

If the direct link is setup for one-to-one communication between a remote UE and a UE-to-network relay, the UE-to-network relay shall obtain the IPv6 prefix assigned to the remote UE via prefix delegation function from the network as defined in 3GPP TS 23.401 [34] before sending the IPv6 prefix to the remote UE. After the remote UE receives the Router Advertisement message, it constructs a full IPv6 address via IPv6 Stateless Address auto-configuration in accordance with IETF RFC 4862 [15]. However, the remote UE shall not use any identifiers defined in TS 23.003 [4] as the basis for generating the interface identifier. For privacy, the remote UE may change the interface identifier used to generate the full IPv6 address, as defined in 3GPP TS 23.221 [35] without involving the network. The remote UE shall use the auto-configured IPv6 address while sending packets in this implicitly created PDN connection.

If the direct link is setup for one-to-one communication between a remote UE and a UE-to-network relay and support for mission critical applications and policy control for remote UEs is required, the remote UE shall be assigned a /64 IPv6 Prefix from a shorter IPv6 prefix by the UE-to-network relay.

NOTE: In order to support policy control per remote UE, the assignment of a /64 IPv6 Prefix from a shorter IPv6 prefix by the UE-to-network relay is used. The support of the extended TFT filter format including the TFT packet filter attribute Local Address and Mask, as defined in 3GPP TS 24.008 [30], is needed in the UE-to-network relay and the network.

10.4.7 ProSe Per-Packet Priority for one-to-one ProSe direct communication

10.4.7.1 General

When receiving the user data from upper layers to be sent over a direct link, the transmitting UE shall associate each outgoing protocol data unit with one of eight possible values to indicate the required ProSe Per-Packet Priority related to the lower layer handling of this packet data unit. The ProSe Per-Packet Priority is selected by the application layer

based on criteria that are outside the scope of this specification, and is independent of the Layer 2 destination address used for this packet data unit.

The UE shall associate any outgoing PC5 signalling message with the single ProSe Per-Packet Priority value provisioned for PC5signall ing messages.

10.4.7.2 ProSe Per-Packet Priority for ProSe UE-to-network relay

For unicast uplink traffic, the ProSe UE-to-network relay uses the uplink TFTs to select the uplink EPS bearers for relayed uplink packets independently from the ProSe Per-Packet Priority applied over PC5 by remote UEs.

For unicast downlink traffic the ProSe UE-to-network relay maps the QCI of the EPS bearer into a ProSe Per-Packet Priority value to be applied for the downlink relayed unicast packets over PC5. The mapping rules are provisioned in the ProSe UE-to-network relay.

NOTE: downlink traffic on EPS bearers associated with the same QCI, but different ARP values, is assigned the same ProSe Per-Packet Priority over PC5.

10.4.8 Direct link rekeying procedure

10.4.8.1 General

This procedure is used to refresh the security context used between two UEs on an established direct link.

The UE sending the DIRECT_REKEYING_REQUEST message is called the "initiating UE"and the other UE is called the "target UE".

This procedure triggers initiation of a direct security mode control procedure by the target UE. If the ProSe UE-to-network relay UE wants to initiate this procedure to refresh K_D, it shall use a DIRECT_REKEYING_TRIGGER message to trigger the remote UE to initiate this procedure from the other direction.

10.4.8.2 Direct link rekeying procedure initiation

A UE shall initiate the direct link rekeying procedure in any of the following cases:

a) the session key $K_{D\text{-}sess}$ used to protect direct link communication is going to expire and needs to be refreshed and neither timer T4111 nor T4112 are running; or

b) the UE wants to refresh K_D and neither timer T4111 nor T4112 are running.

The initiating UE shall generate a new 128-bit Nonce_1 value and the most significant 8-bits of the $K_{D\text{-}sess}$ ID. The UE shall generate a DIRECT_REKEYING_REQUEST message with the following:

- a Nonce_1 IE set to the nonce value provided by the initiating UE for the purpose of session key establishment over this direct link;
- a UE Security Capabilities IE set to indicate the list of algorithms that the initiating UE supports for the security establishment of this direct link;
- an MSB of $K_{D\text{-}sess}$ ID IE set to the most significant 8-bits of the $K_{D\text{-}sess}$ ID;
- Optionally, an Auth Flag IE set to the value indicating the K_D to be refreshed, if the UE wants to refresh K_D; and
- Optionally, a PRUK ID IE if the initiating UE is a remote UE towards a ProSe UE-to-network relay UE.

A UE initiates the direct link rekeying procedure by sending a DIRECT_REKEYING_REQUEST message to the target UE and starting timer T4112 (see figure 10.4.8.2.1).

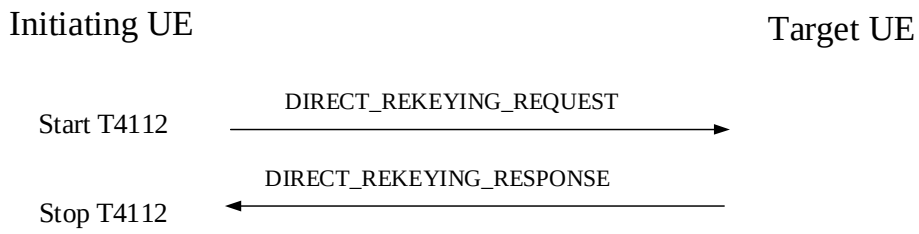

Figure 10.4.8.2.1: Direct link rekeying procedure

If the initiating UE is a ProSe UE-to-network relay UE, the ProSe UE-to-network relay UE wishes to refresh K_D used on an established link between the ProSe UE-to-network relay UE and the remote UE, and there is no pending direct link rekeying procedure initiated by the remote UE, the ProSe UE-to-network relay UE shall send a DIRECT_REKEYING_TRIGGER message with the format specified in subclause 11.4.17 to trigger the remote UE to initiate its own direct link rekeying procedure and start timer T4113, as shown in figure 10.4.8.2.2.

Upon receiving a DIRECT_REKEYING_TRIGGER message, the remote UE shall:

- if timer T4112 is not running, initiate a direct link rekeying procedure to refresh K_D as described above; and
- if timer T4112 is running, discard the DIRECT_REKEYING_TRIGGER message.

NOTE: If timer T4112 is running at the remote UE, the ProSe UE-to-network relay UE will use the direct link rekeying procedure already initiated by the remote UE to refresh K_D.

Once the ProSe UE-to-network relay received the DIRECT_REKEYING_REQUEST message, the T4113 timer shall be stopped.

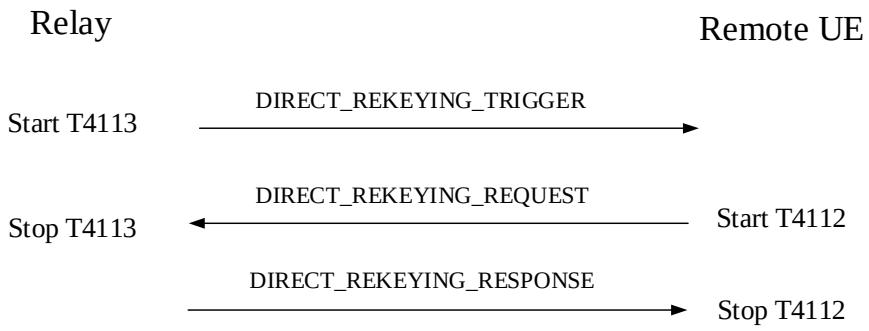

Figure 10.4.8.2.2: Direct link rekeying procedure triggered by a ProSe UE-to-network relay UE to refresh K_D

10.4.8.3 Direct link rekeying procedure accepted by the target UE

If there is no active timer T4112 running, the target UE shall process the received DIRECT_REKEYING_REQUEST message and initiate a direct security mode control procedure acting as the commanding UE as described in subclause 10.4.5.2.

If the timer T4112 is running in the target UE, then:

- if the target UE is a ProSe UE-to-network relay UE, it shall stop timer T4112 and initiate a direct security mode control procedure acting as the commanding UE as described in subclause 10.4.5.2; and

- if the target UE is neither a remote UE nor a ProSe UE-to-network relay UE, and the Nonce_1 value received in the DIRECT_REKEYING_REQUEST message is larger than the Nonce_1 value locally generated (and included in the last DIRECT_REKEYING_REQUEST message sent by the target UE), the target UE shall stop timer T4112 and initiate a direct security mode control procedure acting as the commanding UE as described in subclause 10.4.5.2.

When the target UE is a ProSe UE-to-network relay UE, the ProSe UE-to-network relay UE shall trigger a Key Request procedure to the PKMF (see 3GPP TS 33.303 [6]), before initiating the direct security mode control procedure if one of the following conditions are met:

- the Auth Flag IE is included in the DIRECT_REKEYING_REQUEST message; or
- the Auth Flag IE is not included in the DIRECT_REKEYING_REQUEST message but the ProSe UE-to-network relay UE wants to refresh K_D.

Upon completion of the direct security mode control procedure, i.e. upon receiving a DIRECT_SECURITY_MODE_COMPLETE message, the target UE shall send a DIRECT_REKEYING_RESPONSE message with the format specified in subclause 11.4.16, to notify the initiating UE of the completion of this direct link rekeying procedure.

10.4.8.4 Direct link rekeying procedure completion by the initiating UE

Upon the reception of a DIRECT_REKEYING_RESPONSE message, the initiating UE shall stop timer T4112.

10.4.8.5 Direct link rekeying procedure not accepted by the target UE

A remote UE that receives a DIRECT_REKEYING_REQUEST message shall ignore the message if timer T4112 is running. Also, if there is no timer T4112 running but the remote UE wants to refresh K_D, the UE shall ignore the received DIRECT_REKEYING_REQUEST message and act as the new initiating UE and initiate the direct link rekeying procedure to refresh the K_D as described in subclause 10.4.8.2.

Other UEs shall ignore a DIRECT_REKEYING_REQUEST message if timer T4112 is running and the Nonce_1 value received in the DIRECT_REKEYING_REQUEST message is not larger than the Nonce_1 value locally generated (and included in the last DIRECT_REKEYING_REQUEST message sent by the target UE).

10.4.8.6 Abnormal cases

10.4.8.6.1 Abnormal cases at the initiating UE

If timer T4112 expires, the initiating UE shall initiate the transmission of the DIRECT_REKEYING_REQUEST message again and restart timer T4112. If no response is received from the target UE after reaching the maximum number of allowed retransmissions, the initiating UE shall abort the direct link rekeying procedure and initiate the direct link release procedure (see subclause 10.4.4). Additionally, if the initiating UE is a remote UE, it shall initiate the relay reselection procedure as specified in subclause 10A.2.13.

NOTE: The maximum number of allowed retransmissions is UE implementation specific.

10.4.8.6.2 Abnormal cases at the target UE

If the DIRECT_REKEYING_REQUEST message is malformed, the target UE shall discard the message.

10.5 TMGI monitoring request procedure

10.5.1 General

The purpose of the TMGI monitoring request procedure is for the remote UE to obtain a ProSe Layer 2 Group ID from the ProSe UE-to-network relay UE for receiving the MBMS content for the corresponding TMGI over PC5 interface or for the remote UE to inform the ProSe UE-to-network relay UE to forward the MBMS content for the corresponding TMGI.

The remote UE in this procedure shall be a ProSe-enabled Public Safety UE and authorised to act as a remote UE towards a ProSe UE-to-network relay UE based on the service authorisation procedure as specified in clause 5. The ProSe UE-to-network relay UE in this procedure shall be a ProSe-enabled Public Safety UE and authorised to act as a ProSe UE-to-network relay UE based on the service authorisation procedure as specified in clause 5.

10.5.2 TMGI monitoring request procedure initiation by the remote UE

Before initiating the TMGI monitoring request procedure, the remote UE has successfully discovered the ProSe UE-to-network relay UE and obtained the Layer 2 ID of the ProSe UE-to-network relay UE as described in subclause 10A.2. The remote UE has also obtained TMGI and MBMS SAIs from a group communication application to receive related MBMS content (e.g. as specified in 3GPP TS 23.179 [38]).

The remote UE shall initiate a TMGI monitoring request procedure:

a) when the remote UE is triggered by an upper layer application to receive the MBMS content for a given TMGI and there is no corresponding TMGI monitoring refresh timer T4104 assigned by the ProSe UE-to-network relay UE;

b) when the TMGI monitoring refresh timer T4104 assigned by the ProSe UE-to-network relay UE has expired and the request from the upper layer to receive the MBMS content for a given TMGI is still in place;

c) when the remote UE receives a request from an upper layer application to change the requested ProSe Per-Packet Priority associated with the TMGI of an MBMS content that the remote UE is currently receiving; or

d) when the remote UE receives a request from an upper layer application to change the requested MBMS SAI list associated with the TMGI of an MBMS content that the remote UE is currently receiving.

The remote UE shall initiate the TMGI monitoring request procedure by sending a TMGI_MONITORING_REQUEST with:

- the TMGI set to the TMGI received from the application layer;
- the MBMS SAI list included the TMGI corresponding MBMS SAIs received from the application layer; and
- the Requested ProSe Per-Packet Priority set to the ProSe Per-Packet Priority value mapped from the priority value associated with the TMGI from the application layer.

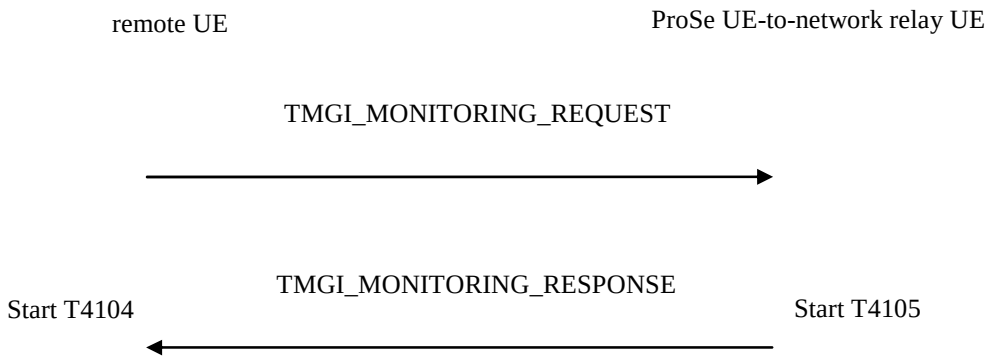

Figure 10.5.2.1: TMGI monitoring request procedure

10.5.3 TMGI monitoring request procedure accepted by the ProSe UE-to-network relay UE

Upon receiving a TMGI_MONITORING_REQUEST, the ProSe UE-to-network relay UE shall store the TMGI and the MBMS SAIs received in the TMGI_MONITORING_REQUEST and check whether at least one of the MBMS SAIs is

included in the MBMS SAI list of the serving cell. If there is no MBMS SAI list of the serving cell, the ProSe UE-to-network relay UE retrieves the MBMS SAI list from the system information of the serving cell as specified in 3GPP TS 36.331 [12].

If the MBMS SAI check indicates at least one of the MBMS SAIs is included in the MBMS SAI list of the serving cell, the ProSe UE-to-network relay UE shall monitor the TMGI received in the TMGI_MONITORING_REQUEST in the MCCH channel of the serving cell as specified in 3GPP TS 36.331 [12].

If the MBMS SAI check indicates none of the MBMS SAIs is included in the MBMS SAI list of the serving cell, the ProSe UE-to-network relay UE shall not monitor the TMGI received in the TMGI_MONITORING_REQUEST in the MCCH channel of the serving cell as specified in 3GPP TS 36.331 [12].

For the receiving TMGI, the ProSe UE-to-network relay UE shall allocate a ProSe Layer 2 Group ID which is neither provisioned for one-to-many direct communication nor used for other TMGI(s). The ProSe UE-to-network relay UE shall also allocate a value for TMGI monitoring refresh timer T4104 to the remote UE, and start a timer T4105. For a given TMGI, the timer T4105 shall be longer than the TMGI monitoring refresh timer T4104.

For the receiving Requested ProSe Per-Packet Priority, the ProSe UE-to-network relay UE shall associate the ProSe Per-Packet Priority value with the receiving TMGI. If there is only one ProSe Per-Packet Priority value associated with the receiving TMGI, the ProSe UE-to-network relay UE shall use the ProSe Per-Packet Priority value to transmit the relayed MBMS traffic corresponding to the TMGI over PC5. If there are several different ProSe Per-Packet Priority values associated with the receiving TMGI, which ProSe Per-Packet Priority value will be used to transmit the TMGI corresponding MBMS traffic over PC5 is based on ProSe UE-to-network relay UE implementation.

Then the ProSe UE-to-network relay UE shall send a TMGI_MONITORING_RESPONSE with:

- the ProSe Layer2 Group ID set to the allocated ProSe Layer 2 Group ID as the link layer identifier of the group for transmitting the MBMS content corresponding to the TMGI received in the TMGI_MONITORING_REQUEST;

- the TMGI monitoring refresh timer T4104 set to the T4104 timer value allocated by the ProSe UE-to-network relay UE for the TMGI received in the TMGI_MONITORING_REQUEST; and

- the SAI Indicator set to "true" if the MBMS SAI check indicates at least one of the MBMS SAIs is included in the MBMS SAI list of the serving cell, set to "false" if the MBMS SAI check indicates none of the MBMS SAIs is included in the MBMS SAI list of the serving cell.

NOTE 1: If different ProSe UE-to-network relay UE allocates the same ProSe Layer 2 Group ID for MBMS content transmitting, the remote UE can use the Source Layer-2 ID (i.e. ProSe Relay UE ID) to distinguish whether the MBMS content is the requested MBMS content or not. If the Source Layer-2 ID is different from the ProSe Relay UE ID of the selected ProSe UE-to-network relay UE, the remote UE can just discard the MBMS content from this Source Layer-2 ID.

NOTE 2: The applicable action when the remote UE receives a TMGI_MONITORING_RESPONSE with the SAI Indicator set to "false" is up to UE implementation (e.g. keep the currently selected ProSe UE-to-network relay UE or reselect another ProSe UE-to-network relay UE).

If timer T4105 expires, the ProSe UE-to-network relay UE shall remove the TMGI and the MBMS SAIs received in the TMGI_MONITORING_REQUEST.

10.5.4 TMGI monitoring request procedure completion by the remote UE

Upon receiving a TMGI_MONITORING_RESPONSE, the UE shall, for the ProSe Layer2 Group ID received in the TMGI_MONITORING_RESPONSE, stop the TMGI monitoring refresh timer T4104 if running and start the TMGI monitoring refresh timer T4104 with the received value.

10.5.5 Abnormal cases

10.5.5.1 Abnormal cases in the remote UE

The following abnormal cases can be identified:

a) No response from the ProSe UE-to-network relay UE after the TMGI_MONITORING_REQUEST has been successfully delivered

The remote UE shall retransmit the TMGI_MONITORING_REQUEST.

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

b) Indication from upper layers that the request to receive the MBMS content for a given TMGI is no longer in place after sending the TMGI_MONITORING_REQUEST, but before the TMGI monitoring request procedure is completed

The remote UE shall discard the TMGI_MONITORING_RESPONSE received from the ProSe UE-to-network relay UE and then abort the procedure.

10.6 Cell ID announcement request procedure

10.6.1 General

The purpose of the cell ID announcement request procedure is for the remote UE to obtain ECGI of the cell serving the ProSe UE-to-network relay.

The remote UE in this procedure shall be a ProSe-enabled Public Safety UE and is authorised to act as a remote UE towards a ProSe UE-to-network relay UE based on the service authorisation procedure as specified in clause 5. The ProSe UE-to-network relay UE in this procedure shall be a ProSe-enabled Public Safety UE and is authorised to act as a ProSe UE-to-network relay UE based on the service authorisation procedure as specified in clause 5.

10.6.2 Cell ID announcement request procedure initiation by the remote UE

Before initiating the cell ID announcement request procedure, a direct link has been successfully established between the remote UE and the ProSe UE-to-network relay UE.

The remote UE shall initiate a cell ID announcement request procedure:

a) when the remote UE is triggered by an upper layer application to report ECGI of the serving cell to the application server, but cannot receive the PC5_DISCOVERY message for Relay Discovery Additional Information from the ProSe UE-to-network relay UE, or the ECGI is not included in the PC5_DISCOVERY message for Relay Discovery Additional Information from the ProSe UE-to-network relay UE; or

b) when the ECGI announcement request refresh timer T4106 expires and the remote UE still needs to obtain ECGI of the cell serving the ProSe UE-to-network relay.

The remote UE shall generate a CELL_ID_ANNOUNCEMENT_REQUEST message and pass this message to the lower layers for transmission along with the remote UE's Layer 2 ID (for unicast communication) and the ProSe UE-to-network relay UE's Layer 2 ID (for unicast communication).

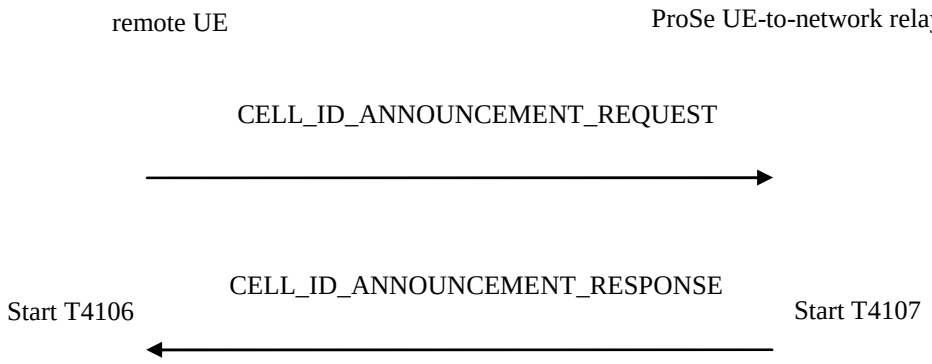

Figure 10.6.2.1: Cell ID announcement request procedure

10.6.3 Cell ID announcement request procedure accepted by the ProSe UE-to-network relay UE

Upon receiving a CELL_ID_ANNOUNCEMENT_REQUEST message, the ProSe UE-to-network relay UE shall allocate an ECGI announcement request refresh timer T4106 to the remote UE, and start a timer T4107. The timer T4107 shall be longer than the ECGI announcement request refresh timer T4106.

Then the ProSe UE-to-network relay UE shall respond a CELL_ID_ANNOUNCEMENT_RESPONSE message with a ECGI announcement request refresh timer T4106 IE set to the T4106 timer value assigned by the ProSe UE-to-network relay UE.

10.6.4 Cell ID announcement request procedure completion by the remote UE

Upon receiving a CELL_ID_ANNOUNCEMENT_RESPONSE message, the UE shall start the ECGI announcement request refresh timer T4106 with the received value.

10.6.5 Abnormal cases

10.6.5.1 Abnormal cases in the remote UE

If there is no response from the ProSe UE-to-network relay UE after the CELL_ID_ANNOUNCEMENT_REQUEST message has been successfully delivered, the remote UE shall retransmit the CELL_ID_ANNOUNCEMENT_REQUEST message.

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

10.7 Remote UE information request procedure

10.7.1 General

The purpose of the remote UE information request procedure is for the serving ProSe UE-to-network relay UE to obtain the information from the remote UE served by the relay. This procedure can only be initiated by the ProSe UE-to-network relay UE, over an established link between the remote UE and the ProSe UE-to-network relay UE.

10.7.2 Remote UE information request procedure initiation by the ProSe UE-to-network relay UE

Before initiating the remote UE information request procedure, a direct link has been successfully established between the remote UE and the ProSe UE-to-network relay UE.

The ProSe UE-to-network relay UE shall generate a REMOTE_UE_INFO_REQUEST message containing the Remote UE Information Type IE set to the requested type of information as specified in subclause 11.4.18, and pass this message to the lower layers for transmission along with the remote UE's Layer 2 ID for unicast communication (i.e., ProSe UE ID) and the ProSe UE-to-network relay UE's Layer 2 ID for unicast communication (i.e., ProSe Relay UE ID).

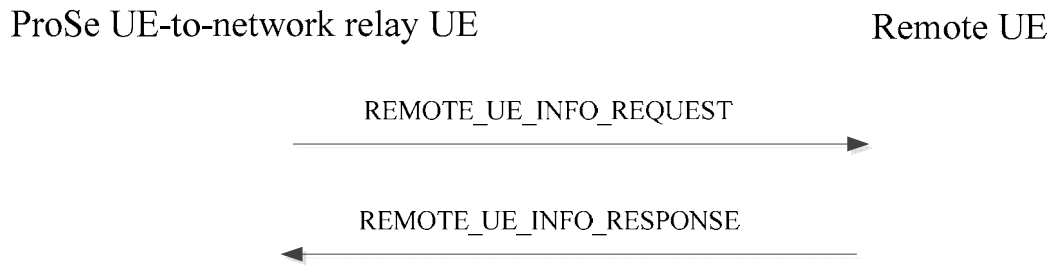

Figure 10.7.2.1: Remote UE information request procedure

10.7.3 Remote UE information request accepted by the remote UE

Upon receiving a REMOTE_UE_INFO_REQUEST message, the remote UE shall include the requested type of information in a REMOTE_UE_INFO_RESPONSE message, as specified in subclause 11.4.19.

10.7.4 Remote UE information request procedure completion by the ProSe UE-to-network relay UE

Upon receiving a REMOTE_UE_INFO_REQUEST message, the ProSe UE-to-network relay UE shall store the information provided by the remote UE temporarily so that the remote UE identity can be reported to the MME, as specified in 3GPP TS 24.301 [11].

NOTE: After the ProSe UE-to-network relay UE reports the information of the remote UE to the MME, the stored remote UE information is deleted.

10.7.5 Abnormal cases

10.7.5.1 Abnormal cases in the ProSe UE-to-network relay UE

If there is no response from the remote UE after the REMOTE_UE_INFO_REQUEST message has been successfully delivered, the ProSe UE-to-network relay UE shall retransmit the REMOTE_UE_INFO_REQUEST message.

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

10A ProSe direct discovery for public safety use

10A.1 Overview

This clause describes the procedures for ProSe direct discovery for public safety use at a ProSe-enabled public safety UE over the PC5 reference point.

10A.2 Procedures

10A.2.1 General

The following procedures are defined for the ProSe direct discovery for public safety use:

- announcing UE procedure for UE-to-network relay discovery;
- monitoring UE procedure for UE-to-network relay discovery;
- discoverer UE procedure for UE-to-network relay discovery;
- discoveree UE procedure for UE-to-network relay discovery;
- announcing UE procedure for group member discovery;
- monitoring UE procedure for group member discovery;
- discoverer UE procedure for group member discovery;
- discoveree UE procedure for group member discovery;
- announcing UE procedure for UE-to-network relay discovery additional information; and
- monitoring UE procedure for UE-to-network relay discovery additional information;

Each ProSe-enabled Public Safety UE needs to obtain the security parameters from the ProSe Key Management Function before participating in ProSe direct discovery for public safety use, as specified in 3GPP TS 33.303 [6]. For each given Relay Service Code in UE-to-network relay discovery or Discovery Group ID in group member discovery, the ProSe Key Management Function (PKMF) will provide the following in the security parameters:

- PSDK (Public Safety Discovery Key) and the associated Expiry Time for this PSDK;
- configurations to signal which combination of keys to be used for the discovery process; and
- optionally, if DUCK is to be used, an indication of which PC5_DISCOVERY message fields shall be protected by the DUCK.

After receiving the PSDK from the PKMF for the relay service or discovery group, the UE shall use it to derive specific DUIK, DUCK and DUSK needed to protect the ProSe direct discovery messages for the corresponding public safety use, as specified in 3GPP TS 33.303 [6].

10A.2.1A Radio resource selection

The UE shall select the radio resource parameters to be used for ProSe direct discovery as follows:

- when the UE is served by E-UTRAN and intends to use the ProSe radio resources (i.e. carrier frequency) obtained from the serving cell,

  1) the UE shall use the radio resource parameters indicated by the serving cell (same or different from that of the serving cell) as specified in 3GPP TS 36.331 [12], if the corresponding PLMN is authorised for ProSe direct discovery; and

  2) according to the radio resources (i.e. carrier frequency) along with PLMN ID which the serving cell indicates as allowed for ProSe direct discovery as defined in 3GPP TS 36.331 [12], if the UE intends to use one of the radio resources not operated by the serving cell for ProSe direct discovery and the corresponding PLMN is authorised for ProSe direct discovery, the UE shall search for a cell with the indicated PLMN operating the indicated radio resources as defined in 3GPP TS 36.331 [12] and 3GPP TS 36.304 [23], and obtain the radio resource parameters for ProSe direct discovery from that cell, without performing PLMN selection; and

- when the UE is not served by E-UTRAN or when the UE is served by E-UTRAN and intends to use the provisioned ProSe radio resources (i.e. carrier frequency):

1) if the UE can determine itself located in a geographical area, and the UE is provisioned with radio parameters for the geographical area, then the UE shall search for a cell with any PLMN operating the selected provisioned radio resources (i.e. carrier frequency) associated with that geographical area, and:

NOTE: It is out of scope of the present specification to define how the UE can locate itself in a specific geographical area. When the UE is in coverage of a 3GPP RAT it can for example use information derived from the serving PLMN. When the UE is not in coverage of a 3GPP RAT it can use other techniques as determined by local regulations.

i) if the UE finds such a cell belonging to a PLMN in which the UE is authorised for ProSe direct discovery and the cell provides radio resource parameters for ProSe direct discovery, then the UE shall use the indicated radio resource parameters for ProSe direct discovery;

ii) if the UE finds such a cell but not in a PLMN authorised for ProSe direct discovery, then the UE shall not use the ProSe direct discovery in that carrier frequency; or

iii) if the UE does not find any such cell in any PLMN, then the UE shall use the provisioned radio resource parameters; or

2) else the UE shall not initiate ProSe direct discovery.

If the UE is performing ProSe direct discovery using radio resource parameters associated with a geographical area and moves out of that geographical area, the UE shall perform ProSe direct discovery using new radio resource parameters selected for ProSe direct discovery as described in this subclause.

10A.2.2 Announcing UE procedure for UE-to-network relay discovery

10A.2.2.1 General

The purpose of the announcing UE procedure for UE-to-network relay discovery is:

- to enable a ProSe-enabled public safety UE to announce availability of a connectivity service provided by a UE-to-network relay of the ProSe-enabled public safety UE to other ProSe-enabled public safety UEs, upon a request from upper layers as defined in 3GPP TS 23.303 [2]; or

- to enable a ProSe-enabled public safety UE to measure the PC5_DISCOVERY message signal strength between the ProSe-enabled public safety UE and the ProSe UE-to-network relay UE(s) for relay selection/reselection.

10A.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, and

- the UE is served by E-UTRAN and the UE is authorised to perform ProSe direct discovery for public safety use announcing in the PLMN as specified in clause 5, and the lower layers indicate that discovery operation of a UE-to-network relay is supported; or

- the UE is authorised to perform ProSe direct discovery for public safety use announcing when not served by E-UTRAN as specified in clause 5 and intends to use the provisioned radio resources for UE-to-network relay discovery; and

b) the UE is configured with the Relay Service Code parameter identifying the connectivity service to be announced and with the User Info ID for the UE-to-network relay discovery parameter, as specified in clause 5;

otherwise the UE is not authorised to perform the announcing UE procedure for UE-to-network relay discovery.

Figure 10A.2.2.2.1 illustrates the interaction of the UEs in the announcing UE procedure for UE-to-network relay discovery.

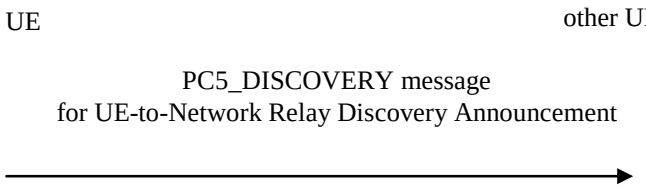

Figure 10A.2.2.2.1: Announcing UE procedure for UE-to-network relay discovery

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 E-UTRAN, and the UE in EMM-IDLE mode needs to request resources for sending PC5_DISCOVERY messages for relay discovery for public safety as specified in 3GPP TS 36.331 [12], shall perform a service request procedure or tracking area update procedure as specified in 3GPP TS 24.301 [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 subclause 12.2.2.18;

c) shall generate a PC5_DISCOVERY message for UE-to-Network Relay Discovery Announcement according to subclause 11.2.5.1. In the PC5_DISCOVERY message for UE-to-Network Relay Discovery Announcement, the UE:

   1) shall set the ProSe Relay UE ID to a ProSe Relay UE ID used for ProSe direct communication for the connectivity service to be announced;

   2) shall set the Announcer Info parameter to the User Info ID for the UE-to-network relay discovery parameter, configured in clause 5;

   3) shall set the Relay Service Code parameter to the Relay Service Code parameter identifying the connectivity service to be announced, configured in clause 5;

   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 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 public safety UEs;

d) shall apply the DUIK, DUSK, or DUCK with the associated Encrypted Bitmask, along with the UTC-based counter to the 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 [6]; and

e) shall pass the resulting PC5_DISCOVERY message for UE-to-Network Relay Discovery Announcement to the lower layers for transmission over the PC5 interface with an indication that the message is for relay discovery for public safety use.

The UE shall ensure that it keeps on passing the same PC5_DISCOVERY message and the indication that the message is for relay discovery for public safety use 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.

10A.2.2.3 Announcing UE procedure for UE-to-network relay discovery completion

When 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 when the 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 EMM-CONNECTED mode, the UE shall trigger the corresponding procedure in lower layers as specified in 3GPP TS 36.331 [12].

10A.2.3 Monitoring UE procedure for UE-to-network relay discovery

10A.2.3.1 General

The purpose of the monitoring UE procedure for UE-to-network relay discovery is:

- to enable a ProSe-enabled public safety 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 23.303 [2]; or

- to enable a ProSe-enabled public safety UE to perform measurements of signal strength of PC5_DISCOVERY messages from ProSe UE-to-network relay UE(s) for relay selection/reselection.

10A.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 E-UTRAN, is authorised to perform ProSe direct discovery for public safety use monitoring when the UE is not served by E-UTRAN as specified in clause 5, is authorised to act as a remote UE towards a UE-to-network relay as specified in clause 5 and is configured with the radio parameters to be used for ProSe direct discovery for public safety use when not served by E-UTRAN;

   2) the UE is served by E-UTRAN, is authorised to perform ProSe direct discovery for public safety use monitoring in at least one PLMN as specified in clause 5, is authorised to act as a remote UE towards a UE-to-network relay, and the lower layers indicate that discovery operation of a UE-to-network relay is supported; or

   3) the UE is:

      - in EMM-IDLE mode, in limited service state as specified in 3GPP TS 23.122 [24], 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 36.304 [23];

         ii) the UE received an ATTACH REJECT message or a TRACKING AREA UPDATE REJECT message or a SERVICE REJECT message with the EMM cause #11 "PLMN not allowed" as specified in 3GPP TS 24.301 [11] or a LOCATION UPDATING REJECT message or a GPRS ATTACH REJECT message or ROUTING AREA UPDATE REJECT message or SERVICE REJECT message with cause #11 "PLMN not allowed" as specified in 3GPP TS 24.008 [30]; or

         iii) the UE received an ATTACH REJECT message or a TRACKING AREA UPDATE REJECT message or a SERVICE REJECT message with the EMM cause #7 "EPS services not allowed" as specified in 3GPP TS 24.301 [11] or a LOCATION UPDATING REJECT message or a GPRS ATTACH REJECT message or ROUTING AREA UPDATE REJECT message or SERVICE REJECT message with cause #7 "GPRS services not allowed" as specified in 3GPP TS 24.008 [30]; and

      - authorised to perform ProSe direct discovery for public safety use monitoring when the UE is not served by E-UTRAN as specified in clause 5, authorised to act as a remote UE towards a UE-to-network relay as specified in clause 5, and:

         i) configured with the radio parameters to be used for ProSe direct discovery for public safety use when not served by E-UTRAN; or

ii) the lower layers indicate that discovery operation of a UE-to-network relay is supported; and:

NOTE 1: When the lower layers indicate that discovery operation of a UE-to-network relay is supported, the serving cell broadcasts a common radio resources pool for public safety discovery reception and the UE can use this common radio resources pool while in limited service state.

b) the UE is configured with the Relay Service Code parameter identifying the connectivity service to be monitored and with the IP version(s) to be used for the traffic of the connectivity service to be monitored, as specified in clause 5;

otherwise the UE is not authorised to perform the monitoring UE procedure for UE-to-network relay discovery.

Figure 10A.2.3.2.1 illustrates the interaction of the UEs in the monitoring UE procedure for UE-to-network relay discovery.

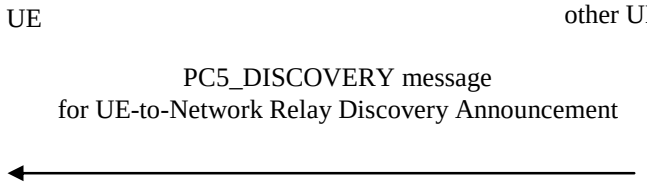

Figure 10A.2.3.2.1: Monitoring UE procedure for UE-to-network relay discovery

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 ProSe UE-to-network relay UE as specified in subclause 10.4.2, 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 PC5_DISCOVERY messages with an indication that the message is for relay discovery for public safety use.

Upon reception of a PC5_DISCOVERY message for UE-to-Network Relay Discovery Announcement according to subclause 11.2.5.1, 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 PC5_DISCOVERY message as described in 3GPP TS 33.303 [6]. 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 in 3GPP TS 33.303 [6]. 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 PC5_DISCOVERY message for UE-to-Network Relay Discovery Announcement.

NOTE 2: The use of an erroneous UTC-based counter for processing the received PC5_DISCOVERY messages at the ProSe-enabled Public Safety 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 Public Safety UE ensures the accuracy of the UTC-based counter is left to UE implementation.

Then if:

- the Relay Service Code parameter of the 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

- 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 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 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 PC5_DISCOVERY message for UE-to-Network Relay Discovery Announcement for relay selection or reselection.

10A.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 a connectivity service provided by a UE-to-network relay, 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 EMM-CONNECTED mode, the UE shall trigger the corresponding procedure in lower layers as specified in 3GPP TS 36.331 [12].

10A.2.4 Discoverer UE procedure for UE-to-network relay discovery

10A.2.4.1 General

The purpose of the discoverer UE procedure for UE-to-network relay discovery is:

- to enable a ProSe-enabled public safety UE to solicit proximity of a connectivity service provided by a UE-to-network relay, upon a request from upper layers as defined in 3GPP TS 23.303 [2]; or
- to enable a ProSe-enabled public safety UE to measure the PC5_DISCOVERY message signal strength between the ProSe-enabled public safety UE and the ProSe UE-to-network relay UE(s) for relay selection/reselection.

10A.2.4.2 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) the following is true:

1) the UE is not served by E-UTRAN, is authorised to perform ProSe direct discovery for public safety use discoverer operation when the UE is not served by E-UTRAN as specified in clause 5, is authorised to act as a remote UE towards a UE-to-network relay as specified in clause 5 and is configured with the radio parameters to be used for ProSe direct discovery for public safety use when not served by E-UTRAN;

2) the UE is served by E-UTRAN, is authorised to perform ProSe direct discovery for public safety use discoverer operation in the PLMN indicated by the serving cell as specified in clause 5, is authorised to act as a remote UE towards a UE-to-network relay, and the lower layers indicate that discovery operation of a UE-to-network relay is supported; or

3) the UE is:

- in EMM-IDLE mode, in limited service state as specified in 3GPP TS 23.122 [24], 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 36.304 [23];

ii) the UE received an ATTACH REJECT message or a TRACKING AREA UPDATE REJECT message or a SERVICE REJECT message with the EMM cause #11 "PLMN not allowed" as specified in 3GPP TS 24.301 [11] or a LOCATION UPDATING REJECT message or a GPRS ATTACH REJECT message or ROUTING AREA UPDATE REJECT message or SERVICE REJECT message with cause #11 "PLMN not allowed" as specified in 3GPP TS 24.008 [30]; or

iii) the UE received an ATTACH REJECT message or a TRACKING AREA UPDATE REJECT message or a SERVICE REJECT message with the EMM cause #7 "EPS services not allowed" as specified in 3GPP TS 24.301 [11] or a LOCATION UPDATING REJECT message or a GPRS ATTACH REJECT message or ROUTING AREA UPDATE REJECT message or SERVICE REJECT message with cause #7 "GPRS services not allowed" as specified in 3GPP TS 24.008 [30]; and

- authorised to perform ProSe direct discovery for public safety use discoverer operation when the UE is not served by E-UTRAN as specified in clause 5, authorised to act as a remote UE towards a UE-to-network relay as specified in clause 5, and:

  i) configured with the radio parameters to be used for ProSe direct discovery for public safety use when not served by E-UTRAN; or

  ii) the lower layers indicate that discovery operation of a UE-to-network relay is supported and that the UE does not need to request resources for sending PC5_DISCOVERY messages for public safety as specified in 3GPP TS 36.331 [12]; and

NOTE 1: When the lower layers indicate that discovery operation of a UE-to-network relay is supported and that the UE does not need to request resources for sending PC5_DISCOVERY messages for public safety as specified in 3GPP TS 36.331 [12], the serving cell broadcasts a common radio resources pool for public safety discovery transmission and the UE can use this common radio resources pool while in limited service state.

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;

otherwise the UE is not authorised to perform the Discoverer UE procedure for UE-to-network relay discovery.

Figure 10A.2.4.2.1 illustrates the interaction of the UEs in the Discoverer UE procedure for UE-to-network relay discovery.

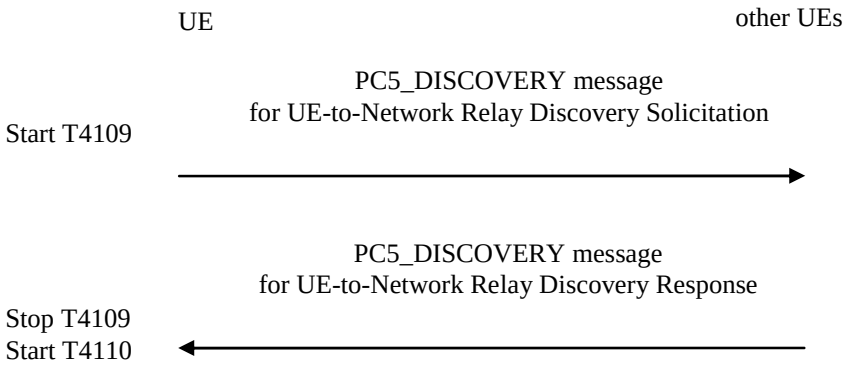

Figure 10A.2.4.2.1: Discoverer UE procedure for UE-to-network relay discovery

For PC5_DISCOVERY message signal strength measurement, the UE manages a periodic measurement timer T4110, which is used to trigger the periodic 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 ProSe UE-to-network relay UE as specified in subclause 10.4.2 and restarted whenever the UE receives the 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.

When the UE is triggered by an upper layer application to solicit proximity of a connectivity service provided by a UE-to-network relay, or when the periodic measurement timer T4110 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 E-UTRAN, and the UE in EMM-IDLE mode needs to request resources for sending PC5_DISCOVERY messages for relay discovery for public safety as specified in 3GPP TS 36.331 [12], shall perform a service request procedure or tracking area update procedure as specified in 3GPP TS 24.301 [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 subclause 12.2.2.18;

c) shall generate a PC5_DISCOVERY message for UE-to-Network Relay Discovery Solicitation according to subclause 11.2.5.1. In the 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) shall set the Relay Service Code parameter to the Relay Service Code parameter identifying the connectivity service to be solicited, configured in clause 5;

   3) if the PC5_DISCOVERY message for UE-to-Network Relay Discovery Solicitation is used to trigger the signal strength measurement for the PC5_DISCOVERY message from a specific ProSe UE-to-network relay UE with which the UE has a link established, shall set the ProSe Relay UE ID parameter to the ProSe Relay UE ID of that ProSe UE-to-network relay UE; and

   4) shall set the UTC-based counter LSB parameter to include the four 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 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 [6]; and

e) shall pass the resulting PC5_DISCOVERY message for UE-to-Network Relay Discovery Solicitation to the lower layers for transmission over the PC5 interface with an indication that the message is for relay discovery for public safety use.

If the 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, the UE shall ensure that it keeps on passing the PC5_DISCOVERY message for UE-to-Network Relay Discovery Solicitation and the indication that the message is for relay discovery for public safety use to the lower layers 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, 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 PC5_DISCOVERY message for UE-to-Network Relay Discovery Solicitation is used to trigger the 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, the UE shall start the retransmission timer T4109. If retransmission timer T4109 expires, the UE shall retransmit the PC5_DISCOVERY message for UE-to-Network Relay Discovery Solicitation and restart timer T4109. 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 2: The maximum number of allowed retransmissions is UE implementation specific.

Upon reception of a PC5_DISCOVERY message for UE-to-Network Relay Discovery Response according to subclause 11.2.5.1, 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 PC5_DISCOVERY message as described in 3GPP TS 33.303 [6]. 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 in 3GPP TS 33.303 [6]. 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 PC5_DISCOVERY message for UE-to-Network Relay Discovery Response.

Then if:

- the Relay Service Code parameter of the PC5_DISCOVERY message for UE-to-Network Relay Discovery Response is the same as the Relay Service Code parameter of the PC5_DISCOVERY message for UE-to-Network Relay Discovery Solicitation; and

- the User Info ID of the UE-to-network relay is not configured as specified in clause 5 for the connectivity service being solicited, or the Discoverer Info parameter of the 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 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 PC5_DISCOVERY message for UE-to-Network Relay Discovery Response for relay selection or reselection. If the UE has received the 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 T4109, and start the periodic measurement timer T4110.

10A.2.4.3 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 EMM-CONNECTED mode, the UE shall trigger the corresponding procedure in lower layers as specified in 3GPP TS 36.331 [12].

10A.2.5 Discoveree UE procedure for UE-to-network relay discovery

10A.2.5.1 General

The purpose of the discoveree UE procedure for UE-to-network relay discovery is to enable a ProSe-enabled public safety UE with a UE-to-network relay to respond to solicitation from other ProSe-enabled public safety UEs on proximity of a connectivity service provided by the UE-to-network relay, upon a request from upper layers as defined in 3GPP TS 23.303 [2].

10A.2.5.2 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 in the PLMN indicated by the serving cell as specified in clause 5, and

   - the UE is served by E-UTRAN and the UE is authorised to perform ProSe direct discovery for public safety use discoveree operation in the PLMN as specified in clause 5, and the lower layers indicate that discovery operation of a UE-to-network relay is supported; or- the UE is authorised to perform ProSe direct discovery for public safety use discoveree operation when not served by E-UTRAN as specified in clause 5 and intends to use the provisioned radio resources for UE-to-network relay discovery; and

b) the UE is configured with the Relay Service Code parameter identifying the connectivity service to be responded to and with the User Info ID for the UE-to-network relay discovery parameter, as specified in clause 5;

otherwise the UE is not authorised to perform the discoveree UE procedure for UE-to-network relay discovery.

Figure 10A.2.5.2.1 illustrates the interaction of the UEs in the discoveree UE procedure for UE-to-network relay discovery.

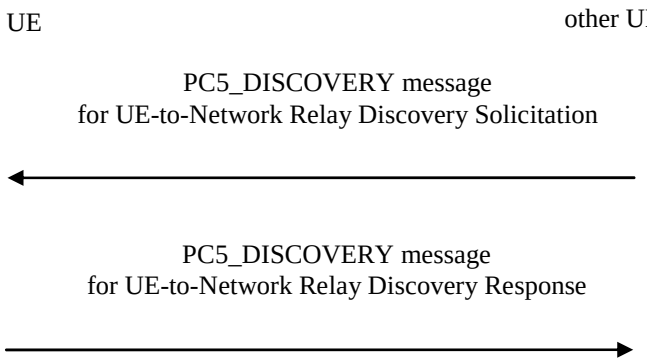

Figure 10A.2.5.2.1: Discoveree UE procedure for UE-to-network relay discovery

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 E-UTRAN, and the UE in EMM-IDLE mode needs to request resources for sending PC5_DISCOVERY messages for public safety as specified in 3GPP TS 36.331 [12], shall perform a service request procedure or tracking area update procedure as specified in 3GPP TS 24.301 [11]; and

b) shall instruct the lower layers to start monitoring for PC5_DISCOVERY messages with an indication that the message is for relay discovery for public safety use.

Upon reception of a PC5_DISCOVERY message for UE-to-Network Relay Discovery Solicitation according to subclause 11.2.5.1, 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 PC5_DISCOVERY message as described in 3GPP TS 33.303 [6]. 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 in 3GPP TS 33.303 [6]. 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 PC5_DISCOVERY message for UE-to-Network Relay Discovery Solicitation.

Then, if the Relay Service Code parameter of the 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 for the connectivity service and either the ProSe Relay UE ID parameter is not included or the included ProSe Relay UE ID parameter is the same as the ProSe Relay UE ID associated with the Relay Service Code parameter configured as specified in clause 5, 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 as specified in subclause 12.2.2.18;

b) shall generate a PC5_DISCOVERY message for UE-to-Network Relay Discovery Response according to subclause 11.2.5.1. In the PC5_DISCOVERY message for UE-to-Network Relay Discovery Response, the UE:

   1) shall set the ProSe Relay UE ID to a ProSe Relay UE ID used for ProSe direct communication for the connectivity service;

   2) shall set the Discoveree Info parameter to the User Info ID for the UE-to-network relay discovery parameter, configured in clause 5;

   3) shall set the Relay Service Code parameter to the Relay Service Code parameter of the PC5_DISCOVERY message for UE-to-Network Relay Discovery Solicitation;

   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 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 public safety UEs;

c) shall apply the DUIK, DUSK, or DUCK with the associated Encrypted Bitmask, along with the UTC-based counter to the 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 [6]; and

d) shall pass the resulting PC5_DISCOVERY message for UE-to-Network Relay Discovery Response with an indication that the message is for relay discovery for public safety use to the lower layers for transmission over the PC5 interface.

10A.2.5.3 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, 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 EMM-CONNECTED mode, the UE shall trigger the corresponding procedure in lower layers as specified in 3GPP TS 36.331 [12].

10A.2.6 Announcing UE procedure for group member discovery

10A.2.6.1 General

The purpose of the announcing UE procedure for group member discovery is to enable a ProSe-enabled public safety UE to announce availability in a discovery group to other ProSe-enabled public safety UEs, upon a request from upper layers as defined in 3GPP TS 23.303 [2].

10A.2.6.2 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 E-UTRAN, is authorised to perform ProSe direct discovery for public safety use announcing when the UE is not served by E-UTRAN as specified in clause 5, and is configured with the radio parameters to be used for ProSe direct discovery for public safety use when not served by E-UTRAN;

2) the UE is served by E-UTRAN, and is authorised to perform ProSe direct discovery for public safety use announcing in the PLMN indicated by the serving cell as specified in clause 5; or

3) the UE is:

- in EMM-IDLE mode, in limited service state as specified in 3GPP TS 23.122 [24], 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 36.304 [23];

ii) the UE received an ATTACH REJECT message or a TRACKING AREA UPDATE REJECT message or a SERVICE REJECT message with the EMM cause #11 "PLMN not allowed" as specified in 3GPP TS 24.301 [11] or a LOCATION UPDATING REJECT message or a GPRS ATTACH REJECT message or ROUTING AREA UPDATE REJECT message or SERVICE REJECT message with cause #11 "PLMN not allowed" as specified in 3GPP TS 24.008 [30]; or

iii) the UE received an ATTACH REJECT message or a TRACKING AREA UPDATE REJECT message or a SERVICE REJECT message with the EMM cause #7 "EPS services not allowed" as specified in 3GPP TS 24.301 [11] or a LOCATION UPDATING REJECT message or a GPRS ATTACH REJECT message or ROUTING AREA UPDATE REJECT message or SERVICE REJECT message with cause #7 "GPRS services not allowed" as specified in 3GPP TS 24.008 [30]; and

- authorised to perform ProSe direct discovery for public safety use announcing when the UE is not served by E-UTRAN as specified in clause 5 and:

  i) configured with the radio parameters to be used for ProSe direct discovery for public safety use when not served by E-UTRAN; or

  ii) the lower layers indicate that the UE does not need to request resources for sending PC5_DISCOVERY messages for public safety as specified in 3GPP TS 36.331 [12]; and

NOTE: When the lower layers indicate that the UE does not need to request resources for sending PC5_DISCOVERY messages for public safety as specified in 3GPP TS 36.331 [12], the serving cell broadcasts a common radio resources pool for public safety discovery transmission and the UE can use this common radio resources pool while in limited service state.

b) the UE is configured with the Discovery Group ID parameter identifying the discovery group to be announced and with the User Info ID for the group member discovery parameter, as specified in clause 5;

otherwise the UE is not authorised to perform the announcing UE procedure for group member discovery.

Figure 10A.2.6.2.1 illustrates the interaction of the UEs in the announcing UE procedure for group member discovery.

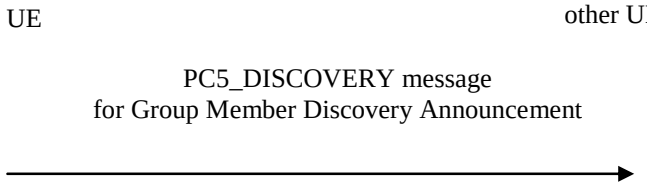

Figure 10A.2.6.2.1: Announcing UE procedure for group member discovery

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 E-UTRAN, and the UE in EMM-IDLE mode needs to request resources for sending PC5_DISCOVERY messages for public safety as specified in 3GPP TS 36.331 [12], shall perform a service request procedure or tracking area update procedure as specified in 3GPP TS 24.301 [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 subclause 12.2.2.18;

c) shall generate a PC5_DISCOVERY message for Group Member Discovery Announcement according to subclause 11.2.5.1. In the PC5_DISCOVERY message for Group Member Discovery Announcement, the UE:

  1) shall set the ProSe UE ID to the Layer 2 ID used for unicast communication configured in clause 5;

  2) shall set the Announcer Info parameter to the User Info ID for the group member discovery parameter, configured in clause 5;

  3) shall set the Discovery Group ID parameter to the Discovery Group ID parameter identifying the discovery group to be announced, configured in clause 5; and

  4) shall set the UTC-based counter LSB parameter to include the eight 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 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 [6]; and

e) shall pass the resulting PC5_DISCOVERY message for Group Member Discovery Announcement to the lower layers for transmission over the PC5 interface with an indication that the message is for public safety use.

The UE shall ensure that it keeps on passing the same PC5_DISCOVERY message and the indication that the message is for public safety use to the lower layers for transmission until the 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. How this is achieved is left up to UE implementation.

10A.2.6.3 Announcing UE procedure for group member discovery completion

When the UE is triggered by an upper layer application to stop announcing availability in a discovery group, or when the 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 EMM-CONNECTED mode, the UE shall trigger the corresponding procedure in lower layers as specified in 3GPP TS 36.331 [12].

10A.2.7 Monitoring UE procedure for group member discovery

10A.2.7.1 General

The purpose of the monitoring UE procedure for group member discovery is to enable a ProSe-enabled public safety UE to become aware of proximity of other ProSe-enabled public safety UEs in a discovery group, upon a request from upper layers as defined in 3GPP TS 23.303 [2].

10A.2.7.2 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 E-UTRAN, is authorised to perform ProSe direct discovery for public safety use monitoring when the UE is not served by E-UTRAN as specified in clause 5, and is configured with the radio parameters to be used for ProSe direct discovery for public safety use when not served by E-UTRAN;

2) the UE is served by E-UTRAN, and is authorised to perform ProSe direct discovery for public safety use monitoring in at least one PLMN as specified in clause 5; or

3) the UE is:

- in EMM-IDLE mode, in limited service state as specified in 3GPP TS 23.122 [24, 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 36.304 [23];

ii) the UE received an ATTACH REJECT message or a TRACKING AREA UPDATE REJECT message or a SERVICE REJECT message with the EMM cause #11 "PLMN not allowed" as specified in 3GPP TS 24.301 [11] or a LOCATION UPDATING REJECT message or a GPRS ATTACH REJECT message or ROUTING AREA UPDATE REJECT message or SERVICE REJECT message with cause #11 "PLMN not allowed" as specified in 3GPP TS 24.008 [30]; or

iii) the UE received an ATTACH REJECT message or a TRACKING AREA UPDATE REJECT message or a SERVICE REJECT message with the EMM cause #7 "EPS services not allowed" as specified in 3GPP TS 24.301 [11] or a LOCATION UPDATING REJECT message or a GPRS ATTACH REJECT message or ROUTING AREA UPDATE REJECT message or SERVICE REJECT message with cause #7 "GPRS services not allowed" as specified in 3GPP TS 24.008 [30]; and

- authorised to perform ProSe direct discovery for public safety use monitoring when the UE is not served by E-UTRAN as specified in clause 5, and:

i) configured with the radio parameters to be used for ProSe direct discovery for public safety use when not served by E-UTRAN; or

ii) the lower layers indicate that public safety discovery operation is supported; and:

NOTE 1: When the lower layers indicate that public safety discovery operation is supported, the serving cell broadcasts a common radio resources pool for public safety discovery reception and the UE can use this common radio resources pool while in limited service state.

b) the UE is configured with the Discovery Group ID parameter identifying the discovery group to be monitored, as specified in clause 5;

otherwise the UE is not authorised to perform the monitoring UE procedure for group member discovery.

Figure 10A.2.7.2.1 illustrates the interaction of the UEs in the monitoring UE procedure for group member discovery.

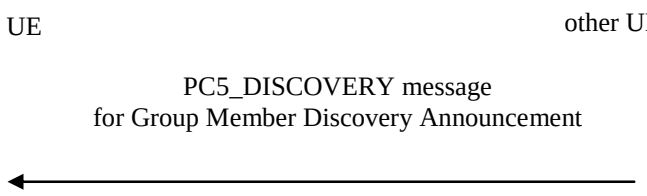

Figure 10A.2.7.2.1: Monitoring UE procedure for group member discovery;

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 PC5_DISCOVERY messages with an indication that the message is for public safety use.

Upon reception of a PC5_DISCOVERY message for Group Member Discovery Announcement according to subclause 11.2.5.1, for the target Discovery Group ID of the discovery group 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 PC5_DISCOVERY message as described in 3GPP TS 33.303 [6]. 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 in 3GPP TS 33.303 [6]. Finally, if a DUIK is configured, the UE shall use the DUIK and UTC-based counter to verify the MIC field in the unscrambled PC5_DISCOVERY message for Group Member Discovery Announcement.

NOTE 2: The use of an erroneous UTC-based counter for processing received PC5_DISCOVERY messages at the ProSe-enabled Public Safety 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 Public Safety UE ensures the accuracy of the UTC-based counter is left to UE implementation.

Then if the Discovery Group ID parameter of the PC5_DISCOVERY message for Group Member Discovery Announcement is the same as the configured Discovery 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.

10A.2.7.3 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 EMM-CONNECTED mode, the UE shall trigger the corresponding procedure in lower layers as specified in 3GPP TS 36.331 [12].

10A.2.8 Discoverer UE procedure for group member discovery

10A.2.8.1 General

The purpose of the discoverer UE procedure for group member discovery is to enable a ProSe-enabled public safety UE to solicit proximity of other ProSe-enabled public safety UEs in a discovery group, upon a request from upper layers as defined in 3GPP TS 23.303 [2].

10A.2.8.2 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 E-UTRAN, is authorised to perform ProSe direct discovery for public safety use discoverer operation when the UE is not served by E-UTRAN as specified in clause 5, and is configured with the radio parameters to be used for ProSe direct discovery for public safety use when not served by E-UTRAN;

2) the UE is served by E-UTRAN, and is authorised to perform ProSe direct discovery for public safety use discoverer operation in the PLMN indicated by the serving cell as specified in clause 5; or

3) the UE is:

- in EMM-IDLE mode, in limited service state as specified in 3GPP TS 23.122 [24, 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 36.304 [23];

ii) the UE received an ATTACH REJECT message or a TRACKING AREA UPDATE REJECT message or a SERVICE REJECT message with the EMM cause #11 "PLMN not allowed" as specified in 3GPP TS 24.301 [11] or a LOCATION UPDATING REJECT message or a GPRS ATTACH REJECT message or ROUTING AREA UPDATE REJECT message or SERVICE REJECT message with cause #11 "PLMN not allowed" as specified in 3GPP TS 24.008 [30]; or

iii) the UE received an ATTACH REJECT message or a TRACKING AREA UPDATE REJECT message or a SERVICE REJECT message with the EMM cause #7 "EPS services not allowed" as specified in 3GPP TS 24.301 [11] or a LOCATION UPDATING REJECT message or a GPRS ATTACH REJECT message or ROUTING AREA UPDATE REJECT message or SERVICE REJECT message with cause #7 "GPRS services not allowed" as specified in 3GPP TS 24.008 [30]; and

- authorised to perform ProSe direct discovery for public safety use discoverer operation when the UE is not served by E-UTRAN as specified in clause 5, and:

i) configured with the radio parameters to be used for ProSe direct discovery for public safety use when not served by E-UTRAN; or

ii) the lower layers indicate that the UE does not need to request resources for sending PC5_DISCOVERY messages for public safety as specified in 3GPP TS 36.331 [12]; and:

NOTE: When the lower layers indicate that the UE does not need to request resources for sending PC5_DISCOVERY messages for public safety as specified in 3GPP TS 36.331 [12], the serving cell broadcasts a common radio resources pool for public safety discovery transmission and the UE can use this common radio resources pool while in limited service state.

b) the UE is configured with the Discovery Group ID parameter identifying the discovery group to be solicited and with the User Info ID for the group member discovery parameter, as specified in clause 5;

otherwise the UE is not authorised to perform the discoverer UE procedure for group member discovery.

Figure 10A.2.8.2.1 illustrates the interaction of the UEs in the discoverer UE procedure for group member discovery.

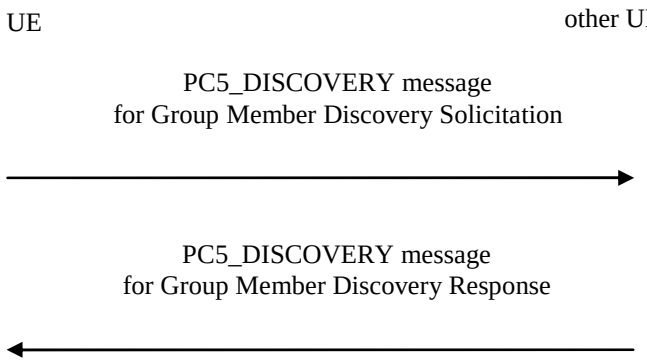

Figure 10A.2.8.2.1: Discoverer UE procedure for group member discovery

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 E-UTRAN, and the UE in EMM-IDLE mode needs to request resources for sending PC5_DISCOVERY messages for public safety as specified in 3GPP TS 36.331 [12], shall perform a service request procedure or tracking area update procedure as specified in 3GPP TS 24.301 [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 subclause 12.2.2.18;

c) shall generate a PC5_DISCOVERY message for Group Member Discovery Solicitation according to subclause 11.2.5.1. In the 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, configured in clause 5;

   2) shall set the Discovery Group ID parameter to the Discovery Group ID parameter identifying the discovery group to be solicited, configured in clause 5;

   3) shall set the Target User Info parameter or the Target Group Info parameter according to the target information provided by the upper layer application; and

   4) shall set the UTC-based counter LSB parameter to include the eight 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 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 [6]; and

e) shall pass the resulting PC5_DISCOVERY message for Group Member Discovery Solicitation to the lower layers for transmission over the PC5 interface with an indication that the message is for public safety use.

The UE shall ensure that it keeps on passing the same PC5_DISCOVERY message to the lower layers for transmission with an indication that the message is for public safety use 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. How this is achieved is left up to UE implementation.

Upon reception of a PC5_DISCOVERY message for Group Member Discovery Response according to subclause 11.2.5.1, for the target Discovery Group ID of the discovery group to be discovered, the UE shall use the associated DUSK, if configured, and the UTC-based counter obtained during the monitoring operation to unscramble the PC5_DISCOVERY message as described in 3GPP TS 33.303 [6]. 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 in 3GPP TS 33.303 [6]. Finally, if a DUIK is configured, the UE shall use the DUIK and UTC-based

counter to verify the MIC field in the unscrambled PC5_DISCOVERY message for Group Member Discovery Response.

Then if the Discovery Group ID parameter of the PC5_DISCOVERY message for Group Member Discovery Response is the same as the Discovery Group ID parameter of the 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.

10A.2.8.3 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 EMM-CONNECTED mode, the UE shall trigger the corresponding procedure in lower layers as specified in 3GPP TS 36.331 [12].

10A.2.9 Discoveree UE procedure for group member discovery

10A.2.9.1 General

The purpose of the discoveree UE procedure for group member discovery is to enable a ProSe-enabled public safety UE to respond to solicitation from other ProSe-enabled public safety UEs on proximity in a discovery group, upon a request from upper layers as defined in 3GPP TS 23.303 [2].

10A.2.9.2 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 E-UTRAN, is authorised to perform ProSe direct discovery for public safety use discoveree operation when the UE is not served by E-UTRAN as specified in clause 5, and is configured with the radio parameters to be used for ProSe direct discovery for public safety use when not served by E-UTRAN;

2) the UE is served by E-UTRAN, and is authorised to perform ProSe direct discovery for public safety use discoveree operation in the PLMN(s) indicated by the serving cell as specified in clause 5; or

3) the UE is:

- in EMM-IDLE mode, in limited service state as specified in 3GPP TS 23.122 [24], 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 36.304 [23];

ii) the UE received an ATTACH REJECT message or a TRACKING AREA UPDATE REJECT message or a SERVICE REJECT message with the EMM cause #11 "PLMN not allowed" as specified in 3GPP TS 24.301 [11] or a LOCATION UPDATING REJECT message or a GPRS ATTACH REJECT message or ROUTING AREA UPDATE REJECT message or SERVICE REJECT message with cause #11 "PLMN not allowed" as specified in 3GPP TS 24.008 [30]; or

iii) the UE received an ATTACH REJECT message or a TRACKING AREA UPDATE REJECT message or a SERVICE REJECT message with the EMM cause #7 "EPS services not allowed" as specified in 3GPP TS 24.301 [11] or a LOCATION UPDATING REJECT message or a GPRS ATTACH REJECT message or ROUTING AREA UPDATE REJECT message or SERVICE REJECT message with cause #7 "GPRS services not allowed" as specified in 3GPP TS 24.008 [30]; and

- authorised to perform ProSe direct discovery for public safety use discoveree operation when the UE is not served by E-UTRAN as specified in clause 5, and:

i) configured with the radio parameters to be used for ProSe direct discovery for public safety use when not served by E-UTRAN; or

ii) the lower layers indicate that the UE does not need to request resources for sending PC5_DISCOVERY messages for public safety as specified in 3GPP TS 36.331 [12]; and

NOTE: When the lower layers indicate that the UE does not need to request resources for sending PC5_DISCOVERY messages for public safety as specified in 3GPP TS 36.331 [12], the serving cell broadcasts a common radio resources pool for public safety discovery transmission and the UE can use this common radio resources pool while in limited service state.

b) the UE is configured with the Discovery Group ID parameter identifying the discovery group to be responded to and with the User Info ID for the group member discovery parameter, as specified in clause 5;

otherwise the UE is not authorised to perform the Discoveree UE procedure for group member discovery.

Figure 10A.2.9.2.1 illustrates the interaction of the UEs in the Discoveree UE procedure for group member discovery.

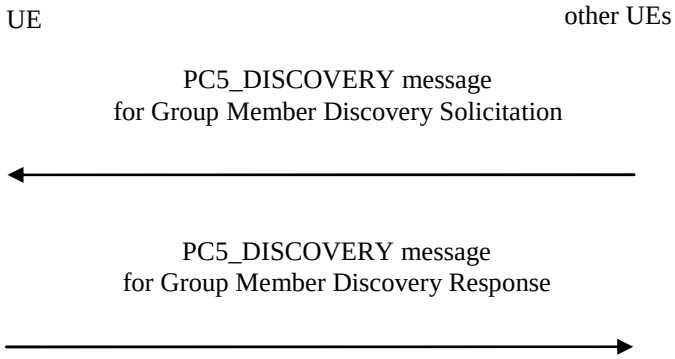

Figure 10A.2.9.2.1: Discoveree UE procedure for group member discovery

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 E-UTRAN, and the UE in EMM-IDLE mode needs to request resources for sending PC5_DISCOVERY messages for public safety as specified in 3GPP TS 36.331 [12], shall perform a service request procedure or tracking area update procedure as specified in 3GPP TS 24.301 [11]; and

b) shall instruct the lower layers to start monitoring for PC5_DISCOVERY messages with an indication that the message is for public safety use.

Upon reception of a PC5_DISCOVERY message for Group Member Discovery Solicitation according to subclause 11.2.5.1, for the Discovery Group ID of the discovery group which the UE is configured to respond for, the UE shall use the associated DUSK, if configured, and the UTC-based counter obtained during the monitoring operation to unscramble the PC5_DISCOVERY message as described in 3GPP TS 33.303 [6]. 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 in 3GPP TS 33.303 [6]. Finally, if a DUIK is configured, the UE shall use the DUIK and UTC-based counter to verify the MIC field in the unscrambled PC5_DISCOVERY message for Group Member Discovery Solicitation.

Then, if:

- the Discovery Group ID parameter of the received PC5_DISCOVERY message is the same as a Discovery Group ID parameter configured as specified in clause 5 for the discovery group;

- the Target User Info parameter is not included in the received PC5_DISCOVERY message or the Target User Info parameter of the received PC5_DISCOVERY message is the same as the User Info ID for the group member discovery parameter specified in clause 5; and

- the Target Group Info parameter is not included in the received PC5_DISCOVERY message or the Target Group Info parameter of the received PC5_DISCOVERY message is the same as a ProSe Layer-2 Group ID of the ProSe direct communication service authorisation specified in clause 5;

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 as specified in subclause 12.2.2.18;

b) shall generate a PC5_DISCOVERY message for Group Member Discovery Response according to subclause 11.2.5.1. In the PC5_DISCOVERY message for Group Member Discovery Response, the UE:

   1) shall set the ProSe UE ID to the Layer 2 ID used for unicast communication, configured in clause 5;

   2) shall set the Discoveree Info parameter to the User Info ID for the group member discovery parameter, configured in clause 5;

   3) shall set the Discovery Group ID parameter to the Discovery Group ID parameter of the PC5_DISCOVERY message for Group Member Discovery Solicitation; and

   4) shall set the UTC-based counter LSB parameter to include the eight least significant bits of the UTC-based counter;

c) shall apply the DUIK, DUSK, or DUCK with the associated Encrypted Bitmask, along with the UTC-based counter to the 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 [6]; and

d) shall pass the resulting PC5_DISCOVERY message for Group Member Discovery Response with an indication that the message is for public safety use to the lower layers for transmission over the PC5 interface.

10A.2.9.3 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 EMM-CONNECTED mode, the UE shall trigger the corresponding procedure in lower layers as specified in 3GPP TS 36.331 [12].

10A.2.10 Announcing UE procedure for Relay Discovery Additional Information

10A.2.10.1 General

The purpose of the announcing UE procedure for Relay Discovery Additional Information is to announce to the remote UEs additional information about:

- the MBMS traffic the ProSe UE-to-network relay is relaying; or

- the E-UTRAN Cell serving the ProSe UE-to-network relay

as defined in 3GPP TS 23.303 [2].

10A.2.10.2 Announcing procedure for Relay Discovery Additional Information

The ProSe UE-to-network relay announces the Relay Discovery Additional Information:

a) if the remote UE requests the ProSe UE-to-network relay to start monitoring a specific TMGI availability by the PC5-S TMGI Monitoring Request message, and as a response the ProSe UE-to-network relay acknowledges with the PC5-S TMGI Monitoring Response message and the TMGI is detected in the serving E-UTRAN cell, then the ProSe UE-to-network relay includes a pair of the TMGI and its corresponding ProSe Layer 2 Group ID

in the PC5_DISCOVERY message for Relay Discovery Additional Information until the timer T4105 expires (see the subclause 10.5); or

b) if the remote UE requests the ProSe UE-to-network relay to announce the E-UTRAN Cell Global ID (ECGI) of the cell serving the ProSe UE-to-network relay, and as a response the ProSe UE-to-network relay acknowledges with the PC5-S Cell ID Announcement Response message, then the ProSe UE-to-network relay includes the ECGI of the serving cell in the PC5_DISCOVERY message for Relay Discovery Additional Information until the timer T4107 expires (see the subclause 10.6).

NOTE 1: ProSe UE-to-network relay announces the Relay Discovery Additional Information only when it is in E-UTRAN coverage.

Figure 10A.2.10.2.1 illustrates the interaction of the ProSe UE-to-network relay and the remote UE in the announcing UE procedure for Relay Discovery Additional Information.

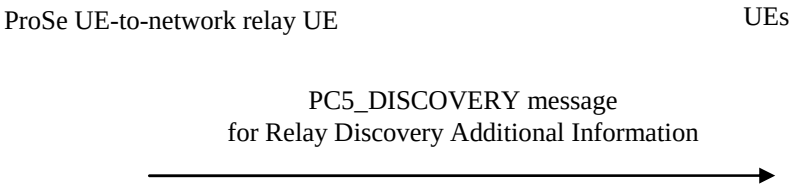

Figure 10A.2.10.2.1: Announcing procedure for Relay Discovery Additional Information

The ProSe UE-to-network relay UE may start announcing Relay Discovery Additional Information if:

a) the ProSe UE-to-network relay UE is currently authorised to perform ProSe direct discovery Model A announcing in the serving PLMN if the UE is served by E-UTRAN; and

   1) TMGI monitoring has been requested and responded to remote UEs, the ProSe UE-to-network relay UE detects the corresponding TMGI in the serving cell and the timer T4105 has not expired; or

   2) ECGI announcement for the serving cell of the ProSe UE-to-network relay UE has been requested and responded to remote UEs, the timer T4107 has not expired.

When the ProSe UE-to-network relay has some additional information to broadcast (i.e. either a pair of TMGI and its corresponding ProSe Layer 2 Group ID or ECGI), then the ProSe UE-to-network relay:

a) shall request the parameters from the lower layers for ProSe direct discovery announcing for public safety use (see 3GPP TS 36.331 [12]). The ProSe UE-to-network relay performs the announcing UE procedure for Relay Discovery Additional Information only if the lower layers indicate that ProSe direct discovery is supported by the network. If the ProSe UE-to-network relay in EMM-IDLE mode needs to request resources for sending PC5_DISCOVERY messages as specified in 3GPP TS 36.331 [12], the ProSe UE-to-network relay shall perform a service request procedure or tracking area update procedure as specified in 3GPP TS 24.301 [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 subclause 12.2.2.18;

c) shall generate PC5_DISCOVERY message(s) for Relay Discovery Additional Information according to subclause 11.2.5.1. In the PC5_DISCOVERY message for Relay Discovery Additional Information, the ProSe UE-to-network relay shall:

   1) include the Relay Service Code and the ProSe Relay UE ID used for ProSe direct communication which the 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 subclause 5;

   3) set the Relay Discovery Additional Information contents by the additional information to broadcast; and

4) shall set the UTC-based counter LSB parameter to include the eight 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 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 [6]; and

e) shall pass the resulting PC5_DISCOVERY message for Relay Discovery Additional Information to the lower layers for transmission over the PC5 interface with an indication that the message is for public safety use.

The ProSe UE-to-network relay shall ensure that it keeps on passing the PC5_DISCOVERY messages to the lower layers for transmission until the corresponding timer (i.e. timer T4105 when the additional information is a pair of TMGI and its corresponding ProSe Layer 2 Group ID and timer T4107 when the additional information is ECGI) expires.

During the announcing operation, if one of the above conditions is no longer met, the ProSe UE-to-network relay may instruct the lower layers to stop announcing. When the ProSe UE-to-network relay stops announcing, if the lower layers indicate that the ProSe UE-to-network relay is required to send a discovery indication to the eNodeB and the ProSe UE-to-network relay is in EMM-CONNECTED mode, the ProSe UE-to-network relay shall trigger the corresponding procedure in lower layers as specified in 3GPP TS 36.331 [12].

10A.2.11Monitoring UE procedure for Relay Discovery Additional Information

10A.2.11.1 General

The purpose of the monitoring UE procedure for Relay Discovery Additional Information is to enable a remote UE to become aware of MBMS traffics the ProSe UE-to-network relay is relaying or the E-UTRAN Cell serving the ProSe UE-to-network relay as defined in 3GPP TS 23.303 [2].

10A.2.11.2 Monitoring procedure for Relay Discovery Additional Information

The remote UE monitors Relay Discovery Additional Information:

a) until the TMGI_monitoring_refresh timer T4104 expires if the remote UE has requested the ProSe UE-to-network relay to start monitoring a specific TMGI availability by the PC5-S TMGI Monitoring Request message and received the PC5-S TMGI Monitoring Response message from the ProSe UE-to-network relay; or

b) until the ECGI_announcement_request_refresh timer T4106 expires if the remote UE has requested the ProSe UE-to-network relay to announce the ECGI of the cell serving the ProSe UE-to-network relay and received the PC5-S Cell ID Announcement Response message from the ProSe UE-to-network relay.

The UE may instruct the lower layers to start monitoring with an indication that the message is for relay discovery for public safety use 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 ProSe direct discovery Model A monitoring in at least one PLMN if the UE is served by E-UTRAN;

2) the UE is currently authorised to perform ProSe direct discovery Model A monitoring if the UE is not served by E-UTRAN; or

3) the UE is:

- in EMM-IDLE mode, in limited service state as specified in 3GPP TS 23.122 [24], 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 36.304 [23];

ii) the UE received an ATTACH REJECT message or a TRACKING AREA UPDATE REJECT message or a SERVICE REJECT message with the EMM cause #11 "PLMN not allowed" as specified in 3GPP TS 24.301 [11] or a LOCATION UPDATING REJECT message or a GPRS

ATTACH REJECT message or ROUTING AREA UPDATE REJECT message or SERVICE REJECT message with cause #11 "PLMN not allowed" as specified in 3GPP TS 24.008 [30]; or

iii) the UE received an ATTACH REJECT message or a TRACKING AREA UPDATE REJECT message or a SERVICE REJECT message with the EMM cause #7 "EPS services not allowed" as specified in 3GPP TS 24.301 [11] or a LOCATION UPDATING REJECT message or a GPRS ATTACH REJECT message or ROUTING AREA UPDATE REJECT message or SERVICE REJECT message with cause #7 "GPRS services not allowed" as specified in 3GPP TS 24.008 [30].

- authorised to perform ProSe direct discovery Model A monitoring when the UE is not served by E-UTRAN as specified in clause 5, and:

  i) configured with the radio parameters to be used for ProSe direct discovery for public safety use when not served by E-UTRAN; or

  ii) the lower layers indicate that public safety discovery operation is supported; and

NOTE 1: When the lower layers indicate that public safety discovery operation is supported, the serving cell broadcasts a common radio resources pool for public safety discovery reception and the UE can use this common radio resources pool while in limited service state.

If the UE is in EMM-CONNECTED mode, the monitoring UE shall also trigger the corresponding procedure in lower layers as specified in 3GPP TS 36.331 [12].

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 EMM-CONNECTED mode, the UE shall trigger the corresponding procedure in lower layers as specified in 3GPP TS 36.331 [12].

Upon reception of a PC5_DISCOVERY message for Relay Discovery Additional Information according to subclause 11.2.5.1, 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 PC5_DISCOVERY message as described in 3GPP TS 33.303 [6]. 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 [6]. Finally, if a DUIK is configured, the UE shall use the DUIK and UTC-based counter to verify the MIC field in the unscrambled PC5_DISCOVERY message for Relay Discovery Additional Information.

NOTE 2: The use of an erroneous UTC-based counter for processing received PC5_DISCOVERY messages at the ProSe-enabled Public Safety 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 Public Safety UE ensures the accuracy of the UTC-based counter is left to UE implementation.

Then, if:

- the Relay Service Code parameter of the PC5_DISCOVERY message for Relay Discovery Additional Information is the same as the Relay Service Code parameter configured as specified in clause 5 for the connectivity service being monitored; and

- the ProSe Relay UE ID parameter of the PC5_DISCOVERY message for Relay Discovery Additional Information is the same as the ProSe Relay UE ID parameter identifying the relay the remote UE intends to communicate with;

then the UE shall consider that the Relay Discovery Additional Information it intends to monitor has been discovered.

If the remote UE detects Relay Discovery Additional Information matched with the requested TMGI, then the remote UE starts to receive the MBMS traffic via the corresponding ProSe Layer-2 Group ID. When the ProSe-enabled public safety UE receives a PC5_DISCOVERY message for Relay Discovery Additional Information containing its interested TMGI, the UE may start to receive the MBMS traffic via the corresponding ProSe Layer-2 Group ID even if it does not have a PC5 link established with the ProSe UE-to-network relay or is not authorized to use a ProSe UE-to-network relay.

10A.2.12UE-to-network relay selection procedure

10A.2.12.1 General

The purpose of the UE-to-network relay selection procedure is to enable a remote UE to select a suitable ProSe UE-to-network relay UE to obtain a connectivity service to EPC.

10A.2.12.2 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:

- the UE is authorised to act as a remote UE towards a ProSe UE-to-network relay UE as specified in clause 5;
- the UE has obtained a list of 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 subclause 10A.2.3 or the discoverer procedure for UE-to-network relay discovery as specified in subclause 10A.2.4; and
- the UE has obtained a list of ProSe UE-to-network relay UE candidate(s) fulfilling lower layers criteria as specified in 3GPP TS 36.331 [12].

10A.2.12.3 UE-to-network relay selection procedure completion

If there exists only one ProSe UE-to-network relay candidate satisfying the conditions in subclause 10A.2.12.2, then that ProSe UE-to-network relay UE is selected. If there exist more than one ProSe UE-to-network relay candidate satisfying the conditions in subclause 10A.2.12.2, 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 PC5_DISCOVERY message for UE-to-Network Relay Discovery Announcement or PC5_DISCOVERY message for UE-to-Network Relay Discovery Response into account when deciding which 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 ProSe UE-to-network relay UE to select.

10A.2.13UE-to-network relay reselection procedure

10A.2.13.1 General

The purpose of the UE-to-network relay reselection procedure is to enable a remote UE to reselect a ProSe UE-to-network relay UE to obtain a connectivity service to EPC when the serving ProSe UE-to-network relay UE is no longer suitable.

10A.2.13.2 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 ProSe UE-to-network relay UE no longer fulfills the lower layers criteria as specified in 3GPP TS 36.331 [12];

b) the parameters related to ProSe UE-to-network relay in the ProSe direct discovery for public safety use service authorisation (e.g., Relay Service Code, User Info ID, etc.) have been updated and the serving ProSe UE-to-network relay UE no longer fulfills the conditions specified in subclause 10A.2.3;

c) the UE has received a DIRECT_COMMUNICATION_REJECT message from the ProSe UE-to-network relay UE with the cause value "Direct communication to target UE not allowed";

d) the UE has received a DIRECT_COMMUNICATION_RELEASE message from the ProSe UE-to-network relay UE with the cause value "Direct communication with the peer UE is no longer allowed";

e) the UE has received a DIRECT_COMMUNICATION_RELEASE message from the ProSe UE-to-network relay UE with the cause value "Direct connection is not available any more";

f) the UE has not received any response from the ProSe UE-to-network relay UE after M consecutive retransmissions of DIRECT COMMUNICATION SETUP or DIRECT COMMUNICATION KEEPALIVE messages; or

g) the UE has not received any response from the ProSe UE-to-network relay UE after M consecutive retransmissions of PC5_DISCOVERY message for UE-to-Network Relay Discovery Solicitation used to trigger the 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.

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) and d), the remote UE shall exclude the ProSe UE-to-network relay UE which sent the message specified in cases c) or d) from the UE-to-network relay reselection process described below.

To conduct UE-to-network relay reselection process, the UE shall first initiate one of the following procedures or both depending on UE's service authorisation for ProSe direct discovery for public safety use:

- monitoring procedure for UE-to-network relay discovery as specified in subclause 10A.2.3; or
- discoverer procedure for UE-to-network relay discovery as specified in subclause 10A.2.4.

After the execution of the above discovery procedure(s), the remote UE performs the UE-to-network relay selection procedure as specified in subclause 10A.2.3.

11 Message functional definitions and contents

11.1 Overview

This clause contains the definition and contents of the messages used in the procedures described in the present document.

11.2 ProSe discovery messages

11.2.1 General

This subclause defines the XML schema and MIME type related to ProSe direct discovery messages and EPC-level ProSe discovery messages.

This subclause also defines the format of the PC5_DISCOVERY message transmitted over the PC5 interface.

11.2.2 application/3gpp-prose+xml

The MIME type is used to carry information related to the ProSe discovery operation. It shall be coded as an XML document containing one of the following ProSe discovery messages:

- DISCOVERY_REQUEST;
- DISCOVERY_RESPONSE;
- MATCH_REPORT;
- MATCH_REPORT_ACK;
- DISCOVERY_UPDATE_REQUEST;
- DISCOVERY_UPDATE_RESPONSE;
- ANNOUNCING_ALERT_REQUEST;

- ANNOUNCING_ALERT_RESPONSE;
- UE_REGISTRATION_REQUEST;
- UE_REGISTRATION_RESPONSE;
- APPLICATION_REGISTRATION_REQUEST;
- APPLICATION_REGISTRATION_RESPONSE;
- PROXIMITY_REQUEST;
- PROXIMITY_REQUEST_RESPONSE;
- PROXIMITY_ALERT;
- UE_DEREGISTRATION_REQUEST;
- UE_DEREGISTRATION_RESPONSE;
- CANCEL_PROXIMITY_REQUEST;
- CANCEL_PROXIMITY_RESPONSE;
- PROXIMITY_REQUEST_VALIDATION; or
- PROXIMITY_REQUEST_VALIDATION_RESPONSE.

Each of those messages is presented in the XML document as an XML element named after the corresponding message.

11.2.3 XML Schema

Implementations in compliance with the present document shall implement the XML schema defined below for messages used in ProSe direct discovery procedures over PC3 interface.

```
<?xml version="1.0" encoding="UTF-8"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema"
           xmlns="urn:3GPP:ns:ProSe:Discovery:2014"
           elementFormDefault="qualified"
           targetNamespace="urn:3GPP:ns:ProSe:Discovery:2014">
       <xs:annotation>
           <xs:documentation>
               Info for 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="IMSI-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-T4002" 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="RestictedDiscFilter-info">
    <xs:sequence>
       <xs:element name="filter" type="MatchingFilter-info" maxOccurs="unbounded"/>
       <xs:element name="TTL-timer-T4009" type="xs:integer"/>
       <xs:element name="restricted-security" type="Security-info" minOccurs="0" />
       <xs:element name="RPAUID" type="xs:string" minOccurs="0" />
       <xs:element name="DUSK" type="xs:hexBinary" minOccurs="0" />
       <xs:element name="DUIK" type="xs:hexBinary" minOccurs="0" />
       <xs:element name="MIC-check-indicator" type="xs:boolean" minOccurs="0" />
       <xs:element name="DUCK" type="DUCK-info" 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-T4007" 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-T4000" 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="hexBinary" />
    <xs:element name="ProSe-Response-Code" type="hexBinary" />
    <xs:element name="anyExt" type="anyExtType" />
    <xs:any namespace="##other" processContents="lax"/>
  </xs:choice>
</xs:complexType>


<xs:complexType name="WLANAssistance-info">
  <xs:sequence>
    <xs:element name="ssid" type="xs:string"/>
    <xs:element name="WLAN-secret-key" type="xs:string"/>
    <xs:element name="group-owner-indication" type="xs:boolean"/>
    <xs:element name="P2P-device-address-self" type="xs:hexBinary" minOccurs="0"/>
    <xs:element name="P2P-device-address-peer" type="xs:hexBinary" minOccurs="0"/>
    <xs:element name="operation-channel" type="xs:integer"/>
    <xs:element name="validity-time" 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="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-T4013" type="xs:integer"/>
    <xs:element name="restricted-security" type="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="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>


  <!-- 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-T4000" 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:any namespace="##any" 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="IMSI-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="IMSI-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:any namespace="##any" 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-T4007" type="xs:integer" minOccurs="0"/>
      <xs:element name="ACE-enabled-indicator" type="xs:integer" minOccurs="0" />
      <xs:element name="restricted- code-security-material" type="Restricted-Security-info"
minOccurs="0" />
      <xs:element name="on-demand-announcing-enabled-indicator" type="xs:boolean" minOccurs="0" />
      <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="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="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="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-T4011" type="xs:integer"/>
      <xs:element name="restricted- code-security-material " type=" Restricted-Security-Info"
minOccurs="0" />
      <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="RestrictedDiscovererRsp-info">
    <xs:sequence>
      <xs:element name="transaction-ID" type="xs:integer"/>
      <xs:element name="subquery-result" type="Subquery-info" minOccurs="0" maxOccurs="unbounded"/>
      <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="RejectRsp-info">
    <xs:sequence>
      <xs:element name="transaction-ID" type="xs:integer"/>
      <xs:element name="PC3-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="prose-function-transaction-ID" type="xs:integer"/>
      <xs:element name="PC3-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="IMSI-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="IMSI-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:any namespace="##any" 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-T4004" 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-T4006" 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-T4016" 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-T4017" 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="PC3-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="prose-function-transaction-ID" type="xs:integer"/>
      <xs:element name="UE-identity" type="IMSI-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="prose-function-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="prose-function-transaction-ID" type="xs:integer"/>
      <xs:element name="RPAUID" type="xs:string"/>
      <xs:element name="UE-identity" type="IMSI-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="prose-function-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>


<!-- Complex types defined for EPC-level Discovery transaction-level -->

  <xs:complexType name="UeRegReq-info">
    <xs:sequence>
      <xs:element name="transaction-ID" type="xs:integer"/>
      <xs:element name="UE-identity" type="IMSI-info" />
      <xs:element name="WLAN-Link-Layer-ID" type="xs:hexBinary" minOccurs="0"/>
      <xs:element name="method-for-server-initiated-transaction" type="xs:integer"/>
      <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="UeRegRsp-info">
    <xs:sequence>
      <xs:element name="transaction-ID" type="xs:integer"/>
      <xs:element name="EPC-ProSe-User-ID" type="xs:hexBinary"/>
      <xs:element name="server-initiated-method-config" 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="UeRegReject-info">
    <xs:sequence>
      <xs:element name="transaction-ID" type="xs:integer"/>
      <xs:element name="PC3-EPC-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="AppRegReq-info">
    <xs:sequence>
      <xs:element name="transaction-ID" type="xs:integer"/>
      <xs:element name="EPC-ProSe-User-ID" type="xs:hexBinary"/>
      <xs:element name="application-identity" type="AppID-info"/>
      <xs:element name="Application-Layer-User-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="AppRegRsp-info">
    <xs:sequence>
      <xs:element name="transaction-ID" type="xs:integer"/>
      <xs:element name="allowed-range-class" type="xs:integer" 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="AppRegReject-info">
  <xs:sequence>
    <xs:element name="transaction-ID" type="xs:integer"/>
    <xs:element name="PC3-EPC-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="ProximityReq-info">
  <xs:sequence>
    <xs:element name="transaction-ID" type="xs:integer"/>
    <xs:element name="EPC-ProSe-User-ID" type="xs:hexBinary"/>
    <xs:element name="application-identity" type="AppID-info"/>
    <xs:element name="Application-Layer-User-ID-A" type="xs:string"/>
    <xs:element name="Application-Layer-User-ID-B" type="xs:string"/>
    <xs:element name="requested-range-class" type="xs:integer"/>
    <xs:element name="UE-A-location" type="xs:string"/>
    <xs:element name="time-window" type="xs:integer"/>
    <xs:element name="WLAN-indication" 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="ProximityReqAccept-info">
  <xs:sequence>
    <xs:element name="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>

<xs:complexType name="ProximityReqReject-info">
  <xs:sequence>
    <xs:element name="transaction-ID" type="xs:integer"/>
    <xs:element name="PC3-EPC-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="ProximityAlert-info">
  <xs:sequence>
    <xs:element name="transaction-ID" type="xs:integer"/>
    <xs:element name="application-identity" type="AppID-info"/>
    <xs:element name="Application-Layer-User-ID-A" type="xs:string"/>
    <xs:element name="Application-Layer-User-ID-B" type="xs:string"/>
    <xs:element name="assistance-information" type="WLANAssistance-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="UeDeregReq-info">
  <xs:sequence>
    <xs:element name="transaction-ID" type="xs:integer"/>
    <xs:element name="EPC-ProSe-User-ID" type="xs:hexBinary"/>
    <xs:element name="PC3-EPC-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="UeDeregRsp-info">
  <xs:sequence>
    <xs:element name="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>

<xs:complexType name="CancelProximityReq-info">
  <xs:sequence>
```

```
      <xs:element name="transaction-ID" type="xs:integer"/>
      <xs:element name="EPC-ProSe-User-ID-A" type="xs:hexBinary"/>
      <xs:element name="application-identity" type="AppID-info"/>
      <xs:element name="EPC-ProSe-User-ID-B" type="xs:hexBinary"/>
      <xs:any namespace="##any" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>

  <xs:complexType name="CancelProximityRsp-info">
    <xs:sequence>
      <xs:element name="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>

  <xs:complexType name="ProximityReqValidation-info">
    <xs:sequence>
      <xs:element name="transaction-ID" type="xs:integer"/>
      <xs:element name="application-identity" type="AppID-info"/>
      <xs:any namespace="##any" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>

  <xs:complexType name="ProximityReqValidationRspAccept-info">
    <xs:sequence>
      <xs:element name="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>

  <xs:complexType name="ProximityReqValidationRspReject-info">
    <xs:sequence>
      <xs:element name="transaction-ID" type="xs:integer"/>
      <xs:element name="PC3-EPC-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>


<!-- Complex types defined for EPC level Discovery Message-level -->

  <xs:complexType name="prose-epc-level-ue-registration-request">
    <xs:sequence>
     <xs:element name="ue-registration-request" type="UeRegReq-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-epc-level-ue-registration-response">
    <xs:sequence>
     <xs:element name="response-register" type="UeRegRsp-info" minOccurs="0" maxOccurs="unbounded"/>
     <xs:element name="response-reject" type="UeRegReject-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-epc-level-application-registration-request">
    <xs:sequence>
     <xs:element name="application-registration-request" type="AppRegReq-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-epc-level-application-registration-response">
    <xs:sequence>
```

```
     <xs:element name="response-register" type="AppRegRsp-info" minOccurs="0"
maxOccurs="unbounded"/>
     <xs:element name="response-reject" type="AppRegReject-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-epc-level-proximity-request">
    <xs:sequence>
     <xs:element name="proximity-request" type="ProximityReq-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-epc-level-proximity-request-response">
    <xs:sequence>
     <xs:element name="response-accept" type="ProximityReqAccept-info" minOccurs="0"
maxOccurs="unbounded"/>
     <xs:element name="response-reject" type="ProximityReqReject-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-epc-level-proximity-alert">
    <xs:sequence>
     <xs:element name="proximity-alert" type="ProximityAlert-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-epc-level-ue-deregistration-request">
    <xs:sequence>
     <xs:element name="ue-deregistration-request" type="UeDeregReq-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-epc-level-ue-deregistration-response">
    <xs:sequence>
     <xs:element name="ue-deregistration-response" type="UeDeregRsp-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-epc-level-cancel-proximity-request">
    <xs:sequence>
     <xs:element name="cancel-proximity-request" type="CancelProximityReq-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-epc-level-cancel-proximity-response">
    <xs:sequence>
     <xs:element name="cancel-proximity-response" type="CancelProximityRsp-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-epc-level-proximity-request-validation">
    <xs:sequence>
     <xs:element name="proximity-request-validation" type="ProximityReqValidation-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-epc-level-proximity-request-validation-response">
    <xs:sequence>
     <xs:element name="response-accept" type="ProximityReqValidationRspAccept-info" minOccurs="0"
maxOccurs="unbounded"/>
     <xs:element name="response-reject" type="ProximityReqValidationRspReject-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>


<!--  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="UE_REGISTRATION_REQUEST" type="prose-epc-level-ue-registration-request"/>
        <xs:element name="UE_REGISTRATION_RESPONSE" type="prose-epc-level-ue-registration-
response"/>
        <xs:element name="APPLICATION_REGISTRATION_REQUEST" type="prose-epc-level-application-
registration-request"/>
        <xs:element name="APPLICATION_REGISTRATION_RESPONSE" type="prose-epc-level-application-
registration-response"/>
        <xs:element name="PROXIMITY_REQUEST" type="prose-epc-level-proximity-request"/>
        <xs:element name="PROXIMITY_REQUEST_RESPONSE" type="prose-epc-level-proximity-request-
response"/>
        <xs:element name="PROXIMITY_ALERT" type="prose-epc-level-proximity-alert"/>
        <xs:element name="UE_DEREGISTRATION_REQUEST" type="prose-epc-level-ue-deregistration-
request"/>
        <xs:element name="UE_DEREGISTRATION_RESPONSE" type="prose-epc-level-ue-deregistration-
response"/>
        <xs:element name="CANCEL_PROXIMITY_REQUEST" type="prose-epc-level-cancel-proximity-
request"/>
        <xs:element name="CANCEL-PROXIMITY_REQUEST" type="prose-epc-level-cancel-proximity-
response"/>
        <xs:element name="PROXIMITY_REQUEST_VALIDATION" type="prose-epc-level-proximity-request-
validation"/>
        <xs:element name="PROXIMITY_REQUEST_VALIDATION_RESPONSE" type="prose-epc-level-proximity-
request-validation-response"/>
        <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.

11.2.4 Semantics

11.2.4.1 General

The <prose-discovery-message> element is the root element of this XML document and it can be one of the following elements:

- <DISCOVERY_REQUEST>;
- <DISCOVERY_RESPONSE>;
- <MATCH_REPORT>;
- <MATCH_REPORT_ACK>;
- <UE_REGISTRATION_REQUEST>;
- <UE_REGISTRATION_RESPONSE>;
- <APPLICATION_REGISTRATION_REQUEST>;
- <APPLICATION_REGISTRATION_RESPONSE>;
- <PROXIMITY_REQUEST>;
- <PROXIMITY_REQUEST_RESPONSE>;
- <PROXIMITY_ALERT>;
- <UE_DEREGISTRATION_REQUEST>;
- <UE_DEREGISTRATION_RESPONSE>;
- <CANCEL_PROXIMITY_REQUEST>;
- <CANCEL_PROXIMITY_RESPONSE>;
- <PROXIMITY_REQUEST_VALIDATION>;
- <PROXIMITY_REQUEST_VALIDATION_RESPONSE>;
- <DISCOVERY_UPDATE_REQUEST>;
- <DISCOVERY_UPDATE_RESPONSE>
- <ANNOUNCE_ALERT_REQUEST>;
- <ANNOUNCE_ALERT_RESPONSE>;
- <message-ext> element containing other discovery message defined in future releases; or
- an element from other namespaces defined in future releases.

11.2.4.2 Semantics of <DISCOVERY_REQUEST>

The <DISCOVERY_REQUEST> element contains one or more of the following elements:

1) zero, one or more <discovery-request> element which contains transactions sent from the UE to the ProSe Function as announcing or monitoring requests for open ProSe direct discovery. Each <discovery-request> consists of:

   a) a <transaction-ID> element containing the parameter defined in subclause 12.2.2.1;

   b) a <command> element containing the parameter defined in subclause 12.2.2.2;

   c) a <UE-identity> element containing the parameter defined in subclause 12.2.2.3;

d) a <Prose-Application-ID> element containing the parameter defined in subclause 12.2.2.4;

e) an <application-identity> element containing the parameter defined in subclause 12.2.2.5;

f) a <Discovery-Entry-ID> element containing the parameter defined in subclause 12.2.2.33;

g) an optional <Requested-Timer> element containing the parameter defined in subclause 12.2.2.27;

h) an optional <metadata> element containing the parameter defined in subclause 12.2.2.21;

i) an optional <Announcing-PLMN-ID> element containing the parameter defined in subclause 12.2.2.64;

j) zero or one <ACE-enabled-indicator> element containing the parameter defined in subclause 12.2.2.38;

k) zero or one <anyExt> element containing elements defined in future releases;

l) zero, one or more elements from other namespaces defined in future releases; and

m) zero, one or more attributes defined in future releases;

2) zero, one, or more <restricted-discovery-request> element which contains transactions sent from the UE to the ProSe Function as announcing or monitoring requests for restricted ProSe directed discovery model A or transactions sent from the UE to the ProSe Function as discoveree or discoverer requests for restricted ProSe directed discovery model B. Each <restricted-discovery-request> consists of:

a) a <transaction-ID> element containing the parameter defined in subclause 12.2.2.1;

b) a <command> element containing the parameter defined in subclause 12.2.2.2;

c) a <UE-identity> element containing the parameter defined in subclause 12.2.2.3;

d) a <RPAUID> element containing the parameter defined in subclause 12.2.2.30;

e) an <application-identity> element containing the parameter defined in subclause 12.2.2.5;

f) a <discovery-type> element containing the parameter defined in subclause 12.2.2.25;

g) zero or one <ACE-enabled-indicator> element containing the parameter defined in subclause 12.2.2.38;

h) an <announcing-type> element containing the parameter defined in subclause 12.2.2.31;

i) an <application-level-container> element containing the parameter defined in subclause 12.2.2.32;

j) zero or one <discovery-model> element containing the parameter defined in subclause 12.2.2.41;

k) zero or one <Announcing-PLMN-ID> element containing the parameter defined in subclause 12.2.2.64;

l) a <discovery-entry-id> element containing the parameter defined in subclause 12.2.2.33;

m) an optional <Requested-Timer> element containing the parameter defined in subclause 12.2.2.27;

n) zero, one or more elements defined in future releases; and

o) zero, one or more attributes defined in future releases;

3) zero or one <anyExt> element containing elements defined in future releases;

4) zero, one or more elements from other namespaces defined in future releases;

5) an optional "network-initiated transaction method" attribute containing the parameter defined in subclause 12.2.2.63; and

6) zero, one or more attributes defined in future releases.

11.2.4.3 Semantics of <DISCOVERY_RESPONSE>

The <DISCOVERY_RESPONSE> element contains one or more of the following elements:

1) a <Current-Time> element containing the parameter defined in subclause 12.2.2.23;

2) a <Max-Offset> element containing the parameter defined in subclause 12.2.2.24;

3) zero, one or more <response-announce> element which contains transactions sent from the ProSe Function to the UE as a response to an announcing request if the ProSe Function accepts the request. Each <response-announce> consists of:

   a) a <transaction-ID> element containing the parameter defined in subclause 12.2.2.1;

   b) zero, one or more <ProSe-Application-Code> elements containing the parameter defined in subclause 12.2.2.6;c)zero or one <ProSe Application Code-ACE> element containing the parameter defined in subclause 12.2.2.70;

   d) zero, or one <validity-timer-T4000> element containing the parameter defined in 12.2.2.7;

   e) zero, or, one <discovery-key> element containing the parameter defined in subclause 12.2.2.9;

   f) a <Discovery-Entry-ID> element containing the parameter defined in subclause 12.2.2.33;

   g) zero or one <ACE-enabled-indicator> element containing the parameter defined in subclause 12.2.2.38;

   h) zero or one <anyExt> element containing elements defined in future releases;

   i) zero, one or more elements from other namespaces defined in future releases; and

   j) zero, one or more attributes defined in future releases;

4) zero, one or more <response-monitor> element which contains transactions sent from the ProSe Function to the UE as a response to a monitoring request if the ProSe Function accepts the request. Each <response-monitor> consists of:

   a) a <transaction-ID> element containing the parameter defined in subclause 12.2.2.1;

   b) zero, one or more <discovery-filter> elements containing the parameter defined in subclause 12.2.2.12;

   c) a <Discovery-Entry-ID> element containing the parameter defined in subclause 12.2.2.33;

   d) zero or one <ACE-enabled-indicator> element containing the parameter defined in subclause 12.2.2.38;

   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;

5) zero, one or more <restricted-announce-response> element which contains transactions sent from the ProSe Function to the UE as a response to an announcing request for restricted ProSe direct discovery model A if the ProSe Function accepts the request. Each <restricted-announce-response> consists of:

   a) a <transaction-ID> element containing the parameter defined in subclause 12.2.2.1;

   b) zero or one <ProSe-Restricted-Code> element containing the parameter defined in subclause 12.2.2.34;

   c) zero, one or more <ProSe-Restricted-Code-Suffix-Range> element containing the parameter defined in subclause 12.2.2.35;

   d) zero or one <validity-timer-T4007> element containing the parameter defined in 12.2.2.39;

   e) zero or one <ACE-enabled-indicator> element containing the parameter defined in subclause 12.2.2.38;

   f) zero or one <restricted-code-security-material> element containing the parameter defined in subclause 12.2.2.40;

   g) an optional <on-demand-announcing-enabled-indicator> element containing the parameter defined in subclause 12.2.2.36;

   h) a <discovery-entry-id> element containing the parameter defined in subclause 12.2.2.33;

i) zero, one or more elements defined in future releases; and

j) zero, one or more attributes defined in future releases;

6) zero, one or more <restricted-monitor-response> element which contains transactions sent from the ProSe Function to the UE as a response to a monitoring request for restricted ProSe direct discovery model A if the ProSe Function accepts the request. Each <restricted-monitor-response> consists of:

a) a <transaction-ID> element containing the parameter defined in subclause 12.2.2.1;

b) zero, one or more <restricted-discovery-filter> elements containing the parameter defined in subclause 12.2.2.37;

c) zero or one <ACE-enabled-indicator> element containing the parameter defined in subclause 12.2.2.38

d) a <discovery-entry-id> element containing the parameter defined in subclause 12.2.2.33;

e) an <application-level-container> element containing the parameter defined in subclause 12.2.2.32;

f) zero, one or more elements defined in future releases; and

g) zero, one or more attributes defined in future releases;

7) zero, one or more <restricted-discoveree-response> element which contains transactions sent from the ProSe Function to the UE as a response to a discoveree UE's request for restricted ProSe direct discovery model B if the ProSe Function accepts the request. Each <restricted-discoveree-response> consists of:

a) a <transaction-ID> element containing the parameter defined in subclause 12.2.2.1;

b) a <ProSe-Response-Code> element containing the element defined in subclause12.2.2.42;

c) one or more <query-filter> elements containing the parameter defined in subclause 12.2.2.43;

d) a <validity-timer-T4011> element containing the parameter defined in subclause 12.2.2.44;

e) zero or one <restricted-code-security-material> element containing the parameter defined in subclause 12.2.2.40;

f) a <discovery-entry-id> element containing the parameter defined in subclause 12.2.2.33;

g) zero, one or more elements defined in future releases; and

h) zero, one or more attributes defined in future releases;

8) zero, one or more <restricted-discoverer-response> element which contains transactions sent from the ProSe Function to the UE as a response to a discoverer UE's request for restricted ProSe direct discovery model B if the ProSe Function accepts the request. Each <restricted-discoverer-response> consists of:

a) a <transaction-ID> element containing the parameter defined in subclause 12.2.2.1;

b) one or more <subquery-result> elements containing the parameter defined in subclause 12.2.2.45;

c) a <discovery-entry-id> element containing the parameter defined in subclause 12.2.2.33;

d) zero, one or more elements defined in future releases; and

e) zero, one or more attributes defined in future releases;

9) zero, one or more <response-reject> element which contains transactions sent from the ProSe Function to the UE as a response to an announcing or monitoring requests if the ProSe Function cannot accept the request. Each <response-reject> consists of:

a) a <transaction-ID> element containing the parameter defined in subclause 12.2.2.1;

b) a <PC3-control-protocol-cause-value> element containing the parameter defined in subclause 12.2.2.8.

c) zero, one or more elements defined in future releases; and

d) zero, one or more attributes defined in future releases;

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;

12) an optional "network-initiated transaction method" attribute containing the parameter defined in subclause 12.2.2.63; and

13) zero, one or more attributes defined in future releases.

11.2.4.4 Semantics of <MATCH_REPORT>

The <MATCH_REPORT> element contains one or more of the following element:

1) zero, one or more <match-report> element which contains transactions sent from the UE to the ProSe Function to report a matching of the direct discovery. Each <match-report> consists of:

   a) a <transaction-ID> element containing the parameter defined in subclause 12.2.2.1;

   b) a <ProSe-Application-Code> element containing the parameter defined in subclause 12.2.2.6;

   c) a <UE-identity> element containing the parameter defined in subclause 12.2.2.3;

   d) a <Monitored-PLMN-id> element containing the parameter defined in subclause 12.2.2.16;

   e) an optional <VPLMN-id> element containing the parameter defined in subclause 12.2.2.17;

   f) a <MIC> element containing the parameter defined in subclause 12.2.2.11;

   g) a <UTC-based-counter> element containing the parameter defined in subclause 12.2.2.18;

   h) a <metadata-flag> element containing the parameter defined in subclause 12.2.2.20;

   i) a <MessageType> element containing the parameter defined in subclause 12.2.2.10;

   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; and

   l) zero, one or more attributes defined in future releases;

2) zero, one or more <restricted-match> element which contain transactions sent from the UE to the ProSe Function to report a matching of the restricted direct discovery model A or model B. Each <restricted-match> consists of:

   a) a <transaction-ID> element containing the parameter defined in subclause 12.2.2.1;

   b) a <UE-identity> element containing the parameter defined in subclause subclause 12.2.2.3;

   c) a <discovery-type> element containing the parameter defined in subclause 12.2.2.25

   d) an <application-identity> element containing the parameter defined in subclause 12.2.2.5

   e) an <RPAUID> element containing the parameter defined in subclause 12.2.2.30;

   f) a <Restricted-Code-Discovered> element containing the ProSe Restricted Code parameter defined in subclause 12.2.2.34 or ProSe Response Code parameter defined in subclause 12.2.2.42;

   g) an optional <MIC> element containing the parameter defined in subclause 12.2.2.11;

   h) an optional <MessageType> element containing the parameter defined in subclause 12.2.2.10;

   i) an optional <UTC-based-counter> element containing the parameter defined in subclause 12.2.2.18;

   j) a <metadata-flag> element containing the parameter defined in subclause 12.2.2.20;

   k) zero, one or more elements defined in future releases; and

l) zero, one or more attributes defined in future releases.

3) zero or one <anyExt> element containing elements defined in future releases;

4) zero, one or more elements from other namespaces defined in future releases; and

5) zero, one or more attributes defined in future releases.

11.2.4.5 Semantics of <MATCH_REPORT_ACK>

The <MATCH_REPORT_ACK> element contains one or more of the following elements:

1) a <Current-Time> element containing the parameter defined in subclause 12.2.2.23;

2) zero, one or more <match-ack> element which contains transactions sent from the ProSe Function to the UE as a response to a match report if the ProSe Function accepts the report. Each <match-ack> consists of:

   a) a <transaction-ID> element containing the parameter defined in subclause 12.2.2.1;

   b) a <ProSe-Application-ID> element containing the parameter defined in subclause 12.2.2.4;

   c) a <validity-timer-T4004> element containing the parameter defined in subclause 12.2.2.19;

   d) an optional <metadata> element containing the parameter defined in subclause 12.2.2.21;

   e) an optional <metadata-index-mask> element containing the parameter defined in subclause 12.2.2.62;

   f) zero or one <anyExt> element containing elements defined in future releases;

   g) zero, one or more elements from other namespaces defined in future releases;

   h) a mandatory "match-report-refresh-timer-T4006" attribute containing the parameter defined in subclause 12.2.2.26; and

   i) zero, one or more attributes defined in future releases;

3) zero, one or more <restricted-match-ack> element which contain transactions sent from the ProSe Function to the UE as a response to a match report if the ProSe Function accepts the report. Each <restricted-match-ack> consists of:

   a) a <transaction-ID> element containing the parameter defined in subclause 12.2.2.1;

   b) an <application-identity> element containing the parameter defined in subclause 12.2.2.5;

   c) an <RPAUID> element containing the parameter defined in subclause 12.2.2.30;

   d) a <validity-timer-T4016> element containing the parameter defined in subclause 12.2.2.60;

   e) an optional <metadata> element containing the parameter defined in subclause 12.2.2.21;

   f) zero or one <anyExt> element containing elements defined in future releases;

   g) zero, one or more elements from other namespaces defined in future releases;

   h) an optional "match-report-refresh-timer-T4017" attribute containing the parameter defined in subclause 12.2.2.61; and

   i) zero, one or more attributes defined in future releases;

4) zero, one or more <match-reject> element which contains transactions sent from the ProSe Function to the UE as a response to a match report if the ProSe Function cannot accept the match report. Each <match-reject> consists of:

   a) a <transaction-ID> element containing the parameter defined in subclause 12.2.2.1;

   b) a <PC3-control-protocol-cause-value> element containing the parameter defined in subclause 12.2.2.8;

c) zero, one or more elements defined in future releases; and

d) zero, one or more attributes defined in future releases;

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.

11.2.4.6 Semantics of <UE_REGISTRATION_REQUEST>

The <UE_REGISTRATION_REQUEST> element contains one or more of the following elements:

1) One or more <UE-register-request> element which contains transactions sent from the UE to the ProSe Function to register the UE. Each <UE-register-request > consists of:

   a) a <transaction-ID> element containing the parameter defined in subclause 12.3.2.1;

   b) a <UE-identity> element containing the parameter defined in subclause 12.3.2.2;

   c) a <WLAN-link-layer-ID> element containing the parameter defined in subclause 12.3.2.6;

   d) a <method-for-server-initiated-transaction> element containing the parameter defined in subclause 12.3.2.14;

   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;

2) zero or one <anyExt> element containing elements defined in future releases;

3) zero, one or more elements from other namespaces defined in future releases; and

4) zero, one or more attributes defined in future releases.

11.2.4.7 Semantics of <UE_REGISTRATION_RESPONSE>

The <UE_REGISTRATION_RESPONSE> element contains one or more of the following elements:

1) zero, one or more <response-register> element which contains transactions sent from the ProSe Function to the UE as a response to the UE_REGISTRATION_REQUEST message if the ProSe Function accepts the request. Each <response-register> consists of:

   a) a <transaction-ID> element containing the parameter defined in subclause 12.3.2.1;

   b) an <EPC-ProSe-User-ID> element containing the parameter defined in subclause 12.3.2.7;

   c) a <server-initiated-method-config> element containing the parameter defined in subclause 12.3.2.15;

   d) zero, one or more elements defined in future releases; and

   e) zero, one or more attributes defined in future releases;

2) zero, one or more <response-reject> element which contains transactions sent from the ProSe Function to the UE as a response to the UE_REGISTRATION_REQUEST message if the ProSe Function cannot accept the request. Each <response-reject> consists of:

   a) a <transaction-ID> element containing the parameter defined in subclause 12.3.2.1;

   b) a <PC3-EPC-control-protocol-cause-value> element containing the parameter defined in subclause 12.3.2.5;

   c) zero, one or more elements defined in future releases; and

   d) zero, one or more attributes defined in future releases;

3) zero or one <anyExt> element containing elements defined in future releases;

4) zero, one or more elements from other namespaces defined in future releases; and

5) zero, one or more attributes defined in future releases.

11.2.4.8 Semantics of <APPLICATION_REGISTRATION_REQUEST>

The <APPLICATION_REGISTRATION_REQUEST> element contains one or more of the following elements:

1) One or more <application-register-request> element which contains transactions sent from the UE to the ProSe Function to activate EPC-level ProSe discovery for a specific application. Each < application-register-request > consists of:

   a) a <transaction-ID> element containing the parameter defined in subclause 12.3.2.1;

   b) an <EPC-ProSe-User-ID> element containing the parameter defined in subclause 12.3.2.7.

   c) an <application-identity> element containing the parameter defined in subclause 12.3.2.3;

   d) an <Application-Layer-User-ID> element containing the parameter defined in subclause 12.3.2.4;

   e) zero, one or more elements defined in future releases; and

   f) zero, one or more attributes defined in future releases;

2) zero or one <anyExt> element containing elements defined in future releases;

3) zero, one or more elements from other namespaces defined in future releases; and

4) zero, one or more attributes defined in future releases.

11.2.4.9 Semantics of <APPLICATION_REGISTRATION_RESPONSE>

The <APPLICATION_REGISTRATION_RESPONSE> element contains one or more of the following elements:

1) zero, one or more <response-register> element which contains transactions sent from the ProSe Function to the UE as a response to the APPLICATION_REGISTRATION_REQUEST message if the ProSe Function accepts the request. Each <response-register> consists of:

   a) a <transaction-ID> element containing the parameter defined in subclause 12.3.2.1;

   b) one or more <allowed-range-class> element containing the parameter defined in subclause 12.3.2.8;

   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;

2) zero,one or more <response-reject> element which contains transactions sent from the ProSe Function to the UE as a response to the APPLICATION_REGISTRATION_REQUEST message if the ProSe Function cannot accept the request. Each <response-reject> consists of:

   a) a <transaction-ID> element containing the parameter defined in subclause 12.3.2.1;

   b) a <PC3-EPC-control-protocol-cause-value> element containing the parameter defined in subclause 12.3.2.5;

   c) zero, one or more elements defined in future releases; and

   d) zero, one or more attributes defined in future releases;

3) zero or one <anyExt> element containing elements defined in future releases;

4) zero, one or more elements from other namespaces defined in future releases; and

5) zero, one or more attributes defined in future releases.

11.2.4.10 Semantics of <PROXIMITY_REQUEST>

The <PROXIMITY_REQUEST> element contains one or more of the following elements:

1) One or more <proximity-request> element which contains transactions sent from the UE to the ProSe Function to request to be alerted when it enters in proximity with a targeted UE. Each < proximity-request > consists of:
   a) a <transaction-ID> element containing the parameter defined in subclause 12.3.2.1;
   b) an <EPC-ProSe-User-ID-A> element containing the parameter defined in subclause 12.3.2.7;
   c) an <application-identity> element containing the parameter defined in subclause 12.3.2.3;
   d) an <Application-Layer-User-ID-A> element containing the parameter defined in subclause 12.3.2.4;
   e) an <Application-Layer-User-ID-B> element containing the parameter defined in subclause 12.3.2.4;
   f) a <requested-range-class> element containing the parameter defined in subclause 12.3.2.8;
   g) a <UE-A-Location> element containing the parameter defined in subclause 12.3.2.11;
   h) a <time-window> element containing the parameter defined in subclause 12.3.2.9;
   i) an optional <WLAN-indication> element containing the parameter defined in subclause 12.3.2.12;
   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; and
   l) zero, one or more attributes defined in future releases;
2) zero or one <anyExt> element containing elements defined in future releases;
3) zero, one or more elements from other namespaces defined in future releases; and
4) zero, one or more attributes defined in future releases.

11.2.4.11 Semantics of <PROXIMITY_REQUEST_RESPONSE>

The <PROXIMITY_REQUEST_RESPONSE> element contains one or more of the following elements:

1) zero,one or more <response-accept> element which contains transactions sent from the ProSe Function to the UE as a response to the PROXIMITY_REQUEST message if the ProSe Function accepts the request. Each <response-register> consists of:
   a) a <transaction-ID> element containing the parameter defined in subclause 12.3.2.1;
   b) zero, one or more elements defined in future releases; and
   c) zero, one or more attributes defined in future releases;
2) zero, one or more <response-reject> element which contains transactions sent from the ProSe Function to the UE as a response to the PROXIMITY_REQUEST message if the ProSe Function cannot accept the request. Each <response-reject> consists of:
   a) a <transaction-ID> element containing the parameter defined in subclause 12.3.2.1;
   b) a <PC3-EPC-control-protocol-cause-value> element containing the parameter defined in subclause 12.3.2.5;
   c) zero, one or more elements defined in future releases; and
   d) zero, one or more attributes defined in future releases;
3) zero or one <anyExt> element containing elements defined in future releases;
4) zero, one or more elements from other namespaces defined in future releases; and

5) zero, one or more attributes defined in future releases.

11.2.4.12 Semantics of <PROXIMITY_ALERT>

The <PROXIMITY_ALERT> element contains one or more of the following elements:

1) One or more <proximity-alert> element which contains transactions sent from the ProSe Function to the (UE A) and optionally to targeted (UE B) to alert them that they have entered in proximity. Each <proximity-alert> consists of:

   a) <transaction-ID> element containing the parameter defined in subclause 12.3.2.1;

   b) an <application-identity> element containing the parameter defined in subclause 12.3.2.3;

   c) an <Application-Layer-User-ID-A> element containing the parameter defined in subclause 12.3.2.4;

   d) an <Application-Layer-User-ID-B> element containing the parameter defined in subclause 12.3.2.4;

   e) an optional <assistance-information> element containing the parameter defined in subclause 12.3.2.13;

   f) zero or one <anyExt> element containing elements defined in future releases;

   g) zero, one or more elements from other namespaces defined in future releases; and

   h) zero, one or more attributes defined in future releases;

2) zero or one <anyExt> element containing elements defined in future releases;

3) zero, one or more elements from other namespaces defined in future releases; and

4) zero, one or more attributes defined in future releases.

11.2.4.13 Semantics of <UE_DEREGISTRATION_REQUEST>

The <UE_DEREGISTRATION_REQUEST> element contains one or more of the following elements:

1) One or more <UE-deregister-request> element which contains transactions sent either from the UE to the ProSe Function or from the ProSe Function to the UE to deregister the UE. Each < UE-deregister-request > consists of:

   a) a <transaction-ID> element containing the parameter defined in subclause 12.3.2.1;

   b) an <EPC-ProSe-User-ID> element containing the parameter defined in subclause 12.3.2.7;

   c) a <PC3-EPC-control-protocol-cause-value> element containing the parameter defined in subclause 12.3.2.5;

   d) zero, one or more elements defined in future releases; and

   e) zero, one or more attributes defined in future releases

2) zero or one <anyExt> element containing elements defined in future releases;

3) zero, one or more elements from other namespaces defined in future releases; and

4) zero, one or more attributes defined in future releases.

11.2.4.14 Semantics of <UE_DEREGISTRATION_RESPONSE>

The <UE_DEREGISTRATION_RESPONSE> element contains one or more of the following elements:

1) One or more <UE-deregister-response> element which contains transactions sent either from the UE to the ProSe Function or from the ProSe Function to the UE to complete the UE deregistration. Each < UE-deregister-response > consists of:

   a) a <transaction-ID> element containing the parameter defined in subclause 12.3.2.1;

   b) zero, one or more elements defined in future releases; and

c) zero, one or more attributes defined in future releases

2) zero or one <anyExt> element containing elements defined in future releases;

3) zero, one or more elements from other namespaces defined in future releases; and

4) zero, one or more attributes defined in future releases.

11.2.4.15 Semantics of <CANCEL_PROXIMITY_REQUEST>

The <CANCEL_PROXIMITY_REQUEST> element contains one or more of the following elements:

1) One or more <cancel-proximity-request> element which contains transactions sent from the UE to the ProSe Function or from the ProSe Function to the UE to request cancellation of an ongoing proximity request. Each < cancel_proximity-request > consists of:

   a) a <transaction-ID> element containing the parameter defined in subclause 12.3.2.1;

   b) an <EPC-ProSe-User-ID-A> element containing the parameter defined in subclause 12.3.2.7;

   c) an <application-identity> element containing the parameter defined in subclause 12.3.2.3;

   d) an <Application-Layer-User-ID-B> element containing the parameter defined in subclause 12.3.2.4;

   e) zero, one or more elements defined in future releases; and

   f) zero, one or more attributes defined in future releases;

2) zero or one <anyExt> element containing elements defined in future releases

3) zero, one or more elements from other namespaces defined in future releases; and

4) zero, one or more attributes defined in future releases.

11.2.4.16 Semantics of <CANCEL_PROXIMITY_RESPONSE>

The <CANCEL_PROXIMITY_RESPONSE> element contains one or more of the following elements:

1) One or more <cancel-proximity-responset> element which contains transactions sent from the ProSe Function to the UE or from the UE to the ProSe Function as a response to CANCEL_PROXIMITY_REQUEST message. Each < cancel_proximity-response > consists of:

   a) a <transaction-ID> element containing the parameter defined in subclause 12.3.2.1;

   b) zero, one or more elements defined in future releases; and

   c) zero, one or more attributes defined in future releases;

2) zero or one <anyExt> element containing elements defined in future releases;

3) zero, one or more elements from other namespaces defined in future releases; and

4) zero, one or more attributes defined in future releases.

11.2.4.17 Semantics of <PROXIMITY_REQUEST_VALIDATION>

The <PROXIMITY_REQUEST_VALIDATION> element contains one or more of the following elements:

1) One or more <proximity-request-validation> element which contains transactions sent by the ProSe Function to the targeted UE (UE B) to request confirmation of permission for proximity request. Each <proximity-request-validation> consists of:

   a) a <transaction-ID> element containing the parameter defined in subclause 12.3.2.1;

   b) an <application-identity> element containing the parameter defined in subclause 12.3.2.3;

c) zero, one or more elements defined in future releases; and

d) zero, one or more attributes defined in future releases;

2) zero or one <anyExt> element containing elements defined in future releases;

3) zero, one or more elements from other namespaces defined in future releases; and

4) zero, one or more attributes defined in future releases.

11.2.4.18 Semantics of <PROXIMITY_REQUEST_VALIDATION_RESPONSE>

The <PROXIMITY_REQUEST_VALIDATION_RESPONSE> element contains one or more of the following elements:

1) zero, one or more <response-accept> element which contains transactions sent from the UE to the ProSe Function as a response to the PROXIMITY_REQUEST_VALIDATION message if the application in the UE accepts the request. Each <response-accept> consists of:

   a) a <transaction-ID> element containing the parameter defined in subclause 12.3.2.1;

   b) zero, one or more elements defined in future releases; and

   c) zero, one or more attributes defined in future releases;

2) zero, one or more <response-reject> element which contains transactions sent from the UE to the ProSe Function as a response to the PROXIMITY_REQUEST_VALIDATION message if the application in the UE does not accept the request. Each <response-reject> consists of:

   a) a <transaction-ID> element containing the parameter defined in subclause 12.3.2.1;

   b) a <PC3-EPC-control-protocol-cause-value> element containing the parameter defined in subclause 12.3.2.5.

   c) zero, one or more elements defined in future releases; and

   d) zero, one or more attributes defined in future releases;

3) zero or one <anyExt> element containing elements defined in future releases;

4) zero, one or more elements from other namespaces defined in future releases; and

5) zero, one or more attributes defined in future releases.

11.2.4.19 Semantics of < DISCOVERY_UPDATE_REQUEST>

The < DISCOVERY_UPDATE_REQUEST> element contains one or more of the following elements:

1) One or more <discovery-update-request> element which contains transactions sent from the ProSe Function to the UE as announcing or monitoring requests. Each <discovery-update-request> consists of:

   a) a <prose-function-transaction-ID> element containing the parameter defined in subclause 12.2.2.28;

   b) a <UE-identity> element containing the parameter defined in subclause 12.2.2.3;

   c) a <discovery-entry-id> element containing the parameter defined in subclause 12.2.2.33;

   d) an optional <update-info> element containing the parameter defined in subclause 12.2.2.29;

   e) zero or one <anyExt> element containing elements defined in future releases;

   f) zero, one or more elements defined in future releases; and

   g) zero, one or more attributes defined in future releases;

2) zero or one <anyExt> element containing elements defined in future releases;

3) zero, one or more elements from other namespaces defined in future releases; and

4) zero, one or more attributes defined in future releases.

11.2.4.20 Semantics of < DISCOVERY_UPDATE_RESPONSE>

The < DISCOVERY_UPDATE _RESPONSE> element contains one or more of the following elements:

1) one or more <response-update> element which contains transactions sent from the UE to the ProSe Function as a response if the UE accepts the request. Each <discovery-update-response> consists of:

   a) a <prose-function-transaction-ID> element containing the parameter defined in subclause 12.2.2.28;

   b) a <discovery-entry-id> element containing the parameter defined in subclause 12.2.2.33;

   c) zero, one or more elements defined in future releases; and

   d) zero, one or more attributes defined in future releases;

2) zero, one or more <response-reject> element which contains transactions sent from the UE to the ProSe Function as a response if the UE cannot accept the request. Each <response-reject> consists of:

   a) a <prose-function-transaction-ID> element containing the parameter defined in subclause 12.2.2.28;

   b) a <PC3-control-protocol-cause-value> element containing the parameter defined in subclause 12.2.2.8.

   c) zero, one or more elements defined in future releases; and

   d) zero, one or more attributes defined in future releases;

3) zero or one <anyExt> element containing elements defined in future releases;

4) zero, one or more elements from other namespaces defined in future releases; and

5) zero, one or more attributes defined in future releases.

11.2.4.21 Semantics of <ANNOUNCING_ALERT_REQUEST>

The <ANNOUNCING_ALERT_REQUEST> element contains one or more of the following elements:

1) One or more <announcing-alert-request> element which contains transactions sent from the UE to the ProSe Function as announcing or monitoring requests. Each <announcing-alert-request> consists of:

   a) a <prose-function-transaction-ID> element containing the parameter defined in subclause 12.2.2.28;

   b) a <UE-identity> element containing the parameter defined in subclause 12.2.2.3;

   c) a <RPAUID> element containing the parameter defined in subclause 12.2.2.30;

   d) a <Discovery-Entry-ID> element containing the parameter defined in subclause 12.2.2.33;

   e) a <ProSe-Restricted-Code> element containing the parameter defined in subclause 12.2.2.34;

   f) zero, one or more <ProSe-Restricted-Code-Suffix-Range> element containing the parameter defined in subclause 12.2.2.35;

   g) zero or one <anyExt> element containing elements defined in future releases;

   h) zero, one or more elements from other namespaces defined in future releases; and

   i) zero, one or more attributes defined in future releases;

2) zero or one <anyExt> element containing elements defined in future releases;

3) zero, one or more elements from other namespaces defined in future releases; and

4) zero, one or more attributes defined in future releases.

11.2.4.22 Semantics of < ANNOUNCING_ALERT_RESPONSE >

The <ANNOUNCING_ALERT_RESPONSE> element contains one or more of the following elements:

1) One or more <announcing-alert-response> element which contains transactions sent from the UE to the ProSe Function as announcing or monitoring requests. Each <announcing-alert-response> consists of:

   a) a <prose-function-transaction-ID> element containing the parameter defined in subclause 12.2.2.28;

   b) zero, one or more elements defined in future releases; and

   c) zero, one or more attributes defined in future releases;

2) zero, one or more <response-reject> element which contains transactions sent from the UE to the ProSe Function as a response if the UE cannot accept the request. Each <response-reject> consists of:

   a) a <prose-function-transaction-ID> element containing the parameter defined in subclause 12.2.2.28;

   b) a <PC3-control-protocol-cause-value> element containing the parameter defined in subclause 12.2.2.8.

   c) zero, one or more elements defined in future releases; and

   d) zero, one or more attributes defined in future releases;

3) zero or one <anyExt> element containing elements defined in future releases;

4) zero, one or more elements from other namespaces defined in future releases; and

5) zero, one or more attributes defined in future releases.

11.2.5 PC5_DISCOVERY

11.2.5.1 Message definition

This message is sent by the UE over the PC5 interface for open ProSe direct discovery and restricted ProSe direct discovery. See table 11.2.5.1.1, table 11.2.5.1.1A, table 11.2.5.1.2, table 11.2.5.1.3, table 11.2.5.1.4, table 11.2.5.1.5, table 11.2.5.1.6, table 11.2.5.1.7, table 11.2.5.1.8, table 11.2.5.1.9 and table 11.2.5.1.10.

Table 11.2.5.1.1: PC5_DISCOVERY message content for open ProSe direct discovery

Information Element	Type/Reference	Presence	Length (bits)
Message Type (NOTE)	Message Type 12.2.2.10	M	8
ProSe Application Code	Binary 12.2.2.6	M	184
MIC	Binary 12.2.2.11	M	32
UTC-based Counter LSB	Binary 12.2.2.22	M	8
NOTE: The Discovery Type is set to "Open discovery" and the Content Type is not set to "application-controlled extension enabled".			

Table 11.2.5.1.1A: PC5_DISCOVERY message content for open ProSe direct discovery with application-controlled extension

Information Element	Type/Reference	Presence	Length (bits)
Message Type (NOTE 1)	Message Type 12.2.2.10	M	8
ProSe Application Code Prefix (NOTE 2)	Binary 12.2.2.68	M	32-176
ProSe Application Code Suffix (NOTE 2)	Binary 12.2.2.69	M	8-152
MIC	Binary 12.2.2.11	M	32
UTC-based Counter LSB	Binary 12.2.2.22	M	8
NOTE 1: The Discovery Type is set to "Open discovery" and the Content Type is set to "application-controlled extension enabled". NOTE 2: The sum of the lengths of the ProSe Application Code Prefix and the ProSe Application Code Suffix is 184 bits.			

Table 11.2.5.1.2: PC5_DISCOVERY message content for restricted ProSe direct discovery

Information Element	Type/Reference	Presence	Length (bits)
Message Type (NOTE)	Message Type 12.2.2.10	M	8
ProSe Restricted Code	Binary 12.2.2.34	M	184
MIC	Binary 12.2.2.11	M	32
UTC-based Counter LSB	Binary 12.2.2.22	M	8
NOTE: The Discovery Type is set to "Restricted discovery" and the Content Type is not set to "application-controlled extension enabled".			

Table 11.2.5.1.3: PC5_DISCOVERY message content for restricted ProSe direct discovery with application-controlled extension

Information Element	Type/Reference	Presence	Length (bits)
Message Type (NOTE)	Message Type 12.2.2.10	M	8
ProSe Restricted Code Prefix	Binary 12.2.2.46	M	64
ProSe Restricted Code Suffix	Binary 12.2.2.47	M	120
MIC	Binary 12.2.2.11	M	32
UTC-based Counter LSB	Binary 12.2.2.22	M	8
NOTE: The Discovery Type is set to "Restricted discovery", the Content Type is set to "application-controlled extension enabled" and the Discovery Model is set to "Model A".			

Table 11.2.5.1.4: PC5_DISCOVERY message for UE-to-Network Relay Discovery Announcement

Information Element	Type/Reference	Presence	Length (bits)
Message Type (NOTE)	Message Type 12.2.2.10	M	8
Relay Service Code	Binary 12.2.2.51	M	24
Announcer Info	Binary 12.2.2.50	M	48
ProSe Relay UE ID	Binary 12.2.2.49	M	24
Status Indicator	Binary 12.2.2.67	M	8
Spare	Binary 12.2.2.56	M	80
MIC	Binary 12.2.2.11	M	32
UTC-based Counter LSB	Binary 12.2.2.22	M	8
NOTE: The Discovery Type is set to "Restricted discovery", the Content Type is set to "UE-to-Network Relay Discovery Announcement or UE-to-Network Relay Discovery Response" and the Discovery Model is set to "Model A".			

Table 11.2.5.1.5: PC5_DISCOVERY message for UE-to-Network Relay Discovery Solicitation

Information Element	Type/Reference	Presence	Length (bits)
Message Type (NOTE 1)	Message Type 12.2.2.10	M	8
Relay Service Code	Binary 12.2.2.51	M	24
Discoverer Info	Binary 12.2.2.50	M	48
URDS Composition	Binary 12.2.2.66	M	8
ProSe Relay UE ID	Binary 12.2.2.49	C (NOTE 2)	24
Spare	Binary 12.2.2.56	M	80 or 104 (NOTE 3)
MIC	Binary 12.2.2.11	M	32
UTC-based Counter LSB	Binary 12.2.2.22	M	8
NOTE 1: 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". NOTE 2: Presence of the ProSe Relay UE ID is indicated by the URDS Composition. NOTE 3: If the ProSe Relay UE ID is present, then the length of the Spare is80 bits. If ProSe Relay UE ID is not included, then the length of the Spare is 104 bits.			

Table 11.2.5.1.6: PC5_DISCOVERY message for UE-to-Network Relay Discovery Response

Information Element	Type/Reference	Presence	Length (bits)
Message Type (NOTE)	Message Type 12.2.2.10	M	8
Relay Service Code	Binary 12.2.2.51	M	24
Discoveree Info	Binary 12.2.2.50	M	48
ProSe Relay UE ID	Binary 12.2.2.49	M	24
Status Indicator	Binary 12.2.2.67	M	8
Spare	Binary 12.2.2.56	M	80
MIC	Binary 12.2.2.11	M	32
UTC-based Counter LSB	Binary 12.2.2.22	M	8
NOTE: The Discovery Type is set to "Restricted discovery", the Content Type is set to "UE-to-Network Relay Discovery Announcement or UE-to-Network Relay Discovery Response" and the Discovery Model is set to "Model B".			

Table 11.2.5.1.7: PC5_DISCOVERY message for Group Member Discovery Announcement

Information Element	Type/Reference	Presence	Length (bits)
Message Type (NOTE)	Message Type 12.2.2.10	M	8
Discovery Group ID	Binary 12.2.2.54	M	24
Announcer Info	Binary 12.2.2.50	M	48
ProSe UE ID	Binary 12.2.2.48	M	24
Spare	Binary 12.2.2.56	M	88
MIC	Binary 12.2.2.11	M	32
UTC-based Counter LSB	Binary 12.2.2.22	M	8
NOTE: The Discovery Type is set to "Restricted discovery", the Content Type is set to "Group Member Discovery Announcement or Group Member Discovery Response" and the Discovery Model is set to "Model A".			

Table 11.2.5.1.8: PC5_DISCOVERY message for Group Member Discovery Solicitation

Information Element	Type/Reference	Presence	Length (bits)
Message Type (NOTE 1)	Message Type 12.2.2.10	M	8
Discovery Group ID	Binary 12.2.2.54	M	24
Discoverer Info	Binary 12.2.2.50	M	48
GMDS Composition	Binary 12.2.2.55	M	8
Target User Info	Binary 12.2.2.52	C (NOTE 2)	48
Target Group Info	Binary 12.2.2.53	C (NOTE 2)	24
Spare	Binary 12.2.2.56	M	56 or 80 (NOTE 3)
MIC	Binary 12.2.2.11	M	32
UTC-based Counter LSB	Binary 12.2.2.22	M	8
NOTE 1: 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". NOTE 2: Presence of the Target User Info and of Target Group Info is indicated by the GMDS Composition. NOTE 3: If the Target User Info is present, then the length of the Spare is 56 bits. If the Target Group Info is present, then the length of the Spare is 80 bits.			

Table 11.2.5.1.9: PC5_DISCOVERY message for Group Member Discovery Response

Information Element	Type/Reference	Presence	Length (bits)
Message Type (NOTE)	Message Type 12.2.2.10	M	8
Discovery Group ID	Binary 12.2.2.54	M	24
Discoveree Info	Binary 12.2.2.50	M	48
ProSe UE ID	Binary 12.2.2.48	M	24
Spare	Binary 12.2.2.56	M	88
MIC	Binary 12.2.2.11	M	32
UTC-based Counter LSB	Binary 12.2.2.22	M	8
NOTE: The Discovery Type is set to "Restricted discovery", the Content Type is set to "Group Member Discovery Announcement or Group Member Discovery Response" and the Discovery Model is set to "Model B".			

Table 11.2.5.1.10: PC5_DISCOVERY message for Relay Discovery Additional Information

Information Element	Type/Reference	Presence	Length (bits)
Message Type (NOTE 1)	Message Type 12.2.2.10	M	8
Relay Service Code	Binary 12.2.2.51	M	24
ProSe Relay UE ID	Binary 12.2.2.49	M	24
Announcer Info	Binary 12.2.2.50	M	48
RDAI Composition	Binary 12.2.2.57	M	8
ECGI	Binary 12.2.2.58	C (NOTE 2)	56
MBMS related information	Binary 12.2.2.59	C (NOTE 2)	72
Spare	Binary 12.2.2.56	M	8 or 24 (NOTE 3)
MIC	Binary 12.2.2.11	M	32
UTC-based Counter LSB	Binary 12.2.2.22	M	8
NOTE 1: 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". NOTE 2: Presence of the ECGI and MBMS related information is indicated by the RDAI Composition. NOTE 3: If the RDAI Composition indicates inclusion of the MBMS related information, it is 8 bits. If the RDAI Composition indicates inclusion of the ECGI, it is 24 bits.			

11.3 Messages transmitted over the PC3ch interface

11.3.1 General

This subclause defines XML schema and MIME type related to messages transmitted over the PC3ch interface.

11.3.2 application/3gpp-prose-pc3ch+xml

The MIME type is used to carry information related to message transmitted over the PC3ch interface. It shall be coded as an XML document compliant to the XML schema in subclause 11.3.3 containing one of the following messages:

- USAGE_INFORMATION_REPORT_LIST; or
- USAGE_INFORMATION_REPORT_LIST_RESPONSE.

Each of those messages is presented in the XML document as an XML element named after the corresponding message.

The XML document can contain elements and attributes defined in future releases of this document. Receiving entity ignores any element not defined by this version of the specification and any attribute not defined by this version of the specification.

11.3.3 XML Schema

```
<?xml version="1.0" encoding="UTF-8"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema"
           xmlns="urn:3GPP:ns:ProSe:PC3ch:2014"
           elementFormDefault="qualified"
           targetNamespace="urn:3GPP:ns:ProSe:PC3ch:2014">

  <xs:annotation>
    <xs:documentation>
      Syntax of messages transmitted over the PC3ch interface
    </xs:documentation>
```

```
  </xs:annotation>

  <!-- Types defined for parameters with complicate structure -->
  <xs:complexType name="IMSI-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:simpleType name="IPAddress-type">
    <xs:restriction base="xs:string"/>
  </xs:simpleType>

  <xs:simpleType name="Layer2Id-type">
    <xs:restriction base="xs:hexBinary"/>
  </xs:simpleType>

  <xs:simpleType name="ECGI-type">
    <xs:restriction base="xs:hexBinary"/>
  </xs:simpleType>

  <xs:simpleType name="AppSpecificInfo-type">
    <xs:restriction base="xs:hexBinary"/>
  </xs:simpleType>

  <xs:simpleType name="RadioResourcesIndicator-type">
    <xs:restriction base="xs:integer"/>
  </xs:simpleType>

  <xs:simpleType name="RadioFrequency-type">
    <xs:restriction base="xs:hexBinary"/>
  </xs:simpleType>

  <!--  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>

  <xs:complexType name="UsageInformationReportList-Info">
    <xs:sequence>
      <xs:element name="transaction-ID" type="xs:integer"/>
      <xs:element name="UE-identity" type="IMSI-info"/>
      <xs:element name="usage-information-report" type="UsageInformationReport-Info"
        minOccurs="1" maxOccurs="unbounded"/>
      <xs:element name="app-specific-info" type="AppSpecificInfo-type" 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="UsageInformationReport-Info">
    <xs:sequence>
      <xs:element name="coverage" type="Coverage-info" minOccurs="0" maxOccurs="unbounded"/>
      <xs:element name="group" type="Group-info" minOccurs="0" maxOccurs="unbounded"/>
      <xs:element name="radio-parameter-set" type="RadioParameterSet-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="sequence-number" type="xs:integer"/>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>

  <xs:complexType name="Coverage-info">
    <xs:sequence>
      <xs:element name="location" type="Location-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="in-coverage" type="xs:boolean"/>
```

```
  <xs:attribute name="timestamp" type="xs:dateTime" use="optional"/>
  <xs:anyAttribute namespace="##any" processContents="lax"/>
</xs:complexType>

<xs:complexType name="Location-info">
  <xs:sequence>
    <xs:element name="anyExt" type="anyExtType" minOccurs="0"/>
    <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
  </xs:sequence>
  <xs:attribute name="ECGI" type="ECGI-type" use="optional"/>
  <xs:attribute name="timestamp" type="xs:dateTime" use="optional"/>
  <xs:anyAttribute namespace="##any" processContents="lax"/>
</xs:complexType>

<xs:complexType name="RadioParameterSet-info">
  <xs:sequence>
    <xs:element name="anyExt" type="anyExtType" minOccurs="0"/>
    <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
  </xs:sequence>
  <xs:attribute name="timestamp" type="xs:dateTime" use="required"/>
  <xs:attribute name="params" type="xs:hexBinary"/>
  <xs:anyAttribute namespace="##any" processContents="lax"/>
</xs:complexType>

<xs:complexType name="Group-info">
  <xs:sequence>
    <xs:element name="UE-source-IP-address" type="IPAddress-type"/>
    <xs:element name="prose-UE-id" type="Layer2Id-type"/>
    <xs:element name="transmitter" type="Transmitter-info" minOccurs="0" maxOccurs="unbounded"/>
    <xs:element name="transmission" type="Transmission-info" minOccurs="0" maxOccurs="unbounded"/>
    <xs:element name="reception" type="Reception-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="prose-layer2-group-ID" type="Layer2Id-type"/>
  <xs:attribute name="prose-group-IP-multicast-address" type="IPAddress-type"/>
  <xs:attribute name="first-transmission-timestamp" type="xs:dateTime" use="optional"/>
  <xs:attribute name="first-reception-timestamp" type="xs:dateTime" use="optional"/>
  <xs:anyAttribute namespace="##any" processContents="lax"/>
</xs:complexType>

<xs:complexType name="Transmitter-info">
  <xs:sequence>
    <xs:element name="anyExt" type="anyExtType" minOccurs="0"/>
    <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
  </xs:sequence>
  <xs:attribute name="source-IP-address" type="IPAddress-type"/>
  <xs:attribute name="prose-UE-id" type="Layer2Id-type"/>
  <xs:anyAttribute namespace="##any" processContents="lax"/>
</xs:complexType>

<xs:complexType name="Transmission-info">
  <xs:sequence>
    <xs:element name="anyExt" type="anyExtType" minOccurs="0"/>
    <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
  </xs:sequence>
  <xs:attribute name="in-coverage" type="xs:boolean"/>
  <xs:attribute name="ECGI" type="ECGI-type" use="optional"/>
  <xs:attribute name="amount" type="xs:integer"/>
  <xs:attribute name="timestamp" type="xs:dateTime" use="optional"/>
  <xs:attribute name="radio-resources-ind" type="RadioResourcesIndicator-type" use="optional"/>
  <xs:attribute name="radio-frequency" type="RadioFrequency-type" use="optional"/>
  <xs:anyAttribute namespace="##any" processContents="lax"/>
</xs:complexType>

<xs:complexType name="Reception-info">
  <xs:sequence>
    <xs:element name="anyExt" type="anyExtType" minOccurs="0"/>
    <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
  </xs:sequence>
  <xs:attribute name="in-coverage" type="xs:boolean"/>
  <xs:attribute name="ECGI" type="ECGI-type" use="optional"/>
  <xs:attribute name="amount" type="xs:integer"/>
  <xs:attribute name="timestamp" type="xs:dateTime" use="optional"/>
  <xs:attribute name="radio-resources-ind" type="RadioResourcesIndicator-type" use="optional"/>
  <xs:attribute name="radio-frequency" type="RadioFrequency-type" use="optional"/>
  <xs:anyAttribute namespace="##any" processContents="lax"/>
</xs:complexType>
```

```
  <xs:complexType name="UsageInformationReportListResponse-Info">
    <xs:sequence>
     <xs:element name="response-accept" type="UsageInformationReportListResponseAccept-Info"
minOccurs="0"/>
     <xs:element name="response-reject" type="UsageInformationReportListResponseReject-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="UsageInformationReportListResponseAccept-Info">
    <xs:sequence>
      <xs:element name="transaction-ID" type="xs:integer"/>
      <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="UsageInformationReportListResponseReject-Info">
    <xs:sequence>
      <xs:element name="transaction-ID" type="xs:integer"/>
      <xs:element name="cause-value" type="xs:integer"/>
      <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:element name="prose-pc3ch-message">
    <xs:complexType>
      <xs:choice>
        <xs:element name="USAGE_INFORMATION_REPORT_LIST" type="UsageInformationReportList-Info"/>
        <xs:element name="USAGE_INFORMATION_REPORT_LIST_RESPONSE"
type="UsageInformationReportListResponse-Info"/>
        <xs:element name="anyExt" type="anyExtType"/>
        <xs:any namespace="##other" processContents="lax"/>
      </xs:choice>
      <xs:anyAttribute namespace="##any" processContents="lax"/>
    </xs:complexType>
  </xs:element>

</xs:schema>
```

11.3.4 Semantics

11.3.4.1 General

The <prose-pc3ch-message> element is the root element of this XML document.

The <prose-pc3ch-message> element contains one of the following:

a) <USAGE_INFORMATION_REPORT_LIST> element;

b) <USAGE_INFORMATION_REPORT_LIST_RESPONSE> element;

c) <anyExt> element containing elements defined in future releases; or

d) one or more elements from other namespace defined in future releases.

The <prose-pc3ch-message> element contains zero, one or more attributes defined in future releases.

11.3.4.2 Semantics of <USAGE_INFORMATION_REPORT_LIST>

The <USAGE_INFORMATION_REPORT_LIST> element contains:

a) a <transaction-ID> element containing the parameter defined in subclause 12.4.2.1;

b) a <UE-identity> element containing the parameter defined in subclause 12.4.2.2;

c) one or more <usage-information-report> elements;

d) zero, one or more <app-specific-info> element;

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.

The <usage-information-report> element carries one usage information report. The <usage-information-report> element contains:

a) mandatory "sequence-number" attribute containing the parameter defined in subclause 12.4.2.3;

b) zero, one or more <coverage> elements;

c) zero, one or more <group> element;

d) zero, one or more <radio-parameter-set> elements;

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.

The <coverage> element carries information whether the UE was in E-UTRAN coverage or out of E-UTRAN coverage. The <coverage> element contains:

a) mandatory "in-coverage" attribute containing the parameter defined in subclause 12.4.2.4;

b) optional "timestamp" attribute containing the parameter defined in subclause 12.4.2.8 indicating date and time when the information given in the element start being valid;

c) if the UE was in E-UTRAN coverage, zero, one or more <location> elements;

d) zero or one <anyExt> element containing elements defined in future releases;

e) zero, one or more elements from other namespaces defined in future releases; and

f) zero, one or more attributes defined in future releases.

The <location> element carries information about an E-UTRAN cell where the UE was camping on or which the UE used in the EMM-CONNECTED mode. The <location> element contains:

a) an optional "ECGI" attribute containing the parameter defined in subclause 12.4.2.5;

b) an optional "timestamp" attribute containing the parameter defined in subclause 12.4.2.8 indicating date and time when the information given in the element start being valid;

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.

The <radio-parameter-set> element carries information about the configured radio parameters for the ProSe direct communication applicable in the geographical area of the UE. The <radio-parameter-set> element contains:

a) a mandatory "params" attribute containing the parameter defined in subclause 12.4.2.6;

b) a mandatory "timestamp" attribute containing the parameter defined in subclause 12.4.2.8 indicating date and time when the information given in the element start being valid;

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.

The <group> element carries information about a ProSe group. The <group> element contains:

a) a mandatory "prose-layer2-group-ID" attribute containing the parameter defined in subclause 12.4.2.9;

b) a mandatory "prose-group-IP-multicast-address" attribute containing the parameter defined in subclause 12.4.2.10;

c) an optional "first-transmission-timestamp" attribute containing the parameter defined in subclause 12.4.2.8 indicating date and time of the first transmission to the ProSe Group IP multicast address in the collection period;

d) an optional "first-reception-timestamp" attribute containing the parameter defined in subclause 12.4.2.8 indicating date and time of the first reception from the ProSe Group IP multicast address in the collection period;

e) a <UE-source-IP-address> element containing the parameter defined in subclause 12.4.2.11, of the UE;

f) a <prose-UE-id> element containing the parameter defined in subclause 12.4.2.12, of the UE;

g) zero, one or more <transmitter> element;

h) zero, one or more <transmission> element;

i) zero, one or more <reception> element;

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; and

l) zero, one or more attributes defined in future releases.

The <transmitter> element carries information about a transmitter in a ProSe group. The <transmitter> element contains:

a) a mandatory "source-IP-address" attribute containing the parameter defined in subclause 12.4.2.11, of the transmitter;

b) a mandatory "prose-UE-id" attribute containing the parameter defined in subclause 12.4.2.12, of the transmitter;

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.

The <transmission> element carries information about a transmission in a ProSe group. The <transmission> element contains:

a) a mandatory "in-coverage" attribute containing the parameter defined in subclause 12.4.2.4;

b) if the UE was in E-UTRAN coverage when transmitting the data, an optional "ECGI" attribute containing the parameter defined in subclause 12.4.2.5, indicating E-UTRAN Cell Global Identification of the E-UTRAN cell where the UE was camping on or which the UE used in the EMM-CONNECTED mode when transmitting the data;

c) if the UE was in E-UTRAN coverage and the "ECGI" attribute is included:

1) a mandatory "amount" attribute containing the parameter defined in subclause 12.4.2.13 indicating the amount of octets transmitted to the ProSe group:

- when the UE was camping on a cell identified by the "ECGI" attribute when transmitting the data; or

- when the UE used in the EMM-CONNECTED mode a cell identified by the "ECGI" attribute when transmitting the data; and

2) an optional "timestamp" attribute containing the parameter defined in subclause 12.4.2.8 indicating date and time of the first transmission in the E-UTRAN cell;

d) if the UE was in E-UTRAN coverage and the "ECGI" attribute is not included:

1) a mandatory "amount" attribute containing the parameter defined in subclause 12.4.2.13 indicating the amount of octets transmitted to the ProSe group during the in E-UTRAN coverage period: and

2) an optional "timestamp" attribute containing the parameter defined in subclause 12.4.2.8 indicating date and time of the first transmission during the in E-UTRAN coverage period;

e) if the UE was out of E-UTRAN coverage:

1) a mandatory "amount" attribute containing the parameter defined in subclause 12.4.2.13 indicating the amount of octets transmitted to the ProSe group during the out of E-UTRAN coverage period; and

2) an optional "timestamp" attribute containing the parameter defined in subclause 12.4.2.8 indicating date and time of the first transmission during the out of E-UTRAN coverage period;

f) an optional "radio-resources-ind" attribute containing the parameter defined in subclause 12.4.2.14;

g) an optional "radio-frequency" attribute containing the parameter defined in subclause 12.4.2.15;

i) zero or one <anyExt> element containing elements defined in future releases;

j) zero, one or more elements from other namespaces defined in future releases; and

k) zero, one or more attributes defined in future releases.

The <reception> element carries information about a reception in a ProSe group. The <reception> element contains:

a) a mandatory "in-coverage" attribute containing the parameter defined in subclause 12.4.2.4 indicating whether the UE was in E-UTRAN coverage when receiving the data;

b) if the UE was in E-UTRAN coverage when receiving the data, an optional "ECGI" attribute containing the parameter defined in subclause 12.4.2.5 indicating E-UTRAN Cell Global Identification of the E-UTRAN cell where the UE was camping on or which the UE used in the EMM-CONNECTED mode when receiving the data;

c) if the UE was in E-UTRAN coverage and the "ECGI" attribute is included:

1) a mandatory "amount" attribute containing the parameter defined in subclause 12.4.2.13 indicating the amount of octets received from the ProSe group:

- when the UE was camping on a cell identified by the "ECGI" attribute when receiving the data; or

- when the UE used in the EMM-CONNECTED mode a cell identified by the "ECGI" attribute when receiving the data; and

2) an optional "timestamp" attribute containing the parameter defined in subclause 12.4.2.8 indicating date and time of the first reception in the E-UTRAN cell;

d) if the UE was in E-UTRAN coverage and the "ECGI" attribute is not included:

1) a mandatory "amount" attribute containing the parameter defined in subclause 12.4.2.13 indicating the amount of octets received from the ProSe group during the in E-UTRAN coverage period: and

2) an optional "timestamp" attribute containing the parameter defined in subclause 12.4.2.8 indicating date and time of the first reception during the in E-UTRAN coverage period;

e) if the UE was out of E-UTRAN coverage:

1) a mandatory "amount" attribute containing the parameter defined in subclause 12.4.2.13 indicating the amount of octets received from the ProSe group during the out of E-UTRAN coverage period; and

2) an optional "timestamp" attribute containing the parameter defined in subclause 12.4.2.8 indicating date and time of the first reception during the out of E-UTRAN coverage period;

f) an optional "radio-resources-ind" attribute containing the parameter defined in subclause 12.4.2.14;

g) an optional "radio-frequency" attribute containing the parameter defined in subclause 12.4.2.15;

h) zero or one <anyExt> element containing elements defined in future releases;

i) zero, one or more elements from other namespaces defined in future releases; and

j) zero, one or more attributes defined in future releases.

The <app-specific-info> element contains an application specific data received from upper layers during the collection period.

11.3.4.3 Semantics of <USAGE_INFORMATION_REPORT_LIST_RESPONSE>

The <USAGE_INFORMATION_REPORT_LIST_RESPONSE> element contains:

a) one of <response-accept> element and <response-reject> element;

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.

The <response-accept> element indicates that a related USAGE_INFORMATION_REPORT_LIST message was accepted. The <response-accept> element contains:

a) <transaction-ID> element containing the parameter defined in subclause 12.4.2.1 indicating the value of the transaction ID of the related USAGE_INFORMATION_REPORT_LIST message;

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.

The <response-reject> element indicates that a related USAGE_INFORMATION_REPORT_LIST message was rejected. The <response-reject> element contains:

a) <transaction-ID> element containing the parameter defined in subclause 12.4.2.1 indicating the value of the transaction ID of the related USAGE_INFORMATION_REPORT_LIST message;

b) <cause-value> element containing the parameter defined in subclause 12.4.2.7;

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.

11.4 PC5 Signalling messages

11.4.1 Overview

This clause defines the structure of the PC5 Signalling messages exchanged between two ProSe-enabled UEs over the PC5 interface. These are standard L3 messages as defined in 3GPP TS 24.007 [12].

Each definition given in the present clause includes:

a) a table listing the Information Elements (IE) present in the message and the order of their appearance in the message. All IEs that may be repeated are explicitly indicated (The V, LV and LV-E formatted IEs, which contain the imperative part of the message, occur before the T, TV, TLV and TLV-E formatted IEs which contain the non-imperative part of the message, see 3GPP TS 24.007 [12]). In a (maximal) sequence of

consecutive IEs with half octet length, the first IE with half octet length occupies bits 1 to 4 of octet N, the second IE bits 5 to 8 of octet N, the third IE bits 1 to 4 of octet N+1 etc. Such a sequence always has an even number of elements.

For each information element the table indicates:

1. The Information Element Identifier (IEI), in hexadecimal notation, if the IE has format T, TV, TLV or TLV-E. If the IEI has half octet length, it is specified by a notation representing the IEI as a hexadecimal digit followed by a "-" (example: B-).

NOTE: The same IEI can be used for different information element types in different messages of the same protocol.

2. The name of the information element (which is indicative of the semantics of the element). The name of the information element followed by "IE" or "information element" is used as reference to the information element within a message.

3. The name of the type of the information element (which indicates the coding of the value part of the IE), and generally, the referenced subclause of clause 9 of the present document describing the value part of the information element.

4. The presence requirement indication (M, C, or O) for the IE as defined in 3GPP TS 24.007 [12].

5. The format of the information element (T, V, TV, LV, TLV, LV-E or TLV-E) as defined in 3GPP TS 24.007 [12].

6. The length of the information element (or permissible range of lengths), in octets, in the message, where "?" means that the maximum length of the IE is only constrained by link layer protocol. This indication is non-normative.

b) subclauses specifying, where appropriate, conditions for IEs with presence requirement C or O in the relevant message which together with other conditions specified in the present document define when the information elements shall be included or not, what non-presence of such IEs means, and – for IEs with presence requirement C – the static conditions for presence or non-presence of the IEs or for both cases (see 3GPP TS 24.007 [12]).

11.4.2 DIRECT_COMMUNICATION_REQUEST

11.4.2.1 Message definition

This message is sent by a UE to another peer UE to establish a direct link. See table 11.4.2.1.1.

Message type: DIRECT_COMMUNICATION_REQUEST

Table 11.4.2.1.1: DIRECT_COMMUNICATION_REQUEST message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	DIRECT_COMMUNICATION_REQUEST message identity	PC5-SP Message Type 12.5.1.1.	M	V	1
	Sequence Number	Sequence Number 12.5.1.2	M	V	2
	User Info	User Info 12.5.1.3	M	LV	3-253
	IP Address Config	IP Address Config 12.5.1.4	M	V	1
	Maximum Inactivity Period	Maximum Inactivity Period 12.5.1.9	M	V	4
	Nonce_1	Nonce_1 12.5.1.30	M	V	16
	UE Security Capabilities	UE Security Capabilities 12.5.1.22	M	V	2
	MSB of $K_{D\text{-}sess}$ ID	MSB of $K_{D\text{-}sess}$ ID 12.5.1.25	M	V	1
17	K_D ID	K_D ID 12.5.1.30	O	TV	5
25	Relay Service Code	Relay Service Code 12.5.1.17	O	TV	4
22	Signature	Signature 12.5.1.33	O	TV	130
3	Link Local IPv6 Address	IPv6 Address 12.5.1.5	O	TV	17

11.4.3 DIRECT_COMMUNICATION_ACCEPT

11.4.3.1 Message definition

This message is sent by the UE to another peer UE to indicate that the corresponding direct link setup request has been accepted. See table 11.4.3.1.1.

.Message type: DIRECT_COMMUNICATION_ACCEPT

Table 11.4.3.1.1: DIRECT_COMMUNICATION_ACCEPT message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	DIRECT_COMMUNICATION_ACCEPT message identity	PC5-SP Message Type 12.5.1.1.	M	V	1
	Sequence Number	Sequence Number 12.5.1.2	M	V	2
	IP Address Config	IP Address Config 12.5.1.4	M	V	1
3	Link Local IPv6 Address	Link Local IPv6 Address 12.5.1.5	O	TV	17

11.4.3.2 Link Local IPv6 Address

The UE shall include this IE if the IP Address Config IE is set to "address allocation not supported".

11.4.4 DIRECT_COMMUNICATION_REJECT

11.4.4.1 Message definition

This message is sent by the UE to another peer UE to indicate that the corresponding direct link setup request has been rejected. See table 11.4.4.1.1.

.Message type: DIRECT_COMMUNICATION_REJECT

Table 11.4.4.1.1: DIRECT_COMMUNICATION_REJECT message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	DIRECT_COMMUNICATION_REJECT message identity	PC5-SP Message Type 12.5.1.1.	M	V	1
	Sequence Number	Sequence Number 12.5.1.2	M	V	2
	PC5 Signalling Cause Value	PC5 Signalling Cause Value 12.5.1.7	M	V	1

11.4.5 DIRECT_COMMUNICATION_KEEPALIVE

11.4.5.1 Message definition

This message is sent by the UE to another peer UE to initiate a direct link keepalive procedure. See table 11.4.5.1.1.

.Message type: DIRECT_COMMUNICATION_KEEPALIVE

Table 11.4.5.1.1: DIRECT_COMMUNICATION_KEEPALIVE message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	DIRECT_COMMUNICATION_KEEPALIVE message identity	PC5-SP Message Type 12.5.1.1	M	V	1
	Sequence Number	Sequence Number 12.5.1.2	M	V	2
	Keepalive Counter	Keepalive Counter 12.5.1.6	M	V	4
7	Maximum Inactivity Period	Maximum Inactivity Period 12.5.1.9	O	TV	5

11.4.6 DIRECT_COMMUNICATION_KEEPALIVE_ACK

11.4.6.1 Message definition

This message is sent by the UE to another peer UE to acknowledge and respond to the link keepalive request. See table 11.4.6.1.1.

.Message type: DIRECT_COMMUNICATION_KEEPALIVE_ACK

Table 11.4.6.1.1: DIRECT_COMMUNICATION_KEEPALIVE_ACK message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	DIRECT_COMMUNICATION_KEEPALIVE_ACK message identity	PC5-SP Message Type 12.5.1.1..	M	V	1
	Sequence Number	Sequence Number 12.5.1.2	M	V	2
	Keepalive Counter	Keepalive Counter 12.5.1.6	M	V	4

11.4.7 DIRECT_COMMUNICATION_RELEASE

11.4.7.1 Message definition

This message is sent by the UE to another peer UE to initiate the direct link release procedure. See table 11.4.7.1.1.

.Message type: DIRECT_COMMUNICATION_RELEASE

Table 11.4.7.1.1: DIRECT_COMMUNICATION_RELEASE message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	DIRECT_COMMUNICATION_RELEASE message identity	PC5-SP Message Type 12.5.1.1	M	V	1
	Sequence Number	Sequence Number 12.5.1.2	M	V	2
	Release Reason	Release Reason 12.5.1.8	M	V	1

11.4.8 DIRECT_COMMUNICATION_RELEASE_ACCEPT

11.4.8.1 Message definition

This message is sent by the UE to another peer UE to indicate that the link release request is accepted. See table 11.4.8.1.1.

.Message type: DIRECT_COMMUNICATION_RELEASE_ACCEPT

Table 11.4.8.1.1: DIRECT_COMMUNICATION_RELEASE_ACCEPT message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	DIRECT_COMMUNICATION_RELEASE_ACCEPT message identity	PC5-SP Message Type 12.5.1.1	M	V	1
	Sequence Number	Sequence Number 12.5.1.2	M	V	2

11.4.9 TMGI_MONITORING_REQUEST

11.4.9.1 Message definition

This message is sent by the remote UE to ProSe UE-to-network relay UE for TMGI monitoring request. See table 11.4.9.1.

Table 11.4.9.1.1: TMGI_MONITORING_REQUEST content

IEI	Information Element	Type/Reference	Presence	Format	Length
	TMGI_MONITORING_REQUEST identity	Message Type 12.5.1.1	M	V	1
	Sequence Number	Sequence Number 12.5.1.2	M	V	2
	TMGI	Binary 12.5.1.10	M	V	6
	MBMS SAI list	Binary 12.5.1.11	M	LV	3-513
	Requested ProSe Per-Packet Priority	Binary 12.5.1.16	M	V	1

11.4.10 TMGI_MONITORING_RESPONSE

11.4.10.1 Message definition

This message is sent by the ProSe UE-to-network relay UE to the remote UE for TMGI monitoring response. See table 11.4.10.1.

Table 11.4.10.1.1: TMGI_MONITORING_RESPONSE content

IEI	Information Element	Type/Reference	Presence	Format	Length
	TMGI_MONITORING_RESPONSE identity	Message Type 12.5.1.1	M	V	1
	Sequence Number	Sequence Number 12.5.1.2	M	V	2
	ProSe Layer2 Group ID	Binary 12.5.1.12	M	V	3
	TMGI monitoring refresh timer T4104	Binary 12.5.1.13	M	V	2
	SAI indicator	Boolean 12.5.1.14	M	V	1

11.4.11 CELL_ID_ANNOUNCEMENT_REQUEST

11.4.11.1 Message definition

This message is sent by the remote UE to ProSe UE-to-network relay UE to initiate the cell ID announcement request procedure. See table 11.4.11.1.

Table 11.4.11.1.1: CELL_ID_ANNOUNCEMENT_REQUEST content

IEI	Information Element	Type/Reference	Presence	Format	Length
	CELL_ID_ANNOUNCEMENT_REQUEST identity	Message Type 12.5.1.1	M	V	1
	Sequence Number	Sequence Number 12.5.1.2	M	V	2

11.4.12 CELL_ID_ANNOUNCEMENT_RESPONSE

11.4.12.1 Message definition

This message is sent by the ProSe UE-to-network relay UE to the remote UE to acknowledge and respond to the cell ID announcement request. See table 11.4.12.1.

Table 11.4.12.1.1: CELL_ID_ANNOUNCEMENT_RESPONSE content

IEI	Information Element	Type/Reference	Presence	Format	Length
	CELL_ID_ANNOUNCEMENT_RESPONSE identity	Message Type 12.5.1.1	M	V	1
	Sequence Number	Sequence Number 12.5.1.2	M	V	2
	ECGI announcement request refresh timer T4106	Binary 12.5.2.15	M	V	2

11.4.12 DIRECT_SECURITY_MODE_COMMAND

11.4.12.1 Message definition

This message is sent by a commanding UE to a peer UE to establish the security for a direct link. See table 11.4.12.1.1.

Message type: DIRECT_SECURITY_MODE_COMMAND

Table 11.4.12.1.1: DIRECT_SECURITY_MODE_COMMAND message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	DIRECT_SECURITY MODE COMMAND message identity	PC5-SP Message Type 12.5.1.1.	M	V	1
	Sequence Number	Sequence Number 12.5.1.2	M	V	2
	UE Security Capabilities	UE Security Capabilities 12.5.1.22	M	V	2
	Nonce 2	Nonce 2 12.5.1.31	M	V	16
	Chosen Algorithms	Chosen Algorithms 12.5.1.23	M	V	1
	LSB of $K_{D\text{-}sess}$ ID	LSB of $K_{D\text{-}sess}$ 12.5.1.24	M	V	1
16	MSB of K_D ID	MSB of K_D ID 12.5.1.27	O	TV	3
18	K_D Freshness	K_D Freshness 12.5.1.30	O	TV	17
24	GPI	GPI 12.5.1.18	O	TLV	Variable
1	User Info	User Info 12.5.1.3	O	TLV	3-253
22	Signature	Signature 12.5.1.33	O	TV	130
23	Encrypted Payload	Encrypted Payload 12.5.1.34	O	TLV	Variable

11.4.13 DIRECT_SECURITY_MODE_COMPLETE

11.4.13.1 Message definition

This message is sent by a peer UE to a commanding UE to confirm the establishment of the security for a direct link. See table 11.4.13.1.

Message type: DIRECT_SECURITY_MODE_COMPLETE

Table 11.4.13.1: DIRECT_SECURITY_MODE_COMPLETE message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	DIRECT_SECURITY MODE COMPLETE message identity	PC5-SP Message Type 12.5.1.1.	M	V	1
	Sequence Number	Sequence Number 12.5.1.2	M	V	2
15	LSB of K_D ID	LSB of K_D ID 12.5.1.26	O	TV	3

11.4.14 DIRECT_SECURITY_MODE_REJECT

11.4.14.1 Message definition

This message is sent by a peer UE to a commanding UE to indicate a failure to establish the security. See table 11.4.14.1.

Message type: DIRECT_SECURITY_MODE_REJECT

Table 11.4.2.14.1: DIRECT_SECURITY_MODE_REJECT message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	DIRECT_SECURITY MODE REJECT message identity	PC5-SP Message Type 12.5.1.1.	M	V	1
	Sequence Number	Sequence Number 12.5.1.2	M	V	2
	PC5 Signalling Protocol Cause Value	PC5 Signalling Protocol Cause Value 12.5.1.7	M	V	1
10	RAND	RAND 12.5.1.21	O	TV	17
9	AUTS	AUTS 12.5.1.20	O	TV	15

11.4.15 DIRECT_REKEYING_REQUEST

11.4.15.1 Message definition

This message is sent by a UE to the peer UE to refresh the security of an established direct link. See table 11.4.15.1.

Message type: DIRECT_REKEYING_REQUEST

Table 11.4.15.1: DIRECT_REKEYING_REQUEST message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	DIRECT_REKEYING_REQUEST message identity	PC5-SP Message Type 12.5.1.1.	M	V	1
	Sequence Number	Sequence Number 12.5.1.2	M	V	2
	UE Security Capabilities	UE Security Capabilities 12.5.1.22	M	V	3
	Nonce_1	Nonce_1 12.5.1.30	M	V	16
	MSB of $K_{D\text{-}sess}$ ID	MSB of $K_{D\text{-}sess}$ 12.5.1.25	M	V	2
21	Auth Flag	Auth Flag 12.5.1.32	O	TV	2
8	PRUK ID	PRUK ID 12.5.1.19	O	TV	9

11.4.16 DIRECT_REKEYING_RESPONSE

11.4.16.1 Message definition

This message is sent by a UE to the peer UE to complete refreshing the security of an established direct link. See table 11.4.16.1.1.

Message type: DIRECT_REKEYING_RESPONSE

Table 11.4.16.1: DIRECT_REKEYING_RESPONSE message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	DIRECT_REKEYING_RESPONSE message identity	PC5-SP Message Type 12.5.1.1.	M	V	1
	Sequence Number	Sequence Number 12.5.1.2	M	V	2

11.4.17 DIRECT_REKEYING_TRIGGER

11.4.17.1 Message definition

This message is sent by a UE to the peer UE to trigger the peer UE to initiate a direct link rekeying procedure to refresh K_D. See table 11.4.17.1.1.

Message type: DIRECT_REKEYING_TRIGGER

Table 11.4.17.1: DIRECT_REKEYING_TRIGGER message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	DIRECT_REKEYING_RESPONSE message identity	PC5-SP Message Type 12.5.1.1.	M	V	1
	Sequence Number	Sequence Number 12.5.1.2	M	V	2

11.4.18 REMOTE_UE_INFO_REQUEST

11.4.18.1 Message definition

This message is sent by the ProSe UE-to-network relay UE to the remote UE to initiate the remote UE information request procedure. See table 11.4.18.1.1.

Table 11.4.18.1.1: REMOTE_UE_INFO_REQUEST content

IEI	Information Element	Type/Reference	Presence	Format	Length
	REMOTE_UE_INFO_REQUEST message identity	Message Type 12.5.1.1	M	V	1
	Sequence Number	Sequence Number 12.5.1.2	M	V	2
	Remote UE Information Type	Remote UE Information Type 12.5.1.35	M	V	1

11.4.19 REMOTE_UE_INFO_RESPONSE

11.4.19.1 Message definition

This message is sent by the remote UE to the ProSe UE-to-network relay UE to respond to the remote UE information request. See table 11.4.19.1.1.

Table 11.4.19.1.1: REMOTE_UE_INFO_RESPONSE content

IEI	Information Element	Type/Reference	Presence	Format	Length
	REMOTE_UE_INFO_RESPONSE message identity	Message Type 12.5.1.1	M	V	1
	Sequence Number	Sequence Number 12.5.1.2	M	V	2
25	IMEI	IMEI 12.5.1.36	O	TV	9 or 10

12 General message format and information elements coding

12.1 Overview

This clause contains general message format and information elements coding for the messages used in the procedures described in the present document.

12.1A General

The sending entity shall set the value of a spare bit to zero. The receiving entity shall ignore the value of a spare bit.

The sending entity shall not set the value of a field to a reserved value. The receiving entity shall discard a message carrying a field with the value set to a reserved value.

12.2 ProSe direct discovery message formats

12.2.1 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 12.2.1.1.

Table 12.2.1.1: 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 subclause 12.2.2, an XML "complexType" can be used.

Message construction shall be compliant with W3C REC-xmlschema-2-20041028: "XML Schema Part 2: Datatypes" [7]

12.2.2 Parameters in ProSe direct discovery messages

12.2.2.1 Transaction ID

This parameter is used to uniquely identify a PC3 Control Protocol for ProSe direct discovery transaction when it is combined with other PC3 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.

12.2.2.2 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 as follows:

0 Reserved

1 announce

2 monitor

3 query

4 response

5 metadata_update

6-255 Unused

12.2.2.3 UE Identity

This parameter is used to indicate the requesting UE's identity and is set to the IMSI. The coding of IMSI is defined in 3GPP TS 23.003 [4].

12.2.2.4 Prose Application ID

This parameter is used to carry an identity used for open ProSe direct discovery, identifying application related information for the ProSe-enabled UE. It is coded as specified in 3GPP TS 23.003 [4].

12.2.2.5 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:

- OS ID: operating system identifier. The format of the OS ID is a Universally Unique IDentifier (UUID) as specified in IETF RFC 4122 [8]; and
- 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.

12.2.2.6 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 PC5_DISCOVERY message or in a MATCH_REPORT message and application-controlled extension is used, the ProSe Application Code is encoded as a 184 bitstring composed of:
   - the ProSe Application Code Prefix; and
   - 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 [4].

12.2.2.7 Validity Timer T4000

This parameter is used to carry the value of validity timer T4000 associated with a ProSe Application Code. It is an integer in the 1-525600 range representing the timer value in unit of minutes.

12.2.2.8 PC3 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 ProSe Function. It is an integer in the 0-255 range encoded as follows:

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

19-255 Unused

12.2.2.9 DiscoveryKey

Thisparameter is used to carry a Discovery Key allocated by the ProSe Function. This key is used by the UE to compute the MIC that is included in the PC5_DISCOVERY message. The format of Discovery Key is defined in 3GPP TS 33.303 [6].

12.2.2.10 Message Type

This parameter is used to indicate the type of ProSe direct discovery.

This parameter is coded as shown in figure 12.2.2.10.1 and table 12.2.2.10.1.

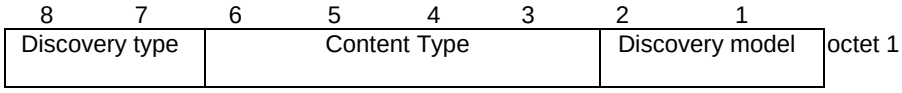

Figure 12.2.2.10.1: Message Type parameter

Table 12.2.2.10.1: 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	announce/response
0	0	0	1	query
0	0	1	0	application-controlled extension enabled
0	0	1	1	Reserved
0	1	0	0	UE-to-Network Relay Discovery Announcement or UE-to-Network Relay Discovery Response
0	1	0	1	UE-to-Network Relay Discovery Solicitation
0	1	1	0	Group Member Discovery Announcement or Group Member Discovery Response
0	1	1	1	Group Member Discovery Solicitation
1	0	0	0	Relay discovery additional information
1	0	0	1	Reserved
1	0	1	0	Reserved
1	0	1	1	Reserved
1	1	0	0	Reserved
1	1	0	1	Reserved
1	1	1	0	Reserved
1	1	1	1	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.

12.2.2.11 MIC

This parameter is used to carry the MIC (Message Integrity Check) associated with the ProSe Application Code contained in a PC5_DISCOVERY message.

12.2.2.12 Discovery Filter

The elements in the Discovery Filter parameter are listed below.

- ProSe Application Code: The ProSe Application Code is used by a monitoring UE for full or partial matching of PC5_DISCOVERY messages received on the PC5 interface (see subclause 12.2.2.6). Only one code is allowed in a Discovery Filter;

- ProSe Application Mask: a bitmask provided by the ProSe Function in order to allow the monitoring UE to perform a full matching or partial matching of 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

- TTLTimer T4002: 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.

12.2.2.13 Void

12.2.2.14 Void

12.2.2.15 Void

12.2.2.16 Monitored PLMN ID

This parameter is used to indicate the PLMN ID of the PLMN in which the 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 [4].

12.2.2.17 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 [4].

12.2.2.18 UTC-based counter

This parameter is used to indicate the UTC time associated with the discovery transmission opportunity in which a 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 36.331 [12].

12.2.2.19 Validity Timer T4004

This parameter is used to carry the value of Validity Timer T4004 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.

12.2.2.20 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 ProSe Function. It is a Boolean value coded as follows:

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 ProSe Function

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 ProSe Function

12.2.2.21 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.

12.2.2.22 UTC-based Counter LSB

This parameter is used to carry:

- the four least significant bits of the UTC-based counter associated with the discovery transmission opportunity used by the UE performing open ProSe direct discovery announcing; or
- 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 ProSe direct discovery or for ProSe direct discovery for public safety use.

This parameter is coded as shown in figures 12.2.2.22.1 and 12.2.2.22.2, and table 12.2.2.22.1.

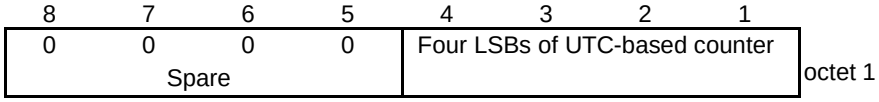

Figure 12.2.2.22.1: UTC-based Counter LSB parameter for open ProSe direct discovery

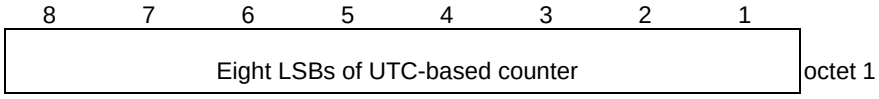

Figure 12.2.2.22. 2: UTC-based Counter LSB parameter for restricted ProSe direct discovery and for ProSe direct discovery for public safety use

Table 12.2.2.22.1: UTC-based Counter LSB parameter

UTC-based Counter LSB value (octet 1) For open 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 subclause 12.2.2.18. Bits 5 to 8 of octet 1 are spare and shall be coded as zero. For restricted 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 subclause 12.2.2.18

12.2.2.23 Current Time

This parameter is used to carry the current UTC-based time at the ProSe Function. The format of this parameter follows the XML data type defined in table 12.2.1.1 for ProSe parameter type "Time".

12.2.2.24 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 33.303 [6]. The Max Offset is an integer in the 1-32 range.

12.2.2.25 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 follows:

0 Reserved

1 Open discovery

2 Restricted discovery

3 Unused

12.2.2.26 Match Report Refresh Timer T4006

This parameter is used to carry the value of Match Report Refresh Timer T4006 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.

12.2.2.27 Requested Timer

During the announce request procedure for open ProSe direct discovery or restricted 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 ProSe Function.When the procedure is to inform the ProSe Function 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 ProSe direct discovery or restricted ProSe direct discovery model A, the Requested Timer element is only used to inform the ProSe Function 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.

12.2.2.28 ProSe Function Transaction ID

This parameter is used to uniquely identify a PC3 Control Protocol for ProSe direct discovery transaction when it is combined with other PC3 Control Protocol for ProSe direct discovery transactions in the same transport message. The ProSe Function shall set this parameter to a new number for each outgoing new request. The ProSe Function transaction ID is an integer in the 0-255 range.

12.2.2.29 Update Info

This parameter is used to carry either:

1) 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:

   - ProSe Restricted Code: See subclause 12.2.2.34; and

   - Validity Timer T4007: See subclause 12.2.2.39.

2) 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 subclause 12.2.2.37;

3) 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:

   - ProSe Application Code: See subclause 12.2.2.6; and

   - Validity Timer T4000: See subclause 12.2.2.7.

4) 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 subclause 12.2.2.12.

12.2.2.30 RPAUID

This parameter is used to carry the RPAUID (Restricted ProSe Application User ID), which is an identity used for restricted ProSe direct discovery, identifying application related information for the ProSe-enabled UE.

12.2.2.31 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 follows:

0 normal

1 on demand

2-255 Unused

12.2.2.32 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.

12.2.2.33 Discovery Entry ID

This parameter is used to carry the Discovery Entry ID, which is an identity allocated by the ProSe Function 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.

12.2.2.34 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 PC5_DISCOVERY message or in a MATCH_REPORT message and application-controlled extension is not used, the ProSe Restricted Code is encoded as a 184 bitstring composed of:

   - the ProSe Restricted Code in the 64 most significant bits; and
   - the remaining 120 bits set to zero;

b) if the ProSe Restricted Code is included in a PC5_DISCOVERY message or in a MATCH_REPORT message and application-controlled extension is used, the ProSe Restricted Code is encoded as a 184 bitstring composed of

   - the ProSe Restricted Code Prefix in the 64 most significant bits;
   - the ProSe Restricted Code Suffix; and
   - 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 [4].

12.2.2.35 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 subclause 12.2.2.34) for restricted 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:

- 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.
- 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.

12.2.2.36 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 ProSe Function.

12.2.2.37 Restricted Discovery Filter

This parameter is used to carry the Discovery Filter(s) used to monitor an individual target RPAUID in restricted ProSe direct discovery model A. It contains one or more filter(s), TTL timer T4009, optionally an RPAUID parameter identifying the target RPAUID, security parameters such as Discovery User Scrambling Key, Discovery User Integrity Key and Discovery User Confidentiality Key, optionally a metadata indicator, and optionally the corresponding metadata. The elements in the Restricted Discovery Filter parameter are defined as below.

- Filter: a matching filter used for restricted 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 PC5_DISCOVERY messages received on the PC5 interface with a ProSe Restricted Code (see subclause 12.2.2.34). Only one code is allowed in a filter. The mask is a bitmask provided by the ProSe Function in order to allow the monitoring UE to perform a full matching or partial matching of 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;

- TTLTimer T4009: 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;

- RPAUID: identifier of the target RPAUID to be monitored;

- DUSK (Discovery User Scrambling Key): an optional key which is allocated by the ProSe Function and is used by the monitoring UE or discoverer UE for unscrambling the PC5_DISCOVERY message containing the ProSe Restricted Code in restricted ProSe direct discovery. The format of the DUSK is defined in 3GPP TS 33.303 [6];

- DUIK (Discovery User Integrity Key) or a MIC Check Indicator :DUIK is an optional key which is allocated by the ProSe Function and is used by the UE to compute the MIC that is included in the PC5_DISCOVERY message containing the ProSe Restricted Code in restricted ProSe direct discovery. The format of the DUIK is defined in 3GPP TS 33.303 [6]. When the DUIK is absent, an optional MIC Check Indicator parameter may be included to inform a UE receiving PC5_DISCOVERY messages that the MIC field needs to be checked by sending a MATCH_REPORT message to the ProSe Function;

- DUCK material: an optional parameter containing a DUCK (Discovery User Confidentiality Key) and an Encrypted Bitmask. The DUCK is allocated by the ProSe Function and is used by the UE to decrypt a portion of the PC5_DISCOVERY message in restricted ProSe direct discovery. The format of the DUCK is defined in 3GPP TS 33.303 [6]. 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;

- Metadata indicator: It contains the information element defined in subclause 12.2.2.65; and

- Metadata: application-layer metadata associated with the monitoring target.

12.2.2.38 ACE Enabled Indicator

This parameter is used to indicate whether application-controlled extension for open ProSe direct discovery or restricted ProSe direct discovery is enabled. It is an integer value in the 0-255 range encoded as follows:

0 Reserved

1 Normal

2 Application-controlled extension enabled

3-255 Unused

12.2.2.39 Validity Timer T4007

This parameter is used to carry the value of validity timer T4007 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.

12.2.2.40 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 ProSe direct discovery messages over the PC5 interface. The elements in the Restricted Code Security Material parameter are listed below:

DUSK (Discovery User Scrambling Key): an optional key which is allocated by the ProSe Function and is used by the UE for scrambling or unscrambling the PC5_DISCOVERY message containing the ProSe Restricted Code in restricted ProSe direct discovery. The format of the DUSK is defined in 3GPP TS 33.303 [6];

- DUIK (Discovery User Integrity Key): an optional key which is allocated by the ProSe Function and is used by the UE to compute the MIC that is included in the PC5_DISCOVERY message containing the ProSe Restricted Code in restricted ProSe direct discovery. The format of the DUIK is defined in 3GPP TS 33.303 [6]; and

- DUCK (Discovery User Confidentiality Key) and associated Encrypted Bitmask): DUCK is an optional key which is allocated by the ProSe Function and is used by the UE to encrypt a portion of the PC5_DISCOVERY message containing the ProSe Restricted Code in restricted ProSe direct discovery. The format of the DUCK is defined in 3GPP TS 33.303 [6]. 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.

12.2.2.41 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 follows:

0 Reserved

1 Model A

2 Model B

3 Unused

12.2.2.42 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 [4].

12.2.2.43 Discovery Query Filter

This parameter is used to carry the Discovery Query Filter that is allocated by the ProSe Function 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.

- Code: The code is used by a Discoveree UE for full or partial matching of PC5_DISCOVERY messages received on the PC5 interface containing a ProSe Query Code. Only one code is allowed in a Discovery Query Filter.;

- Mask: The mask is a bitmask provided by the ProSe Function in order to allow the Discoveree UE to perform a full matching or partial matching of 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.

12.2.2.44 Validity Timer T4011

This parameter is used to carry the value of validity timer T4011 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.

12.2.2.45 Subquery Result

This parameter is used to contain the information allocated by the ProSe Function related to one particular query target RPAUID which the discoverer UE intends to query with restricted ProSe direct discovery Model B. It contains one ProSe Query Code, one or more Discovery Response Filter(s), Validity Timer T4013, 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.

- ProSe Query Code: It is a ProSe Restricted Code allocated by the ProSe Function to a discoverer UE to solicit the response from a discoveree UE for a particular target RPAUID.
- Discovery Response Filter: It contains one code and one or more masks to be used to matching ProSe Response Code, as described in subclause 6.2.3B.4. The code is used by a discoverer UE to represent a targeted ProSe Response Code (see subclause 12.2.2.42). The mask is a bitmask provided by the ProSe Function in order to allow the discoverer UE to perform a full matching or partial matching of 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.
- Validity Timer T4013: 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.
- Restricted Security: It contains the information element defined in subclause 12.2.2.40.
- RPAUID: identifier of the target RPAUID to be monitored.
- Metadata: application-layer metadata associated with the querying target.

12.2.2.46 ProSe Restricted Code Prefix

This parameter is used to contain a ProSe Restricted Code Prefix, whose format is defined in 3GPP TS 23.003 [4].

12.2.2.47 ProSe Restricted Code Suffix

This parameter is used to contain a ProSe Restricted Code Suffix, whose format is defined in 3GPP TS 23.003 [4]. If the size of ProSe Restricted Code Suffix is less than 120 bits, the information element shall be padded with zeros in the least significant bits.

12.2.2.48 ProSe UE ID

The ProSe UE ID parameter is used to indicate a ProSe UE ID. The value of the ProSe UE ID parameter is a 24-bit long bit string.

12.2.2.49 ProSe Relay UE ID

The ProSe Relay UE ID parameter is used to indicate a ProSe Relay UE ID. The value of the ProSe Relay UE ID parameter is a 24-bit long bit string.

12.2.2.50 User Info ID

The User Info ID parameter carries a User Info ID as specified in 3GPP TS 23.303 [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.

12.2.2.51 Relay Service Code

The Relay Service Code parameter identifies a connectivity service the UE-to-Network relay provides. The value of the Relay Service Code parameter is a 24-bit long bit string. The format of the Relay Service Code parameter is out of scope of this specification.

12.2.2.52 Target User Info

The Target User Info parameter is used to provide the User Info ID of the targeted discoveree user. The value of the Target User Info parameter is a 48-bit long bit string.

12.2.2.53 Target Group Info

The Target Group Info parameter is used to provide the ProSe Layer-2 Group ID of the targeted group. The value of the Target Group Info parameter is 24-bit long bit string.

12.2.2.54 Discovery Group ID

The Discovery Group ID parameter carries an identifier of a discovery group that the UE belongs to. The value of the Discovery Group ID parameter is a 24-bit long bit string. The format of the Discovery Group ID parameter is out of scope of this specification.

12.2.2.55 GMDS Composition

This parameter is used to indicate the content of the PC5_DISCOVERY message for Group Member Discovery Solicitation.

This parameter is coded as shown in figure 12.2.2.55.1 and table 12.2.2.55.1.

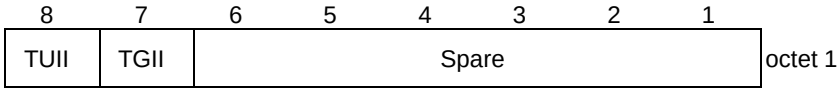

Figure 12.2.2.55.1: GMDS Composition parameter

Table 12.2.2.55.1: GMDS Composition parameter

TUII (octet 1) Bit **8** 0 1	 Target User Info is not included Target User Info is included
TGII (octet 1) Bit **7** 0 1	 Target Group Info is not included Target Group Info is included
Bits 1 to 6 of octet 1 are spare and shall be coded as zero (see NOTE).	
NOTE: Bits 1 to 6 of octet 1 were reserved in earlier versions of the protocol.	

12.2.2.56 Spare

This parameter is a string of spare bits. The length of this parameter is variable and is indicated in a message where this parameter is included.

12.2.2.57 RDAI Composition

This parameter is used to indicate the content of the PC5_DISCOVERY message for Relay Discovery Additional Information.

This parameter is coded as shown in figure 12.2.2.57.1 and table 12.2.2.57.1.

8	7	6	5	4	3	2	1	
MBMSRI	ECGII	Spare						octet 1

Figure 12.2.2.57.1: RDAI Composition IE parameter

Table 12.2.2.57.1: RDAI Composition IE parameter

MBMS related information (octet 1) Bit **8** 0 MBMS related information is not included 1 MBMS related information is included ECGI information (octet 1) Bit **7** 0 ECGI information is not included 1 ECGI information is included Bits 1 to 6 of octet 1 are spare and shall be coded as zero (see NOTE 2). NOTE 1: Either the ECGI information or the MBMS related information is to be included, but not both. NOTE 2: Bits 1 to 6 of octet 1 were reserved in earlier versions of the protocol.

12.2.2.58 ECGI

This parameter is used to indicate the ECGI of the serving cell where the ProSe UE-to-network relay UE is camping.

The UE-to-network relay ECGI parameter is coded as shown in figure 12.2.2.58 and table 12.2.2.58.

8	7	6	5	4	3	2	1	
MCC digit 2				MCC digit 1				octet 1
MNC digit 3				MCC digit 3				octet 2
MNC digit 2				MNC digit 1				octet 3
ECI digit 2				ECI digit 1				octet 4
ECI digit 4				ECI digit 3				octet 5
ECI digit 6				ECI digit 5				octet 6
Spare				ECI digit 7				octet 7

Figure 12.2.2.58.1: UE-to-network relay ECGI parameter

Table 12.2.2.58.1: UE-to-network relay ECGI parameter

MCC, Mobile country code (octet 1, octet 2 bits 1 to 4) The MCC field is coded as in ITU-T Rec. E.212 [32], Annex A. MNC, Mobile network code (octet 2 bits 5 to 8, octet 3) 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". ECI, E-UTRAN cell identity (octet 4, octet 5, octet 6, octet 7 bits 1 to 4) The ECI field is coded as in 3GPP TS 23.003 [4]. Spare(octet 7 bits 5 to 8) The Spare field is coded as zeros.

12.2.2.59 MBMS related information

This parameter is used to indicate a TMGI and its corresponding ProSe Layer-2 Group ID.

The MBMS related information parameter is coded as shown in figure 12.2.2.59.1 and table 12.2.2.59.1.

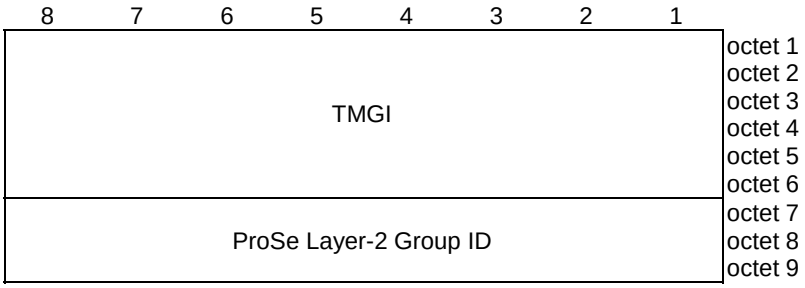

Figure 12.2.2.59.1: TMGIs and ProSe Layer-2 Group IDs parameter

Table 12.2.2.59.1: TMGIs and ProSe Layer-2 Group IDs parameter

TMGI (octets 1 to 6) The TMGI field is coded exactly same as octet 3 to octet 8 of TMGI element in the figure 10.5.154/3GPP TS 24.008 [30] and table 10.5.168/3GPP TS 24.008 [30]. ProSe Layer-2 Group ID (octets 7 to 9) The ProSe Layer-2 Group ID field contains a ProSe Layer-2 Group ID.

12.2.2.60 Validity Timer T4016

This parameter is used to carry the value of Validity Timer T4016 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.

12.2.2.61 Match Report Refresh Timer T4017

This parameter is used to carry the value of Match Report Refresh Timer T4017 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.

12.2.2.62 Metadata Index Mask

This parameter is a bitmask provided by the ProSe Function 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.

12.2.2.63 Network-Initiated Transaction Method

This parameter is used to indicate the method enabling transport of PC3 messages for ProSe Function-initiated ProSe direct discovery procedures. It is an integer in the 0-255 range encoded as follows:

0 Unused

1 HTTP long polling

2-255 Unused

12.2.2.64 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 PC5_DISCOVERY message. It is coded as specified in 3GPP TS 23.003 [4].

12.2.2.65 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 follows:

0 No metadata associated

1 Metadata associated

2-255 Unused

12.2.2.66 URDS Composition

This parameter is used to indicate the content of the PC5_DISCOVERY message for UE-to-Network Relay Discovery Solicitation.

This parameter is coded as shown in figure 12.2.2.66.1 and table 12.2.2.66.1.

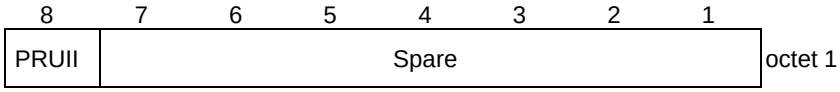

Figure 12.2.2.66.1: UDRS Composition parameter

Table 12.2.2.66.1: UDRS Composition parameter

PRUII (octet 1)	
Bit	
8	
0	ProSe Relay UE ID is not included
1	ProSe Relay UE ID is included
Bits 1 to 7 of octet 1 are spare and shall be coded as zero (see NOTE).	
NOTE: Bits 1 to 7 of octet 1 were reserved in earlier versions of the protocol.	

12.2.2.67 Status Indicator

This parameter is used to indicate the staus of ProSe UE-to-network relay.

This parameter is coded as shown in figure 12.2.2.67.1 and table 12.2.2.67.1.

Resource Status Indicator (RSI) is used to indicate whether or not the UE has resources available to provide a connectivity service for additional ProSe-enabled public safety UEs.

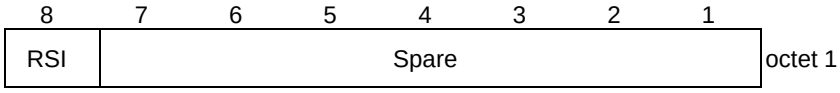

Figure 12.2.2.67.1: Status Indicator parameter

Table 12.2.2.67.1: Status Indicator parameter

RSI (octet 1)	
Bit	
8	
0	the UE does not have resources available to provide a connectivity service for additional ProSe-enabled public safety UEs
1	the UE has resources available to provide a connectivity service for additional ProSe-enabled public safety UEs
Bits 1 to 7 of octet 1 are spare and shall be coded as zero (see NOTE).	
NOTE: Bits 1 to 7 of octet 1 were reserved in earlier versions of the protocol.	

12.2.2.68 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 ProSe Function by means that are out of scope of 3GPP.

12.2.2.69 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 ProSe direct discovery with application-controlled extension.

12.2.2.70 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:

- ProSe Application Code Prefix: as defined in subclause 12.2.2.68;
- ProSe Application Code Suffix Range: this parameter is used to carry a range of consecutive ProSe Application Code Suffixes (see subclause 12.2.2.69). A ProSe Application Code Suffix Range includes a Beginning Suffix Code and optionally an Ending Suffix Code, as described below:
  - 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.
  - 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.

12.3 EPC-level ProSe discovery message formats

12.3.1 Data types format in XML schema

To exchange structured information over the transport protocol, XML text format/notation is introduced. XML data type definitions and requirements as specified in subclause 12.2.1 apply.

12.3.2 Information elements in EPC-level ProSe discovery messages

12.3.2.1 Transaction ID

This parameter is used to uniquely identify a PC3 Control Protocol for EPC-level ProSe discovery transaction when it is combined with other PC3 Control Protocol for EPC-level ProSe 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.

12.3.2.2 UE Identity

This parameter is used to indicate the requesting UE's identity and is set to the IMSI. The coding of IMSI is defined in 3GPP TS 23.003 [4].

12.3.2.3 Application Identity

This parameter is used to identify the particular application that triggers the APPLICATION_REGISTRATION_REQUEST message. The format of the Application Identity consists of two parts:

- OS ID: operating system identifier. The format of the OS ID is a Universally Unique IDentifier (UUID) as specified in IETF RFC 4122 [8]; and
- 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.

12.3.2.4 Application Layer User ID

This parameter is used to carry an Application Layer User ID that identifies the user in the context of specific application. It is encoded as a bit string.

12.3.2.5 PC3 EPC Control Protocol cause value

This parameter is used to indicate the particular reason why either the UE or the ProSe function sends the UE_DEREGISTRATION_REQUEST message or why the following messages have been rejected by the ProSe Function:

- UE_REGISTRATION_REQUEST;
- APPLICATION_REGISTRATION_REQUEST;
- PROXIMITY_REQUEST; and
- PROXIMITY_REQUEST_VALIDATION.

It is an integer in the 0-255 range encoded as follows:

0 Reserved

1 Invalid Application

2 UE authorisation failure

3 Invalid Message Format

4 Application not registered

5 Range class not allowed for this application

6 Proximity detection unlikely within requested time window

7 Targeted user not registered for this application

8 Proximity validation rejected by B-side

9 Application disabled temporarily

10 Invalid Application Layer User ID

11-255 Unused

12.3.2.6 WLAN Link Layer ID

This parameter is used to carry WLAN link layer identifier. The value of WLAN Link Layer ID is coded as a bit string of length 48.

12.3.2.7 EPC ProSe User ID

This parameter is used to carry an EPC ProSe User ID that identifies the UE registered for EPC-level ProSe Discovery in the context of the ProSe Function. It is specified in 3GPP TS 23.003 [4].

12.3.2.8 Range Class

This parameter is used to carry one range class used for APPLICATION_REGISTRATION_RESPONSE or PROXIMITY_REQUEST messages. It is an integer in the 0-255 range encoded as follows:

0 Reserved

1 0-50 m

2 0-100 m

3 0-200 m

4 0-500 m

5 0-1000 m

6-255 Unused

12.3.2.9 Time Window

This parameter is used to specify a time interval in minutes during which a proximity request is valid. The Time Window is an integer in the range of 1 – 1440 minutes.

12.3.2.10 Void

12.3.2.11 UE Location

The UE Location is set to the cell identity part of the Evolved Cell Global Identifier, as described in 3GPP TS 36.331 [12] and obtained from the lower layers of the UE. The value of UE Location is a bit string coded as specified in 3GPP TS 36.331 [12].

12.3.2.12 WLAN Indication

This parameter is used to carry an indication of whether the searching UE wishes to engage in WLAN direct discovery and communication subsequent to successful proximity detection. It is a Boolean value coded as follows:

False the searching UE does not wish to engage in WLAN direct discovery and communication subsequent to successful proximity detection

True the searching UE wishes to engage in WLAN direct discovery and communication subsequent to successful proximity detection

12.3.2.13 Assistance Information

This parameter is used to carry information for expediting WLAN direct discovery and communication. The content of this parameter depends on the WLAN technology.

Wi-Fi Peer-to-Peer (P2P) specification [13] defines an architecture and set of protocols that facilitate direct discovery and communication using the IEEE 802.11 technology [14]. To assist WLAN direct discovery and communication as required by the Wi-Fi P2P technology, the Assistance Information includes the following parameters.

- SSID: The SSID to use for Wi-Fi P2P operation. To be compliant with the Wi-Fi P2P specification [13] the SSID should be in the form "DIRECT-ab" where a, b are two random characters;
- WLAN Secret Key: The pre-shared key to be used by UEs to secure their Wi-Fi P2P communication. This is used by UEs as the Pairwise Master Key (PMK);
- Group Owner indication: If set, the UE should implement the Group Owner (GO) functionality specified in the Wi-Fi P2P specification [13]. The UE implementing this functionality essentially becomes an AP that transmits Beacons with the P2P Information Element and accepts associations from other Wi-Fi P2P devices or from legacy Wi-Fi devices (those not implementing the Wi-Fi P2P functionality). If not set, the UE should behave as a Wi-Fi P2P client that attempts to discover and associate with a GO;
- P2P Device Address of self: This is the WLAN Link Layer ID to be used by UE to advertise itself. A UE implementing the Group Owner and indicates the WLAN Direct device from which the GO should accept WLAN association requests. Association requests from all other WLAN devices should be rejected by GO.
- P2P Device Address of peers: This is the WLAN Link Layer ID to be used by UE to discover peer UEs. A UE implementing the Group Owner should accept WLAN association requests only from devices that are in this list;
- Operation channel: The channel on which Wi-Fi P2P discovery and communication should take place; and
- Validity time: The time period during which the content provided in the assistance information is valid.

12.3.2.14 Method for server-initiated transaction

This parameter is used to indicate the capability of the UE to support methods other than OMA Push (e.g., HTTP long polling method) for server initiated procedures for EPC-level ProSe discovery. It is an integer in the 0-255 range encoded as follows:

0 No extra methods available

1 HTTP long polling

2-255 Unused

12.3.2.15 Method for server-initiated transaction configuration

This parameter is used to indicate the preference of a server-initiated method type to be used by the UE and the ProSe Function for server-initiated procedures for EPC-level ProSe discovery other than OMA Push (e.g., HTTP long polling). It is an integer in the 0-255 range encoded as follows:

0 The ProSe Function does not prefer other method

1 HTTP long polling

2-255 Unused

12.4 Formats for messages transmitted over the PC3ch interface

12.4.1 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 PC3ch messages are provided in table 12.4.1.

Table 12.4.1: Primitive or derived types for ProSe PC3ch 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 subclause 12.4.2, an XML "complexType" can be used.

Message construction shall be compliant with W3C REC-xmlschema-2-20041028: "XML Schema Part 2: Datatypes" [7].

12.4.2 Parameters in messages transmitted over the PC3ch interface

12.4.2.1 Transaction ID

This parameter is used to uniquely identify a message transmitted over the PC3ch interface when it is combined with another message transmitted over the PC3ch interface in the same transport message. The UE shall set this parameter to a new number for each outgoing new message which includes this information element and is transmitted over the PC3ch interface. The transaction ID is an integer in the 0-255 range.

12.4.2.2 UE Identity

This parameter is used to indicate the requesting UE's identity and is set to the IMSI. The coding of IMSI is defined in 3GPP TS 23.003 [4].

12.4.2.3 Sequence number

This parameter is used to indicate sequence number of the usage information report. The sequence number is an integer in the 0-4294967295 range. The sequence number is set to 0 on UE power up and is increased by 1 whenever a new usage information report is created.

12.4.2.4 In coverage

This parameter is used to indicate whether the UE was in E-UTRAN coverage. It is a Boolean value coded as follows:

True the UE is in E-UTRAN coverage.

False the UE is out of E-UTRAN coverage.

12.4.2.5 ECGI

This parameter is used to indicate E-UTRAN Cell Global Identification of the E-UTRAN cell where the UE was camping on or which the UE used in the EMM-CONNECTED mode. The coding of ECGI is defined in 3GPP TS 23.003 [4].

12.4.2.6 ProSe direct communication radio parameters

This parameter is used to indicate the radio parameters used for ProSe direct communication. Format of the value is according to the SL-Preconfiguration-r12 ASN.1 data type described in 3GPP TS 36.331 [12].

12.4.2.7 Cause value

This parameter is used to indicate the particular reason why the ProSe function CTF (ADF) rejects USAGE_INFORMATION_REPORT_LIST message. It is an integer in the 0-255 range encoded as follows:

0 Reserved

2 UE authorisation failure

3 Invalid Message Format

10 Unable to process usage information report list

1, 4-9, 11-255 Unused

12.4.2.8 Timestamp

This parameter is used to indicate time and date. The format of this parameter follows the XML data type defined in table 12.4.1 for ProSe PC3ch message parameter type "Time".

12.4.2.9 ProSe Layer-2 Group ID

This parameters is used to indicate a ProSe Layer-2 Group ID. The value of ProSe Layer 2 Group ID is a 24-bit bit-string.

12.4.2.10 Prose Group IP multicast address

This parameters is used to indicate a ProSe Group IP multicast address. If the IP address is an IPv4 address, its value is coded as a string representing the dotted-decimal format of the IPv4 address as specified in IETF RFC 1166 [28]. If the IP address is an IPv6 address, its value is coded as a string representing the canonical text representation format of the IPv6 address as specified in IETF RFC 5952 [29].

12.4.2.11 IP address of the UE

This parameters is used to indicate an IP address used by the UE as a source address. If the IP address is an IPv4 address, its value is coded as a string representing the dotted-decimal format of the IPv4 address as specified in IETF RFC 1166 [28]. If the IP address is an IPv6 address, its value is coded as a string representing the canonical text representation format of the IPv6 address as specified in IETF RFC 5952 [29].

12.4.2.12 Prose UE ID

This parameters is used to indicate a ProSe UE ID. The value of ProSe UE ID is a 24-bit bit-string.

12.4.2.13 Transported data amount

This parameters is used to indicate the amount of transported data in octets. The value of this parameter is coded as an integer.

12.4.2.14 Radio resources indicator

This parameters is used to indicate whether the operator-provided radio resources or the configured radio resources were used for ProSe direct communication.

It is an integer in the 0-255 range encoded as follows:

0 Reserved

1 the operator-provided radio resources

2 the configured radio resources

3-255 Unused

12.4.2.15 Radio frequency

This parameter is used to indicate the radio frequency used for ProSe direct communication.

Format of the value is according to the ARFCN-ValueEUTRA-r9 ASN.1 data type described in 3GPP TS 36.331 [12].

12.5 PC5 Signalling message formats

12.5.1 Information elements in PC5 Signalling messages

12.5.1.1 PC5-SP Message Type

The PC5 SP Message Type IE is a type 3 information element, with the length of 1 octet. It is used to indicate the type of messages used in PC5 Signaling Protocol.

Table 12.5.1.1.1 defines the value part of the PC5-SP Message Type IE used in the PC5 Signalling messages.

Table 12.5.1.1.1: PC5-SP message types for PC5 Signalling Protocol

Bits								
8	7	6	5	4	3	2	1	
0	0	0	0	0	0	0	1	DIRECT_COMMUNICATION_REQUEST
0	0	0	0	0	0	1	0	DIRECT_COMMUNICATION_ACCEPT
0	0	0	0	0	0	1	1	DIRECT_COMMUNICATION_REJECT
0	0	0	0	0	1	0	0	DIRECT_COMMUNICATION_KEEPALIVE
0	0	0	0	0	1	0	1	DIRECT_COMMUNICATION_KEEPALIVE_ACK
0	0	0	0	0	1	1	0	DIRECT_COMMUNICATION_RELEASE
0	0	0	0	0	1	1	1	DIRECT_COMMUNICATION_RELEASE_ACCEPT
0	0	0	0	1	0	0	0	TMGI_MONITORING_REQUEST
0	0	0	0	1	0	0	1	TMGI_MONITORING_RESPONSE
0	0	0	0	1	0	1	0	CELL_ID_ANNOUNCEMENT_REQUEST
0	0	0	0	1	0	1	1	CELL_ID_ANNOUNCEMENT_RESPONSE
0	0	0	0	1	1	0	0	DIRECT_SECURITY_MODE_COMMAND
0	0	0	0	1	1	0	1	DIRECT_SECURITY_MODE_COMPLETE
0	0	0	0	1	1	1	0	DIRECT_SECURITY_MODE_REJECT
0	0	0	0	1	1	1	1	DIRECT_REKEYING_REQUEST
0	0	0	1	0	0	0	0	DIRECT_REKEYING_RESPONSE
0	0	0	1	0	0	0	1	DIRECT_REKEYING_TRIGGER
0	0	0	1	0	0	1	0	REMOTE_UE_INFO_REQUEST
0	0	0	1	0	0	1	1	REMOTE_UE_INFO_RESPONSE
All other values are reserved								

12.5.1.2 Sequence Number

The purpose of the Sequence Number is to uniquely identify a PC5 Signalling message being sent or received. The sending UE will increment the sequence number for each outgoing new PC5 Signalling message. The Sequence Number information element is an integer in the 0-65535 range.

12.5.1.3 User Info

The purpose of the User Info information element is to provide either the User Info received from upper layers identifying the user which is using this direct link, the PRUK ID received from the PKMF that the remote UE wants to use to connect to a relay using this direct link, or the IMSI of the remote UE using this direct link.

The User Info IE content is a Type 4 information element, with a minimum length of 3 octets. The IEI of the User Info IE is 1.

The User Info information element is coded as shown in figure 12.5.1.3.1, figure 12.5.1.3.2 and table 12.5.1.3.1.

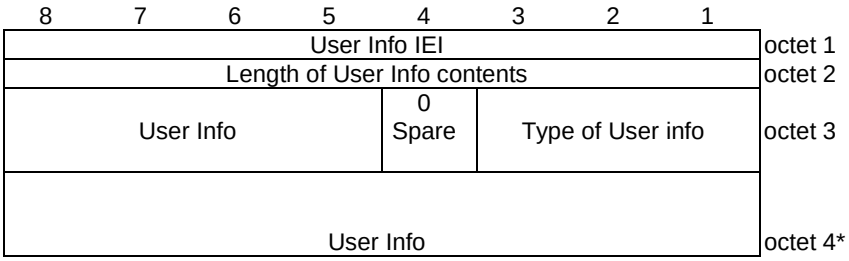

Figure 12.5.1.3.1: User Info information element

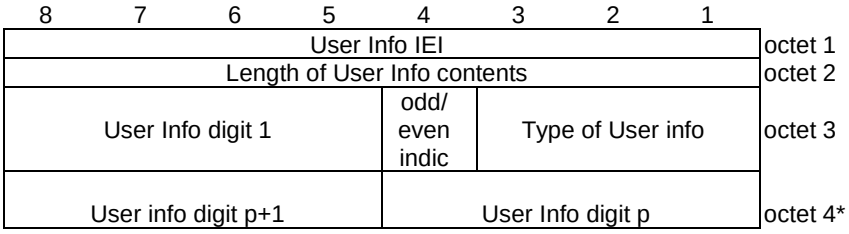

Figure 12.5.1.3.2: User Info information element for type of User Info "IMSI"

Table 12.5.1.3.1: User Info information element

Type of User Info (octet 3) Bits **3 2 1** 0 0 1 Upper layers User Info 0 1 0 PRUK ID 0 1 1 IMSI All other values are reserved. Odd/even indication (octet 3) Bit **4** 0 even number of identity digits 1 odd number of identity digits Identity digits (octet 3 etc) For the IMSI, this field is coded using BCD coding. If the number of identity digits is even then bits 5 to 8 of the last octet shall be filled with an end mark coded as "1111". For Type of identity "Upper layers User Info", the User Info bits are set to a bit string received from upper layers. Any unused bit in the last octet shall be coded as "0". For Type of identity "PRUK ID", the User Info bits are set to a bit string received from the PKMF. Any unused bit in the last octet shall be coded as "0".

12.5.1.4 IP Address Config

The purpose of the IP Address Config information element is to indicate the configuration options for IP address used by the UE over this direct link.

The IP Address Config is a type 3 information element. The IEI of the IP Address Config IE is 2.

The IP Address Config information element is coded as shown in figure 12.5.1.4.1 and table 12.5.1.4.1.

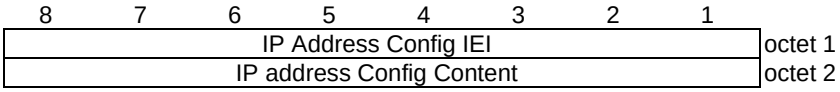

Figure 12.5.1.4.1: IP Address Config information element

Table12.5.1.4.1: IP Address Config information element

IP Address Config value (octet 2) Bits **4 3 2 1**	
0 0 0 0	DHCPv4 Server
0 0 0 1	IPv6 Router
0 0 1 0	DHCPv4 Server & IPv6 Router
0 0 1 1	address allocation not supported
All other values are reserved.	
Bit 5 to 8 of octet 2 are spare and shall be coded as zero.	

12.5.1.5 Link Local IPv6 Address

The Link Local IPv6 Address information element contains a link-local IPv6 address.

The Link Local IPv6 Address is a type 3 information element. The IEI of the Link Local IPv6 Address IE is 3.

The Link Local IPv6 Address element is coded as shown in figure 12.5.1.5.1 and table 12.5.1.5.1.

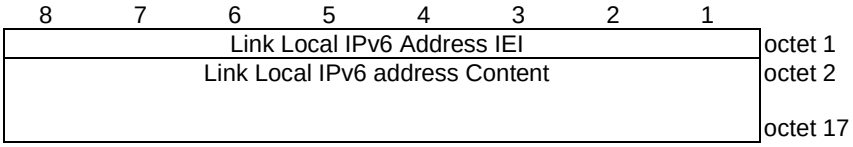

Figure 12.5.1.5.1: IP Address Config information element

Table12.5.1.5.1: IPv6 Address information element

IP 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 [36].

12.5.1.6 Keepalive Counter

The Keepalive Counter information element contains a 32-bit counter used for the direct link keepalive procedure.

The IPv6 Address is a type 3 information element with a length of 4 octets. The IEI of the KeepAlive Counter IE is 4.

The Keepalive Counter information element is coded as shown in figure 12.5.1.6.1 and table 12.5.1.6.1.

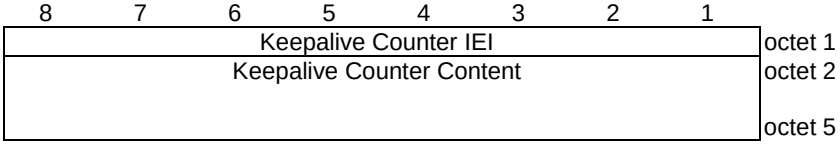

Figure 12.5.1.6.1: Keepalive Counter information element

Table12.5.1.6.1: Keepalive Counter information element

Keepalive Counter value (octet 2 to 5) This contains the 32-bit keepalive counter.

12.5.1.7 PC5 Signalling Protocol Cause Value

The purpose of the PC5 Signaling Protocol Cause Value information element is to indicate the error cause values used in the PC5 Signalling Protocol procedures.

The PC5 Signalling Protocol Cause Value is a type 3 information element, with a length of 1 octet. The IEI of PC5 Signaling Protocol Cause Value IE is 5.

The PC5 Signalling Protocol Cause Value information element is coded as shown in figure 12.5.1.7.1 and table 12.5.1.7.1.

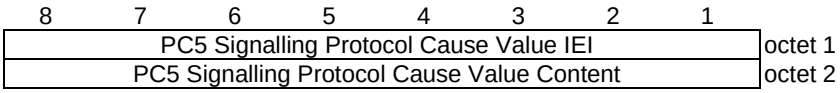

Figure 12.5.1.7.1: PC5 Signaling Protocol Cause Value information element

Table12.5.1.7.1: PC5 Signaling Protocol Cause Value information element

PC5 Signaling Error Cause value (octet 2)

Bits

4	**3**	**2**	**1**	
0	0	0	1	Direct communication to target UE not allowed
0	0	1	0	Authentication failure
0	0	1	1	Conflict of Layer 2 ID for unicast communication is detected
0	1	0	0	Lack of resources for proposed link
0	1	0	1	IP version mismatch
0	1	1	0	Link setup failure due to other errors
0	1	1	1	UE security capabilities mismatch
1	0	0	0	Unspecified error
1	0	0	1	Authentication synchronisation error
1	0	1	0	Non-responsive peer during security mode procedure

All other values are reserved.

Bit 5 to 8 of octet 2 are spare and shall be coded as zero.

12.5.1.8 Release Reason

The purpose of the Release Reason information element is to indicate the reason why the direct link is to be released.

The Release Reason IE is a type 3 information element, with a length of 1 octet. The IEI of Release Reason IE is 6.

The Release Reason information element is coded as shown in figure 12.5.1.8.1 and table 12.5.1.8.1.

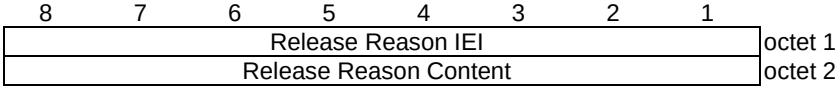

Figure 12.5.1.8.1: Release Reason information element

Table 12.5.1.8.1: Release Reason information element

Release Reason value (octet 2) Bits **4 3 2 1**	
0 0 0 1	Direct communication to the peer UE no longer needed
0 0 1 0	Direct communication with the peer UE is no longer allowed
0 0 1 1	Direct connection is not available any more
All other values are reserved.	
Bit 5 to 8 of octet 2 are spare and shall be coded as zero.	

12.5.1.9 Maximum Inactivity Period

The purpose of the Maximum Inactivity Period information element is to indicate the maximum inactivity period of the requesting UE over the direct link.

The Maximum Inactivity Period IE is a type 3 information element, with a length of 4 octet. The IEI of Maximum Inactivity Period IE is 7.

The Maximum Inactivity Period information element is coded as shown in figure 12.5.1.9.1 and table 12.5.1.9.1.

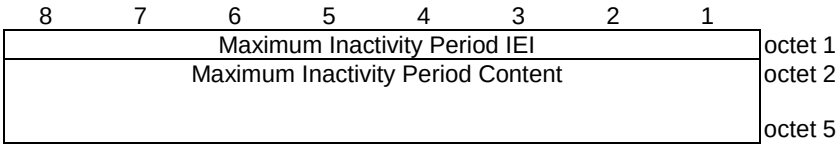

Figure 12.5.1.9.1: Maximum Inactivity Period information element

Table12.5.1.9.1: Maximum Inactivity Period information element

Maximum Inactivity Period value (octet 2 to 5)
This contains the 32-bit inactivity period value in seconds.

12.5.1.10 TMGI

This parameter is used to identify the Multicast and Broadcast bearer services. The coding of TMGI is specified in 3GPP TS 24.008 [30].

12.5.1.11 MBMS SAI list

This parameter is used to transfer a list of MBMS Service Area Identities to the ProSe UE-to-network relay UE. The MBMS SAI list is a type 4 information element, with a minimum length of 3 octets and a maximum length of 513 octets. The list can contain a maximum of 256 different MBMS Service Area Identities. The length of MBMS SAI is 2 octets.

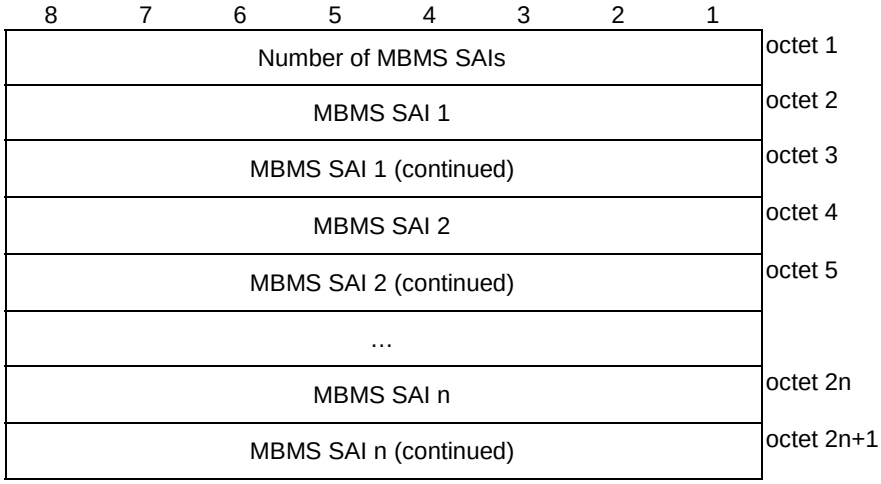

Figure 12.5.1.11.1: MBMS SAI list information element

Table 12.5.1.11.1: MBMS SAI list information element

The value part of the MBMS SAI list information element consists of the number of MBMS SAIs and one or more MBMS SAIs. The length of MBMS SAI list can be determined from the 'Number of MBMS SAIs'. The ProSe UE-to-network relay UE shall store the complete list received.

Number of MBMS SAIs (octet 1)
Bits

8	**7**	**6**	**5**	**4**	**3**	**2**	**1**	
0	0	0	0	0	0	0	0	1 element
0	0	0	0	0	0	0	1	2 element
0	0	0	0	0	0	1	0	3 element
				…				
1	1	1	1	1	1	0	1	254 element
1	1	1	1	1	1	1	0	255 element
1	1	1	1	1	1	1	1	256 element

If the number of MBMS SAIs = n:

for i=1, n;
octet 2i and 2i+1 contain the MBMS SAI of the i-th MBMS SAI belonging to the MBMS SAI list

The coding of MBMS SAI is specified in 3GPP TS 23.003 [4].

12.5.1.12 ProSe Layer2 Group ID

This parameter is a link layer identifier of the group that transmits the MBMS traffic associated with a TMGI. The coding of ProSe Layer2 Group ID is specified in 3GPP TS 23.003 [4].

12.5.1.13 TMGI Monitoring Refresh Timer T4104

This parameter is used to carry the value of TMGI monitoring refresh timer T4104 associated with a TMGI. It is an integer in the 1-1440 range representing the timer value in unit of minutes.

12.5.1.14 SAI Indicator

This parameter is used to carry the SAI indicator, which is a Boolean value indicating whether the ProSe UE-to-network relay UE can forward the MBMS content associated with the received TMGI for the remote UE.

12.5.1.15 ECGI announcement request refresh timer T4106

This parameter is used to carry the value of ECGI announcement request refresh timer. It is an integer in the 1-1440 range representing the timer value in unit of minutes.

12.5.1.16 Requested ProSe Per-Packet Priority

This parameter is used for representing a protocol data unit transmission priority for relaying eMBMS traffic over PC5. It is provided by the remote UE. It is an integer in the 1-8 range and the lower number means the higher priority.

The Requested ProSe Per-Packet Priority is a type 3 information element, with a length of 1 octet. The Requested ProSe Per-Packet Priority information element is coded as shown in table 12.5.1.16.1.

Table 12.5.1.16.1: TMGI_MONITORING_REQUEST content

ProSe Per-Packet Priority value (octet 1) Bits				
4	**3**	**2**	**1**	
0	0	0	0	Reserved
0	0	0	1	PPPP 1
0	0	1	0	PPPP 2
0	0	1	1	PPPP 3
0	1	0	0	PPPP 4
0	1	0	1	PPPP 5
0	1	1	0	PPPP 6
0	1	1	1	PPPP 7
1	0	0	0	PPPP 8
All other values are reserved.				
Bit 5 to 8 of octet 1 are spare and shall be coded as zero.				

12.5.1.17 Relay Service Code

The purpose of the Relay Service Code information element is to indicate the parameter defined in subclause 12.2.2.51.

The Relay Service Code information element is coded as shown in figure 12.5.1.17.1 and table 12.5.1.17.1.

The Relay Service Code is a type 3 information element with a length of 4 octets. The IEI of the Relay Service Code IE is 25.

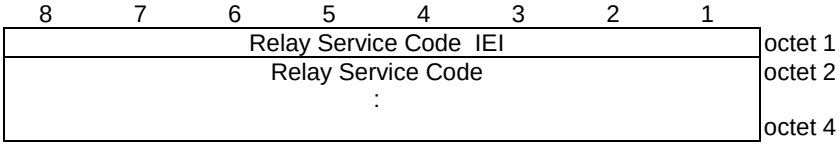

Figure 12.5.1.17.1: Relay Service Code information element

Table 12.5.1.17.1: Relay Service Code information element

Relay Service Code value (octet 2 to 4) This contains the 24-bit Relay Service Code.

12.5.1.18 GPI

The purpose of the GPI information element is to include the GBA Push Information as defined in 3GPP TS 33.223 [42].

The GPI information element is coded as shown in figure 12.5.1.18.1 and table 12.5.1.18.1.

The GPI is a type 3 information element with a variable length. The IEI of the GPI IE is 24.

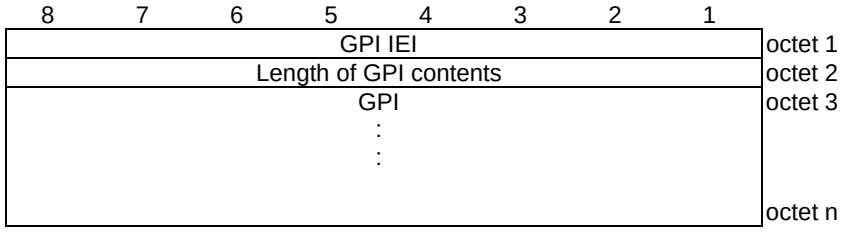

Figure 12.5.1.18.1: GPI information element

Table 12.5.1.18.1: GPI information element

GPI value (octet 3 to 9) GPI message layout as defined in 3GPP TS 33.223 [42]

12.5.1.19 PRUK ID

The purpose of the PRUK ID information element is to provide the ProSe UE-to-network relay with the latest PRUK ID at the remote UE when the remote UE triggers rekeying.

The PRUK ID information element is coded as shown in figure 12.5.1.19.1 and table 12.5.1.19.1.

The PRUK ID is a type 3 information element with a length of 9 octets. The IEI of the PRUK ID IE is 8.

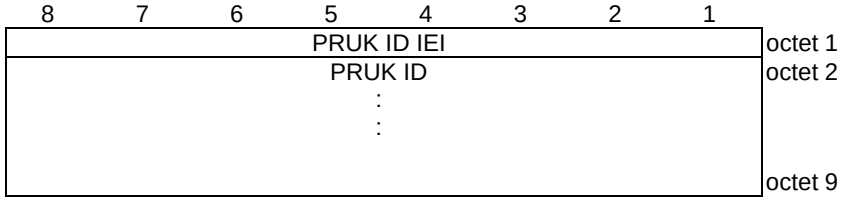

Figure 12.5.1.19.1: PRUK ID information element

Table 12.5.1.19.1: PRUK ID information element

PRUK ID value (octet 2 to 9) This contains the PRUK ID

12.5.1.20 AUTS

The purpose of the AUTS information element is to provide the network with the necessary information to begin a re-synchronisation as part of the AKA procedure (see 3GPP TS 33.102 [41]).

The AUTS information element is coded as shown in figure 12.5.1.20.1 and table 12.5.1.20.1.

The AUTS is a type 3 information element with a length of 15 octets. The IEI of the AUTS IE is 9.

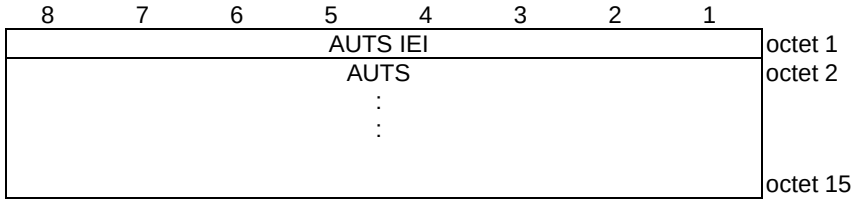

Figure 12.5.1.20.1: AUTS information element

Table 12.5.1.20.1: AUTS information element

AUTS value (octet 2 to 15) This contains AUTS (see 3GPP TS 33.102 [41])

12.5.1.21 RAND

The purpose of the RAND information element is to provide the mobile station with a non-predictable challenge for the AKA procedure.

The RAND information element is coded as shown in figure 12.5.1.21.1 and table 12.5.1.21.1.

The RAND is a type 3 information element with a length of 17 octets. The IEI of the RAND IE is 10.

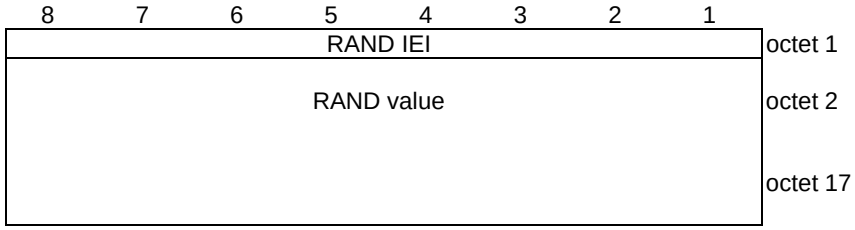

Figure 12.5.1.21.1: RAND information element

Table 12.5.1.21.1: RAND information element

RAND value (octet 2, 3,... and 17) The RAND value consists of 128 bits.

12.5.1.22 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 information element is coded as shown in figure 12.5.1.22.1 and table 12.5.1.22.1.

The UE Security Capabilities is a type 3 information element with a length of 3 octets. The IEI of the UE Security Capabilities IE is 11.

8	7	6	5	4	3	2	1	
UE security capabilities IEI								octet 1
EEA0	128-EEA1	128-EEA2	128-EEA3	EEA4	EEA5	EEA6	EEA7	octet 2
EIA0	128-EIA1	128-EIA2	128-EIA3	EIA4	EIA5	EIA6	EIA7	octet 3

Figure 12.5.1.22.1: UE Security Capabilities information element

Table 12.5.1.22.1: UE Security Capabilities information element

EPS encryption algorithms supported (octet 2)

EPS encryption algorithm EEA0 supported (octet 2, bit 8)
0 EPS encryption algorithm EEA0 not supported
1 EPS encryption algorithm EEA0 supported

EPS encryption algorithm 128-EEA1 supported (octet 2, bit 7)
0 EPS encryption algorithm 128-EEA1 not supported
1 EPS encryption algorithm 128-EEA1 supported

EPS encryption algorithm 128-EEA2 supported (octet 2, bit 6)
0 EPS encryption algorithm 128-EEA2 not supported
1 EPS encryption algorithm 128-EEA2 supported

EPS encryption algorithm 128-EEA3 supported (octet 2, bit 5)
0 EPS encryption algorithm 128-EEA3 not supported
1 EPS encryption algorithm 128-EEA3 supported

EPS encryption algorithm EEA4 supported (octet 2, bit 4)
0 EPS encryption algorithm EEA4 not supported
1 EPS encryption algorithm EEA4 supported

EPS encryption algorithm EEA5 supported (octet 2, bit 3)
0 EPS encryption algorithm EEA5 not supported
1 EPS encryption algorithm EEA5 supported

EPS encryption algorithm EEA6 supported (octet 2, bit 2)
0 EPS encryption algorithm EEA6 not supported
1 EPS encryption algorithm EEA6 supported

EPS encryption algorithm EEA7 supported (octet 1, bit 1)
0 EPS encryption algorithm EEA7 not supported
1 EPS encryption algorithm EEA7 supported

EPS integrity algorithms supported (octet 3)

EPS integrity algorithm EIA0 supported (octet 3, bit 8)
0 EPS integrity algorithm EIA0 not supported
1 EPS integrity algorithm EIA0 supported

EPS integrity algorithm 128-EIA1 supported (octet 3, bit 7)
0 EPS integrity algorithm 128-EIA1 not supported
1 EPS integrity algorithm 128-EIA1 supported

EPS integrity algorithm 128-EIA2 supported (octet 3, bit 6)
0 EPS integrity algorithm 128-EIA2 not supported
1 EPS integrity algorithm 128-EIA2 supported

EPS integrity algorithm 128-EIA3 supported (octet 3, bit 5)
0 EPS integrity algorithm 128-EIA3 not supported
1 EPS integrity algorithm 128-EIA3 supported

EPS integrity algorithm EIA4 supported (octet 3, bit 4)
0 EPS integrity algorithm EIA4 not supported
1 EPS integrity algorithm EIA4 supported

EPS integrity algorithm EIA5 supported (octet 3, bit 3)
0 EPS integrity algorithm EIA5 not supported
1 EPS integrity algorithm EIA5 supported

EPS integrity algorithm EIA6 supported (octet 3, bit 2)
0 EPS integrity algorithm EIA6 not supported
1 EPS integrity algorithm EIA6 supported

EPS integrity algorithm EIA7 supported (octet 3, bit 1)
0 EPS integrity algorithm EIA7 not supported

1	EPS integrity algorithm EIA7 supported

12.5.1.23 Chosen Algorithms

The purpose of the Chosen Algorithms information element is to indicate the algorithms to be used for ciphering and integrity protection.

The Chosen Algorithms information element is coded as shown in figure 12.5.1.23.1 and table 12.5.1.23.1.

The Chosen Algorithms is a type 3 information element with a length of 2 octets. The IEI of the Chosen Algorithms IE is 12.

8	7	6	5	4	3	2	1	
Chosen Algorithms IEI								octet 1
0 spare	Type of ciphering algorithm			0 spare	Type of integrity protection algorithm			octet 2

Figure 12.5.1.23.1: Chosen Algorithms information element

Table 12.5.1.23.1: Chosen Algorithms information element

Type of integrity protection algorithm (octet 2, bit 1 to 3)

Bits

3	**2**	**1**	
0	0	0	EPS integrity algorithm EIA0 (null integrity protection algorithm)
0	0	1	EPS integrity algorithm 128-EIA1
0	1	0	EPS integrity algorithm 128-EIA2
0	1	1	EPS integrity algorithm 128-EIA3
1	0	0	EPS integrity algorithm EIA4
1	0	1	EPS integrity algorithm EIA5
1	1	0	EPS integrity algorithm EIA6
1	1	1	EPS integrity algorithm EIA7

Type of ciphering algorithm (octet 2, bit 5 to 7)

Bits

7	**6**	**5**	
0	0	0	EPS encryption algorithm EEA0 (null ciphering algorithm)
0	0	1	EPS encryption algorithm 128-EEA1
0	1	0	EPS encryption algorithm 128-EEA2
0	1	1	EPS encryption algorithm 128-EEA3
1	0	0	EPS encryption algorithm EEA4
1	0	1	EPS encryption algorithm EEA5
1	1	0	EPS encryption algorithm EEA6
1	1	1	EPS encryption algorithm EEA7

Bit 4 and 8 of octet 2 are spare and shall be coded as zero.

12.5.1.24 LSB of $K_{D\text{-}sess}$ ID

The purpose of the LSB of $K_{D\text{-}sess}$ ID information element is to carry the 16 least significant bits of the $K_{D\text{-}sess}$ ID.

The LSB of $K_{D\text{-}sess}$ ID IE is a type 3 information element, with a length of 1 octet. The IEI of the LSB of $K_{D\text{-}sess}$ ID IE is 13.

The LSB of $K_{D\text{-}sess}$ ID information element is coded as shown in figure 12.5.1.24.1 and table 12.5.1.24.1.

8	7	6	5	4	3	2	1	
LSB of $K_{D\text{-}sess}$ ID IEI								octet 1
LSB of $K_{D\text{-}sess}$ ID Content								octet 2

Figure 12.5.1.24.1: LSB of $K_{D\text{-}sess}$ ID information element

Table12.5.1.24.1: LSB of $K_{D\text{-}sess}$ ID information element

LSB of $K_{D\text{-}sess}$ ID value (octet 2) This contains the 8 least significant bits of $K_{D\text{-}sess}$ ID.

12.5.1.25 MSB of $K_{D\text{-}sess}$ ID

The purpose of the MSB of $K_{D\text{-}sess}$ ID information element is to carry the 8 most significant bits of the $K_{D\text{-}sess}$ ID.

The MSB of $K_{D\text{-}sess}$ ID IE is a type 3 information element, with a length of 1 octet. The IEI of the MSB of $K_{D\text{-}sess}$ ID Request Nonce IE is 14.

The MSB of $K_{D\text{-}sess}$ ID information element is coded as shown in figure 12.5.1.25.1 and table 12.5.1.25.1.

8	7	6	5	4	3	2	1	
MSB of $K_{D\text{-}sess}$ ID IEI								octet 1
MSB of $K_{D\text{-}sess}$ ID Content								octet 2

Figure 12.5.1.25.1: MSB of $K_{D\text{-}sess}$ ID information element

Table12.5.1.25.1: MSB of $K_{D\text{-}sess}$ ID information element

MSB of $K_{D\text{-}sess}$ ID value (octet 2) This contains the 16 most significant bits of $K_{D\text{-}sess}$ ID.

12.5.1.26 LSB of K_D ID

The purpose of the LSD of K_D ID information element is to carry the 16 least significant bits of the K_D ID.

The LSB of K_D ID IE is a type 3 information element, with a length of 2 octets. The IEI of the LSB of K_D ID is 15.

The LSB of K_D ID information element is coded as shown in figure 12.5.1.26.1 and table 12.5.1.26.1.

8	7	6	5	4	3	2	1	
LSD of K_D ID IEI								octet 1
LSB of K_D ID Content								octet 2
								octet 3

Figure 12.5.1.26.1: LSB of K_D ID information element

Table12.5.1.26.1: LSB of K_D ID information element

LSB of K_D ID value (octet 2 to 3) This contains the 16 least significant bits of K_D ID.

12.5.1.27 MSB of K_D ID

The purpose of the MSB of K_D ID information element is to carry the 16 most significant bits of the K_D ID.

The MSB of K_D ID IE is a type 3 information element, with a length of 2 octets. The IEI of the MSB of K_D ID IE is 16.

The MSB of K_D ID information element is coded as shown in figure 12.5.1.27.1 and table 12.5.1.27.1.

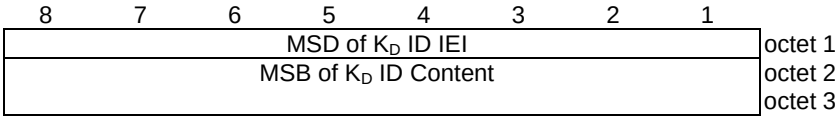

Figure 12.5.1.27.1: MSB of K_D ID information element

Table12.5.1.27.1: MSB of K_D ID information element

MSB of K_D ID value (octet 2 to 3) This contains the 16 most significant bits of K_D ID.

12.5.1.28 K_D ID

The purpose of the K_D ID information element is to carry the identity of the K_D held by a UE.

The K_D ID IE is a type 3 information element, with a length of 4 octets. The IEI of the K_D ID IE is 17.

The K_D ID information element is coded as shown in figure 12.5.1.28.1 and table 12.5.1.28.1.

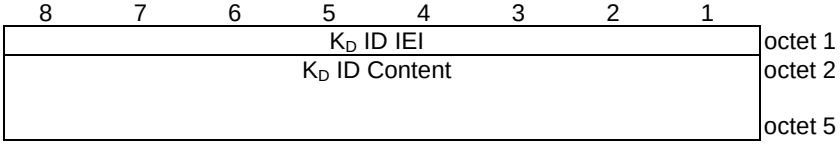

Figure 12.5.1.28.1: K_D ID information element

Table12.5.1.28.1: K_D ID information element

K_D ID value (octet 2 to 5) This contains the 32-bit identifier of a K_D.

12.5.1.29 K_D Freshness

The purpose of the K_D Freshness information element is to indicate the nonce value generated by initiating PKMF to ensure that any calculated K_D is fresh.

The K_D Freshness parameter IE is a type 3 information element, with a length of 16 octets. The IEI of the K_D Freshness IE is 18.

The K_D Freshness parameter information element is coded as shown in figure 12.5.1.29.1 and table 12.5.1.29.1.

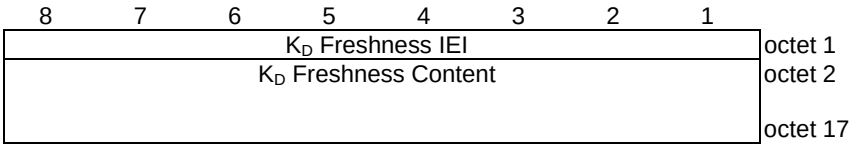

Figure 12.5.1.29.1: K_D Freshness information element

Table12.5.1.29.1: K_D Freshness information element

K_D Freshness value (octet 2 to 17) This contains the 128-bit nonce value.

12.5.1.30 Nonce_1

The purpose of the Nonce_1 information element is to indicate the nonce value generated by the UE which initiated the direct link setup procedure or direct link rekeying procedure.

The Nonce_1 IE is a type 3 information element, with a length of 16 octets. The IEI of the Nonce_1 IE is 19.

The Nonce_1 information element is coded as shown in figure 12.5.1.30.1 and table 12.5.1.30.1.

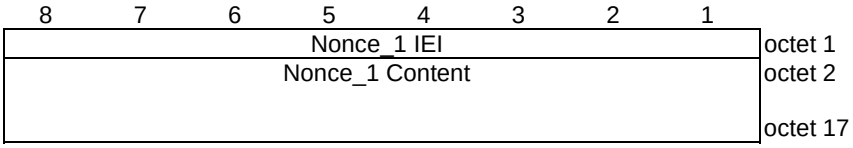

Figure 12.5.1.30.1: Nonce_1 information element

Table12.5.1.30.1: Nonce_1 information element

Nonce1 value (octet 2 to 17) This contains the 128-bit nonce value.

12.5.1.31 Nonce_2

The purpose of the Nonce_2 information element is to indicate the nonce value generated by the UE which initiated the direct security mode control procedure.

The Nonce_2 IE is a type 3 information element, with a length of 16 octets. The IEI of the Nonce_2 IE is 20.

The Nonce_2 information element is coded as shown in figure 12.5.1.31.1 and table 12.5.1.31.1.

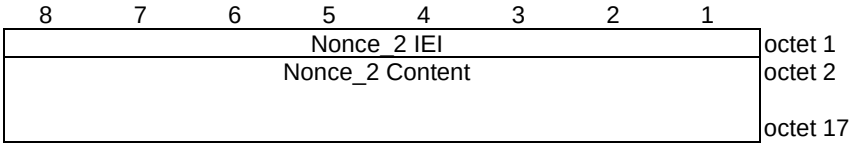

Figure 12.5.1.31.1: Nonce_2 information element

Table12.5.1.31.1: Nonce_2 information element

Nonce_2 value (octet 2 to 17) This contains the 128-bit nonce value.

12.5.1.32 Auth Flag

The purpose of the Auth Flag information element is to indicate that the K_D is to be refreshed..

The Auth Flag IE is a type 3 information element, with a length of 2 octets. The IEI of the Auth Flag IE is 21.

The Auth Flag information element is coded as shown in figure 12.5.1.32.1 and table 12.5.1.32.1.

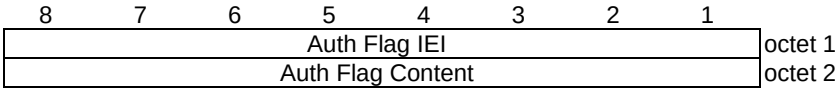

Figure 12.5.1.32.1: Auth Flag information element

Table12.5.1.32.1: Auth Flag information element

Auth Flag value (octet 2) Bits **1** 0 Reserved 1 K_D is requested to be refreshed Bit 2 to 8 of octet 2 are spare and shall be coded as zero.

12.5.1.33 Signature

The purpose of the Signature information element is to indicate the ECCSI signature calculated based on information exchanged during the direct link setup.

The Signature IE is a type 3 information element, with a length of 129 octets. The IEI of the Signature IE is 22.

The Signature information element is coded as shown in figure 12.5.1.33.1 and table 12.5.1.33.1.

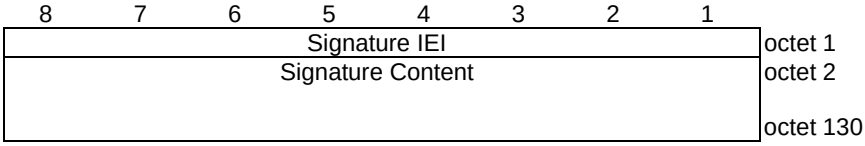

Figure 12.5.1.33.1: Signature information element

Table12.5.1.33.1: Signature information element

Signature value (octet 2 to 130) This contains the signature with a length of 129 octets. The exact content structure is specified in 3GPP TS 33.303 [6].

12.5.1.34 Encrypted Payload

The purpose of the Encrypted Payload information element is to indicate the encrypted data encapsulating the shared secret key to be used for the established link.

The Encrypted Payload IE is a type 3 information element, with a variable length. The IEI of the Encrypted Payload IE is 23.

The Encrypted Payload information element is coded as shown in figure 12.5.1.34.1 and table 12.5.1.34.1.

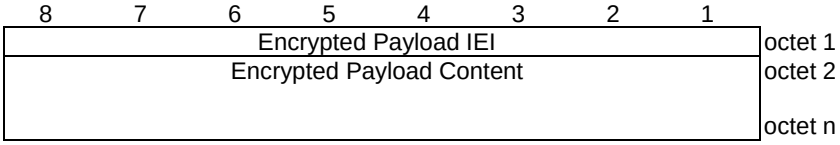

Figure 12.5.1.34.1: Encrypted Payload information element

Table12.5.1.34.1: Encrypted Payload information element

Encrypted Payload value (octet 2 to n) This contains the encrypted data content with a variable length. The exact content structure is specified in 3GPP TS 33.303 [6].

12.5.1.35 Remote UE Information Type

The purpose of the Remote UE Information Type element is to indicate the type of information requested regarding the remote UE.

The Remote UE Information Type IE is a type 3 information element, with a length of 2 bytes. The IEI of the Remote UE Information Type IE is 24.

The Remote UE Information Type information element is coded as shown in figure 12.5.1.35.1 and table 12.5.1.35.1.

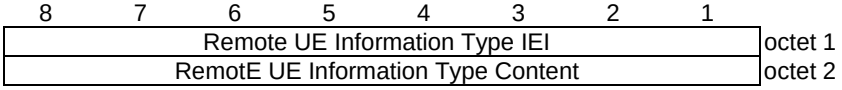

Figure 12.5.1.35.1: Remote UE Information Type information element

Table 12.5.1.35.1: Remote UE Information Type information element

Bits								
8	7	6	5	4	3	2	1	
0	0	0	0	0	0	0	1	IMEI
0	0	0	0	0	0	1	0	IMEISV
All other values are reserved								

12.5.1.36 IMEI

The purpose of the IMEI information element is to indicate the IMEI or IMEISV of a UE.

The IMEI IE is a type 3 information element, with a length of 9 or 10 bytes, depending on the IMEI type. The IEI of the IMEI IE is 25.

The IMEI information element is coded as shown in figure 12.5.1.36.1 and table 12.5.1.36.1.

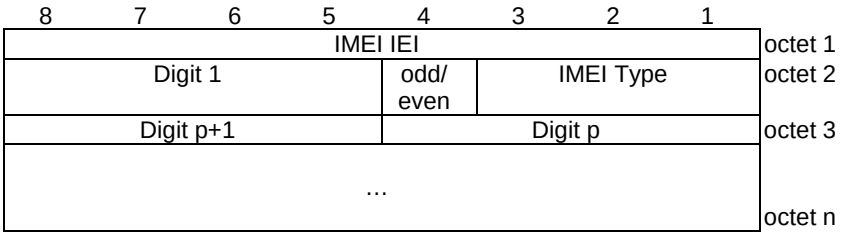

Figure 12.5.1.36.1: IMEI information element

Table 12.5.1.36.1: IMEI information element

IMEI Content (octet 2- octet n (n is either 9 or 10)

Odd/even indication (octet 2)
Bit
4
0 even number of IMEI identity digits
1 odd number of IMEI identity digits

IMEI Type (octet 2)
Bits

3	**2**	**1**	
1	0	0	IMEI
1	0	1	IMEISV

All other values are reserved.

IMEI Identity digits (octet 2 etc)

For the IMEI, this field is coded using BCD coding from octet 2 to octet 9. The format of the IMEI is described in 3GPP TS 23.003 [4].

For the IMEISV, this field is coded using BCD coding from octet 2 to octet 10. Bits 5 to 8 of Octet 10 shall be filled with an end mark coded as "1111". The format of the IMEISV is described in 3GPP TS 23.003 [4].

13 List of system parameters

13.1 General

The description of timers in table 13.2.1 and table 13.2.2 should be considered a brief summary. The complete descriptions of the timers are in the procedures defined in subclause 5 and subclause 6.

13.2 Timers of ProSe direct services procedures

Table 13.2.1: ProSe direct services timers – UE side

TIMER NUM.	TIMER VALUE	CAUSE OF START	NORMAL STOP	ON EXPIRY
T4000	NOTE 1	Upon receiving a ProSe Application Code with an associated T4000 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 subclause 6.2.2.4. Upon receiving a ProSe Application Code with an associated T4000 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 subclause 6.2.7.3.	Upon receiving a new T4000 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 subclause 6.2.7.3.	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.
T4002	NOTE 2	Upon receiving a Discovery Filter with an associated T4002 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 subclause 6.2.3.4. 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 subclause 6.2.7.3.	Upon receiving a new T4002 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 subclause 6.2.7.3.	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.

T4004	NOTE 3	Upon receiving a T4004 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 subclause 6.2.4.4.	Upon receiving a new T4004 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 PC3 Control Protocol cause value is #5.	The UE may inform the upper layers that the corresponding ProSe Application ID is no longer matched.
T4005	NOTE 4	Upon receiving a monitoring, announcing, discoveree operation, discoverer operation or communication policy for a given PLMN with an associated T4005 value in the ProSe service authorisation as described in subclause 5.1.3.	When the service authorisation for the corresponding PLMN is revoked by the ProSe Function. Upon receiving a new T4005 timer value for the same operation (monitoring, announcing, discoveree operation, discoverer operation or communication) in the same PLMN.	Stop the monitoring, announcing, discoveree, discoverer or communication operation in the corresponding PLMN and re-initiate the service authorisation procedure if the UE wants to continue performing announcing, monitoring, discoveree, discoverer or communication operation in that PLMN.
T4006	NOTE 3	Upon receiving a T4006 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 subclause 6.2.4.4.	Upon receiving a new T4006 timer value for the same ProSe Application Code in a MATCH_REPORT_ ACK message. When the corresponding T4004 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.

T4007	NOTE 5	Upon receiving a ProSe Restricted Code or ProSe Restricted Code Prefix with an associated T4007 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 subclause 6.2.2A.4. Upon receiving a ProSe Restricted Code with an associated T4007 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 subclause 6.2.6.3.	Upon receiving a new T4007 timer value for the same ProSe Restricted Code or ProSe Restricted Code Prefix, or upon receiving a new T4007 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 T4007 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 subclause 6.2.6.3.	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.
T4009	NOTE 6	Upon receiving a Restricted Discovery Filter with an associated T4009 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 subclause 6.2.3A.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 subclause 6.2.6.2.	Upon receiving one or more new T4009 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 subclause 6.2.6.2.	Stop using the associated Restricted Discovery Filter for restricted 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.

T4011	NOTE 7	Upon receiving a ProSe Response Code and Discovery Query Filters with an associated T4011 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 subclause 6.2.2B.4.	Upon receiving a new T4011 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.
T4013	NOTE 8	Upon receiving a ProSe Query Code and Discovery Response Filters with an associated T4013 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 subclause 6.2.3B.4.	Upon receiving a new T4013 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.
T4015	NOTE 4	Upon receiving a ProSe Discovery UE ID with an associated T4015 value in the ProSe service authorisation as described in subclause 5.1.3.	Upon receiving a new ProSe Discovery UE ID.	Stop performing ProSe restricted discovery and re-initiate the service authorisation procedure if the UE wants to continue performing ProSe restricted discovery.
T4016	NOTE 13	Upon receiving a T4016 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_REPORTmessage, as described in subclause 6.2.4A.4 or 6.2.4B.4.	Upon receiving a new T4016 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 PC3 Control Protocol cause value #5.	The UE may inform the upper layers that the corresponding RPAUID is no longer matched.

T4017	NOTE 13	Upon receiving a T4017 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_REPORTmessage, as described in subclause 6.2.4A.4.	Upon receiving a new T4017 timer value for the same ProSe Restricted Code or ProSe Response Code in a MATCH_REPORT_ACK message. When the corresponding T4016 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.
T4100		Upon sending a DIRECT_COMMUNICATION_REQUEST message	Upon receiving a DIRECT_COMMUNICATION_ACCEPT or DIRECT_COMMUNICATION_REJECT message from the target UE	Retransmission of DIRECT_COMMUNICATION_SETUP message
T4101		DIRECT_COMMUNICATION_KEEPALIVE message sent	Upon Receiving a DIRECT_COMMUNICATION_KEEPALIVE_ACK message or other PC5 Signaling message or user data from the peer UE	Retransmission of DIRECT_COMMUNICATION_KEEPALIVE message
T4102		Upon Receiving a DIRECT_COMMUNICATION_KEEPALIVE_ACK message, or other PC5 Signaling message, or any user data from the peer UE	Upon receiving an upper layer request to check whether the direct link is alive and sending out a DIRECT_COMMUNICATION_KEEPALIVE message	Send a DIRECT_COMMUNICATION_KEEP_ALIVE message
T4103		Upon sending a DIRECT_COMMUNICATION_RELEASE message	Upon receiving a DIRECT_COMMUNICATION_RELEASE_ACCEPT message from the peer UE.	Stop using the corresponding direct link for one-to-one communication
T4104	NOTE 9	Upon receiving a ProSe Layer2 Group ID with an associated T4104 timer in a TMGI_MONITORING_RESPONSE message, as described in subclause 10.5.	Upon receiving one or more new T4104 timer values for the same ProSe Layer2 Group ID in a TMGI_MONITORING_RESPONSE message.	Re-initiate the TMGI monitoring request procedure, if the request from upper layers to receive the MBMS content for the given TMGI is still in place.
T4105	NOTE 10	Upon assigning a ProSe Layer2 Group ID with an associated T4104 value to the remote UE, as described in subclause 10.5.	Upon sending a new TMGI_MONITORING_RESPONSE for the same TMGI.	Delete the associated TMGI and MBMS SAI list.
T4106	NOTE 11	Upon receiving a T4106 value in a CELL_ID_ANNOUNCEMENT_RESPONSE message as described in subclause 10.6.	Upon receiving one or more new T4106 timer values in a CELL_ID_ANNOUNCEMENT_RESPONSE message.	Re-initiate the cell ID announcement request procedure, if the upper layer application still needs to obtain ECGI of the cell serving the ProSe UE-to-network relay.

T4107	NOTE 12	Upon sending a CELL_ID_ANNOUNCEMENT_RESPONSE message as described in subclause 10.6.	Upon sending a new CELL_ID_ANNOUNCEMENT_RESPONSE message.	Stop the cell ID announcement in the PC5_DISCOVERY message for Relay Discovery Additional Information.
T4108		Upon receiving a Maximum Inactivity Period IE in DIRECT_COMMUNICATION_KEEPALIVE message; or when the UE has no more message or user data to send over the direct link.	Upon sending or receiving a PC5 Signaling message or user data over the direct link	Either initiate the direct link keepalive procedure or direct link release procedure.
T4109		Upon sending the PC5_DISCOVERY message for UE-to-Network Relay Discovery Solicitation used to trigger the 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.	Upon Receiving the 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,	Retransmission the PC5_DISCOVERY message for UE-to-Network Relay Discovery Solicitation,
T4110		Upon Receiving the 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,	Upon being established a direct link with a ProSe UE-to-network relay UE.	Send the PC5_DISCOVERY message for UE-to-Network Relay Discovery Solicitation used to trigger the 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,
T4111		Upon sending a DIRECT_SECURITY_MODE_COMMAND message.	Upon receiving the DIRECT_SECURITY_MODE_COMPLETE or DIRECT_SECURITY_MODE_REJECT message.	Sending a DIRECT_COMMUNICATION_REJECT if the security mode control procedure is triggered by the DIRECT_COMMUNICATION_REQUEST message from the peer UE.
T4112		Upon sending a DIRECT_REKEYING_REQUEST message.	Upon receiving the DIRECT_REKEYING_RESPONSE message or receiving a DIRECT_REKEYING_REQUEST message from the peer UE and satisfying the conditions specified in subclause 10.4.8.	Retransmission of DIRECT_REKEYING_REQUEST message.
T4113		Upon sending a DIRECT_REKEYING_TRIGGER message.	Upon receiving the DIRECT_REKEYING_REQUEST message from the remote UE.	Retransmission of DIRECT_REKEYING_TRIGGER message.

NOTE 1: The value of this timer is provided by the ProSe Function during the announce request and discovery update procedure for open ProSe direct discovery.
NOTE 2: The value of this timer is provided by the ProSe Function during the monitor request and discovery update procedure for open ProSe direct discovery.
NOTE 3: The value of this timer is provided by the ProSe Function during the match report procedure for open ProSe direct discovery.
NOTE 4: The value of this timer is provided by the ProSe Function during service authorisation procedure.
NOTE 5: The value of this timer is provided by the ProSe Function during the announce request and discovery update procedure for restricted ProSe direct discovery model A.
NOTE 6: The value of this timer is provided by the ProSe Function during the monitor request and discovery update procedure for restricted ProSe direct discovery model A.
NOTE 7: The value of this timer is assigned by the ProSe Function during the discoveree request procedure for restricted ProSe direct discovery model B.
NOTE 8: The value of this timer is assigned by the ProSe Function during the discoverer request procedure for restricted ProSe direct discovery model B.
NOTE 9: The value of this timer is provided by the ProSe UE-to-network relay UE during the TMGI monitoring request procedure.
NOTE 10: The value of this timer is assigned by the ProSe UE-to-network relay UE during the TMGI monitoring request procedure
NOTE 11: The value of this timer is provided by the ProSe UE-to-network relay UE during the cell ID announcement request procedure.
NOTE 12: The value of this timer is assigned by the ProSe UE-to-network relay UE during the cell ID announcement request procedure.
NOTE 13: The value of this timer is provided by the ProSe Function during the match report procedure for restricted ProSe direct discovery model A or match report procedure for restricted ProSe direct discovery model B.

Table 13.2.2: ProSe direct services timers – ProSe Function side

TIMER NUM.	TIMER VALUE	CAUSE OF START	NORMAL STOP	ON EXPIRY
T4001	NOTE 1	Upon assigning a ProSe Application Code with an associated T4000 value to the UE, as described in subclause 6.2.2.3 and subclause 6.2.7.2.	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 ProSe Function.
T4003	NOTE 2	Upon assigning a Discovery Filter with an associated T4002 value to the UE, as described in subclause 6.2.3.3 and subclause 6.2.7.2.	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 ProSe Function.
T4008	NOTE 3	Upon assigning a ProSe Restricted Code or ProSe Restricted Code Prefix with an associated T4007 value to the UE, as described in subclause 6.2.2A.3 and subclause 6.2.6.3.	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 ProSe Function.
T4010	NOTE 4	Upon assigning a Restricted Discovery Filter with an associated T4009 value to the UE, as described in subclause 6.2.3A.3 and subclause 6.2.6.2.	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 ProSe Function.
T4012	NOTE 5	Upon assigning a ProSe Query Code, ProSe Response Code and Discovery Query Filter(s) with an associated T4011 value to the UE, as described in subclause 6.2.2B.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 ProSe Function.

TIMER NUM.	TIMER VALUE	CAUSE OF START	NORMAL STOP	ON EXPIRY
T4014	NOTE 6	Upon retrieving the ProSe Query Code, ProSe Response Code from discoveree UE context and assigning Discovery Response Filter(s) with an associated T4013 value to the UE, as described in subclause 6.2.3B.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 ProSe Function.
T4018	NOTE 7	Upon assigning a ProSe Discovery UE ID with an associated T4015 value in the ProSe service authorisation as described in subclause 5.1.3.	Upon assigning a new ProSe Discovery UE ID for the same UE.	Delete the UE context related to the restricted discovery.

NOTE 1: The value of this timer is assigned by the ProSe Function during the announce request and discovery update procedure for open ProSe direct discovery.
NOTE 2: The value of this timer is assigned by the ProSe Function during the monitor request and discovery update procedure for open ProSe direct discovery.
NOTE 3: The value of this timer is assigned by the ProSe Function during the announce request and discovery update procedure for restricted ProSe direct discovery model A.
NOTE 4: The value of this timer is assigned by the ProSe Function during the monitor request and discovery update procedure for restricted ProSe direct discovery model A.
NOTE 5: The value of this timer is assigned by the ProSe Function during the discoveree request procedure for restricted ProSe direct discovery model B.
NOTE 6: The value of this timer is assigned by the ProSe Function during the discoverer request procedure for restricted ProSe direct discovery model B.
NOTE 7: The value of this timer is assigned by the ProSe Function during the service authorisation procedure.

NOTE: Multiple timers T4001, T4003, T4008, T4010, T4012 and T4014 can run simultaneously in the ProSe Function.

Annex A (informative): IANA registrations

A.1 IANA registrations for MIME types

A.1.1 General

RFC 4288 [26], subclause 9, states the process that applies in case of changes to the registry of media types. Any changes to the format after the registration with IANA would invoke this procedure.

A.1.2 application/3gpp-prose-pc3ch+xml

Your Name:

<MCC name>

Your Email Address:

<MCC email address>

Media Type Name:

Application

Subtype name:

Vendor Tree – 3gpp-prose-pc3ch+xml

Required parameters:

None

Optional parameters:

"charset" the parameter has identical semantics to the charset parameter of the "application/xml" media type as specified in section 9.1 of IETF RFC 7303.

Encoding considerations:

binary.

Security considerations:

Same as general security considerations for application/xml media type as specified in section 9.1 of IETF RFC 7303 [25]. The information transported in this media type does not include active or executable content. Mechanisms for privacy and integrity protection of protocol parameters exist. Those mechanisms as well as authentication and further security mechanisms are described in 3GPP TS 33.303.

This media type does not include provisions for directives that institute actions on a recipient's files or other resources.

This media type does not include provisions for directives that institute actions that, while not directly harmful to the recipient, may result in disclosure of information that either facilitates a subsequent attack or else violates a recipient's privacy in any way.

This media type does not employ compression.

Interoperability considerations:

The media type allows for interoperability of messages transmitted over the PC3ch interface, including those related to transport of the usage information request of proximity services. The messages are sent between user equipment and mobile network.

Published specification:

3GPP TS 24.334 (http://www.3gpp.org/ftp/Specs/html-info/24334.htm)

Applications which use this media type:

n/a

Fragment identifier considerations:

The handling in section 5 of IETF RFC 7303 applies.

Restrictions on usage:

None

Provisional registration? (standards tree only):

n/a

Additional information:

1. Deprecated alias names for this type: n/a

2. Magic number(s): n/a

3. File extension(s): n/a

4. Macintosh File Type Code(s): n/a

5. Object Identifier(s) or OID(s): n/a

Intended usage:

Common.

Other information/general comment:

The media type is intended to be used in proximity service procedures.

Person to contact for further information:

- Name: <MCC name>
- Email: <MCC email address>
- Author/Change controller:
  i) Author: 3GPP CT1 Working Group/3GPP_TSG_CT_WG1@LIST.ETSI.ORG
  ii) Change controller: <MCC name>/<MCC email address>

A.1.3 application/3gpp-prose+xml

Your Name:

<MCC name>

Your Email Address:

<MCC email address>

Media Type Name:

Application

Subtype name:

Vendor Tree – 3gpp-prose+xml

Required parameters:

None

Optional parameters:

"charset" the parameter has identical semantics to the charset parameter of the "application/xml" media type as specified in section 9.1 of IETF RFC 7303.

Encoding considerations:

binary.

Security considerations:

Same as general security considerations for application/xml media type as specified in section 9.1 of IETF RFC 7303. The information transported in this media type does not include active or executable content. Mechanisms for privacy and integrity protection of protocol parameters exist. Those mechanisms as well as authentication and further security mechanisms are described in 3GPP TS 33.303.

This media type does not include provisions for directives that institute actions on a recipient's files or other resources.

This media type does not include provisions for directives that institute actions that, while not directly harmful to the recipient, may result in disclosure of information that either facilitates a subsequent attack or else violates a recipient's privacy in any way.

This media type does not employ compression.

Interoperability considerations:

The media type allows for interoperability of messages transmitted for ProSe over the PC3 interface. The messages are sent between user equipment and mobile network.

Published specification:

3GPP TS 24.334 (http://www.3gpp.org/ftp/Specs/html-info/24334.htm)

Applications which use this media type:

n/a

Fragment identifier considerations:

The handling in section 5 of IETF RFC 7303 applies.

Restrictions on usage:

None

Provisional registration? (standards tree only):

n/a

Additional information:

1. Deprecated alias names for this type: n/a

2. Magic number(s): n/a

3. File extension(s): n/a

4. Macintosh File Type Code(s): n/a

5. Object Identifier(s) or OID(s): n/a

Intended usage:

Common.

Other information/general comment:

The media type is intended to be used in proximity service procedures.

Person to contact for further information:

- Name: <MCC name>
- Email: <MCC email address>
- Author/Change controller:
  i) Author: 3GPP CT1 Working Group/3GPP_TSG_CT_WG1@LIST.ETSI.ORG
  ii) Change controller: <MCC name>/<MCC email address>

Annex B (informative): Change history

Change history							
Date	**TSG #**	**TSG Doc.**	**CR**	**Rev**	**Subject/Comment**	**Old**	**New**
2014-03					TS skeleton generated for submission at CT1#86bis	-	0.0.0
2014-04	CT1#86 bis				Implementation of C1-141576, C1-141623, C1-141533 and C1-141534.	0.0.0	0.1.0
2014-05	CT1#87				Implementation of C1-142123, C1-142152, C1-142153, C1-142187, C1-142188, C1-142189, C1-142190, C1-142191, C1-142192, C1-142195, C1-142198 and C1-142498.	0.1.0	0.2.0
2014-06	CT-64	CP-140279			Version 1.0.0 created for presentation for information to CT plenary	0.2.0	1.0.0
2014-07	CT1#88				Implementation of C1-142652, C1-142674, C1-142700, C1-142833, C1-142851, C1-142852, C1-142998, C1-143022, C1-143027, C1-143238, C1-143240, C1-143241, C1-143243, C1-143246, C1-143247, C1-143248, C1-143249, C1-143251, C1-143319, C1-143347, C1-143348, C1-143349, C1-143359 and C1-143360. Editorial corrections.	1.0.0	1.1.0
2014-09	CT-65	CP-140630			Version 2.0.0 created for presentation for approval to CT plenary	1.1.0	2.0.0
2014-09	CT-65	CP-140717			Plenary tdoc revised to include missing cover sheet	1.1.0	2.0.0
2014-09	Post CT-65				Version 12.0.0 created after approval	2.0.0	12.0.0
2014-12	CT-66	CP-140847	0002	5	Update of PC5_DISCOVERY message	12.0.0	12.1.0
2014-12	CT-66	CP-140847	0003	4	Update of provisioning parameters list in subclause 5.1.3	12.0.0	12.1.0
2014-12	CT-66	CP-140847	0004	3	Update 'time parameter' to 'UTC-based counter'	12.0.0	12.1.0
2014-12	CT-66	CP-140847	0005	1	Maximum number of retransmissions and retransmission timers in case of abnormal cases during ProSe direct discovery	12.0.0	12.1.0
2014-12	CT-66	CP-140847	0006		Update of range for timers T4000, T4002 and T4004	12.0.0	12.1.0
2014-12	CT-66	CP-140847	0007		Correction and clarification of Prose Function processing for monitor request procedure in ProSe direct discovery	12.0.0	12.1.0
2014-12	CT-66	CP-140847	0009	4	Methods for Server-initiated Procedures EPC-level ProSe Discovery	12.0.0	12.1.0
2014-12	CT-66	CP-140847	0011	1	ProSe Indication for ProSe Announcement and Monitoring	12.0.0	12.1.0
2014-12	CT-66	CP-140847	0012	2	Handling of unknown, unforseen, and erroneous protocol data in TS 24.334	12.0.0	12.1.0
2014-12	CT-66	CP-140847	0013	1	Addition of CURRENT_TIME and MAX_OFFSET parameters for ProSe direct discovery	12.0.0	12.1.0
2014-12	CT-66	CP-140847	0014	1	Correction of HTTP RFC reference in TS 24.334	12.0.0	12.1.0
2014-12	CT-66	CP-140847	0015	1	Editorial changes to subclause 11.2.4	12.0.0	12.1.0
2014-12	CT-66	CP-140847	0016	2	Addition of Overview subclause to TS 24.334	12.0.0	12.1.0
2014-12	CT-66	CP-140847	0017		Format of metadata	12.0.0	12.1.0
2014-12	CT-66	CP-140847	0018	1	Clarification of UE Identity Encoding	12.0.0	12.1.0
2014-12	CT-66	CP-140847	0019	4	Prose Service authorisation	12.0.0	12.1.0
2014-12	CT-66	CP-140847	0021	1	Correction on triggering condition and ProSe Function processing for Match Report procedure	12.0.0	12.1.0
2014-12	CT-66	CP-140847	0022	2	Definition for EPC Prose User ID	12.0.0	12.1.0
2014-12	CT-66	CP-140847	0023	2	Correction for PC3 EPC control Protocol cause value	12.0.0	12.1.0
2014-12	CT-66	CP-140847	0024	2	Correction for proximity request cancellation procedure	12.0.0	12.1.0
2014-12	CT-66	CP-140847	0025	1	Handling of Announce request in the ProSe function	12.0.0	12.1.0
2014-12	CT-66	CP-140847	0026	1	Trigger to initiate announce request procedure	12.0.0	12.1.0
2014-12	CT-66	CP-140847	0027		Correction to match report procedure – storage of mapping	12.0.0	12.1.0
2014-12	CT-66	CP-140847	0028	1	Correction to UE context handling	12.0.0	12.1.0
2014-12	CT-66	CP-140847	0029		Alignement on ProSe service authorisation update procedure	12.0.0	12.1.0
2014-12	CT-66	CP-140847	0035	1	Gaps between T4001/T4000 and T4003/T4002 timers in ProSe	12.0.0	12.1.0
2014-12	CT-66	CP-140847	0036	1	Addition of parameters for usage information reporting	12.0.0	12.1.0
2014-12	CT-66	CP-140847	0037	1	Update of subclause 8	12.0.0	12.1.0

2014-12	CT-66	CP-140847	0038		Erroneous Cause Values & editorial corrections	12.0.0	12.1.0
2014-12	CT-66	CP-140847	0039		ProSe Function initiated ProSe Request Cancellation message	12.0.0	12.1.0
2014-12	CT-66	CP-140847	0040	1	Unknown ProSe App ID in Announce Request Procedure	12.0.0	12.1.0
2014-12	CT-66	CP-140847	0042	2	Correction to monitoring request procedure not accepted by ProSe Function	12.0.0	12.1.0
2014-12	CT-66	CP-140847	0043		UE Identity coding for EPC-level ProSe discovery	12.0.0	12.1.0
2014-12	CT-66	CP-140847	0044	2	Use of mask for full matching	12.0.0	12.1.0
2014-12	CT-66	CP-140847	0045	2	Restructure of Discovery Filter IE	12.0.0	12.1.0
2014-12	CT-66	CP-140847	0048	1	Correction on Allowed Range parameter	12.0.0	12.1.0
2014-12	CT-66	CP-140847	0049	1	Correction on application registration using user"s profile	12.0.0	12.1.0
2014-12	CT-66	CP-140847	0010	4	ProSe for UEs in Limited Service State	12.0.0	12.1.0
2014-12	CT-66	CP-140847	0020	3	Clarification on the service authorisation triggering condition	12.0.0	12.1.0
2014-12	CT-66	CP-140847	0034	1	Geographic Area Check for UICC-Configured Radio Resource for ProSe	12.0.0	12.1.0
2014-12	CT-66	CP-140847	0050	1	Clarification on ProSe Application ID authorization	12.0.0	12.1.0
2015-01	Post CT-66				Correct implementation of CR0018	12.1.0	12.1.1
2015-03	CT-67	CP-150071	0032	6	Specifying PDN connection to be used to reach HPLMN ProSe Function	12.1.1	12.2.0
2015-03	CT-67	CP-150071	0054	1	Proximity Request Validation	12.1.1	12.2.0
2015-03	CT-67	CP-150071	0055		Removal of Editor"s note on XML schema namespace in TS 24.334	12.1.1	12.2.0
2015-03	CT-67	CP-150071	0057	1	Information for IANA registration of MIME type application/3gpp-prose+xml	12.1.1	12.2.0
2015-03	CT-67	CP-150071	0058	1	Update of definition for UTC-based counter in TS 24.334	12.1.1	12.2.0
2015-03	CT-67	CP-150071	0060	2	Clarification on the application identity check	12.1.1	12.2.0
2015-03	CT-67	CP-150071	0062	1	start of validity timer on the UE side during announce request procedure	12.1.1	12.2.0
2015-03	CT-67	CP-150071	0064		Removal of text that should have been marked as deleted in agreed C1-144911	12.1.1	12.2.0
2015-03	CT-67	CP-150071	0066	2	Alignment to Stage 2 regarding using provisioned radio resource for ProSe direct communication	12.1.1	12.2.0
2015-03	CT-67	CP-150071	0067		Change the data type of EPUID in XML schema	12.1.1	12.2.0
2015-03	CT-67	CP-150071	0069		Scope clarification for ProSe direct discovery in TS 24.334 – alternative 1	12.1.1	12.2.0
2015-03	CT-67	CP-150071	0071		Clarification for service continuity of ProSe direct communication service	12.1.1	12.2.0
2015-03	CT-67	CP-150071	0072	1	UE behaviour when moving out of a geographical area while performing ProSe direct communication	12.1.1	12.2.0
2015-03	CT-67	CP-150071	0073	1	Radio parameters and geographical areas for ProSe direct communication	12.1.1	12.2.0
2015-03	CT-67	CP-150071	0075	1	Update of XML semantic descriptions for ProSe discovery messages to include extensible XML elements	12.1.1	12.2.0
2015-03	CT-67	CP-150071	0076	1	Corrections to one-to-many direct communication	12.1.1	12.2.0
2015-03	CT-67	CP-150071	0077	1	TAU for ProSe Direct Discovery and ProSe Direct Communication	12.1.1	12.2.0
2015-03	CT-67	CP-150071	0078	1	Invalid Application Layer User ID for EPC level discovery	12.1.1	12.2.0
2015-03	CT-67	CP-150071	0079	2	Discovery Type element in PC3 message	12.1.1	12.2.0
2015-03	CT-67	CP-150071	0080		Update scope of TS 24.334	12.1.1	12.2.0
2015-03	CT-67	CP-150071	0081	2	Update clause 4.1	12.1.1	12.2.0
2015-03	CT-67	CP-150071	0089		Corrections to XML schema for direct discovery	12.1.1	12.2.0
2015-03	CT-67	CP-150071	0052	1	Usage information report - data format	12.1.1	12.2.0
2015-03	CT-67	CP-150071	0053	1	Usage information report - procedures	12.1.1	12.2.0
2015-03	CT-67	CP-150179	0065	3	Adding behavior description of receiving UE for ProSe direct communication	12.1.1	12.2.0
2015-06	CT-68	CP-150316	0068	7	PLMN selection triggered by ProSe direct communication	12.2.0	12.3.0
2015-06	CT-68	CP-150316	0090	1	Stop the running T4000/T4002 before restart	12.2.0	12.3.0
2015-06	CT-68	CP-150316	0095		Editor's notes on references to ASN.1 data types specified in TS 36.331	12.2.0	12.3.0
2015-06	CT-68	CP-150316	0096		ProSe Direct communication when UE cannot determine its location	12.2.0	12.3.0
2015-06	CT-68	CP-150316	0103	1	Correction of inconsistencies in Message format and Information Element definitions	12.2.0	12.3.0
2015-06	CT-68	CP-150316	0104	1	Addition of Match Report Refresh Timer T4006	12.2.0	12.3.0

2015-06	CT-68	CP-150316	0105		Removal of Editor"s Note about Radio Parameter Configuration for ProSe Direct Communication	12.2.0	12.3.0
2015-06	CT-68	CP-150316	0106	5	ProSe direct discovery announcements to AS layer	12.2.0	12.3.0
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History

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