ETSI TS 129 343 V19.0.0 (2025-10)

TECHNICAL SPECIFICATION

Universal Mobile Telecommunications System (UMTS);
LTE;
Proximity-services (ProSe) function
to ProSe application server aspects (PC2);
Stage 3
(3GPP TS 29.343 version 19.0.0 Release 19)

Reference
RTS/TSGC-0329343vj00

Keywords
LTE,UMTS

ETSI

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Contents

Foreword

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1 Scope

This document provides the stage 3 specification of the PC2 reference point. The functional requirements and the stage 2 procedures of the PC2 reference point are contained in 3GPP TS 23.303 [2]. The PC2 reference point lies between the ProSe Function and ProSe Application Server.

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] Void.

[4] IETF RFC 791: "Transmission Control Protocol".

[5] IETF RFC 4960: "Stream Control Transmission Protocol".

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

[7] 3GPP TS 29.345: "Inter-Proximity-services (ProSe) Function signalling aspects; Stage 3".

[8] IETF RFC 5719: "Updated IANA Considerations for Diameter Command Code Allocations".

[9] IETF RFC 2234: "Augmented BNF for syntax specifications".

[10] 3GPP TS 24.334: "Proximity-services (ProSe) User Equipment (UE) to Proximity-services (ProSe) Function Protocol aspects; Stage 3".

[11] IETF RFC 8583:"Diameter Load Information Conveyance".

[12] IETF RFC 6733: "Diameter Base Protocol".

3 Definitions 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]. The term definition in the present document has a reference to that in 3GPP TS 23.303 [2].

Announcing UE: The UE that announces certain information that could be monitored by UEs in proximity that have permission to discover.

Discoveree UE: The UE that receives the request message and responds with certain information related to the discoverer UE's request.

Discoverer UE: The UE that transmits a request containing certain information about what it is interested to discover.

Monitoring UE: The UE that monitors certain information of interest in proximity of announcing UEs.

EPC-level ProSe Discovery: A ProSe Discovery procedure by which the EPC determines the proximity of two ProSe-enabled UEs and informs them of their proximity.

Model A: involves one UE announcing "I am here" in restricted ProSe direct discovery.

Model B: involves one UE asking "who is there" and/or "are you there" in restricted ProSe direct discovery.

ProSe Discovery: A process that identifies that a UE that is ProSe-enabled is in proximity of another, using E-UTRA (with or without E-UTRAN) or EPC.

ProSe Discovery UE ID: A temporary identifier assigned by the ProSe Function in the HPLMN to the UE for the restricted direct discovery service. It includes the PLMN ID and a temporary identifier that uniquely identifies the UE in the HPLMN.

ProSe Function ID: An FQDN that identifies a ProSe Function.

Restricted ProSe Application User ID: An identifier associated with the Application Layer User ID in the ProSe Application Server in order to hide/protect the application level user identity from the 3GPP layer. It unambiguously identifies the user within a given application. The format of this identifier is outside the scope of 3GPP.

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
ALUID	Application Layer User ID
AVP	Attribute-Value Pair
EPUID	EPC ProSe User ID
PDUID	ProSe Discovery UE ID
PFID	ProSe Function ID
ProSe	Proximity-based Services
RPAUID	Restricted ProSe Application User ID

4 PC2 reference point

4.1 PC2 reference model

Proximity Services (ProSe) are services that can be provided by the 3GPP system based on UEs being in proximity to each other. The PC2 reference point is located between the ProSe Application Server and the ProSe Function. It is used to define the interaction between ProSe Application Server and ProSe functionality provided by the 3GPP EPS via ProSe Function (e.g. name translation) for open ProSe direct discovery, restricted ProSe direct discovery and EPC-level ProSe discovery.

The stage 2 level requirements for the PC2 reference point are defined in 3GPP TS 23.303 [2].The relationships between the functional entities are depicted in Figure 4.1.1.

NOTE: For EPC-level ProSe discovery the roaming architecture is not specified in this release.

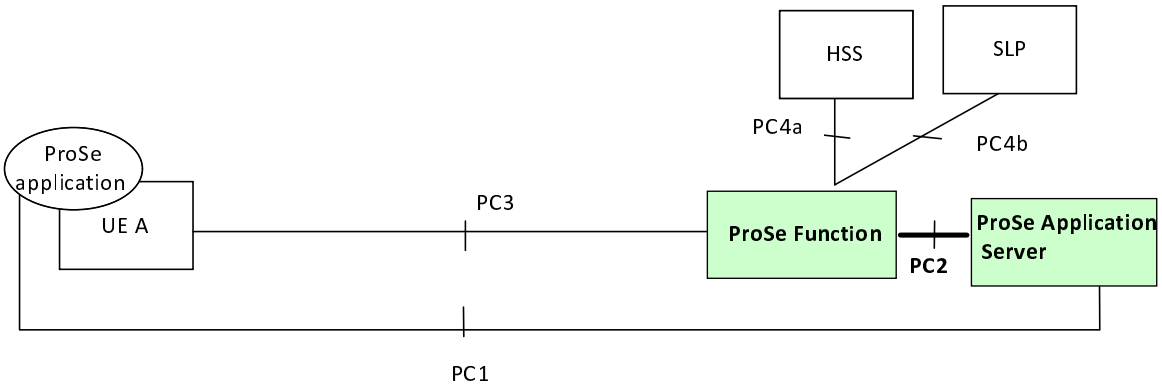

Figure 4.1.1: PC2 reference point in ProSe Architecture

4.2 Functional elements

4.2.1 ProSe Function

The ProSe Function is the logical function that is used for network related actions required for ProSe. The ProSe Function plays different roles for each of the features of ProSe. In this version of the specification it is assumed that there is only one logical ProSe Function in each PLMN that supports Proximity Services.

Over PC2 reference point, the ProSe Function supports EPC-level discovery by the following functionality:

- Storage of a list of applications that are authorized to use EPC-level ProSe Discovery.
- Handling of EPC ProSe User IDs and Application Layer User IDs;
- Exchange of signalling with 3rd party Application Servers for application registration and identifier mapping;

The ProSe Function also supports open ProSe direct discovery and restricted ProSe direct discovery by the following functionality:

- Generates and maintains the ProSe Discovery UE ID (PDUID) for restricted ProSe direct discovery.
- Initiates authorization of the discovery requests over PC2 reference point.

The ProSe Function provides the necessary charging and security functionality for usage of ProSe via the EPC.

4.2.2 ProSe Application Server

The ProSe Application Server supports the following functionality:

- Storage of EPC ProSe User IDs, ProSe Function IDs, ProSe Discovery UE ID, metadata and RPAUIDs;
- Mapping of Application Layer User IDs and EPC ProSe User IDs.
- Mapping of RPAUID and PDUID for restricted ProSe direct discovery.
- Maintaining permission information for the restricted ProSe direct discovery using RPAUIDs;
- Allocation of the ProSe Restricted Code Suffix pool, if restricted direct discovery with application-controlled extension is used;
- Allocation of the mask(s) for ProSe Restricted Code Suffix, if restricted direct discovery with application-controlled extension is used;
- Allocation of the mask(s) for ProSe Application Code Suffix, if open direct discovery with application-controlled extension is used.

5 PC2 procedures

5.1 EPC-level ProSe discovery

5.1.1 Application registration for ProSe

5.1.1.1 General Description

The application registration procedure is used by a ProSe Function serving the originating UE to request the ProSe Application Server to register the UE's Application Layer User ID (ALUID) with an EPC ProSe User ID (EPUID).

This procedure uses the Diameter commands ProXimity-Action-Request (PXR) and ProXimity-Action-Answer (PXA) in the Diameter application as specified in clause 6.

5.1.1.2 Detailed description of the application registration for ProSe procedure

The ProSe Function of the UE triggering the ProSe EPC-level discovery application registration procedure shall send the ProXimity-Action-Request (PXR) command to the ProSe Application Server of the specific application requested by the UE in its initial Application Registration message. The ProSe Function shall include in the request the ProSe-Request-Type AVP with the value APPLICATION_REGISTRATION_FOR_PROSE (0), the Requesting-EPUID AVP with the EPC ProSe User ID of the originating UE, the Origin-App-Layer-User-Id AVP with the Application Layer User Identity of the originating UE, and the ProSe-Function-ID AVP with the ProSe Function Identity of the originating UE.

When receiving a PXR command for application registration from a ProSe Function, the ProSe Application Server shall process the request and respond to the ProSe Function with a PXA command.

If the ProSe Application Server accepts the PXR command, it acknowledges the reception of the PXR command for ProSe application registration and sets the Result-Code AVP to "SUCCESS" in the PXA command. When receiving PXA from the ProSe Application Server, the ProSe Function of the originating UE checks the Result-Code AVP. If it indicates SUCCESS, the ProSe Function notifies the originating UE, according to the ProSe EPC-level discovery application registration procedure as specified in clause 7.2.3 of 3GPP TS 24.334 [10]. In case of an unsuccessful application registration request, applicable value defined in clause 6.7.3 shall be used to indicate the cause.

5.1.2 Proximity map request

5.1.2.1 General

The Proximity map request procedure may be used by the ProSe Function to request the EPC ProSe User identity for a targeted application user for which the originating UE shall get alerts when in proximity of the targeted UE, and the identity of the ProSe Function for this targeted UE as well. The identity of the ProSe Function is used in the execution of the Proximity Request procedure described in 3GPP TS 29.345 [7].

5.1.2.2 Detailed description of the proximity map request procedure

To apply this procedure, the ProSe Function shall send a ProXimity-Action-Request (PXR) command including the ProSe-Request-Type AVP with the value PROSE_MAP_REQUEST (1), the Origin-App-Layer-User-ID AVP indicating the application layer user identity of the originating UE and the Target-App-Layer-User-ID AVP indicating the application layer user identity of the targeted UE.

Upon reception of a PXR command including the Origin-App-Layer-User-ID AVP and the Target-App-Layer-User-ID AVP, the ProSe Application Server shall determine whether the originating UE is allowed to discover the targeted UE.

The ProSe Application Server shall then send a ProXimity-Action-Answer (PXA) command including the Targeted-EPUID AVP and ProSe-Function-ID AVP indicating the targeted UE and the corresponding ProSe Function ID respectively.
In case of an unsuccessful proximity map request, applicable value defined in clause 6.7.3 shall be used to indicate the cause.

5.2 Restricted ProSe direct discovery

5.2.1 Overview

Restricted ProSe direct discovery is a process that a UE detects and identifies another UE in proximity using E-UTRA direct radio signals with explicit permission of the UE that is being discovered. Detailed description of ProSe direct discovery refers to 3GPP TS 23.303 [2] clause 5.3. There are two models that restricted ProSe direct discovery applies:

Model A ("I am here")

Two roles of ProSe-enabled UEs are involved in this model: Announcing UE and Monitoring UE. The announcing UE broadcasts discovery messages at pre-defined discovery intervals and the monitoring UEs that are interested in these messages read them and process them.

Model B ("who is there?" / "are you there?")

Two roles of ProSe-enabled UEs are involved in this model: Discoverer UE and Discoveree UE. It is equivalent to " who is there/are you there" since the discoverer UE sends information about other UEs that would like to receive responses from, e.g. the information can be about a ProSe Application Identity corresponding to a group and the members of the group can respond.

5.2.2 Authorization for Announce Request (model A)

5.2.2.1 General Description

The announce authorization procedure (model A) is used by the ProSe Function serving the originating UE to obtain announce authorization information related to restricted ProSe direct discovery. The procedure is invoked by the ProSe Function and is used for the following purposes:

- to request the ProSe Application Server to map the UE's Restricted ProSe Application User ID (RPAUID) to the corresponding ProSe Discovery UE ID(s) (PDUID(s)) .

5.2.2.2 Detailed description of the procedure

To apply this procedure, the ProSe Function of the UE triggering the restricted ProSe direct discovery announce request procedure shall send the ProXimity-Action-Request (PXR) command to the ProSe Application Server of the specific application requested by the UE in its initial request message. The ProSe Function shall include in the request the ProSe-Request-Type AVP with the value AUTHORIZATION_ANNOUNCE (2) and the Requesting-RPAUID AVP with the RPAUID assigned for this application to the originating UE.

When receiving a PXR command for announce authorization for restricted ProSe direct discovery, the ProSe Application Server shall acknowledge the reception of the PXR command and shall send a PXA command with the Result-Code AVP set to "SUCCESS", with one or more PDUID AVPs set to each PDUID associated with the requesting RPAUID. In case of an unsuccessful announce authorization request for restricted ProSe direct discovery, applicable value defined in clause 6.7.3 shall be used to indicate the cause.

When receiving PXA from the ProSe Application Server, the ProSe Function of the originating UE checks the Result-Code AVP. If it indicates SUCCESS, the ProSe Function verifies that there exists one received PDUID belonging to the requesting UE, and notifies the originating UE, according to the procedure specified in 3GPP TS 24.334 [10].

5.2.3 Authorization for Announce Request with Application-controlled extension (model A)

5.2.3.1 General Description

The announce authorization procedure (model A) with application-controlled extension is used by the ProSe Function serving the originating UE to obtain announce authorization information related to restricted ProSe direct discovery. The procedure is invoked by the ProSe Function and is used for the following purposes:

- to request the ProSe Application Server to map the UE's Restricted ProSe Application User ID (RPAUID) to the corresponding ProSe Discovery UE ID(s) (PDUID(s));

- to request the ProSe Application Server to allocate ProSe Restricted Code Suffix(es) for the RPAUID based on application layer information provided by the UE.

5.2.3.2 Detailed description of the procedure

To apply this procedure, the ProSe Function of the UE triggering the restricted ProSe direct discovery announce request procedure shall send the ProXimity-Action-Request (PXR) command to the ProSe Application Server of the specific application requested by the UE in its initial request message, the PXR command shall include the ProSe-Request-Type AVP with the value AUTHORIZATION_ANNOUNCE_ACE (3), the Requesting-RPAUID AVP with the RPAUID assigned for this application to the originating UE, the Application-Data AVP with the data contained in the Application Level Container parameter in the initial request message from the originating UE, and the Allowed-Suffix-Number AVP with the allowed number of suffixes provisioned based on operator policy for this application.

When receiving a PXR command for announce authorization for restricted ProSe direct discovery with application controlled extension, the ProSe Application Server shall first check if the application supports application-controlled extension. If yes, the ProSe Application Server shall assign the ProSe Restricted Code Suffix(es) for the requesting RPAUID based on the Application-Data AVP. The number of ProSe Restricted Code Suffixes allocated shall not exceed the value in Allowed-Suffix-Number AVP in the PXR command. The ProSe Application Server shall then send a ProXimity-Action-Answer (PXA) command including the PDUID(s) associated with the requesting RPAUID in one or more PDUID AVP(s), and one or more ProSe-Restricted-Code-Suffix-Range AVP(s) indicating the assigned ProSe Restricted Code Suffix(es). In case of an unsuccessful announce authorization request for restricted ProSe direct discovery with application-controlled extension, applicable value defined in clause 6.7.3 shall be used to indicate the cause.

When receiving PXA from the ProSe Application Server, the ProSe Function of the originating UE checks the Result-Code AVP. If it indicates SUCCESS, the ProSe Function verifies that there exists one received PDUID belonging to the requesting UE, and notifies the originating UE, according to the procedure specified in 3GPP TS 24.334 [10].

5.2.4 Authorization for Monitor Request (model A)

5.2.4.1 General Description

The authorization for monitor request procedure is used by the ProSe Function serving the originating UE to obtain monitor authorization information related to restricted ProSe direct discovery. The procedure is invoked by the ProSe Function and is used:

- to request the ProSe Application Server to select eligible target RPAUIDs from the application layer data enclosed in the monitoring request from the originating UE and provide the corresponding PDUIDs for those target RPAUIDs .

5.2.4.2 Detailed description of the procedure

To apply this procedure, the ProSe Function serving the monitoring UE shall send a ProXimity-Action-Request (PXR) command including the ProSe-Request-Type AVP with the value AUTHORIZATION_MONITOR (4), the Requesting-RPAUID AVP indicating the restricted ProSe Application User ID of the monitoring UE, and the Application-Data AVP with the data contained in the Application Level Container parameter in the initial request message from the originating UE.

When receiving a PXR command for monitor authorization for restricted ProSe direct discovery, the ProSe Application Server shall examine the Application-Data AVP and determine which target RPAUID(s) the requesting RPAUID is allowed to discover based on application-specific permissions. The ProSe Application Server shall then acknowledge the reception via a PXA command, set the Result-Code AVP to "SUCCESS" in the PXA command, include the PDUID(s) associated with the requesting RPAUID in PDUID AVP(s) in the PXA command, and one or more Monitor-Target AVP(s), each of which contains the target RPAUID that the requesting RPAUID is allowed to discover as well as the corresponding PDUID. If there is metadata associated with a target RPAUID, the ProSe Application Server shall also include the Metadata-Indicator in the corresponding Monitor-Target AVP. The ProSe Function shall include the Application-Data AVP with the successfully authenticated Target RPAUID(s), too. In case of an unsuccessful monitor

authorization request for restricted ProSe direct discovery, applicable value defined in clause 6.7.3 shall be used to indicate the cause.

When receiving PXA from the ProSe Application Server, the ProSe Function of the originating UE checks the Result-Code AVP. If it indicates SUCCESS, the ProSe Function verifies that there exists one received PDUID belonging to the requesting UE, and notifies the originating UE, according to the procedure specified in 3GPP TS 24.334 [10].

5.2.5 Authorization for Monitor Request with Application-controlled Extension (model A)

5.2.5.1 General Description

The authorization for monitor request with application-controlled extension procedure is used by the ProSe Function serving the originating UE to obtain monitor authorization information related to restricted ProSe direct discovery with application-controlled extension. The procedure is invoked by the ProSe Function and is used:

- to request the ProSe Application Server to select eligible target RPAUIDs from the application layer data enclosed in the monitoring request from the originating UE and provide the corresponding PDUIDs for those target RPAUIDs; and

- to request the ProSe Application Server to allocate "masks" for the ProSe Restricted Code Suffix for the target RPAUID based on application layer information provided by the originating UE, if restricted discovery with application-controlled extension is used .

5.2.5.2 Detailed description of the procedure

To apply this procedure, the ProSe Function serving the monitoring UE shall send a ProXimity-Action-Request (PXR) command including the ProSe-Request-Type AVP with the value AUTHORIZATION_MONITOR_ACE (5), the Requesting-RPAUID AVP with the RPAUID assigned for this application to the originating UE, and the Application-Data AVP with the data contained in the Application Level Container parameter in the initial request message from the originating UE.

When receiving a PXR command for monitor authorization for restricted ProSe direct discovery with application-controlled extension, the ProSe Application Server shall examine the Application-Data AVP and determine which target RPAUID(s) the requesting RPAUID is allowed to discover based on application-specific permissions. The ProSe Application Server shall then acknowledge the reception via a PXA command, sets the Result-Code AVP to "SUCCESS" in the PXA command, include the PDUID associated with the requesting RPAUID in PDUID AVP in the PXA command, and one or more Monitor-Target AVP(s), each of which contains the target RPAUID that the requesting RPAUID is allowed to discover as well as the corresponding PDUID. If there is metadata associated with a target RPAUID, the ProSe Application Server shall also include the Metadata-Indicator in the corresponding Monitor-Target AVP. The ProSe Application Server shall also include the ProSe Restricted Code Suffix Masks in each Monitor-Target AVP. The ProSe Function shall include the Application-Data AVP with the successfully authenticated Target RPAUID(s), too. In case of an unsuccessful monitor authorization request for restricted ProSe direct discovery, applicable value defined in clause 6.7.3 shall be used to indicate the cause.

When receiving PXA from the ProSe Application Server, the ProSe Function of the originating UE checks the Result-Code AVP. If it indicates SUCCESS, the ProSe Function verifies that there exists one received PDUID belonging to the requesting UE, and notifies the originating UE, according to the procedure specified in 3GPP TS 24.334 [10].

5.2.6 Authorization for Discovery Permission (model A)

5.2.6.1 General

The discovery permission authorization procedure is used by the ProSe Function to verify the application layer permission for restricted discovery model A between a requesting application user and a target application user, which are represented, respectively, by the requesting RPAUID and the target RPAUID.

5.2.6.2 Detailed description of the procedure

To apply this procedure, the ProSe Function shall send a PXR command including the ProSe-Request-Type AVP with the value RESTRICTED_DISCOVERY_MONITOR_PERMISSION (6), the Requesting-RPAUID AVP indicating, respectively, the RPAUID of the originating UE and the Target-RPAUID AVP indicating the RPAUID of the targeted UE.

Upon reception of a PXR command including the Requesting-RPAUID AVP and the Target-RPAUID AVP, the ProSe Application Server shall determine whether the application user of the originating UE is allowed to discover the application user of the targeted UE. If it is allowed, the ProSe Application Server shall then acknowledge the reception of the PXR command by sending the PXA command with the Result-Code AVP set to "SUCCESS" and the target-PDUID AVP(s) set to the PDUID(s) of the targeted application user. In case of an unsuccessful permission authorization request, an applicable value defined in clause 6.7.3 shall be used to indicate the cause.

When receiving PXA from the ProSe Application Server, the ProSe Function checks the Result-Code AVP. If it indicates SUCCESS, the ProSe Function notifies the ProSe Function of the originating UE, according to the procedure specified in 3GPP TS 29.345 [7].

5.2.7 Authorization for Match Report (model A/model B)

5.2.7.1 General Description

This procedure is used by the ProSe Function serving the monitoring UE (in model A) or discoverer UE (in model B) to obtain authorization information related to Match Report in restricted ProSe Direct Discovery.

5.2.7.2 Detailed description of the procedure

To apply this procedure, the ProSe Function shall send a ProXimity-Action-Request (PXR) command including the ProSe-Request-Type AVP with the value AUTHORIZATION_MATCH_REPORT (9), the Requesting-RPAUID AVP indicating the restricted ProSe Application User ID of the requesting UE and the Target-RPAUID AVP indicating the target restricted ProSe Application User ID.

Upon reception of the PXR command, the ProSe Application Server shall determine whether the restricted ProSe Application User ID within Requesting-RPAUID AVP is allowed to discover the target restricted ProSe Application User ID within Target-RPAUID AVP.

The ProSe Application Server shall then send a ProXimity-Action-Answer (PXA) command including the PDUID AVP(s) indicating the PDUID(s) associated with the RPAUID of the requesting UE, the Target-PDUID AVP(s) indicating the PDUID(s) associated with the target RPAUID, and optionally the ProSe-Application-Metadata AVP indicating certain metadata corresponding to the target RPAUID, such as welcome message.

In case of an unsuccessful authorization for Match Report Request, an applicable value defined in clause 6.7.3 shall be used to indicate the cause.

NOTE: The application logic in the ProSe Application Server triggered by the Diameter PXR command in this procedure is out of the scope of 3GPP.

When receiving PXA from the ProSe Application Server, the ProSe Function checks the Result-Code AVP. If it indicates SUCCESS, the ProSe Function shall verify that there exists one received PDUID belonging to the requesting UE, and the target PDUID(s) are the same as the stored target PDUID(s) for the target RPAUID. If the ProSe-Application-Metadata AVP has been included in the PXA command, and the Metadata -Indicator (see clauses 5.2.4.2 and 5.2.5.2) associated with the target RPAUID indicates METADATA_UPDATE_ALLOWED, the ProSe Function shall not cache the received metadata as the latest metadata for this target RPAUID. If the check of PDUID(s) is successful, ProSe Function notifies the originating UE, according to the procedure specified in 3GPP TS 24.334 [10].

5.2.8 Authorization for Discoveree Request (model B)

5.2.8.1 General Description

This procedure may be used by the ProSe Function serving the Discoveree UE to obtain authorization information of the Discoveree UE related to Discoveree Request in restricted ProSe direct discovery.

5.2.8.2 Detailed description of the procedure

The procedure in clause 5.2.4.2 shall be applied, with the only exception that the ProSe-Request-Type AVP included in PXR and PXA messages shall be set with the value AUTHORIZATION_RESPONSE (7).

5.2.9 Authorization for Discoverer Request (model B)

5.2.9.1 General Description

This procedure is used by the ProSe Function serving the Discoverer UE to obtain authorization information of the Discoverer UE related to Discoverer Request in restricted ProSe Direct Discovery.

5.2.9.2 Detailed description of the procedure

The procedure in clause 5.2.4.2 shall be applied, with the only exception that the ProSe-Request-Type AVP included in PXR and PXA messages shall be set with the value AUTHORIZATION_QUERY (8).

5.2.10 Authorization for Discovery Permission (model B)

5.2.10.1 General Description

The discovery permission authorization procedure is used by the ProSe Function to verify the application layer permission for restricted discovery model B between a requesting application user and a target application user, which are represented, respectively, by the requesting RPAUID and the target RPAUID.

5.2.10.2 Detailed description of the procedure

The procedure in clause 5.2.6.2 shall be applied, with the only exception that the ProSe-Request-Type AVP included in PXR and PXA messages shall be set with the value QUERY_PERMISSION (10).

5.2.11 Discovery Authorization Update

5.2.11.1 General Description

The discovery authorization update procedure is used by the ProSe Application Server to request the Prose Function serving the UE which has revoked permissions related to other users, to take actions to update the ProSe Restricted Code or Restricted Discovery Filters to prevent the banned users (users whose permissions have been revoked) from discovering the announcing user.

This procedure uses the Diameter commands ProXimity-Application-Request (XAR)/ProXimity-Application-Answer (XAA), and ProXimity-Action-Request (PXR)/ProXimity-Action-Answer (PXA) in the respective Diameter applications as specified in clause 6.

5.2.11.2. Detailed description of the discovery authorization update procedure

The ProSe Application Server shall send the ProXimity-Application-Request (XAR) command to the ProSe Function serving the UE which has announced the RPAUID whose discovery permissions related to other users has been revoked. The identity of this ProSe Function is found by the ProSe Application Server by mapping the RPAUID to a PDUID. If multiple PDUIDs have been found to be used for this RPAUID, the procedure shall be invoked multiple times, for each ProSe Function to which the PDUID belongs.

The ProSe Application Server shall include in the request the ProSe-Request-Type AVP with the value AUTHORIZATION_UPDATE (11), the Requesting-RPAUID AVP with the RPAUID which originated this application-layer permission change, and one or more Banned-User-Target AVP identifying the RPAUID(s) whose discovery permissions have been revoked and the corresponding PDUID(s).

When receiving an XAR command for authorization update for restricted ProSe direct discovery, the ProSe Function shall examine the RPAUID AVP and locate the UE context which stores the allocated ProSe Restricted Code for this

RPAUID. If this check is successful, the ProSe Function shall then acknowledge the reception of the XAR command, set the Result-Code AVP to "SUCCESS" in the XAA command, and include the ProSe-Request Type AVP set to the same value as that included in the XAR command. In case of an unsuccessful request, an applicable value defined in clause 6.7.3 shall be used to indicate the cause.

Then the ProSe Function shall check the Banned-User-Target AVP(s) (i.e. , blacklist users) and compare it with all RPAUIDs which are currently authorized for monitoring the RPAUID being announced (i.e. , white-list users). If the black-list users and white-list users have no overlapping, the procedure is completed and no further action needs to be taken. Otherwise, the ProSe Function shall either allocate a new ProSe Restricted Code and notify the still-eligible white-list users, or revoke the Restricted Discovery Filters for the white-list users who have been banned. Depending on the action, the corresponding procedures described in 3GPP TS 29.345 [7] are to be invoked.

When receiving XAA from the ProSe Function, the ProSe Application Server shall check if the Result-Code AVP indicates SUCCESS. If it indicates SUCCESS, the ProSe Application Server shall wait for the result of this discovery authorization update.

After a time configured by the operator, the ProSe Function of the UE announcing the requesting RPAUID shall send the ProximityAction-Request (PXR) command to notify the ProSe Application Server of the specific application requested by the UE in its initial request message, about the result of discovery update process. The ProSe Function shall include in the request the ProSe-Request-Type AVP with the value AUTHORIZATION_UPDATE (11) and the Requesting-RPAUID AVP with the RPAUID of the announcing UE involved in this discovery authorization update, and one or more Banned-User-Target AVPs including the RPAUID-PDRID pairs which have been successfully banned from discovering the requesting RPAUID.

When receiving a PXR command for discovery authorization update for restricted ProSe direct discovery, the ProSe Application Server shall acknowledge the reception of the PXR command and shall send a PXA command with the Result-Code AVP set to "SUCCESS". In case of an unsuccessful discovery authorization update result notification for restricted ProSe direct discovery, applicable value defined in clause 6.7.3 shall be used to indicate the cause.

When receiving PXA from the ProSe Application Server, the ProSe Function checks the Result-Code AVP to see if it indicates SUCCESS.

5.3 Open ProSe direct discovery

5.3.1 Authorization for Announce Request with Application-controlled extension

5.3.1.1 General Description

The announce authorization procedure with application-controlled extension is used by the ProSe Function serving the originating UE to obtain announce authorization information related to open ProSe direct discovery. The procedure is invoked by the ProSe Function and to request the ProSe Application Server to allocate ProSe Application Code Suffix(es) for the ProSe Application ID based on application layer information provided by the UE.

5.3.1.2 Detailed description of the procedure

To apply this procedure, the ProSe Function of the UE triggering the open ProSe direct discovery announce request procedure shall send the ProximityAction-Request (PXR) command to the ProSe Application Server of the specific application requested by the UE in its initial request message, the PXR command shall include the ProSe-Request-Type AVP with the value AUTHORIZATION_ANNOUNCE_ACE_OPEN (12), the ProSe-Application-ID AVP with the ProSe Application ID requested by the application in the originating UE, the Application-Data AVP with the data contained in the Application Level Container parameter in the initial request message from the originating UE, and the Allowed-Suffix-Number AVP with the allowed number of suffixes provisioned based on operator policy for this application.

When receiving a PXR command for announce authorization for open ProSe direct discovery with application-controlled extension, the ProSe Application Server shall first check if the application supports application-controlled extension. If yes, the ProSe Application Server shall assign the ProSe Application Code Suffix(es) for the requesting ProSe Application ID based on the Application-Data AVP. The number of ProSe Application Code Suffixes allocated shall not exceed the value in Allowed-Suffix-Number AVP in the PXR command. The ProSe Application Server shall

then send a ProXimity-Action-Answer (PXA) command including one or more ProSe-Application-Code-Suffix-Range AVP(s) indicating the assigned ProSe Application Code Suffix(es). In case of an unsuccessful announce authorization request for open ProSe direct discovery with application-controlled extension, applicable value defined in clause 6.7.3 shall be used to indicate the cause.

When receiving PXA from the ProSe Application Server, the ProSe Function of the originating UE checks the Result-Code AVP. If it indicates SUCCESS, the ProSe Function notifies the originating UE, according to the procedure specified in 3GPP TS 24.334 [10].

5.3.2 Authorization for Monitor Request with Application-controlled Extension

5.3.2.1 General Description

The authorization for monitor request with application-controlled extension procedure is used by the ProSe Function serving the originating UE to obtain monitor authorization information related to open ProSe direct discovery with application-controlled extension. The procedure is invoked by the ProSe Function and is used to request the ProSe Application Server to allocate "masks" for the ProSe Application Code Suffix for the monitored ProSe Application ID based on application layer information provided by the originating UE, if open discovery with application-controlled extension is used.

5.3.2.2 Detailed description of the procedure

To apply this procedure, the ProSe Function serving the monitoring UE shall send a ProXimity-Action-Request (PXR) command including the ProSe-Request-Type AVP with the value AUTHORIZATION_MONITOR_ACE_OPEN (13), the ProSe Application ID AVP with the ProSe Application ID requested by the application in the originating UE, and the Application-Data AVP with the data contained in the Application Level Container parameter in the initial request message from the originating UE.

When receiving a PXR command for monitor authorization for open ProSe direct discovery with application-controlled extension, the ProSe Application Server shall examine the Application-Data AVP and determine proper ProSe Application Code Suffix Masks matching the data enclosed in the Application-Data AVP. Then, the ProSe Application Server shall then acknowledge the reception via a PXA command, sets the Result-Code AVP to "SUCCESS" in the PXA command, include one or more ProSe Application Code Suffix Masks in ProSe-Code-Suffix-Mask AVP(s). In case of an unsuccessful monitor authorization request for open ProSe direct discovery, applicable value defined in clause 6.7.3 shall be used to indicate the cause.

When receiving PXA from the ProSe Application Server, the ProSe Function of the originating UE checks the Result-Code AVP. If it indicates SUCCESS, the ProSe Function notifies the originating UE, according to the procedure specified in 3GPP TS 24.334 [10].

6 PC2 protocol

6.1 Protocol Support

6.1.1 Use of Diameter base protocol

The Diameter base protocol as specified in IETF RFC 6733 [12] shall apply except as modified by the defined support of the methods and the defined support of the commands and AVPs, result and error codes as specified in this specification. Unless otherwise specified, the procedures specified in IETF RFC 6733 [12] (including error handling and unrecognised information handling) shall be used unmodified. Only commands related to peer-to-peer connection are re-used from the Diameter base protocol (IETF RFC 6733 [12]), i.e. Capabilities-Exchange-Request (CER), Capabilities-Exchange-Answer (CEA), Disconnect-Peer-Request (DPR), Disconnect-Peer-Answer (DPA), Device-Watchdog-Request (DWR) and Device-Watchdog-Answer (DWA).

With regards to the Diameter protocol defined over the PC2 interface, the ProSe Application Server shall act as the Diameter server, in the sense that it is the network element that handles action requests. The ProSe Function shall act as the Diameter client, in the sense that it is the network element requesting actions.

A Diameter routing table entry can have a different destination based on the application identifier of the command. The application identifier stored in the command header must match the value of any application identifier AVPs in the command body. Diameter agents (relay, proxy, redirection, translation agents) should use the application identifier in the command header to route to a suitable destination.

6.1.2 Transport protocol

Diameter messages over the PC2 interface shall make use of TCP IETF RFC 791 [4] or SCTP IETF RFC 4960 [5].

6.1.3 Advertising Application Support

The Diameter application identifier assigned to the PC2 interface application in the present release is 16777350.

NOTE: The PC2 interface application identifier 16777337 is used in Release 12 document where only the usage PXR/PXA is specified. For backward compatibility, the ProSe Applicaiton Server in releases later than Rel-12 is encouraged to also support the Rel-12 version of this specification and the old application ID 16777337.

The ProSe Application Server and ProSe Function shall advertise support of the Diameter PC2 applications by including the value of the PC2 application identifiers in the Auth-Application-Id AVP within the Vendor-Specific-Application-Id grouped AVP of the CER and CEA commands.

The vendor identifier value of 3GPP (10415) shall be included in the Supported-Vendor-Id AVP of the CER and CEA commands, and in the Vendor-Id AVP within the Vendor-Specific-Application-Id grouped AVP of the CER and CEA commands.

The Vendor-Id AVP included in CER and CEA commands that is not included in the Vendor-Specific-Application-Id AVPs as described above shall indicate the manufacturer of the Diameter node as per IETF RFC 6733 [12].

6.2 Initialization and maintenance of connection and session

A peer-to-peer connection is a connection between ProSe Application Server and ProSe Function.

A PC2 Diameter session shall consist of a single request and answer pair. The PC2 Diameter session is terminated after each request and answer pair interaction. In order to indicate that the session state is not to be maintained, the Diameter client and server shall include the Auth-Session-State AVP with the value set to NO_STATE_MAINTAINED (1), in the request and in the answer messages (see IETF RFC 6733 [12]).

6.3 Security over PC2 reference point

Security aspects of ProSe PC2 reference point are defined in 3GPP TS 33.303 [6].

6.4 PC2 specific AVPs

6.4.1 General

Table 6.4.1-1 describes the Diameter AVPs defined for the PC2 reference point, their AVP Code values, types and possible flag values. The Vendor-Id header of all AVPs defined in the present document shall be set to 3GPP (10415).

Table 6.4.1-1: PC2 specific Diameter AVPs

Attribute Name	AVP Code	Clause defined	Value Type	AVP Flag rules (Note)			
				Must	May	Should not	Must not
Origin-App-Layer-User-Id	3600	6.4.2	UTF8String	M,V	P		
Target-App-Layer-User-Id	3601	6.4.3	UTF8String	M,V	P		
ProSe-Function-ID	3602	6.4.4	OctetString	M,V	P		
ProSe-Request-Type	3603	6.4.5	Unsigned32	M,V	P		
PDUID	3604	6.4.6	OctetString	V	P		M
Application-Data	3605	6.4.7	UTF8String	V	P		M
Allowed-Suffixes-Number	3606	6.4.8	Unsigned32	V	P		M
Monitor-Target	3607	6.4.9	Grouped	V	P		M
ProSe-Code-Suffix-Mask	3608	6.4.10	Grouped	V	P		M
Suffix-Code	3609	6.4.11	OctetString	V	P		M
Suffix-Mask	3610	6.4.12	OctetString	V	P		M
Banned-User-Target	3611	6.4.17	Grouped	V	P		M
Metadata-Indicator	3612	6.4.18	Unsigned32	V	P		M
NOTE : The AVP header bit denoted as 'M', indicates whether support of the AVP is required. The AVP header bit denoted as 'V', indicates whether the optional Vendor-ID field is present in the AVP header. For further details, see IETF RFC 6733 [12].							

6.4.2 Origin-App-Layer-User-Id AVP

The Origin-App-Layer-User-Id AVP (AVP code 3600) is of type UTF8String, and it contains an identity identifying an origin user within the context of a specific application (e.g. alice@social.net).

6.4.3 Target-App-Layer-User-Id AVP

The Target-App-Layer-User-Id AVP (AVP code 3601) is of type UTF8String, and it contains an identity identifying a target user within the context of a specific application (e.g. tommy@social.net).

6.4.4 ProSe-Function-ID AVP

The ProSe-Function-ID AVP (AVP code 3602) is of type OctetString, and it indicates an FQDN that identifies a ProSe Function.

6.4.5 ProSe-Request-Type AVP

The ProSe-Request-Type AVP (AVP code 3603) is of type Unsigned32, and contains the reason for sending the PX-Request message or XA-Request message.

The following values are defined:

0 (APPLICATION_REGISTRATION_FOR_PROSE):

The ProXimity-Action-Request message is sent to initiate an application registration for ProSe procedure.

1 (PROSE_MAP_REQUEST):

The ProXimity-Action-Request message is sent to initiate a Proximity map request procedure.

2 (AUTHORIZATION_ANNOUNCE):

The ProXimity-Action-Request message is sent to initiate an announce authorization procedure for restricted discovery.

3 (AUTHORIZATION_ANNOUNCE_ACE):

The ProXimity-Action-Request message is sent to initiate an announce authorization procedure for restricted discovery with application-controlled extension.

4 (AUTHORIZATION_MONITOR):

The ProXimity-Action-Request message is sent to initiate a monitor authorization procedure for restricted discovery.

5 (AUTHORIZATION_MONITOR_ACE):

The ProXimity-Action-Request message is sent to initiate a monitor authorization procedure for restricted discovery with application-controlled extension.

6 (MONITOR_PERMISSION):

The ProXimity-Action-Request message is sent to initiate an inquiry for the discovery permissions between two RPAUIDs used in restricted ProSe direct discovery monitoring model A.

7 (AUTHORIZATION_RESPONSE):

The ProXimity-Action-Request message is sent to initiate an authorization for Discoveree Request procedure.

8 (AUTHORIZATION_QUERY):

The ProXimity-Action-Request message is sent to initiate an authorization for Discoverer Request procedure.

9 (AUTHORIZATION_MATCH_REPORT):

The ProXimity-Action-Request message is sent to initiate an authorization for Match Report procedure in model A or model B.

10 (QUERY_PERMISSION)

The ProXimity-Action-Request message is sent to initiate an inquiry for the discovery permissions between two RPAUIDs used in restricted ProSe direct discovery model B discoverer operation.

11 (AUTHORIZATION_UPDATE)

The ProXimity-Action-Request message or ProXimity-Application-Request message is sent for the purpose of discovery authorization update.

12 (AUTHORIZATION_ANNOUNCE_ACE_OPEN):

The ProXimity-Action-Request message is sent to initiate an announce authorization procedure for open discovery with application-controlled extension.

13 (AUTHORIZATION_MONITOR_ACE_OPEN):

The ProXimity-Action-Request message is sent to initiate a monitor authorization procedure for open discovery with application-controlled extension.

6.4.6 PDUID AVP

The PDUID AVP (AVP code 3604) is of type OctetString, and it indicates a ProSe Discovery UE ID that identifies a UE identity used in restricted ProSe direct discovery.

6.4.7 Application-Data AVP

The Application-Data AVP (AVP code 3605) is of type UTF8String, and it contains

- a list of target RPAUIDs of UEs in restricted ProSe Direct Discovery for monitoring or query requests.
- information related to suffix allocation for an announcing UE when application-controlled extension is used.
- a list of successfully authenticated target RPAUIDs of UEs in restricted ProSe Direct Discovery.

6.4.8 Allowed-Suffixes-Number AVP

The Allowed-Suffixes-Number AVP (AVP code 3606) is of type Unsigned32, and it indicates the maximum number of suffix codes which are used as part of ProSe Application Code or ProSe Restricted Code that the ProSe Application Server can assign to the UE for a ProSe Appplication ID or an RPAUID.

6.4.9 Monitor-Target AVP

The Monitor-Target AVP (AVP code 3607) is of type Grouped. It contains a Target-RPAUID, a PDUID and zero or more ProSe Code Suffix Mask(s).

The AVP format shall conform to:

```
Monitor-Target ::= <AVP header:3607>
                    { Target-RPAUID }
                    { PDUID }
                    [ Metadata-Indicator ]
                   *[ ProSe-Code-Suffix-Mask ]
                   *[AVP]
```

If the Metadata-Indicator value is "0 (NO_METADATA)", the Metadata-Indicator AVP may be omitted.

6.4.10 ProSe- Code-Suffix-Mask AVP

The ProSe-Code-Suffix-Mask AVP (AVP code 3608) is of type Grouped. It contains a suffix code and one or more suffix mask(s), each of which has the same size as the suffix code.

The AVP format shall conform to:

```
ProSe-Code-Suffix-Mask ::= <AVP header:3608>
                     { Suffix-Code }
                   1*{ Suffix-Mask }
                    *[AVP]
```

6.4.11 Suffix-Code AVP

The Suffix-Code AVP (AVP code 3609) is of type OctetString. It contains a suffix code which shall be used as either the allocated ProSe Application Code Suffix or ProSe Restricted Code Suffix, or a matching target for the suffix part of a ProSe Application Code or ProSe Restricted Code.

6.4.12 Suffix-Mask AVP

The Suffix-Mask AVP (AVP code 3610) is of type OctetString. It contains a suffix mask which shall be used as a bitmask for matching the target suffix code in the suffix part of a ProSe Application Code or ProSe Restricted Code.

6.4.13 Void

6.4.14 Void

6.4.15 Void

6.4.16 Void

6.4.17 Banned-User-Target AVP

The Banned-User-Target AVP (AVP code 3611) is of type Grouped. It contains a Target-RPAUID and a Target-PDUID.

The AVP format shall conform to:

```
Banned-User-Target ::= <AVP header:3611>
                    { Target-RPAUID }
                    { Target-PDUID }
                   *[AVP]
```

6.4.18 Metadata-Indicator AVP

The Metadata-Indicator AVP (AVP code 3612) is of type Unsigned32, and contains the options for metadata associated with a particular target RPAUID. The following values are defined:

0 (NO_METADATA):

This value may be used to indicate that there is no metadata associated with the target RPAUID. This is the default value applicable if this AVP is not supplied.

1 (METADATA_UPDATE_DISALLOWED):

This value shall be used to indicate that there exists metadata associated with the target RPAUID, but the metadata is not allowed to be updated.

2 (METADATA_UPDATE_ALLOWED):

This value shall be used to indicate that there exists metadata associated with the target RPAUID, and the metadata is allowed to be updated.

6.5 PC2 re-used AVPs

Table 6.5.1-1 lists the Diameter AVPs re-used by the PC2 reference point from existing Diameter Applications, reference to their respective specifications and a short description of their usage within the PC2 reference point. Other AVPs from existing Diameter Applications, except for the AVPs from the Diameter base protocol specified in IETF RFC 6733 [12], do not need to be supported. The AVPs from the Diameter base protocol specified in IETF RFC 6733 [12] are not included in Table 6.5.1-1, but they are re-used for the PC2 reference point. Unless otherwise stated, re-used AVPs shall maintain their 'M', 'P' and 'V' flag settings.

Table 6.5.1-1: PC2 re-used Diameter AVPs

Attribute Name	Reference	Description
Load	IETF RFC 8583 [11]	The AVP used to convey load information between Diameter nodes. This AVP and all AVPs within this grouped AVP shall have the 'M' bit cleared.
Requesting-EPUID	3GPP TS 29.345 [7]	Contains an identifier for EPC-level ProSe Discovery that uniquely identifies a UE registered for ProSe triggering a Proximity request.
Targeted-EPUID	3GPP TS 29.345 [7]	Contains an identifier for EPC-level ProSe Discovery that uniquely identifies a UE registered for ProSe targeted by a Proximity request.
ProSe-Restricted-Code-Suffix-Range	3GPP TS 29.345 [7]	Contains a range of suffixes which can be used for restricted ProSe direct discovery announcing when application-controlled extension is used.
ProSe-Application-Code-Suffix-Range	3GPP TS 29.345 [7]	Contains a range of suffixes which can be used for open ProSe direct discovery announcing when application-controlled extension is used.
ProSe-App-Id	3GPP TS 29.345 [7]	Contains an ProSe Application ID associated with the announcing or monitoring request for open ProSe direct discovery with application-controlled extension.
Requesting-RPAUID	3GPP TS 29.345 [7]	Contains a Restricted ProSe Application User ID associated with the requesting UE for the announcing or monitoring request for restricted ProSe direct discovery.
Target-RPAUID	3GPP TS 29.345 [7]	Contains a Restricted ProSe Application User ID of the target UE associated with the monitoring request for restricted ProSe direct discovery.
Target-PDUID	3GPP TS 29.345 [7]	Contains a ProSe Discovery User ID of the target UE associated with the monitoring request for restricted ProSe direct discovery.
ProSe-Application-Metadata	3GPP TS 29.345 [7]	Contains the metadata corresponding to the target RPAUID for restricted ProSe direct discovery, such as welcome message.

6.6 PC2 messages

6.6.1 Command-Code Values

This clause defines the Command-Code values for the PC2 interface application as allocated by IANA from the vendor-specific namespace defined in IETF RFC 5719 [8]. Every command is defined by means of the ABNF syntax in IETF RFC 2234 [9], and according to the Command Code Format (CCF) specification defined in IETF RFC 6733 [12].

The following Command Codes are defined in this specification:

Table 6.6.1.1: Command-Code values for PC2

Command-Name	Abbreviation	Code	Section
ProXimity-Action-Request	PXR	8388676	6.6.2
ProXimity-Action-Answer	PXA	8388676	6.6.3
ProXimity-Application-Request	XAR	8388727	6.6.4
ProXimity-Application-Answer	XAA	8388727	6.6.5

6.6.2 ProXimity-Action-Request (PXR) command

The PXR command, indicated by the Command-Code field set to 8388676 and the 'R' bit set in the Command Flags field, is sent by the ProSe Function to the ProSe Application Server as part of the procedures specified for EPC-level ProSe discovery and ProSe direct discovery in clause 5.

Message Format:

```
<PX-Request> ::= <Diameter Header: 8388676, REQ, PXY >
                 < Session-Id >
                 { Auth-Application-Id }
                 { Auth-Session-State }
                 { Origin-Host }
                 { Origin-Realm }
                 { Destination-Realm }
                 [ Destination-Host ]
                 [ Origin-State-Id ]
                *[ Proxy-Info ]
                *[ Route-Record ]
                 { ProSe-Request-Type }
                 [ Origin-App-Layer-User-Id ]
                 [ Target-App-Layer-User-Id ]
                 [ Requesting-EPUID ]
                 [ ProSe-Function-ID ]
                 [ Requesting-RPAUID ]
                 [ ProSe-App-Id ]
                 [ Application-Data ]
                 [ Allowed-Suffix-Number]
                 [ Target-RPAUID ]
                *[ Banned-User-Target ]
                *[ AVP ]
```

6.6.3 ProXimity-Action-Answer (PXA) command

The PXA command, indicated by the Command-Code field set to 8388676 and the 'R' bit cleared in the Command Flags field, is sent by the ProSe Application Server to the ProSe Function in response to the PXR command as part of the procedures specified for EPC-level ProSe discovery and ProSe direct discovery in clause 5.

Message Format:

```
<PX-Answer> ::=  < Diameter Header: 8388676, PXY >
                 < Session-Id >
                 { Auth-Application-Id }
                 { Auth-Session-State }
                 { Origin-Host }
                 { Origin-Realm }
                 [ Result-Code ]
                 [ Experimental-Result ]
                 [ Error-Message ]
                 [ Error-Reporting-Host ]
                 [ Failed-AVP ]
                 [ Origin-State-Id ]
                *[ Redirect-Host ]
                 [ Redirect-Host-Usage ]
                 [ Redirect-Max-Cache-Time ]
                *[ Proxy-Info ]
                 { ProSe-Request-Type }
                 [ Targeted-EPUID ]
                 [ ProSe-Function-ID ]
                *[ PDUID ]
                *[ ProSe-Restricted-Code-Suffix-Range ]
                *[ ProSe-Application-Code-Suffix-Range ]
                *[ ProSe-Code-Suffix-Mask ]
                *[ Monitor-Target ]
                *[ Target-PDUID ]
                 [ProSe-Application-Metadata ]
                 [Application-Data ]
                *[ Load ]
                *[ AVP ]
```

6.6.4 ProXimity-Application-Request (XAR) command

The XAR command, indicated by the Command-Code field set to 8388727 and the 'R' bit set in the Command Flags field, is sent by the ProSe Application Server to the ProSe Function as part of the discovery authorization update procedure.

Message Format:

```
<XA-Request> ::= <Diameter Header: 8388727, REQ, PXY >
                 < Session-Id >
                 { Auth-Application-Id }
```

```
                { Auth-Session-State }
                { Origin-Host }
                { Origin-Realm }
                { Destination-Realm }
                [ Destination-Host ]
                [ Origin-State-Id ]
                *[ Proxy-Info ]
                *[ Route-Record ]
                { ProSe-Request-Type }
                [ Requesting-RPAUID ]
                *[ Banned-User-Target}
                *[ AVP ]
```

6.6.5 ProXimity-Application-Answer (XAA) command

The XAA command, indicated by the Command-Code field set to 8388727 and the 'R' bit cleared in the Command Flags field, is sent by the ProSe Function to the ProSe Application Server in response to the XAR command as part of the discovery authorization update procedure.

Message Format:

```
<XA-Answer> ::=  < Diameter Header: 8388727, PXY >
                < Session-Id >
                { Auth-Application-Id }
                { Auth-Session-State }
                { Origin-Host }
                { Origin-Realm }
                [ Result-Code ]
                [ Experimental-Result ]
                [ Error-Message ]
                [ Error-Reporting-Host ]
                [ Failed-AVP ]
                [ Origin-State-Id ]
                *[ Redirect-Host ]
                [ Redirect-Host-Usage ]
                [ Redirect-Max-Cache-Time ]
                *[ Proxy-Info ]
                { ProSe-Request-Type }
                *[ AVP ]
```

6.7 PC2 specific Experimental-Result-Code AVP values

6.7.1 General

This clause defines result code values that shall be supported by Diameter implementations that conform to this specification.

6.7.2 Success

Result Codes that fall into the Success category are used to inform a peer that a request has been successfully completed. The Result-Code AVP values defined in the Diameter base protocol (IETF RFC 6733 [12] are applied.

6.7.3 Failures

Errors that fall into the Failures category shall be used to inform the peer that the request has failed. The Result-Code AVP values defined in Diameter base protocol (IETF RFC 6733 [12] are applied. When one of the result codes as defined below is included in the PXA command, it is included in an Experimental-Result AVP and the Result-Code AVP is absent.

6.7.3.1 DIAMETER_ERROR_ORIGIN_ALUID_UNKNOWN (5590)

This result code indicates that there is no valid context associated to the origin ALUID received in the request.

6.7.3.2 DIAMETER_ERROR_TARGET_ALUID_UNKNOWN (5591)

This result code indicates that there is no valid context associated to the target ALUID received in the request.

6.7.3.3 DIAMETER_ERROR_PFID_UNKNOWN (5592)

This result code indicates that there is no valid ProSe Function associate to the PFID received in the request.

6.7.3.4 DIAMETER_ERROR_APP_REGISTER_REJECT (5593)

This result code indicates that the ProSe Application Server cannot accept the application registration request for an unspecific reason.

6.7.3.5 DIAMETER_ERROR_PROSE_MAP_REQUEST_DISALLOWED (5594)

This result code indicates that the ProSe Application Server cannot accept the map request because the targeted application user is not allowed to be discovered by the originating application user.

6.7.3.6 DIAMETER_ERROR_MAP_REQUEST_REJECT (5595)

This result code indicates that the ProSe Application Server cannot accept the map request for an unspecific reason.

6.7.3.7 DIAMETER_ERROR_REQUESTING_RPAUID_UNKNOWN (5596)

This result code indicates that the ProSe Application Server cannot find the requesting RPAUID included in the restricted discovery authorization request.

6.7.3.8 DIAMETER_ERROR_UNKNOWN_OR_INVALID_TARGET_SET (5597)

This result code indicates that the ProSe Application Server cannot authorize the request because all target RPAUID(s) provided in the request are either unknown to the ProSe Application Server, or not eligible to be discovered by the requesting RPAUID.

6.7.3.9 DIAMETER_ERROR_MISSING_APPLICATION_DATA (5598)

This result code indicates that there is no application data provided so the ProSe Application Server cannot process the corresponding discovery request.

6.7.3.10 DIAMETER_ERROR_AUTHORIZATION_REJECT (5599)

This result code indicates that for the particular requesting type of restricted discovery, the ProSe Application Server found that the requesting RPAUID is not authorized.

6.7.3.11 DIAMETER_ERROR_DISCOVERY_NOT_PERMITTED (5600)

This result code indicates that the requesting RPAUID is not allowed to discover the target RPAUID.

6.7.3.12 DIAMETER_ERROR_TARGET_RPAUID_UNKNOWN (5601)

This result code indicates that there is no valid target RPAUID received in the request.

6.7.3.13 DIAMETER_ERROR_INVALID_APPLICATION_DATA (5602)

This result code indicates that there is invalid application data provided so the ProSe Application Server cannot process the corresponding discovery request.

Annex A (informative): Call Flows over PC2

A.1 EPC-Level ProSe discovery

A.1.1 Application registration for ProSe

The Application registration for ProSe procedure is used by the UE to register an application with the ProSe Function to activate ProSe features e.g. EPC-level ProSe discovery for a specific application.

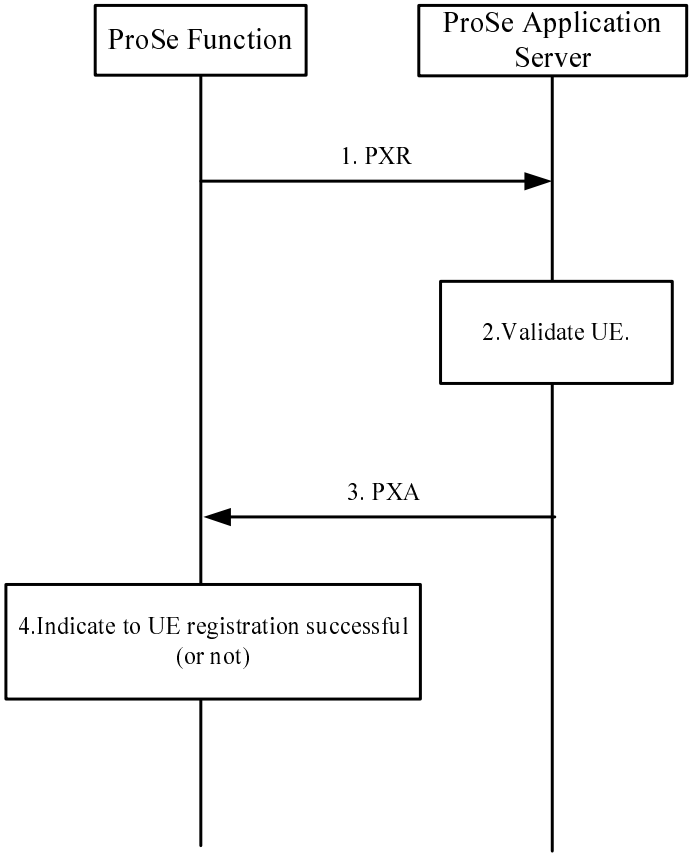

Figure A.1.1: Application registration for ProSe Procedure

1. When the ProSe Function have received an application registration request, as defined in 3GPP TS 24.334 [10], from the originating UE and the requested application is on the stored list of authorised Application IDs, the ProSe Function sends a PXR command to the ProSe Application Server including the parameters as defined in clause 5.1.1.

2. The ProSe Application Server determines whether the registration can be accepted for the originating UE.

3. The ProSe Application Server sends a PXA command to the ProSe Function including the parameters as defined in clause 5.1.1.

4. The ProSe Function send a response message to the originating UE indicating that the registration was successful (or not) as defined in 3GPP TS 24.334 [10].

A.1.2 Proximity map request

The proximity map request procedure is used by the ProSe Function to request the identity of the ProSe Function for the targeted UE for which the originating UE shall get alerts when in proximity of the targeted UE.

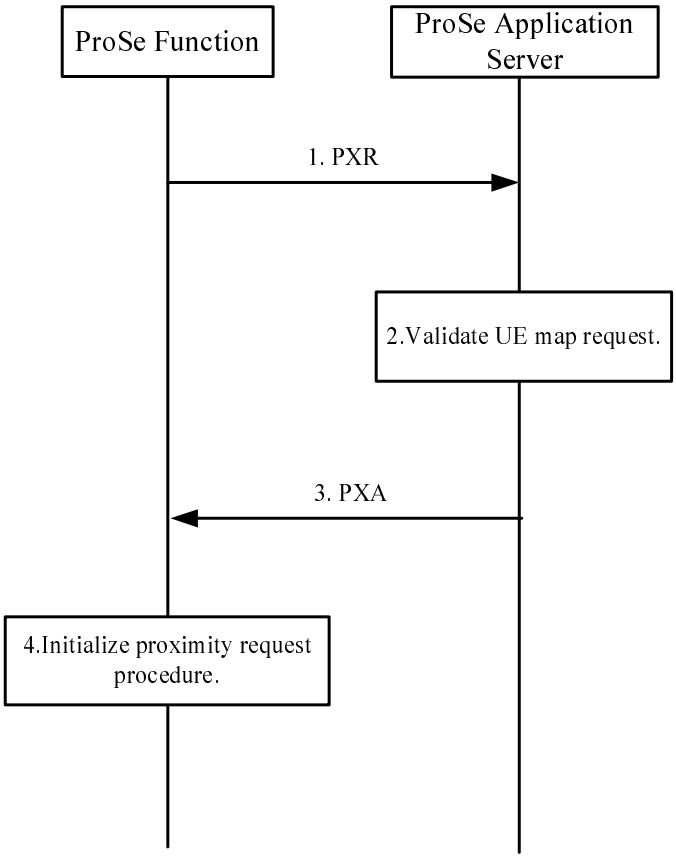

Figure A.2.1: Proximity map request procedure

1. When the ProSe Function have received a proximity request, as defined in 3GPP TS 24.334 [10], from the UE the ProSe Function sends a PXR command to the ProSe Application Server including the parameters as defined in clause 5.1.2.
2. The ProSe Application Server determines whether the originating UE is allowed to discover the targeted UE.
3. The ProSe Application Server sends a PXA command to the ProSe Function including the parameters as defined in clause 5.1.2.
4. If the mapping is successful, the ProSe Function initialize the proximity request procedure as defined in 3GPP TS 29.345 [7].

A.2 Restricted ProSe direct discovery

A.2.1 Authorization for Announce Request (model A)

The authorization for announce request procedure is used by the ProSe Function serving the originating UE to obtain announce authorization information related to restricted ProSe direct discovery.

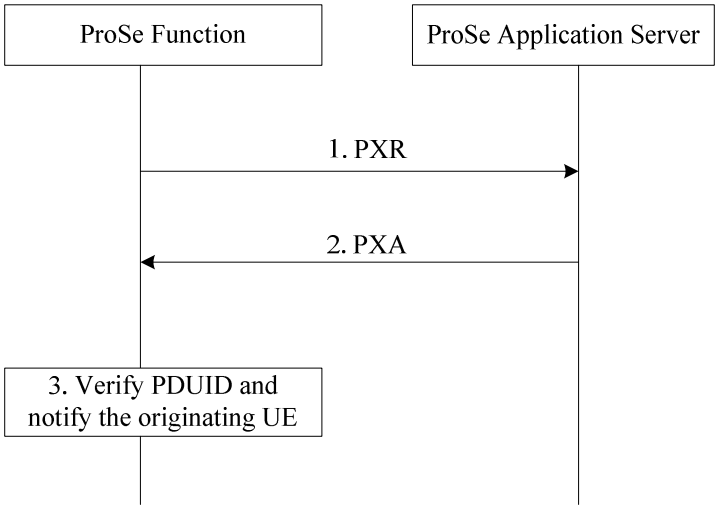

Figure A.2.1: Authorization for announce request procedure

1. When the ProSe Function has received an announce request, as defined in 3GPP TS 24.334 [10], from the originating UE and the application represented by the Application ID is authorized for restricted ProSe direct discovery model A announcing, the ProSe Function sends a PXR command to the ProSe Application Server including the parameters as defined in clause 5.2.2.
2. The ProSe Application Server sends a PXA command to the ProSe Function including the parameters as defined in clause 5.2.2.
3. The ProSe Function verifies that the received PDUID belongs to the originating UE and sends a response message to the originating UE as defined in 3GPP TS 24.334 [10].

A.2.2 Authorization for Restricted Discovery Announce Request with Application-controlled extension (model A)

The announce authorization procedure with application-controlled extension is used by the ProSe Function serving the originating UE to obtain announce authorization information related to restricted ProSe direct discovery.

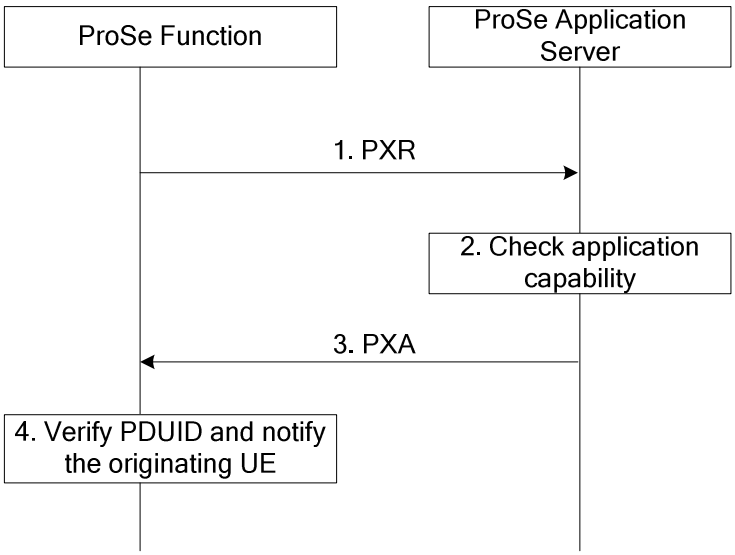

Figure A.2.2: Authorization for restricted discovery announce request with application-controlled extension procedure

1. When the ProSe Function has received an announce request with application-controlled extension, as defined in 3GPP TS 24.334 [10], from the originating UE and the application represented by the Application ID is authorized for restricted ProSe direct discovery model A announcing, the ProSe Function sends a PXR command to the ProSe Application Server including the parameters as defined in clause 5.2.3.

2. The ProSe Application Server shall check if the application supports application-controlled extension.

3 The ProSe Application Server sends a PXA command to the ProSe Function including the parameters as defined in clause 5.2.3.

4. The ProSe Function verifies that the received PDUID belongs to the originating UE and sends a response message to the originating UE as defined in 3GPP TS 24.334 [10].

A.2.3 Authorization for Monitor Request (model A)

The authorization for monitor request procedure is used by the ProSe Function serving the originating UE to obtain monitor authorization information related to restricted ProSe direct discovery.

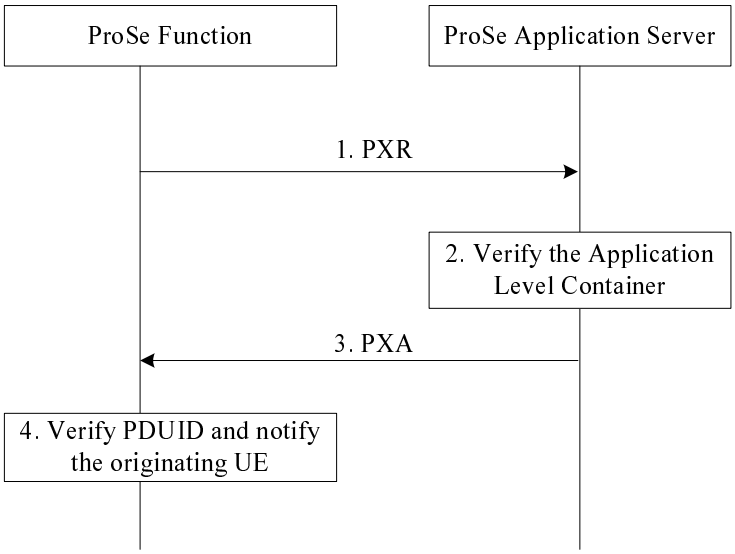

Figure A.2.3: Authorization for Monitor request

1. When the ProSe Function has received a monitor request as defined in 3GPP TS 24.334 [10], from the originating UE and the application represented by the Application ID is authorized for restricted ProSe direct discovery model A monitoring, the ProSe Function sends a PXR command to the ProSe Application Server including the parameters as defined in clause 5.2.4.

2. The ProSe Application Server shall examine the Application-Data AVP and determine which target RPAUID(s) the requesting RPAUID is allowed to discover based on application-specific permissions.

3 The ProSe Application Server sends a PXA command to the ProSe Function including the parameters as defined in clause 5.2.4.

4. The ProSeF unction verifies that the received PDUID belongs to the originating UE and sends a response message to the originating UE as defined in 3GPP TS 24.334 [10].

A.2.4 Authorization for Restricted Discovery Monitor Request with Application-controlled extension (model A)

The authorization for monitor request with application-controlled extension procedure is used by the ProSe Function serving the originating UE to obtain monitor authorization information related to restricted ProSe direct discovery with application-controlled extension.

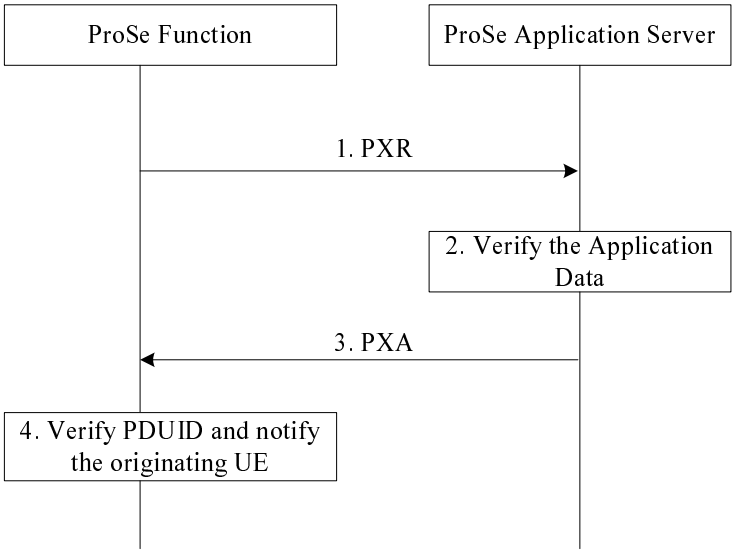

Figure A.2.4: Authorization for restrictred discovery monitor request with application-controlled extension procedure

1. When the ProSe Function has received a monitor request with application-controlled extension as defined in 3GPP TS 24.334 [10], from the originating UE and the application represented by the Application ID is authorized for restricted ProSe direct discovery model A monitoring, the ProSe Function sends a PXR command to the ProSe Application Server including the parameters as defined in clause 5.2.5.

2. The ProSe Application Server shall examine the Application-Data AVP and determine which target RPAUID(s) the requesting RPAUID is allowed to discover based on application-specific permissions.

3 The ProSe Application Server sends a PXA command to the ProSe Function including the parameters as defined in clause 5.2.5.

4. The ProSe Function verifies that the received PDUID belongs to the originating UE and sends a response message to the originating UE as defined in 3GPP TS 24.334 [10].

A.2.5 Authorization for Discovery Permission (model A)

The discovery permission authorization procedure is used by the ProSe Function to verify the application layer permission for restricted discovery model A between an originating application user and a target application user, which are represented, respectively, by the requesting RPAUID and the target RPAUID.

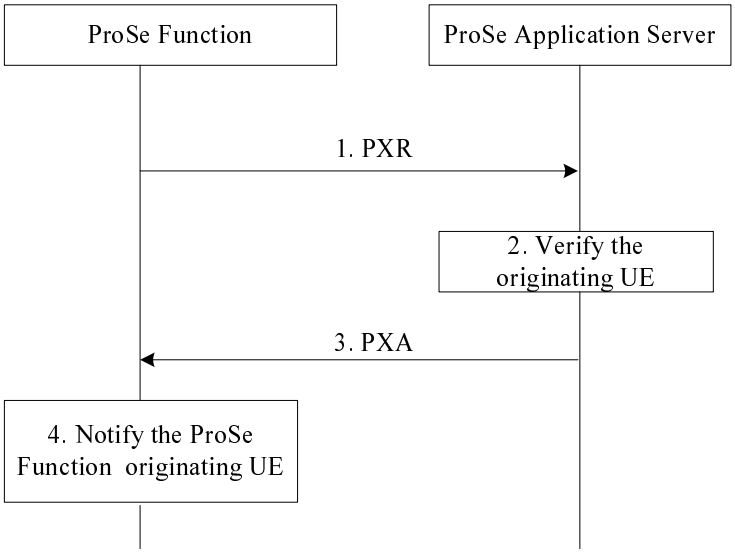

Figure A.2.5: Authorization for discovery permission procedure

1. When the ProSeFunction has received a monitor request as defined in 3GPP TS 29.345 [7], from the ProSe Function of the origination UE and the ProSe Restricted Code has been retrieved, the ProSe Function sends a PXR command to the ProSe Application Server including the parameters as defined in clause 5.2.6.
2. The ProSe Application Server shall determine whether the originating UE is allowed to discover the targeted UE.
3 The ProSe Application Server sends a PXA command to the ProSe Function including the parameters as defined in clause 5.2.6.
4. The ProSe Function sends a response message to the ProSe Function of the originating UE as defined in 3GPP TS 29.345 [7].

A.2.6 Authorization for Match Report (model A/model B)

This authorization for match report procedure is used by the ProSe Function serving the monitoring UE (in model A) or discoverer UE (in model B) to obtain authorization information related to Match Report in restricted ProSe Direct Discovery.

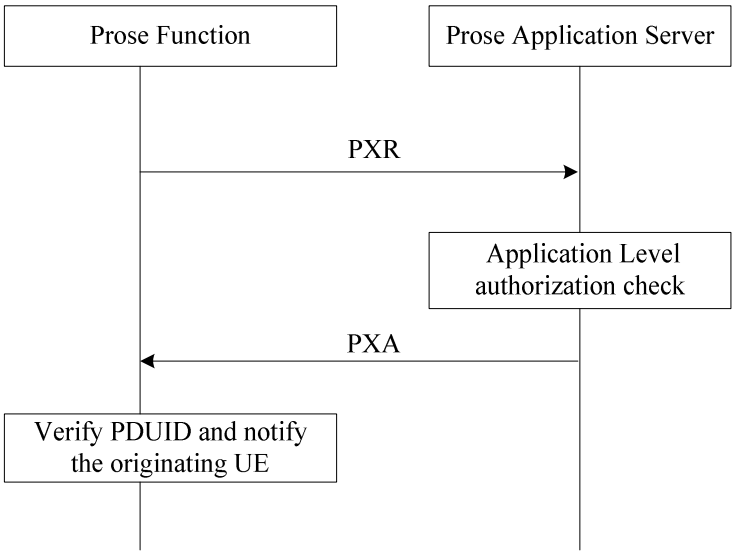

Figure A.2.6: Authorization for Match report procedure

1. When the ProSe Function has received a match report from the originating UE and the originating UE is authorized for restricted discovery, t he ProSe Function sends a PXR command to the ProSe Application Server including the parameters as defined in clause 5.2.7.

2. The ProSe Application Server shall determine whether the originating UE is allowed to discover the target restricted ProSe Application User.

3 The ProSe Application Server sends a PXA command to the ProSe Function including the parameters as defined in clause 5.2.7.

4. The ProSe Function verifies that the received PDUID belongs to the originating UE and and the target PDUID is the same as the stored target PDUID, then sends a response message to the originating UE.

A.2.7 Authorization for Discoveree Request (model B)

This authorization for discoveree request procedure is used by the ProSe Function serving the Discoveree UE to obtain authorization information of the Discoveree UE related to Discoveree Request in restricted ProSe direct discovery.

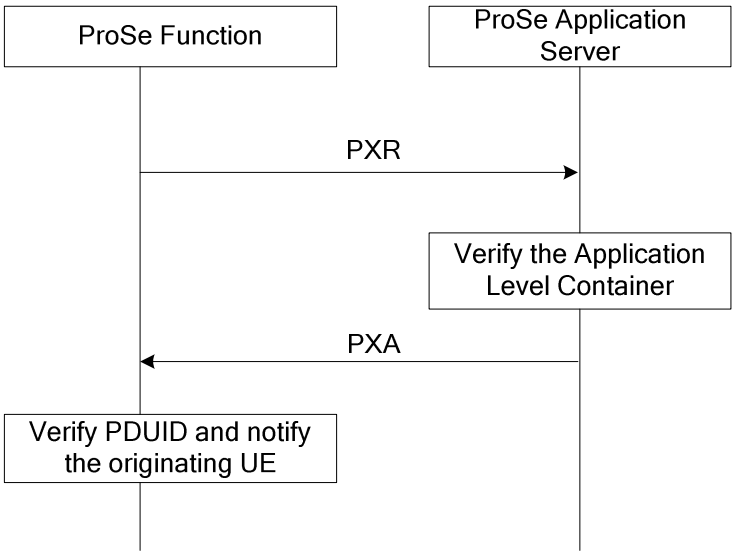

Figure A.2.7: Authorization for Discoveree request

1. When the ProSe Function have received a discoveree request as defined in 3GPP TS 24.334 [10], from the originating UE and the application represented by the Application ID is authorized for restricted ProSe direct discovery model B discoveree operation, the ProSe Function sends a PXR command to the ProSe Application Server including the parameters as defined in clause 5.2.8.

2. The ProSe Application Server shall examine the Application-Data AVP and determine which target RPAUID(s) the requesting RPAUID is allowed to discover based on application-specific permissions.

3 The ProSe Application Server sends a PXA command to the ProSe Function including the parameters as defined in clause 5.2.8.

4. The ProSeF unction verifies that the received PDUID belongs to the originating UE and sends a response message to the originating UE as defined in 3GPP TS 24.334 [10].

A.2.8 Authorization for Discoverer Request (model B)

This authorization for discoverer procedure is used by the ProSe Function serving the Discoverer UE to obtain authorization information of the Discoverer UE related to Discoverer Request in restricted ProSe Direct Discovery.

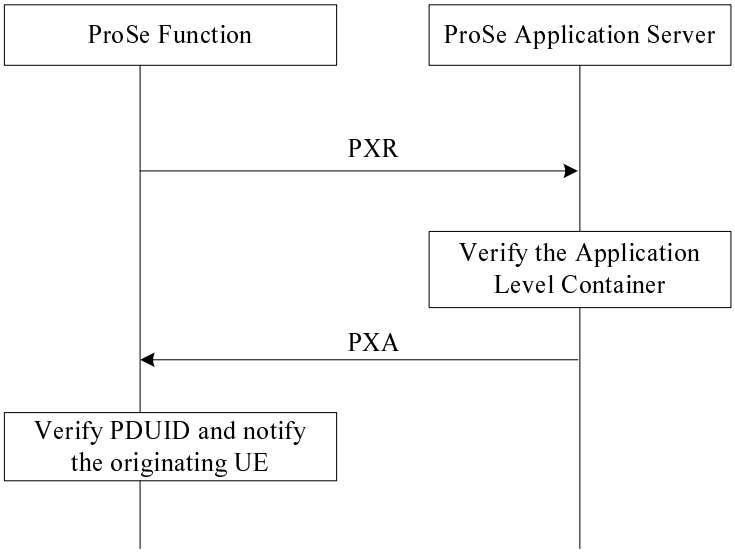

Figure A.2. 8: Authorization for Discoverer request

1. When the ProSe Function have received a discoverer request as defined in 3GPP TS 24.334 [10], from the origination UE and the application represented by the Application ID is authorized for restricted ProSe direct discovery model B discoverer operation, t he ProSe Function sends a PXR command to the ProSe Application Server including the parameters as defined in clause 5.2.9.

2. The ProSe Application Server shall examine the Application-Data AVP and determine which target RPAUID(s) the requesting RPAUID is allowed to discover based on application-specific permissions.

3 The ProSe Application Server sends a PXA command to the ProSe Function including the parameters as defined in clause 5.2.9.

4. The ProSe Function verifies that the received PDUID belongs to the originating UE and sends a response message to the originating UE as defined in 3GPP TS 24.334 [10].

A.2.9 Authorization for Discovery Permission (model B)

The discovery permission authorization procedure is used by the ProSe Function to verify the application layer permission for restricted discovery model B between an originating application user and a target application user, which are represented, respectively, by the requesting RPAUID and the target RPAUID.

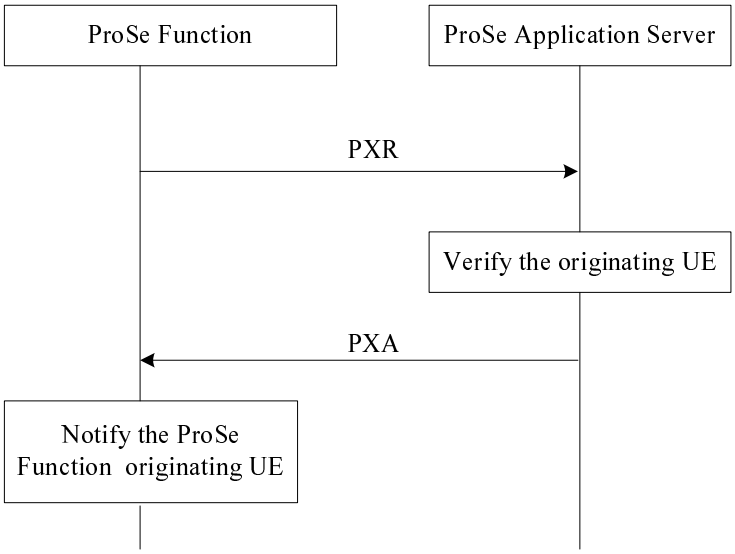

Figure A.2.9: Authorization for discovery permission procedure

1. When the ProSe Function have received a discovery request as defined in 3GPP TS 29.345 [7], from the ProSe Function of the originating UE and the ProSe Restricted Code has been retrieved. The ProSe Function sends a PXR command to the ProSe Application Server including the parameters as defined in clause 5.2.10.

2. The ProSe Application Server shall determine whether the originating UE is allowed to discover the targeted UE.

3 The ProSe Application Server sends a PXA command to the ProSe Function including the parameters as defined in clause 5.2.10.

4. The ProSe Function sends a response message to the ProSe Function of the originating UE as defined in 3GPP TS 29.345 [7].

A.2.10 Discovery Authorization Update

The discovery authorization update procedure is used by ProSe Application Server to revoke discovery permissions without a delay while a specific originating user revokes the discovery permissions relating to some other users in the ProSe Application Server.

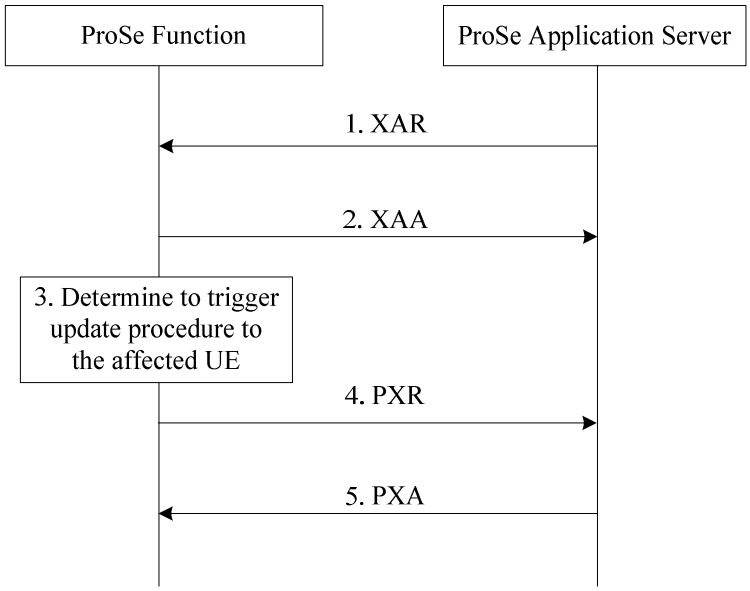

Figure A.2.10: Discovery authorization update

1. When the ProSe Application Server has received authorization update request from the UE, the ProSe Application Server sends a XAR command to the ProSe Function including the parameters as defined in clause 5.2.11;

2. The ProSe Function acknowledges the XAR command and sends the XAA command to the ProSe Application Server including the parameters as defined in clause 5.2.11.

3. The ProSe Function determines to trigger the discovery update procedure to the afftected UE(s) based on the received update information from the ProSe Application.

4. After a time configured by the operator, the ProSe Function sends a PXR command to the ProSe Application Server including the parameters as defined in clause 5.2.11 for reporting the authorization update result.

5. The ProSe Application Server acknowledges the PXR Command and sends the PXA command back to the ProSe Function.

A.2.11 Authorization for Open Discovery Announce Request with Application-controlled extension

The announce authorization procedure with application-controlled extension is used by the ProSe Function serving the originating UE to obtain announce authorization information related to open ProSe direct discovery.

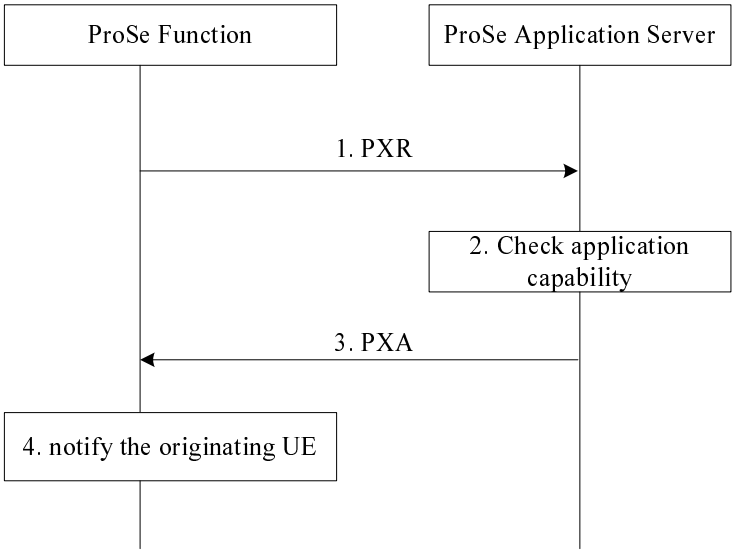

Figure A.2.11: Authorization for open discovery announce request with application-controlled extension procedure

1. When the ProSe Function has received an announce request with application-controlled extension, as defined in 3GPP TS 24.334 [10], from the originating UE and the application represented by the Application ID is authorized for open ProSe direct discovery announcing, the ProSe Function sends a PXR command to the ProSe Application Server including the parameters as defined in clause 5.3.1.

2. The ProSe Application Server shall check if the application supports application-controlled extension and allocate ProSe Application Code suffix(es).

3 The ProSe Application Server sends a PXA command to the ProSe Function including the parameters as defined in clause 5.3.1.

4. The ProSe Function sends a response message to the originating UE as defined in 3GPP TS 24.334 [10].

A.2.12 Authorization for Open Discovery Monitor Request with Application-controlled extension

The authorization for monitor request with application-controlled extension procedure is used by the ProSe Function serving the originating UE to obtain monitor authorization information related to open ProSe direct discovery with application-controlled extension.

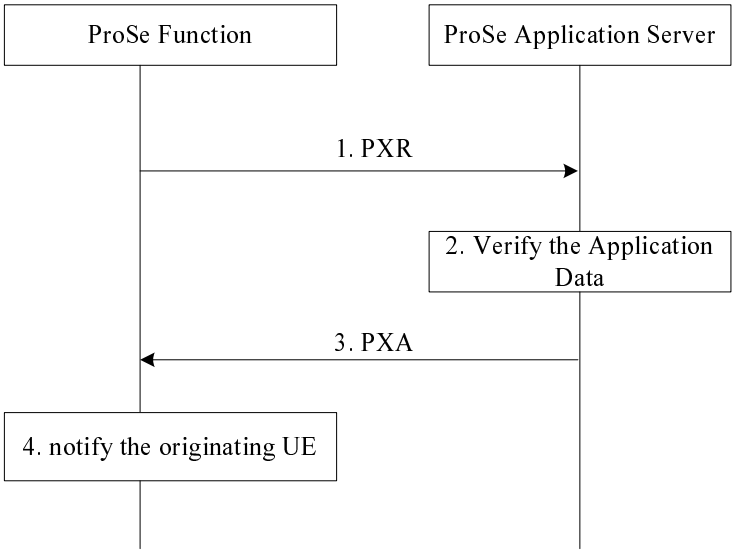

Figure A.2.12: Authorization for open discovery monitor request with application-controlled extension procedure

1. When the ProSe Function has received a monitor request with application-controlled extension as defined in 3GPP TS 24.334 [10], from the originating UE and the application represented by the Application ID is authorized for open ProSe direct discovery monitoring, the ProSe Function sends a PXR command to the ProSe Application Server including the parameters as defined in clause 5.3.2.

2. The ProSe Application Server shall check if the application supports application-controlled extension and examine the Application-Data AVP and determine the suffix masks to be used to monitor the information represented by the Application Data.

3 The ProSe Application Server sends a PXA command to the ProSe Function including the parameters as defined in clause 5.3.2.

4. The ProSe Function sends a response message to the originating UE as defined in 3GPP TS 24.334 [10].

Annex B (normative): Diameter load control mechanism

B.1 General

IETF RFC 8583 [11] specifies the Diameter load control mechanism. This includes the definition of Diameter Load AVP and the Diameter load related behaviour.

The Diameter load control mechanism on the PC2 interface is optional for the ProSe Function and the ProSe Application Server.

NOTE: The Diameter Load AVP will simply be ignored by peers not supporting Diameter load control.

If the ProSe Function and the ProSe Application Server support the Diameter load control mechanism, they shall apply the procedures in the present Annex.

B.2 ProSe Function behaviour

The ProSe Function shall act as a reacting node as defined in IETF RFC 8583 [11] and may use the load information in an implementation dependent manner, e.g. when deciding where to route requests for new Diameter sessions.

B.3 ProSe Application Server behaviour

The ProSe Application Server shall act as endpoint reporting node as defined IETF RFC 8583 [11]. The ProSe Application Server shall include load information in the the Load AVP within ProXimity-Action-Answer messages.

When and in which frequency to include the Load AVP is implementation dependent and based on operator policy.

How the ProSe Application Server determines the specific contents of the Load-Value AVP within the Load AVP is implementation dependent and based on operator policy.

Annex C (informative): Change history

Change history							
Date	**TSG #**	**TSG Doc.**	**CR**	**Rev**	**Subject/Comment**	**Old**	**New**
2014-09		CP-140557			Raised to v.12.0.0 following one-step-approval	1.0.0	12.0.0
2014-12	CT-66	CP-140921	0001	1	Resource allocation of PC2 Diameter protocol	12.0.0	12.1.0
2015-03	CT-67	CP-150116	0002	1	Roaming applicability in EPC-level ProSe discovery	12.1.0	12.2.0
2015-09	CT-69	CP-150474	0008	-	Correction to the PXR command	12.2.0	12.3.0
2015-09	CT-69	CP-150481	0004	1	Addition of ProSe discovery authorization for restricted discovery	12.3.0	13.0.0
2015-09	CT-69	CP-150481	0005	1	Add functional description on Rel-13 eProSe-Ext features	12.3.0	13.0.0
2015-09	CT-69	CP-150481	0006	3	General introduction to restricted ProSe direct discovery	12.3.0	13.0.0
2015-12	CT-70	CP-150633	0009	1	Support multiple PDUIDs in response of the announce request authorization	13.0.0	13.1.0
2015-12	CT-70	CP-150633	0010		Correction of UE definitions for restricted discovery	13.0.0	13.1.0
2015-12	CT-70	CP-150633	0011	2	Call flows for authorization in Model A	13.0.0	13.1.0
2015-12	CT-70	CP-150633	0012	2	Call flows for authorization in Model B	13.0.0	13.1.0
2015-12	CT-70	CP-150633	0013	1	Call flow for match report in Model A/Model B	13.0.0	13.1.0
2015-12	CT-70	CP-150633	0015	2	Call flow for discovery authorization update	13.0.0	13.1.0
2015-12	CT-70	CP-150633	0016	2	Addition of ProSe discovery authorization update for restricted discovery	13.0.0	13.1.0
2015-12	CT-70	CP-150633	0017	3	Invalid Application Data AVP Failure	13.0.0	13.1.0

Change history							
Date	**TSG #**	**TSG Doc.**	**CR**	**Rev**	**Cat**	**Subject/Comment**	**New**
2016-03	CT#71	CP-160092	0018	2	F	Metadata indicator for restricted discovery monitor request procedure	13.2.0
2016-03	CT#71	CP-160092	0019	1	F	Open discovery procedures in PC2 interface for application-controlled extension	13.2.0
2016-03	CT#71	CP-160092	0020	1	F	Correction to wrong Experimental-Result-Code values for PC2 interface	13.2.0
2016-06	CT#72	CP-160254	0021	3	F	Add command code and application ID for PC2 protocol	13.3.0
2016-06	CT#72	CP-160254	0022	-	F	Successfully authenticated Targeted RPAUIDs for restricted discovery monitor request procedure	13.3.0
2016-06	CT#72	CP-160254	0023	1	F	Reuse AVPs defined in PC6/PC7 interface	13.3.0
2016-06	CT#72	CP-160254	0024	1	F	Inconsistency about the ProSe discovery support in PC2 interface	13.3.0
2016-09	CT#73	CP-160454	0025	1	F	Correction of the inconsistent AVP definition	13.4.0
2016-12	CT#74	CP-160615	0026	-	B	Diameter Load Control Mechanism	14.0.0
2017-03	CT#75	CP-170076	0027	1	F	Update of reference for the Diameter base protocol	14.1.0
2017-06	CT#76	CP-171119	0028	3	F	Reference update for draft-ietf-dime-load	14.2.0
2018-06	CT#80					Automatic upgrade from previous Release	15.0.0
2019-09	CT#85	CP-192154	0030	1	A	draft-ietf-dime-load published as RFC 8583	15.1.0
2020-06	CT#88e	CP-201246	0031	1	F	Correct open ProSe direct discovery	16.0.0
2022-03	SA#95e	-	-	-		Update to Rel-17 version (MCC)	17.0.0
2024-03	SA#103	-	-	-		Update to Rel-18 version (MCC)	18.0.0
2025-09	SA#109	-	-	-		Update to Rel-19 version (MCC)	**19.0.0**

History

Document history		
V19.0.0	October 2025	Publication