ETSI TS 129 343 V12.0.0 (2014-10)

Universal Mobile Telecommunications System (UMTS);
LTE;
Proximity-services (Prose) Function to
Proximity-services (ProSe)
Application Server aspects (PC2);
Stage 3
(3GPP TS 29.343 version 12.0.0 Release 12)

Reference
DTS/TSGC-0329343vc00

Keywords
LTE,UMTS

ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
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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] IETF RFC 3588: "Diameter Base Protocol".

[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".

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].

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.

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 Function ID: An FQDN that identifies a ProSe Function.

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].

ALUID	Application Layer User ID
AVP	Attribute-Value Pair
EPUID	EPC ProSe User ID
PFID	ProSe Function ID
ProSe	Proximity-based Services

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 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 4.2-1.

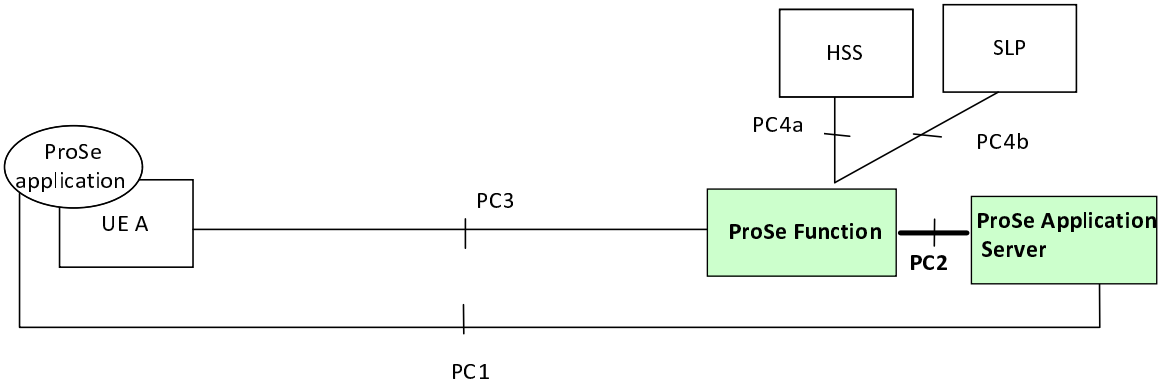

Figure 4.1.1: PC2 reference point in ProSe Architecture

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 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 and ProSe Function IDs;
- Mapping of Application Layer User IDs and EPC ProSe User IDs.

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 subclause 7.2.3 of 3GPP TS 24.334 [10]. In case of an unsuccessful application registration request, applicable value defined in subclause 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 subclause 6.7.3 shall be used to indicate the cause.

6 PC2 protocol

6.1 Protocol Support

6.1.1 Use of Diameter base protocol

The Diameter Base Protocol as specified in IETF RFC 3588 [3] 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 3588 [3] (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, 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 is xxx.

Editor´s Note: The Diameter application identifier will be requested from IANA.

The ProSe Application Server and ProSe Function shall advertise support of the Diameter PC2 application by including the value of the PC2 application identifier 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 3588 [3].

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 3588 [3]).

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 1)			
				Must	May	Should not	Must not
Origin-App-Layer-User-Id	xxxx	6.4.2	UTF8String	M,V	P		
Target-App-Layer-User-Id	yyyy	6.4.3	UTF8String	M,V	P		
ProSe-Function-ID	zzzz	6.4.4	OctetString	M,V	P		
ProSe-Request-Type	aaaa	6.4.5	Unsigned32	M,V	P		
NOTE 1: 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 3588 [3].							

Editor´s Note: AVP Codes will be allocated once CT4 has assigned a range of AVP codes.

6.4.2 Origin-App-Layer-User-Id AVP

The Origin-App-Layer-User-Id AVP (AVP code xxxx) 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 yyyy) 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 zzzz) 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 aaaa) is of type Unsigned32, and contains the reason for sending the PA-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.

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 Diameter base protocol, do not need to be supported. The AVPs from Diameter base protocol 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
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.

6.6 PC2 messages

6.6.1 Command-Code Values

This section 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 rules in IETF RFC 3588 [3].

Editor´s Note: Command Codes will be added once IANA has assigned them.

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		6.6.2
ProXimity-Action-Answer	PXA		6.6.3

For the commands defined in this specification and reused commands, the Application-ID field shall be set to xxx.

Editor´s Note: Application ID will be added once IANA has assigned it.

6.6.2 ProXimity-Action-Request (PXR) command

The PXR command, indicated by the Command-Code field set to xxx 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 application registration or map request procedure.

Message Format:

```
<PX-Request> ::= <Diameter Header: xxx, 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 ]
               *[ AVP ]
```

6.6.3 ProXimity-Action-Answer (PXA) command

The PXA command, indicated by the Command-Code field set to xxx 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 application registration or Proximity map request procedure.

Message Format:

```
<PX-Answer> ::=  < Diameter Header: xxx, 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 ]
                *[ AVP ]
```

6.7 PC2 specific Experimental-Result-Code AVP values

6.7.1 General

This subclause 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 Diameter BASE IETF RFC 3588 [3] 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 3588 [3] 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 (5xx1)

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 (5xx2)

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 (5xx3)

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 (5xx4)

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 (5xx5)

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 (5xx6)

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

Annex A (informative): Call Flows over PC2

A.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.

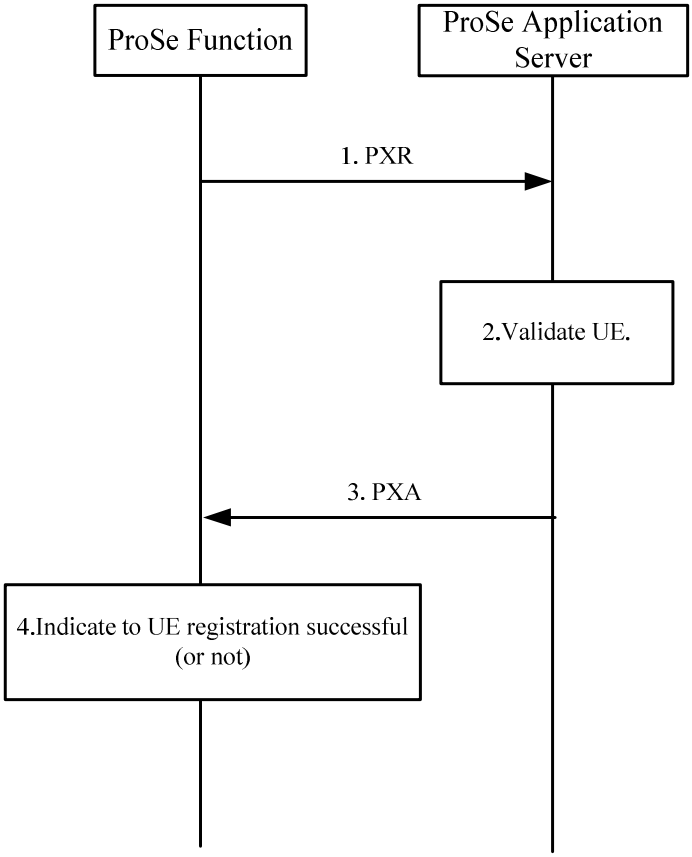

Figure A.1.1: Application registration for ProSe Procedure

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 subclause 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 subclause 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.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.

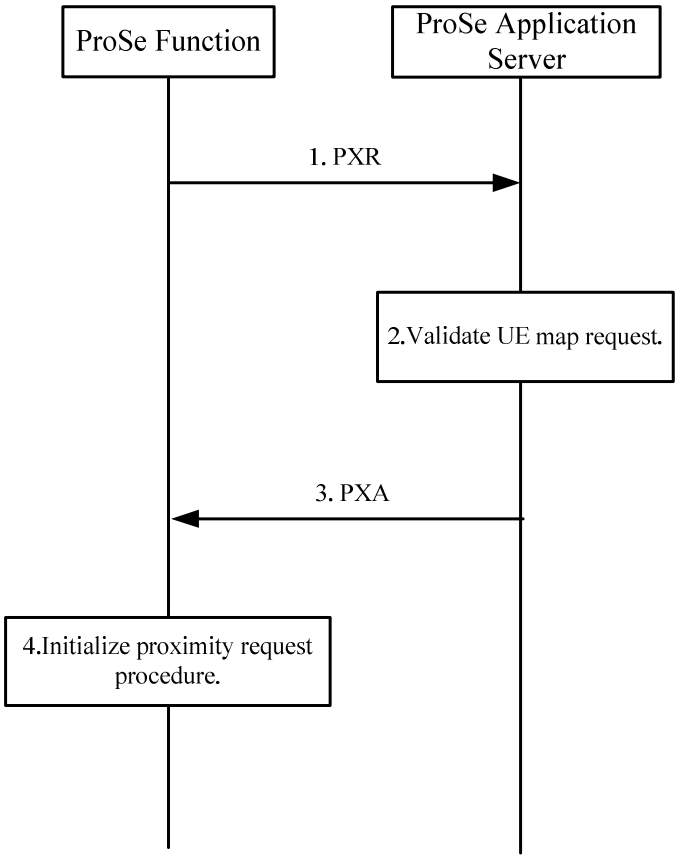

Figure A.2.1: Proximity map request procedure

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 subclause 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 subclause 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].

Annex B (informative): Change history

Change history							
Date	**TSG #**	**TSG Doc.**	**CR**	**Rev**	**Subject/Comment**	**Old**	**New**
2014-04					TS skeleton of PC2 reference point stage 3.		0.0.0
2014-04					Include the following tdocs agreed at CT3 #76bis meeting: C3-141327, C3-141328, C3-141425.	0.0.0	0.1.0
2014-07					Includes the following tdocs agreed at CT3#78: C3-143260, C3-143029, C3-143261, C3-143262, C3-143347, C3-143352, C3-143266, C3-143259, C3-143263, C3-143268.	0.1.0	0.2.0
2014-09	CP-140557				MCC clean-up for presentation for information and approval to CT#65	0.2.0	1.0.0
2014-09	CP-140557				Raised to v.12.0.0 following one-step-approval	1.0.0	12.0.0

History

Document history		
V12.0.0	October 2014	Publication