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Contents

Foreword

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

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

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2 presented to TSG for approval;

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y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the document.

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

shall indicates a mandatory requirement to do something

shall not indicates an interdiction (prohibition) to do something

The constructions "shall" and "shall not" are confined to the context of normative provisions, and do not appear in Technical Reports.

The constructions "must" and "must not" are not used as substitutes for "shall" and "shall not". Their use is avoided insofar as possible, and they are not used in a normative context except in a direct citation from an external, referenced, non-3GPP document, or so as to maintain continuity of style when extending or modifying the provisions of such a referenced document.

should indicates a recommendation to do something

should not indicates a recommendation not to do something

may indicates permission to do something

need not indicates permission not to do something

The construction "may not" is ambiguous and is not used in normative elements. The unambiguous constructions "might not" or "shall not" are used instead, depending upon the meaning intended.

can indicates that something is possible

cannot indicates that something is impossible

The constructions "can" and "cannot" are not substitutes for "may" and "need not".

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

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

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

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

In addition:

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

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

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

1 Scope

The present document specifies the protocols for ranging based service and sidelink positioning in 5G system as specified in 3GPP TS 23.586 [2] for the following aspects:

a) provisioning of configuration information for ranging and sidelink positioning service;

b) ranging and sidelink positioning UE discovery; and

c) ranging and sidelink positioning communication, including the communication among UEs and the communication between UE and LMF. The support of ranging and sidelink positioning protocol (RSPP) transport is defined as part of the ranging and sidelink positioning communication.

The present document defines the associated procedures for the aspects listed above, and also defines the message format, message contents, error handling and system parameters applied by the protocols for ranging based service and sidelink positioning in 5GS.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TR 23.586: " Ranging based services and Sidelink Positioning ".

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

[4] 3GPP TS 24.587: "Vehicle-to-Everything (V2X) services in 5G System (5GS); Protocol aspects; Stage 3".

[5] 3GPP TS 33.533: "Security aspects of ranging based services and sidelink positioning".

[6] 3GPP TS 24.554: "Proximity-services (ProSe) in 5G System (5GS) protocol aspects".

[7] ITU-T Recommendation E.212: "The international identification plan for public networks and subscriptions", 2016-09-23.

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

[9] ISO TS 17419 ITS-AID AssignedNumbers : http://standards.iso.org/iso/ts/17419/TS17419%20Assigned%20Numbers/TS17419_ITS-AID_AssignedNumbers.pdf.

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

[11] 3GPP TS 23.273: "5G System (5GS) Location Services (LCS); Stage 2".

[12] 3GPP TS 38.355: "NR; Sidelink Positioning Protocol (SLPP); Protocol Specification".

[13] IETF RFC 9110: "HTTP Semantics".

[14] IETF RFC 9112: "HTTP/1.1".

[15] 3GPP TS 24.526: "UE policies for 5G System (5GS); Stage 3".

[16] 3GPP TS 23.032: "Universal Geographical Area Description (GAD)".

3 Definitions of terms, symbols and abbreviations

3.1 Terms

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

example: text used to clarify abstract rules by applying them literally.

For the purposes of the present document, the following terms and definitions given in 3GPP TS 23.586 [2] apply:

Located UE
Network-assisted operation
Network-based operation
Positioning
Ranging
Relative position
Relative velocity
SL reference UE
Sidelink positioning
SL positioning client UE
SL positioning server UE
Target UE
UE-only operation
User info ID
Application layer ID

3.2 Abbreviations

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

MO-LR	Mobile Originated Location Request
MT-LR	Mobile Terminated Location Request
RSLPP	Ranging and sidelink positioning policy
RSPP	Ranging and sidelink positioning protocol
SLPP	Sidelink positioning protocol
SLPKMF	SideLink Positioning Key Management Function
SL-MO-LR	Sidelink Mobile Originating Location Request
SL-MT-LR	Sidelink Mobile Terminating Location Request

4 General description

Any UE supporting ranging and sidelink positioning, e.g. target UE, reference UE, sidelink positioning server UE, supports a ranging and sidelink positioning (RSP) layer. The RSP layer handles service requests received from application layer to control the ranging and sidelink positioning operation.

The RSP layer supports the following functionalities:

a) Provisioning of configuration information and authorization for ranging and sidelink positioning;

b) UE discovery and selection; and

c) Ranging and sidelink positioning communication between UEs or between the UE and the LMF.

Transport of ranging and sidelink positioning protocol (RSPP) payload over PC5-U is supported by the ranging and sidelink positioning communication between UEs over PC5.

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

The security aspects for 5G ranging and sidelink positioning features are specified in 3GPP TS 33.533 [5].

5 Provisioning of configuration information for ranging and sidelink positioning service

5.1 General

Editor's Note: This clause will provide description of provisioning of Raning_SL configuration.

5.2 Configuration and precedence of ranging and sidelink positioning configuration parameters

5.2.1 General

UE's usage of ranging and sidelink positioning service is controlled by ranging and sidelink positioning configration information.

5.2.2 Precedence of ranging and sidelink positioning configuration information

The configuration information for ranging and sidelink positioning can be:

a) pre-configured in the ME;

b) configured in the UICC;

c) provided as a RSLPP by PCF;

d) provided by a ranging and sidelink positioning application server via SR1 reference point; or

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

The UE shall use the ranging and sidelink positioning configuration information in the following order of decreasing precedence:

a) the configuration information for ranging and sidelink positioning provided as a RSLPP by PCF;

b) the configuration information for ranging and sidelink positioning by a ranging and sidelink positioning application server via SR1 reference point;

c) the configuration information for ranging and sidelink positioning configured in the UICC; and

d) the configuration information for ranging and sidelink positioning pre-configured in the ME.

5.2.3 Configuration parameters for ranging and sidelink positioning

The configuration parameters for ranging and sidelink positioning consist of:

a) a validity timer for the validity of the configuration parameter for ranging and sidelink positioning;

b) a list of PLMNs in which the UE is authorised to perform ranging and sidelink positioning when the UE is "served by NG-RAN" and in each PLMN the role which the UE is authorized to act as one or more of the following:

   1) located UE;

   2) SL positioning client UE; and

   3) SL positioning server UE;

NOTE 1: A UE authorised to perform ranging and sidelink positioning in a given PLMN is also authorised to act as a target UE and as a SL reference UE in this PLMN.

c) an indication of whether the UE is authorized to perform ranging and sidelink positioning when "not served by NG-RAN" and the role which the UE is authorized to act as one or more of the following:

   1) located UE; or

   2) SL positioning server UE;

NOTE 2: A UE authorised to perform ranging and sidelink positioning when "not served by NG-RAN" is also authorised to act as a target UE and as a SL reference UE when "not served by NG-RAN".

d) one or more of the below:

   1) 5G ProSe related mapping rules including:

      i) a list of ProSe identifier for ranging and sidelink positioning to ranging and sidelink positioning QoS parameters mapping rules. The ranging and sidelink positioning QoS parameters are defined in clause 5.7.2 of 3GPP TS 23.586 [2]; and

      ii) a list of ProSe identifier for ranging and sidelink positioning to PQI for RSPP transport QoS mapping rules. The PQI for RSPP transport QoS is defined in clause 5.7.3 of 3GPP TS 23.586 [2]; or

   2) V2X service related mapping rules including:

      i) a list of V2X service identifier for ranging and sidelink positioning to ranging and sidelink positioning QoS parameters mapping rules. The ranging and sidelink positioning QoS parameters are defined in clause 5.7.2 of 3GPP TS 23.586 [2]; and

      ii) a list of V2X service identifier for ranging and sidelink positioning to PQI for RSPP transport QoS mapping rules. The PQI for RSPP transport QoS is defined in clause 5.7.3 of 3GPP TS 23.586 [2];

e) an indication of whether the UE is allowed to use UE-only operation to perform ranging and sidelink positioning when the UE is served by the NG-RAN and the network-based operation is not supported by the network;

f) optionally, the SLPKMF address information and

g) optionally, user Info ID for Ranging/SL Positioning UE discovery.

NOTE: If the application layer ID is not available then the user Info ID can be used as provided by the PCF, configure in the UICC, or configured in the ME.

5.3 Procedures

5.3.1 General

The procedure for provisioning of parameters for ranging and sidelink positioning allows the UE to obtain the ranging and sidelink positioning policy (RSLPP).

5.3.2 UE-requested RSLPP provisioning procedure

5.3.2.1 General

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

a) if the T5aaa for UE policies for ranging and sidelink positioning expires;

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

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

5.3.2.2 UE-requested RSLPP provisioning procedure initiation

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

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

b) shall include the Requested UE policies IE indicating whether the UE policies for ranging and sidelink positioning are requested;

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

d) shall start timer T5040.

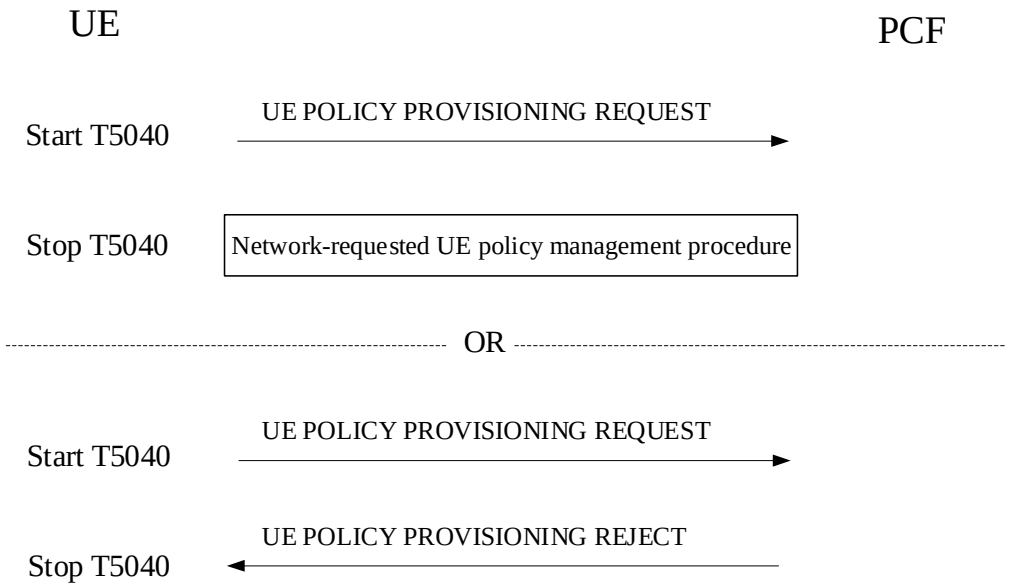

Figure 5.3.2.2.1: UE-requested RSLPP provisioning procedure

5.3.2.3 UE-requested RSLPP provisioning procedure accepted by the network

Handling in 3GPP TS 24.587 [4] clause 5.3.2.3 shall apply.

If new UE policies for ranging and sidelink positioning are included in the MANAGE UE POLICY COMMAND message, the UE shall stop timer T5aaa if it is running and start timer T5aaa with the value included in the UE policies for ranging and sidelink positioning and start using the new UE policies for ranging and sidelink positioning included in the MANAGE UE POLICY COMMAND message.

5.3.2.4 UE-requested RSLPP provisioning procedure not accepted by the network

Handling in 3GPP TS 24.587 [4] clause 5.3.2.4 shall apply.

5.3.2.5 Abnormal cases on the network side

Handling in 3GPP TS 24.587 [4] clause 5.3.2.5 shall apply.

5.3.2.6 Abnormal cases on the UE

Handling in 3GPP TS 24.587 [4] clause 5.3.2.6 shall apply.

6 Ranging and sidelink positioning UE discovery and selection

6.1 Overview

Ranging and sidelink positioning UE discovery and selection includes:

a) ranging and sidelink positioning UE discovery with 5G ProSe capable UE (see clause 6.2);

b) ranging and sidelink positioning UE discovery with V2X capable UE (see clause 6.3);

c) located UE selection (see clause 6.4);

d) sidelink positioning server UE selection (see clause 6.5); and

e) sidelink positioning reference UE selection (see clause 6.6).

6.2 Ranging and sidelink positioning UE discovery with 5G ProSe capable UE

6.2.1 General

This clause describes the procedures of 5G ProSe direct discovery for ranging and sidelink positioning over PC5 interface. The purpose of 5G ProSe direct discovery for ranging and sidelink positioning procedure over PC5 interface is to enable a ProSe-enabled UE to detect and identify another ProSe-enabled UE for ranging and sidelink positioning over PC5 interface.

NOTE 1: The procedures of 5G ProSe direct discovery for ranging and sidelink positioning are triggered by the RSP layer and performed in the 5G ProSe layer.

To perform 5G ProSe direct discovery for ranging and sidelink positioning procedure with 5G ProSe capable UE over PC5 interface, the UE is configured with the related information as described in clause 5.2.3. If a UE cannot derive any of the necessary configurations (e.g. default destination layer-2 ID for initial discovery signalling) according to the mapping rules for the ProSe identifier of a "Ranging and Sidelink Positioning" service, then the UE is not allowed to perform any operation specified in clause 6.2.2 for the "Ranging and Sidelink Positioning" service.

The following procedures 5G ProSe direct discovery for ranging and sidelink positioning UE discovery procedure over PC5 interface are supported:

a) model A uses a single discovery protocol message (Announcement);

b) model B uses two discovery protocol messages (Solicitation and Response);

c) group member discovery in model A; and

d) group member discovery in model B.

NOTE 2: If the UE is authorized to perform both 5G ProSe direct discovery model A and 5G ProSe direct discovery model B, it is up to UE implementation to select which model to perform or perform both models simultaneously.

6.2.2 Procedures

6.2.2.1 5G ProSe direct discovery for ranging and sidelink positioning procedure over PC5 interface with model A

6.2.2.1.1 General

In this procedure, the UE sending the PROSE PC5 DISCOVERY message is called the "announcing UE" and the "monitoring UE" is the UE that triggers the lower layer to start monitoring for PROSE PC5 DISCOVERY message.

6.2.2.1.2 Announcing UE procedure for 5G ProSe direct discovery for ranging and sidelink positioning initiation

The UE is authorised to perform the announcing UE procedure for ranging and sidelink positioning UE discovery if:

a) the UE is not served by NG-RAN, is authorised to perform 5G ProSe direct discovery for ranging and sidelink positioning using announcing procedure when the UE is not served by NG-RAN and is configured with the radio parameters to be used for 5G ProSe direct discovery when not served by NG-RAN;

b) the UE is served by NG-RAN and is authorised to perform 5G ProSe direct discovery for ranging and sidelink positioning using announcing in the PLMN indicated by the serving cell; or

c) the UE is:

1) in 5GMM-IDLE mode, in limited service state as specified in 3GPP TS 23.122 [14] and the reason for the UE being in limited service state is one of the following:

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

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

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

2) authorised to perform 5G ProSe direct discovery for ranging and sidelink positioning using announcing when the UE is not served by NG-RAN; and:

i) configured with the radio parameters to be used for 5G ProSe direct discovery when not served by NG-RAN; or

ii) the lower layers indicate that the UE does not need to request resources for 5G ProSe direct discovery procedure.

NOTE 1: When the lower layers indicate that the UE does not need to request resources for 5G ProSe direct discovery procedure, the serving cell broadcasts a common radio resources pool for ProSe discovery transmission and the UE can use this common radio resources pool while in limited service state.

otherwise, the UE is not authorised to perform the announcing UE procedure for 5G ProSe direct discovery for ranging and sidelink positioning.

Figure 6.2.2.1.2.1 illustrates the interaction of the UEs in the announcing UE procedure for 5G ProSe direct discovery.

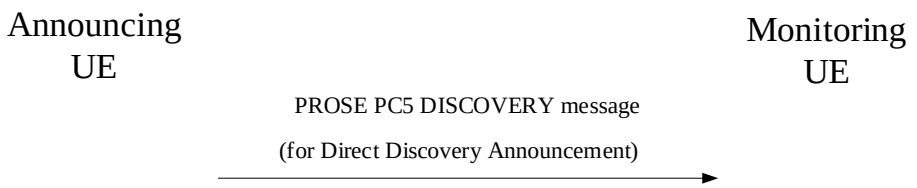

Figure 6.2.2.1.2.1: Announcing UE procedure for 5G ProSe direct discovery for ranging and sidelink positioning

When the UE is triggered by an upper layer application to perform announcing UE procedure for 5G ProSe direct discovery announcing procedure, if the UE is authorised to perform the announcing UE procedure for 5G ProSe direct discovery for ranging and sidelink positioning, then the UE:

a) if the UE is served by NG-RAN and the UE in 5GMM-IDLE mode needs to request resources for sending PROSE PC5 DISCOVERY messages as specified in 3GPP TS 38.331 [13], shall perform a service request procedure as specified in 3GPP TS 24.501 [11];

b) shall generate a PROSE PC5 DISCOVERY message for ranging and sidelink positioning UE discovery announcement according to clause 10.2.1. In the PROSE PC5 DISCOVERY message for ranging and sidelink positioning UE discovery announcement, the UE:

   1) shall set the ProSe direct discovery PC5 message type parameter for 5G ProSe direct discovery announcement for ranging and sidelink positioning UE discovery according to clause 11.2.1 3GPP TS 24.554 [6];

   2) shall include the RSPP metadata IE to provide the RSPP metadata information e.g., the role(s) of the announcing UE;

   3) shall set the announcer info parameter to the user info ID of announcing UE;

   4) shall include the PLMN ID IE to provide the serving PLMN ID of the announcing UE if the announcing UE is acting as a located UE and the announcing UE performs the ranging and sidelink positioning operation utilizing the location services signaling messages as defined in 3GPP TS 23.273 [11];

   5) shall include the MIC field computed as described in 3GPP TS 33.533 [5], by using the UTC-based counter and the DUIK contained in the <RangingSl-discovery-security-parameters-accept> element of the PROSE_SECURITY_PARAM_RESPONSE message; and

   6) shall set the UTC-based counter LSB parameter to the 4 least significant bits of the UTC-based counter;

c) shall apply the DUIK, DUSK, or DUCK with the associated Encrypted Bitmask, along with the UTC-based counter to the PROSE PC5 DISCOVERY message for whichever security mechanism(s) configured to be applied, e.g., integrity protection, message scrambling or confidentiality protection of one or more above parameters, as specified in 3GPP TS 33.533 [5];

d) shall set the destination layer-2 ID to the default destination layer-2 ID as specified in clause 5.2.3 and self-assign a source layer-2 ID for sending the direct discovery announcement; and

e) shall pass the resulting PROSE PC5 DISCOVERY message along with the source layer-2 ID and destination layer-2 ID for direct discovery announcement and an indication that the message is for 5G ProSe direct discovery to the lower layers for transmission over the PC5 interface.

The announcing UE shall ensure that it keeps on passing the same PROSE PC5 DISCOVERY message to the lower layers for transmission until the request from upper layers to perform announcing UE procedure for 5G ProSe direct discovery is still in place. How this is achieved is left up to UE implementation.

NOTE 2: The announcing UE can stop announcing UE procedure for 5G ProSe direct discovery for power saving by implementation specific means e.g. an implementation-specific maximum number of 5G ProSe direct links configured in the UE, or an implementation-specific timer expires.

6.2.2.1.3 Announcing UE procedure 5G ProSe direct discovery for ranging and sidelink positioning completion

When the request from upper layers to perform announcing UE procedure for 5G ProSe direct discovery is not in place, the UE may instruct the lower layers to stop announcing.

NOTE: The announcing UE can stop announcing UE procedure for 5G ProSe direct discovery for power saving by implementation specific means e.g. an implementation-specific maximum number of 5G ProSe direct links configured in the UE, or an implementation-specific timer expires.

When the UE stops announcing, if the UE is in 5GMM-CONNECTED mode, the UE shall trigger the corresponding procedure in lower layers as specified in 3GPP TS 38.331 [13].

6.2.2.1.4 Monitoring UE procedure for 5G ProSe direct discovery for ranging and sidelink positioning initiation

The UE is authorised to perform the monitoring UE procedure for 5G ProSe direct discovery for ranging and sidelink positioning if:

a) the UE is not served by NG-RAN, is authorised to perform 5G ProSe direct discovery using monitoring when the UE is not served by NG-RAN and is configured with the radio parameters to be used for 5G ProSe direct discovery when not served by NG-RAN;

b) the UE is served by NG-RAN and is authorised to perform 5G ProSe direct discovery monitoring in at least one PLMN; or

c) the UE is:

1) in 5GMM-IDLE mode, in limited service state as specified in 3GPP TS 23.122 [14] and the reason for the UE being in limited service state is one of the following:

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

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

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

2) authorised to perform 5G ProSe direct discovery for ranging and sidelink positioning using monitoring when the UE is not served by NG-RAN; and:

i) configured with the radio parameters to be used for 5G ProSe direct discovery when not served by NG-RAN; or

ii) the lower layers indicate that the UE does not need to request resources for 5G ProSe direct discovery procedure.

NOTE 1: When the lower layers indicate that the UE does not need to request resources for 5G ProSe direct discovery procedure, the serving cell broadcasts a common radio resources pool for ProSe discovery transmission and the UE can use this common radio resources pool while in limited service state.

otherwise, the UE is not authorised to perform the monitoring UE procedure for 5G ProSe direct discovery procedure.

Figure 6.2.2.1.4.1 illustrates the interaction of the UEs in the monitoring UE procedure for 5G ProSe direct discovery procedure for ranging and sidelink positioning.

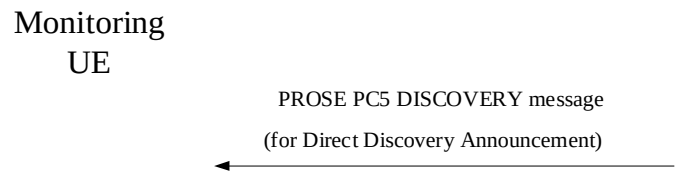

Figure 6.2.2.1.4.1: Monitoring UE procedure for 5G ProSe direct discovery for ranging and sidelink positioning

When the UE is triggered by an upper layer application to perform monitoring UE procedure for 5G ProSe direct discovery for ranging and sidelink positioning for a ProSe application identifier for ranging and sidelink positioning; and:

a) if the UE is authorised to perform the monitoring UE procedure for 5G ProSe direct discovery;

then the UE shall instruct the lower layers to start monitoring for PROSE PC5 DISCOVERY message.

NOTE 2: The UE can determine the received PROSE PC5 DISCOVERY message for 5G ProSe direct discovery announcement is for 5G ProSe direct discovery based on an indication from the lower layer.

Upon reception of a PROSE PC5 DISCOVERY message for direct discovery announcement for ranging and sidelink positioning, the UE shall use the associated DUSK, if received from the SLPKMF and the UTC-based counter obtained during the reception operation to unscramble the PROSE PC5 DISCOVERY message as described in 3GPP TS 33.533 [5]. Then, if a DUCK is received from the SLPKMF, the UE shall use the DUCK and the UTC-based counter to decrypt the configured message-specific confidentiality-protected portion, as described in 3GPP TS 33.533 [5]. Finally, if a DUIK is received from the SLPKMF, the UE shall use the DUIK and the UTC-based counter to verify the MIC field in the unscrambled PROSE PC5 DISCOVERY message direct discovery announcement for ranging and sidelink positioning.

The UE shall consider that the target RPAUID it seeks to monitor has been discovered if there is a match event as follows:

a) the role(s) of the announcing UE included in the RSPP metadata information of the PROSE PC5 DISCOVERY message for ranging and sidelink positioning UE discovery announcement, should be the same as the configured role(s) for the UE as specified in clause 5.2.3.

6.2.2.1.5 Monitoring UE procedure for 5G ProSe direct discovery for ranging and sidelink positioning completion

During the monitoring UE procedure for 5G ProSe direct discovery for ranging and sidelink positioning, if the request from upper layers to perform the monitoring UE procedure for 5G ProSe direct discovery is not in place, the UE may instruct the lower layers to stop monitoring.

When the UE stops monitoring, if the UE is in 5GMM-CONNECTED mode, the UE shall trigger the corresponding procedure in lower layers as specified in 3GPP TS 38.331 [13].

6.2.2.2 5G ProSe direct discovery procedure for ranging and sidelink positioning over PC5 interface with model B

6.2.2.2.1 General

In this procedure, the UE sending the PROSE PC5 DISCOVERY message is called the "discoverer UE" and the other UE is called the "discoveree UE".

6.2.2.2.2 Discoverer UE procedure for 5G ProSe direct discovery for ranging and sidelink positioning initiation

The UE is authorised to perform the discoverer UE procedure for ranging and sidelink positioning UE discovery if:

a) the UE is not served by NG-RAN, is authorised to perform 5G ProSe direct discovery discoverer operation for ranging and sidelink positioning when the UE is not served by NG-RAN and is configured with the radio parameters to be used for 5G ProSe direct discovery when not served by NG-RAN;

b) the UE is served by NG-RAN and is authorised to perform 5G ProSe direct discovery discoverer operation for ranging and sidelink positioning in the PLMN indicated by the serving cell; or

c) the UE is:

1) in 5GMM-IDLE mode, in limited service state as specified in 3GPP TS 23.122 [14] and the reason for the UE being in limited service state is one of the following:

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

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

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

2) authorised to perform 5G ProSe direct discovery discoverer operation for ranging and sidelink positioning when the UE is not served by NG-RAN; and:

i) configured with the radio parameters to be used for 5G ProSe direct discovery use when not served by NG-RAN; or

ii) the lower layers indicate that the UE does not need to request resources for 5G ProSe direct discovery procedure.

NOTE 1: When the lower layers indicate that the UE does not need to request resources for 5G ProSe direct discovery procedure, the serving cell broadcasts a common radio resources pool for ProSe discovery transmission and the UE can use this common radio resources pool while in limited service state.

otherwise, the UE is not authorised to perform the discoverer UE procedure for 5G ProSe direct discovery for ranging and sidelink positioning.

Figure 6.2.2.2.2.1 illustrates the interaction of the UEs in the discoverer UE procedure for 5G ProSe direct discovery for ranging and sidelink positioning.

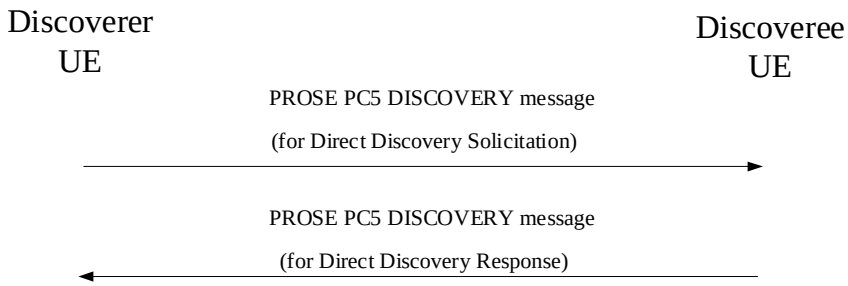

Figure 6.2.2.2.2.1: Discoverer UE procedure for 5G ProSe direct discovery for ranging and sidelink positioning

When the UE is triggered by an upper layer application to perform the discoverer UE procedure for 5G ProSe direct discovery for ranging and sidelink positioning; and if the UE is authorised to perform the discoverer UE procedure for 5G ProSe direct discovery for ranging and sidelink positioning in the registered PLMN or the local PLMN operating the radio resources that the UE intends to use; then the UE:

a) if the UE is served by NG-RAN and the UE in 5GMM-IDLE mode needs to request resources for sending PROSE PC5 DISCOVERY messages as specified in 3GPP TS 38.331 [13], shall perform a service request procedure as specified in 3GPP TS 24.501 [11];

b) shall generate a PROSE PC5 DISCOVERY message for 5G ProSe direct discovery solicitation for ranging and sidelink positioning. In the PROSE PC5 DISCOVERY message for 5G ProSe direct discovery solicitation for ranging and sidelink positioning, the UE:

1) shall set the ProSe direct discovery PC5 message type parameter for PROSE PC5 DISCOVERY message for ranging and sidelink positioning UE discovery solicitation according to clause 11.2.1 of 3GPP TS 24.554 [6];

2) shall include the discoveree user info set to the application layer ID of the discoveree UE if it is provided by the upper layers to identify a specific discoveree UE;

3) shall include the discoverer user info set to the application layer ID of the discoverer UE as provided by the upper layers;

4) may include the RSPP metadata IE to provide the RSPP metadata information e.g., the specific role(s) to be discovered;

5) shall include the MIC field computed as described in 3GPP TS 33.533 [5], by using the UTC-based counter and the DUIK contained in the <RangingSl-discovery-security-parameters-accept> element of the PROSE_SECURITY_PARAM_RESPONSE message; and

6) shall set the UTC-based counter LSB parameter to the 4 least significant bits of the UTC-based counter.

c) shall apply the DUIK, DUSK, or DUCK with the associated Encrypted Bitmask, along with the UTC-based counter to the PROSE PC5 DISCOVERY message for whichever security mechanism(s) configured to be applied, e.g., integrity protection, message scrambling or confidentiality protection of one or more above parameters, as specified in 3GPP TS 33.533 [5];

d) shall set the destination layer-2 ID to the default destination layer-2 ID as specified in clause 5.2.3 of 3GPP TS 24.554 [6] and self-assign a source layer-2 ID for sending the direct discovery solicitation; and

NOTE 2: The UE implementation ensures that the value of the self-assigned source layer-2 ID is different from any other self-assigned source layer-2 ID(s) in use for 5G ProSe direct communication, is different from any other provisioned destination layer-2 ID(s), and is different from any other self-assigned source layer-2 ID in use for a simultaneous 5G ProSe direct discovery procedure over PC5 with a different discovery model as specified in 3GPP TS 24.554 [6].

e) shall pass the resulting PROSE PC5 DISCOVERY message along with the source layer-2 ID and destination layer-2 ID for 5G ProSe direct discovery solicitation and the PLMN ID of the intended announcing PLMN if available in the discovery entry and an indication that the message is for 5G ProSe direct discovery to the lower layers for transmission over the PC5 interface and shall instruct the lower layer to start monitoring.

The UE shall ensure that it keeps on passing the same PROSE PC5 DISCOVERY message to the lower layers for transmission until the request from upper layers to perform the discoverer UE procedure for 5G ProSe direct discovery for ranging and sidelink positioning is not in place. How this is achieved is left up to UE implementation.

NOTE 3: The discoverer UE can stop discoverer UE procedure for 5G ProSe direct discovery for power saving by implementation specific means e.g. an implementation-specific maximum number of 5G ProSe direct links configured in the UE, or an implementation-specific timer expires.

Upon reception of a PROSE PC5 DISCOVERY message for direct discovery response for ranging and sidelink positioning, for the target destination layer-2 ID of the direct discovery to be discovered, the UE shall use the associated DUSK, if received from the SLPKMF and the UTC-based counter obtained during the reception operation to unscramble the PROSE PC5 DISCOVERY message as described in 3GPP TS 33.533 [5]. Then, if a DUCK is received from the SLPKMF, the UE shall use the DUCK and the UTC-based counter to decrypt the configured message-specific confidentiality-protected portion, as described in 3GPP TS 33.533 [5]. Finally, if a DUIK is received from the SLPKMF, the UE shall use the DUIK and the UTC-based counter to verify the MIC field in the unscrambled PROSE PC5 DISCOVERY message for direct discovery response for ranging and sidelink positioning. Then the UE decides that the other UE the UE seeks to discover has been discovered if the role(s) to be discovered included in the RSPP metadata of the PROSE PC5 DISCOVERY message UE discovery solicitation for ranging and sidelink positioning, if available, should be the same as the role(s) of the discoveree UE included in the RSPP metadata of the PROSE PC5 DISCOVERY message for UE discovery response for ranging and sidelink positioning.

6.2.2.2.3 Discoverer UE procedure for 5G ProSe direct discovery for ranging and sidelink positioning completion

During the discoverer operation, if the request from upper layers to perform the discoverer UE procedure for 5G ProSe direct discovery for ranging and sidelink positioning in restricted discovery Model B, is not in place, then the UE may instruct the lower layers to stop the discoverer operation. When the UE stops discoverer operation, if the UE is in

5GMM-CONNECTED mode, the UE shall trigger the corresponding procedure in lower layers as specified in 3GPP TS 38.331 [13].

6.2.2.2.4 Discoveree UE procedure for 5G ProSe direct discovery for ranging and sidelink positioning initiation

The UE is authorised to perform the discoveree UE procedure for 5G ProSe direct discovery for ranging and sidelink positioning if:

a) the UE is not served by NG-RAN, is authorised to perform 5G ProSe direct discovery discoveree operation for ranging and sidelink positioning when the UE is not served by NG-RAN and is configured with the radio parameters to be used for 5G ProSe direct discovery when not served by NG-RAN;

b) the UE is served by NG-RAN and is authorised to perform 5G ProSe direct discovery discoverer operation for ranging and sidelink positioning in the PLMN indicated by the serving cell; or

c) the UE is:

1) in 5GMM-IDLE mode, in limited service state as specified in 3GPP TS 23.122 [14] and the reason for the UE being in limited service state is one of the following:

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

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

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

2) authorised to perform 5G ProSe direct discovery discoverer operation for ranging and sidelink positioning when the UE is not served by NG-RAN; and:

i) configured with the radio parameters to be used for 5G ProSe direct discovery use when not served by NG-RAN; or

ii) the lower layers indicate that the UE does not need to request resources for 5G ProSe direct discovery procedure.

NOTE 1: When the lower layers indicate that the UE does not need to request resources for 5G ProSe direct discovery procedure, the serving cell broadcasts a common radio resources pool for ProSe discovery transmission and the UE can use this common radio resources pool while in limited service state.

otherwise, the UE is not authorised to perform the discoveree UE procedure for 5G ProSe direct discovery for ranging and sidelink positioning.

Figure 6.2.2.2.4.1 illustrates the interaction of the UEs in the discoveree UE procedure for 5G ProSe direct discovery for ranging and sidelink positioning.

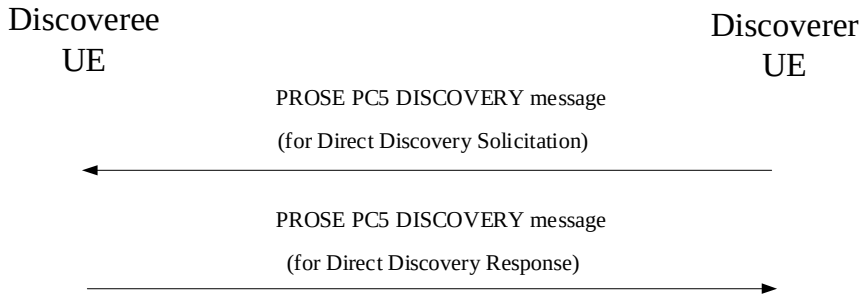

Figure 6.2.2.2.4.1: Discoveree UE procedure for 5G ProSe direct discovery for ranging and sidelink positioning

When the UE is triggered by an upper layer application to perform discoveree operation for ranging and sidelink positioning; and if:

a) the UE is authorised to perform the discoveree UE procedure for 5G ProSe direct discovery for ranging and sidelink positioning;

then the UE:

a) if the UE is served by NG-RAN and the UE in 5GMM-IDLE mode needs to request resources for sending PROSE PC5 DISCOVERY messages as specified in 3GPP TS 38.331 [13], shall perform a service request procedure or registration procedure as specified in 3GPP TS 24.501 [11]; and

b) shall instruct the lower layers to start monitoring for PROSE PC5 DISCOVERY messages as specified in 3GPP TS 38.331 [13].

Upon reception of a PROSE PC5 DISCOVERY message for direct discovery solicitation for ranging and sidelink positioning for the destination layer-2 ID which the UE is configured to respond for, the match occurs if:

a) If the discoveree user info is included in the PROSE PC5 DISCOVERY message, the discoveree user info shall match the user info ID of the UE; and

b) The role(s) to be discovered included in the RSPP metadata of the PROSE PC5 DISCOVERY message for ranging and sidelink positioning UE discovery solicitation, if available, is the same as the configured role(s) for the UE as specified in clause 5.2.3;

Once the match occurs, the UE process this match event and requests the lower layers to announce the corresponding response. If the UE in 5GMM-IDLE mode has to request resources for 5G ProSe direct discovery announcing as specified in 3GPP TS 38.331 [13], the UE shall perform a service request procedure or registration procedure as specified in 3GPP TS 24.501 [11]. The UE shall generate a PROSE PC5 DISCOVERY message for 5G ProSe direct discovery response for ranging and sidelink positioning. In the PROSE PC5 DISCOVERY message for 5G ProSe direct discovery response for ranging and sidelink positioning, the UE:

1) shall set the ProSe direct discovery PC5 message type parameter for 5G ProSe direct discovery response for ranging and sidelink positioning according to clause 9.2.1;

2) shall include the RSPP metadata IE to provide the RSPP metadata information e.g., the specific role(s) of the discoveree UE;

3) shall include the discoveree user info set to the application layer ID of the discoveree UE;

4) shall include the PLMN ID IE to provide the serving PLMN ID of the discoveree UE if the discoveree UE is acting as a located UE and the discoveree UE performs the ranging and sidelink positioning operation utilizing the location services signaling messages as defined in 3GPP TS 23.273 [11];

5) shall include the MIC field computed as described in 3GPP TS 33.533 [5], by using the UTC-based counter and the DUIK contained in the <RangingSl-discovery-security-parameters-accept> element of the PROSE_SECURITY_PARAM_RESPONSE message; and

6) shall set the UTC-based counter LSB parameter to the 4 least significant bits of the UTC-based counter.

After generating the PROSE PC5 DISCOVERY message for 5G ProSe direct discovery response, the UE:

a) shall apply the DUIK, DUSK, or DUCK with the associated Encrypted Bitmask, along with the UTC-based counter to the PROSE PC5 DISCOVERY message for whichever security mechanism(s) configured to be applied, e.g., integrity protection, message scrambling or confidentiality protection of one or more above parameters, as specified in 3GPP TS 33.533 [5];

b) shall set the destination layer-2 ID to the source layer-2 ID of the received message and self-assign a source layer-2 ID for sending the direct discovery response message; and

NOTE 5: The UE implementation ensures that the value of the self-assigned source layer-2 ID is different from any other self-assigned source layer-2 ID(s) in use for 5G ProSe direct communication and is different from any other provisioned destination layer-2 ID(s) as specified in 3GPP TS 24.554 [6].

c) shall pass the resulting PROSE PC5 DISCOVERY message along with the source layer-2 ID and destination layer-2 ID for 5G ProSe direct discovery response, the PLMN ID of the intended announcing PLMN and an indication that the message is for 5G ProSe direct discovery to the lower layers for transmission over the PC5 interface.

NOTE 6: If the UE is processing a PROSE DIRECT LINK ESTABLISHMENT REQUEST message from the same source layer-2 ID of the received PROSE PC5 DISCOVERY message for direct discovery solicitation for ranging and sidelink positioning, it depends on UE implementation to avoid the conflict of destination layer-2 ID (e.g. send a PROSE DIRECT LINK ESTABLISHMENT REJECT message containing PC5 signalling protocol cause value #3 "conflict of layer-2 ID for unicast communication is detected", or ignore the PROSE DIRECT DISCOVERY message for direct discovery solicitation for ranging and sidelink positioning).

For each match event, the UE shall at least pass PROSE PC5 DISCOVERY message once to the lower layers for transmission. The UE shall ensure that it keeps on passing PROSE PC5 DISCOVERY messages to the lower layers for transmission as response(s) to the match event(s).

6.2.2.2.5 Discoveree UE procedure for 5G ProSe direct discovery for ranging and sidelink positioning completion

During the discoveree operation, if the request from upper layers to perform discoveree operation for ranging and sidelink positioning is not in place, then the UE may instruct the lower layers to stop monitoring.

When the UE stops monitoring, if the lower layers indicate that the UE is required to send a discovery indication to the NG-RAN and the UE is in 5GMM-CONNECTED mode, the UE shall trigger the corresponding procedure in lower layers as specified in 3GPP TS 38.331 [13].

6.2.2.3 Group member procedure for ranging and sidelink positioning over PC5 interface with model A

6.2.2.3.1 General

In this procedure, the UE sending the PROSE PC5 DISCOVERY message is called the "announcing UE" and the "monitoring UE" is the UE that triggers the lower layer to start monitoring for PROSE PC5 DISCOVERY message.

6.2.2.3.2 Announcing UE procedure for group member discovery for ranging and sidelink positioning initiation

The UE is authorised to perform the announcing UE procedure for ranging and sidelink positioning UE discovery if:

a) the UE is not served by NG-RAN, is authorised to perform 5G ProSe direct discovery for ranging and sidelink positioning using announcing procedure when the UE is not served by NG-RAN and is configured with the radio parameters to be used for 5G ProSe direct discovery when not served by NG-RAN;

b) the UE is served by NG-RAN and is authorised to perform 5G ProSe direct discovery for ranging and sidelink positioning using announcing in the PLMN indicated by the serving cell; or

c) the UE is:

1) in 5GMM-IDLE mode, in limited service state as specified in 3GPP TS 23.122 [14] and the reason for the UE being in limited service state is one of the following:

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

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

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

2) authorised to perform 5G ProSe direct discovery for ranging and sidelink positioning using announcing when the UE is not served by NG-RAN; and:

i) configured with the radio parameters to be used for 5G ProSe direct discovery when not served by NG-RAN; or

ii) the lower layers indicate that the UE does not need to request resources for 5G ProSe direct discovery procedure. and

NOTE 1: When the lower layers indicate that the UE does not need to request resources for 5G ProSe direct discovery procedure, the serving cell broadcasts a common radio resources pool for ProSe discovery transmission and the UE can use this common radio resources pool while in limited service state.

d) the UE is configured with the application layer group ID identifying the application layer group for ranging and sidelink positioning using announcing to be announced and with the User info ID for the group member discovery parameter;

otherwise, the UE is not authorised to perform the announcing UE procedure for group member discovery procedure for ranging and sidelink positioning.

Figure 6.2.2.3.2.1 illustrates the interaction of the UEs in the announcing UE procedure for group member discovery for ranging and sidelink positioning.

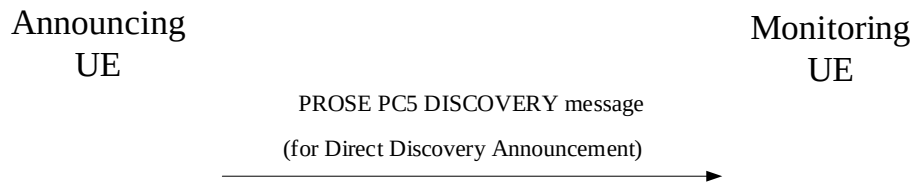

Figure 6.2.2.3.2.1: Announcing UE procedure for group member discovery for ranging and sidelink positioning

When the UE is triggered by an upper layer application to announce availability in a discovery group for ranging and sidelink positioning, if the UE is authorised to perform the announcing UE procedure for group member discovery for ranging and sidelink positioning, then the UE:

a) if the UE is served by NG-RAN and the UE in 5GMM-IDLE mode needs to request resources for sending PROSE PC5 DISCOVERY messages as specified in 3GPP TS 38.331 [13], shall perform a service request procedure as specified in 3GPP TS 24.501 [11];

b) shall generate a PROSE PC5 DISCOVERY message for group member discovery announcement for ranging and sidelink positioning. In the PROSE PC5 DISCOVERY message for group member discovery announcement for ranging and sidelink positioning, the UE:

   1) shall set the announcer info parameter to the user info ID for the group member discovery parameter;

   2) shall set the application layer group ID parameter to the application layer group ID identifying the ranging and sidelink positioning group that the UE belongs to be announced;

   3) shall set the ProSe direct discovery PC5 message type parameter for 5G ProSe direct discovery announcement for group member discovery for ranging and sidelink positioning according to clause 11.2.1 3GPP TS 24.554 [6];

   4) shall include the RSPP metadata IE to provide the RSPP metadata information e.g., the role(s) of the Announcing UE;

   5) shall set the PLMN ID IE to provide the serving PLMN ID of the announcing UE if the announcing UE is acting as a located UE and the announcing UE performs the ranging and sidelink positioning operation utilizing the location services signaling messages as defined in 3GPP TS 23.273 [11];

   6) shall include the MIC field computed as described in 3GPP TS 33.533 [5], by using the UTC-based counter and the DUIK contained in the <RangingSl-discovery-security-parameters-accept> element of the PROSE_SECURITY_PARAM_RESPONSE message; and

   7) shall set the UTC-based counter LSB parameter to the 4 least significant bits of the UTC-based counter.

c) shall apply the DUIK, DUSK, or DUCK with the associated Encrypted Bitmask, along with the UTC-based counter to the PROSE PC5 DISCOVERY message for whichever security mechanism(s) configured to be applied, e.g., integrity protection, message scrambling or confidentiality protection of one or more above parameters, as specified in 3GPP TS 33.533 [5];

d) shall apply one of the following to determine the destination layer-2 ID:

1) if the application layer group ID has a configured layer-2 group ID as specified in clause 5.2.3, set the destination layer-2 ID to the layer-2 group ID; or

2) otherwise, convert the application layer group ID into a destination layer-2 ID as following:

i) to use the group identifier as the input to the SHA-256 hashing algorithm as specified in ISO/IEC 10118-3:2018 [10]; and

ii) to use the 24 least significant bits of the 256 bits of the output as destination layer-2 ID;

e) shall self-assign a source layer-2 ID for sending the direct discovery announcement; and

f) shall pass the resulting PROSE PC5 DISCOVERY message for group member discovery announcement along with the source layer-2 ID and destination layer-2 ID for direct discovery announcement to the lower layers for transmission over the PC5 interface.

The announcing UE shall ensure that it keeps on passing the same PROSE PC5 DISCOVERY message to the lower layers for transmission until the announcing UE is triggered by an upper layer application to stop announcing availability in a discovery group, or until the UE stops being authorised to perform the announcing UE procedure for group member discovery for ranging and sidelink positioning.

NOTE 4: The announcing UE can stop announcing UE procedure for group member discovery for ranging and sidelink positioning for power saving by implementation specific means e.g. an implementation-specific maximum number of 5G ProSe direct links configured in the UE, or an implementation-specific timer expires.

6.2.2.3.3 Announcing UE procedure for group member discovery for ranging and sidelink positioning completion

When the announcing UE is triggered by an upper layer application to stop announcing availability in a discovery group, or when the announcing UE stops being authorised to perform the announcing UE procedure for group member discovery for ranging and sidelink positioning, the UE shall instruct the lower layers to stop announcing.

NOTE: The announcing UE can stop announcing UE procedure for group member discovery for ranging and sidelink positioning for power saving by implementation specific means e.g. an implementation-specific maximum number of 5G ProSe direct links configured in the UE, or an implementation-specific timer expires.

When the UE stops announcing, if the UE is in 5GMM-CONNECTED mode, the UE shall trigger the corresponding procedure in lower layers as specified in 3GPP TS 38.331 [13].

6.2.2.3.4 Monitoring UE procedure for group member discovery for ranging and sidelink positioning initiation

The UE is authorised to perform the monitoring UE procedure for group member discovery for ranging and sidelink positioning if:

a) the UE is not served by NG-RAN, is authorised to perform 5G ProSe direct discovery using monitoring when the UE is not served by NG-RAN and is configured with the radio parameters to be used for 5G ProSe direct discovery when not served by NG-RAN;

b) the UE is served by NG-RAN and is authorised to perform 5G ProSe direct discovery monitoring in at least one PLMN; or

c) the UE is:

1) in 5GMM-IDLE mode, in limited service state as specified in 3GPP TS 23.122 [14] and the reason for the UE being in limited service state is one of the following:

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

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

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

2) authorised to perform 5G ProSe direct discovery for ranging and sidelink positioning using monitoring when the UE is not served by NG-RAN; and:

i) configured with the radio parameters to be used for 5G ProSe direct discovery when not served by NG-RAN; or

ii) the lower layers indicate that the UE does not need to request resources for 5G ProSe direct discovery procedure. and

NOTE 1: When the lower layers indicate that the UE does not need to request resources for 5G ProSe direct discovery procedure, the serving cell broadcasts a common radio resources pool for ProSe discovery transmission and the UE can use this common radio resources pool while in limited service state.

b) the UE is configured with the application layer group ID parameter identifying the discovery group for ranging and sidelink positioning to be monitored;

otherwise, the UE is not authorised to perform the monitoring UE procedure for group member discovery for ranging and sidelink positioning.

Figure 6.2.2.3.4.1 illustrates the interaction of the UEs in the monitoring UE procedure for group member discovery for ranging and sidelink positioning.

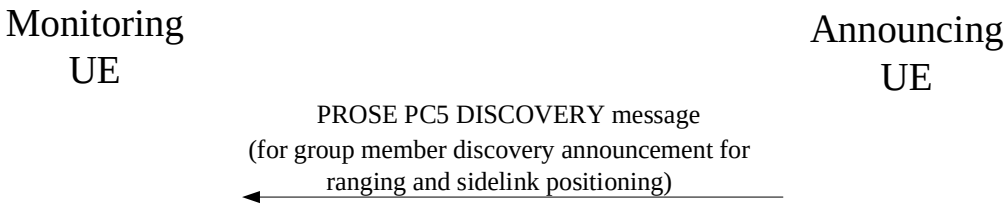

Figure 6.2.2.3.4.1: Monitoring UE procedure for group member discovery for ranging and sidelink positioning

When the UE is triggered by an upper layer application to monitor proximity of other UEs in a discovery group for ranging and sidelink positioning and if the UE is authorised to perform the monitoring UE procedure for group member discovery for ranging and sidelink positioning, then the UE shall instruct the lower layers to start monitoring for PROSE PC5 DISCOVERY message as following:

a) if the application layer group ID has a configured layer-2 group ID as specified in clause 5.2.3, the UE shall monitor for PROSE PC5 DISCOVERY message with the layer-2 group ID as specified in clause 5.2.3; or

b) otherwise, the UE shall convert the application layer group ID into a destination layer-2 ID and shall monitor for PROSE PC5 DISCOVERY message with the converted destination layer-2 ID. The UE shall convert the application layer group ID for ranging and sidelink positioning into a destination layer-2 ID as following:

1) to use the group identifier as the input to the SHA-256 hashing algorithm as specified in ISO/IEC 10118-3:2018 [10]; and

2) to use the 24 least significant bits of the 256 bits of the output as destination layer-2 ID.

NOTE 2: SHA-256 hashing algorithm is implemented in the ME.

Upon reception of a PROSE PC5 DISCOVERY message for direct discovery announcement for ranging and sidelink positioning, the UE shall use the associated DUSK, if received from the SLPKMF and the UTC-based counter obtained during the reception operation to unscramble the PROSE PC5 DISCOVERY message as described in 3GPP TS 33.533 [5]. Then, if a DUCK is received from the SLPKMF, the UE shall use the DUCK and the UTC-based counter to decrypt the configured message-specific confidentiality-protected portion, as described in 3GPP TS 33.533 [5]. Finally, if a DUIK is received from the SLPKMF, the UE shall use the DUIK and the UTC-based counter to verify the MIC field in the unscrambled PROSE PC5 DISCOVERY message direct discovery announcement for ranging and sidelink positioning.

The UE shall consider that the target RPAUID it seeks to monitor has been discovered if there is a match event as follows:

a) the application layer group ID parameter of the PROSE PC5 DISCOVERY message for group member discovery announcement for ranging and sidelink positioning is the same as the configured application layer group ID parameter as specified in clause 5.2.3;

b) if the PLMN ID parameter is included in the PROSE PC5 DISCOVERY message for group member discovery announcement for ranging and sidelink positioning and it is the same with the serving PLMN ID of the monitoring UE; and

c) the role(s) of the announcing UE included in the RSPP metadata information of the PROSE PC5 DISCOVERY message for ranging and sidelink positioning UE discovery announcement, is the same as the configured role(s) for the UE as specified in clause 5.2.3.

6.2.2.3.5 Monitoring UE procedure for group member discovery for ranging and sidelink positioning completion

When the UE is triggered by an upper layer application to stop monitoring proximity of other UEs in a discovery group for ranging and sidelink positioning, or when the UE stops being authorised to perform the monitoring UE procedure for group member discovery for ranging and sidelink positioning, the UE shall instruct the lower layers to stop monitoring.

When the UE stops monitoring, if the UE is in 5GMM-CONNECTED mode, the UE shall trigger the corresponding procedure in lower layers as specified in 3GPP TS 38.331 [13].

6.2.2.4 Group member discovery for ranging and sidelink positioning over PC5 interface with model B

6.2.2.4.1 General

In this procedure, the UE sending the PROSE PC5 DISCOVERY message is called the "discoverer UE" and the other UE is called the "discoveree UE".

6.2.2.4.2 Discoverer UE procedure for group member discovery for ranging and sidelink positioning initiation

The UE is authorised to perform the discoverer UE procedure for group member discovery for ranging and sidelink positioning initiation if:

a) the UE is not served by NG-RAN, is authorised to perform 5G ProSe direct discovery discoverer operation for ranging and sidelink positioning when the UE is not served by NG-RAN and is configured with the radio parameters to be used for 5G ProSe direct discovery when not served by NG-RAN;

b) the UE is served by NG-RAN and is authorised to perform 5G ProSe direct discovery for ranging and sidelink positioning using announcing in the PLMN indicated by the serving cell; or

c) the UE is:

   1) in 5GMM-IDLE mode, in limited service state as specified in 3GPP TS 23.122 [14] and the reason for the UE being in limited service state is one of the following:

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

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

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

   2) authorised to perform 5G ProSe direct discovery discoverer operation for ranging and sidelink positioning when the UE is not served by NG-RAN; and:

i) configured with the radio parameters to be used for 5G ProSe direct discovery when not served by NG-RAN; or

ii) the lower layers indicate that the UE does not need to request resources for 5G ProSe direct discovery procedure. and

NOTE 1: When the lower layers indicate that the UE does not need to request resources for 5G ProSe direct discovery procedure, the serving cell broadcasts a common radio resources pool for ProSe discovery transmission and the UE can use this common radio resources pool while in limited service state.

d) the UE is configured with the application layer group ID identifying the application layer group for ranging and sidelink positioning using announcing to be announced and with the User info ID for the group member discovery parameter;

otherwise, the UE is not authorised to perform the discoverer UE procedure for group member discovery for ranging and sidelink positioning.

Figure 6.2.2.4.2.1 illustrates the interaction of the UEs in the discoverer UE procedure for group member discovery for ranging and sidelink positioning.

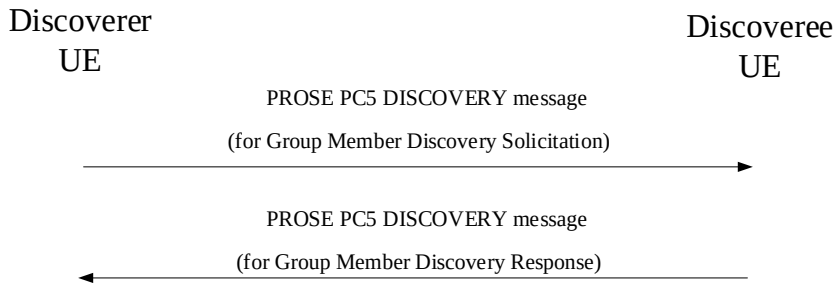

Figure 6.2.2.4.2.1: Discoverer UE procedure for group member discovery for ranging and sidelink positioning

When the UE is triggered by an upper layer application to solicit proximity of other UEs in a discovery group for ranging and sidelink positioning and if the UE is authorised to perform the discoverer UE procedure for group member discovery, then the UE:

a) if the UE is served by NG-RAN and the UE in 5GMM-IDLE mode needs to request resources for sending PROSE PC5 DISCOVERY messages as specified in 3GPP TS 38.331 [13], shall perform a service request procedure as specified in 3GPP TS 24.501 [11];

b) shall generate a PROSE PC5 DISCOVERY message for group member discovery solicitation for ranging and sidelink positioning. In the PROSE PC5 DISCOVERY message for group member discovery solicitation for ranging and sidelink positioning, the UE:

1) shall set the discoverer info parameter to the user info ID for the group member discovery parameter;

2) shall set the application layer group ID parameter to the application layer group ID parameter identifying the ranging and sidelink positioning group to be solicited;

3) shall set the ProSe direct discovery PC5 message type parameter for PROSE PC5 DISCOVERY message for group member discovery solicitation for ranging and sidelink positioning according to clause 9.2.1;

4) shall set the target user info parameter to the target info, if the target information is provided by the upper layers to identify a specific group member of the application layer group identified by the configured application layer group ID;

5) may include the RSPP metadata IE to provide the RSPP metadata information e.g., the specific role(s) to be discovered; ;

6) shall include the MIC field computed as described in 3GPP TS 33.533 [5], by using the UTC-based counter and the DUIK contained in the <RangingSl-discovery-security-parameters-accept> element of the PROSE_SECURITY_PARAM_RESPONSE message; and

7) shall set the UTC-based counter LSB parameter to the 4 least significant bits of the UTC-based counter.

c) shall apply the DUIK, DUSK, or DUCK with the associated Encrypted Bitmask, along with the UTC-based counter to the PROSE PC5 DISCOVERY message for whichever security mechanism(s) configured to be applied, e.g., integrity protection, message scrambling or confidentiality protection of one or more above parameters, as specified in 3GPP TS 33.533 [5];

d) shall apply one of the following to determine the destination layer-2 ID:

1) if the application layer group ID has a configured layer-2 group ID as specified in clause 5.2.3, set the destination layer-2 ID to the layer-2 group ID; or

2) otherwise, convert the application layer group ID into a destination layer-2 ID as following:

i) to use the group identifier as the input to the SHA-256 hashing algorithm as specified in ISO/IEC 10118-3:2018 [10]; and

ii) to use the 24 least significant bits of the 256 bits of the output as destination layer-2 ID;

NOTE 3: SHA-256 hashing algorithm is implemented in the ME.

e) shall self-assign a source layer-2 ID for sending the group member discovery solicitation message for ranging and sidelink positioning; and

NOTE 4: The UE implementation ensures that the value of the self-assigned source layer-2 ID is different from any other self-assigned source layer-2 ID(s) in use for 5G ProSe direct communication, is different from any other provisioned destination layer-2 ID(s), and is different from any other self-assigned source layer-2 ID in use for a simultaneous 5G ProSe direct discovery procedure over PC5 with a different discovery model as specified in 3GPP TS 24.554 [6].

f) shall pass the resulting PROSE PC5 DISCOVERY message for group member discovery solicitation for ranging and sidelink positioning along with the source layer-2 ID and destination layer-2 ID to the lower layers for transmission over the PC5 interface.

The UE shall ensure that it keeps on passing the same PROSE PC5 DISCOVERY message to the lower layers for transmission until the UE is triggered by an upper layer application to stop soliciting proximity of other UEs in a discovery group for ranging and sidelink positioning, or until the UE stops being authorised to perform the discoverer UE procedure for group member discovery for ranging and sidelink positioning. How this is achieved is left up to UE implementation.

NOTE 5: The discoverer UE can stop discoverer UE procedure for group member discovery for ranging and sidelink positioning for power saving by implementation specific means e.g. an implementation-specific maximum number of 5G ProSe direct links configured in the UE, or an implementation-specific timer expires.

Upon reception of a PROSE PC5 DISCOVERY message for group member discovery response for ranging and sidelink positioning, the UE shall use the associated DUSK, if received from the SLPKMF and the UTC-based counter obtained during the reception operation to unscramble the PROSE PC5 DISCOVERY message as described in 3GPP TS 33.533 [5]. Then, if a DUCK is received from the SLPKMF, the UE shall use the DUCK and the UTC-based counter to decrypt the configured message-specific confidentiality-protected portion, as described in 3GPP TS 33.533 [5]. Finally, if a DUIK is received from the SLPKMF, the UE shall use the DUIK and the UTC-based counter to verify the MIC field in the unscrambled PROSE PC5 DISCOVERY message for group member discovery response for ranging and sidelink positioning. Then for the target application layer group ID of the discovery group to be discovered, if:

a) the application layer group ID parameter of the PROSE PC5 DISCOVERY message for group member discovery response for ranging and sidelink positioning is the same as the application layer group ID parameter of the PROSE PC5 DISCOVERY message for group member discovery solicitation for ranging and sidelink positioning,

b) the target information is not provided by the upper layers to identify a specific group member of the application layer group, or the discoveree info in the PROSE PC5 DISCOVERY message for group member discovery response for ranging and sidelink positioning is the same as the target information if the target information is provided by the upper layers, and

c) the role(s) to be discovered included in the RSPP metadata of the PROSE PC5 DISCOVERY message UE discovery solicitation for ranging and sidelink positioning, if available, is the same as the role(s) of the discoveree UE included in the RSPP metadata of the PROSE PC5 DISCOVERY message for UE discovery response for ranging and sidelink positioning.

the UE shall consider that other UE in the discovery group the UE seeks to discover has been discovered.

6.2.2.4.3 Discoverer UE procedure for group member discovery for ranging and sidelink positioning completion

When the UE is triggered by an upper layer application to stop soliciting proximity of other UEs in a discovery group for ranging and sidelink positioning, or when the UE stops being authorised to perform the discoverer UE procedure for group member discovery for ranging and sidelink positioning, the UE shall instruct the lower layers to stop discoverer operation.

NOTE: The discoverer UE can stop discoverer UE procedure for group member discovery for ranging and sidelink positioning for power saving by implementation specific means e.g. an implementation-specific maximum number of 5G ProSe direct links configured in the UE, or an implementation-specific timer expires.

When the UE stops discoverer operation, if the UE is in 5GMM-CONNECTED mode, the UE shall trigger the corresponding procedure in lower layers as specified in 3GPP TS 38.331 [13].

6.2.2.4.4 Discoveree UE procedure for group member discovery for ranging and sidelink positioning initiation

The UE is authorised to perform the Discoveree UE procedure for group member discovery for ranging and sidelink positioning initiation if:

a) the UE is not served by NG-RAN, is authorised to perform 5G ProSe direct discovery discoveree operation for ranging and sidelink positioning when the UE is not served by NG-RAN and is configured with the radio parameters to be used for 5G ProSe direct discovery when not served by NG-RAN;

b) the UE is served by NG-RAN and is authorised to perform 5G ProSe direct discovery for ranging and sidelink positioning using announcing in the PLMN indicated by the serving cell; or

c) the UE is:

1) in 5GMM-IDLE mode, in limited service state as specified in 3GPP TS 23.122 [14] and the reason for the UE being in limited service state is one of the following:

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

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

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

2) authorised to perform 5G ProSe direct discovery discoveree operation for ranging and sidelink positioning when the UE is not served by NG-RAN; and:

i) configured with the radio parameters to be used for 5G ProSe direct discovery when not served by NG-RAN; or

ii) the lower layers indicate that the UE does not need to request resources for 5G ProSe direct discovery procedure. and

NOTE 1: When the lower layers indicate that the UE does not need to request resources for 5G ProSe direct discovery procedure, the serving cell broadcasts a common radio resources pool for ProSe discovery transmission and the UE can use this common radio resources pool while in limited service state.

d) the UE is configured with the application layer group ID identifying the application layer group for ranging and sidelink positioning using announcing to be announced and with the User info ID for the group member discovery parameter;

otherwise, the UE is not authorised to perform the discoverer UE procedure for group member discovery for ranging and sidelink positioning.

Figure 6.2.2.4.4.1 illustrates the interaction of the UEs in the discoveree UE procedure for group member discovery. for ranging and sidelink positioning.

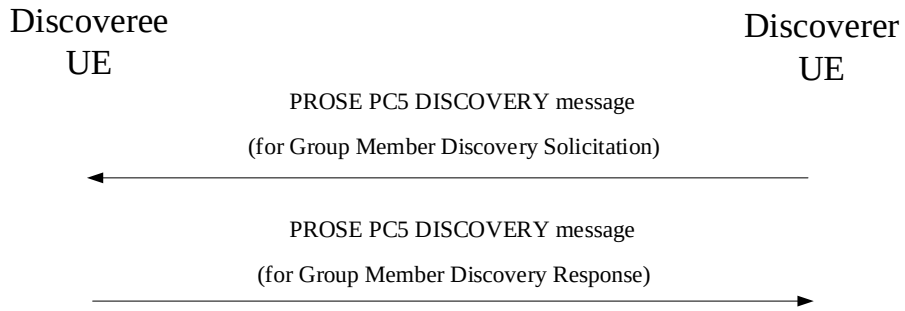

Figure 6.2.2.4.4.1: Discoveree UE procedure for group member discovery for ranging and sidelink positioning

When the UE is triggered by an upper layer application to start responding to solicitation on proximity of a UE in a discovery group for ranging and sidelink positioning and if the UE is authorised to perform the discoveree UE procedure for group member discovery for ranging and sidelink positioning, then the UE:

a) if the UE is served by NG-RAN and the UE in 5GMM-IDLE mode needs to request resources for sending PROSE PC5 DISCOVERY messages as specified in 3GPP TS 38.331 [13], shall perform a service request procedure as specified in 3GPP TS 24.501 [11]; and

b) shall instruct the lower layers to start monitoring for PROSE PC5 DISCOVERY messages.

Upon reception of a PROSE PC5 DISCOVERY message for group member discovery solicitation for ranging and sidelink positioning, if:

a) the application layer group ID parameter of the received PROSE PC5 DISCOVERY message is the same as the application layer group ID parameter for the discovery group;

b) the target user info parameter is not included in the received PROSE PC5 DISCOVERY message or the target user info parameter in the received PROSE PC5 DISCOVERY message is the same as the user info ID for the group member discovery provided by the upper layers or same as the configured user info ID for the group member discovery as specified in clause 5.2.3; and

c) The role(s) to be discovered included in the RSPP metadata of the PROSE PC5 DISCOVERY message for group member discovery solicitation for ranging and sidelink positioning, if available, is the same as the configured role(s) for the UE as specified in clause 5.2.3;

the UE:

a) shall generate a PROSE PC5 DISCOVERY message for group member discovery response for ranging and sidelink positioning. In the PROSE PC5 DISCOVERY message for group member discovery response for ranging and sidelink positioning, the UE:

1) shall set the ProSe direct discovery PC5 message type parameter for group member discovery response for ranging and sidelink positioning according to clause 9.2.1;

2) shall include the RSPP metadata IE to provide the RSPP metadata information e.g., the specific role(s) of the discoveree UE;

3) shall include the discoveree user info set to the application layer ID of the discoveree UE;

4) shall include the PLMN ID IE to provide the serving PLMN ID of the discoveree UE if the discoveree UE is acting as a located UE and the discoveree UE performs the ranging and sidelink positioning operation utilizing the location services signaling messages as defined in 3GPP TS 23.273 [11],

5) may include the Metadata IE to provide the application layer metadata information;

6) shall include the MIC field computed as described in 3GPP TS 33.533 [5], by using the UTC-based counter and the DUIK contained in the <RangingSl-discovery-security-parameters-accept> element of the PROSE_SECURITY_PARAM_RESPONSE message; and

7) shall set the UTC-based counter LSB parameter to the 4 least significant bits of the UTC-based counter.

b) shall apply the DUIK, DUSK, or DUCK with the associated Encrypted Bitmask, along with the UTC-based counter to the PROSE PC5 DISCOVERY message for whichever security mechanism(s) configured to be applied, e.g., integrity protection, message scrambling or confidentiality protection of one or more above parameters, as specified in 3GPP TS 33.533 [5]

c) shall set the destination layer-2 ID to the source layer-2 ID from the discoverer UE used in the transportation of the PROSE PC5 DISCOVERY message for group member discovery solicitation for ranging and sidelink positioning and self-assign a source layer-2 ID for sending the group member discovery response message for ranging and sidelink positioning; and

NOTE 2: The UE implementation ensures that the value of the self-assigned source layer-2 ID is different from any other self-assigned source layer-2 ID(s) in use for 5G ProSe direct communication and is different from any other provisioned destination layer-2 ID(s) as specified in 3GPP TS 24.554 [6].

d) shall pass the resulting PROSE PC5 DISCOVERY message for group member discovery response for ranging and sidelink positioning along with the source layer-2 ID and the destination layer-2 ID to the lower layers for transmission over the PC5 interface.

NOTE 3: If the UE is processing a PROSE DIRECT LINK ESTABLISHMENT REQUEST message from the same source layer-2 ID of the received PROSE PC5 DISCOVERY message for group member discovery solicitation for ranging and sidelink positioning, it depends on UE implementation to avoid the conflict of destination layer-2 ID (e.g. send a PROSE DIRECT LINK ESTABLISHMENT REJECT message containing PC5 signalling protocol cause value #3 "conflict of layer-2 ID for unicast communication is detected", or ignore the PROSE DIRECT DISCOVERY message for group member discovery solicitation for ranging and sidelink positioning).

6.2.2.4.5 Discoveree UE procedure for group member discovery for ranging and sidelink positioning completion

When the UE is triggered by an upper layer application to stop responding to solicitation on proximity of other UEs in a discovery group for ranging and sidelink positioning, or when the UE stops being authorised to perform the discoveree UE procedure for group member discovery for ranging and sidelink positioning, the UE shall instruct the lower layers to stop monitoring.

When the UE stops monitoring, if the UE is in 5GMM-CONNECTED mode, the UE shall trigger the corresponding procedure in lower layers as specified in 3GPP TS 38.331 [13].

6.3 Ranging and sidelink positioning UE discovery with V2X capable UEs

The ranging and sidelink positioning UE discovery with V2X capable UE uses the PC5 unicast establishment procedure with the V2X service identifier indicating "ranging and sidelink positioning" as specified in clause 6.1.2.2 of 3GPP TS 24.587 [4].

6.4 Located UE selection

6.4.1 General

Located UE selection (s) can be performed by the target UE or by LMF as specified in clause 5.2.2 of 3GPP TS 23.586 [2]. Whether the selection is done by the LMF or by the target UE, is based on the procedure in which the located UE selection is performed as specified in clause 6.20 of 3GPP TS 23.273 [11].

Procedure of target UE selecting located UE is specified in clause 6.4.2.1.

Procedure of LMF selecting located UE is specified in clause 6.4.2.2.

6.4.2 Procedures

6.4.2.1 Target UE selecting located UE

6.4.2.1.1 General

If the UE is authorised to act as a target UE as specified in clause 5.2.3, the located UE selection is performed by target UE in following cases:

a) when the LMF is not involved, and UE-only operation for ranging and sidelink positioning is used (see clause 6.4.2.1.2); and

b) when the LMF is involved, network-based operation or network-assisted operation for ranging and sidelink positioning is used and the LMF determines the located UE selection is performed by the target UE (see clause 6.4.2.1.3).

Editor's note: It is FFS whether and how to consider the "Capabilities of the candidate located UE(s), which include the supported Sidelink Positioning methods" for UE selection.

Editor's note: It is FFS whether and how to consider the "UE's information including whether UE is in coverage or not" for UE selection.

6.4.2.1.2 Target UE selecting located UE for UE-only operation

The target UE shall select the located UE(s) from the UE(s) which are discovered using:

a) the monitoring procedure for UE discovery as specified in clause 6.2.2.1 or clause 6.2.2.3 when located UE acts as announcing UE;

b) the discoverer procedure for UE discovery as specified in clause 6.2.2.2 or clause 6.2.2.4 when located UE acts as discoveree UE;

c) the procedure for ranging and sidelink positioning UE discovery with V2X capable UEs as specified in clause 6.3; or

c) both a) and b).

NOTE: How the located UE can be triggered to perform the announcing procedure for UE discovery as specified in clause 6.2.2.1 or clause 6.2.2.3 is up to UE implementation.

The target UE may select the located UE(s) if:

a) the UE role in the RSPP metadata in the PROSE PC5 DISCOVERY message or, for V2X capable UEs, in the DIRECT LINK ESTABLISHMENT ACCEPT message indicates that the UE supports UE role as a located UE (see 3GPP TS 38.355 [12]); and

b) the serving PLMN ID in the PROSE PC5 DISCOVERY message or, for V2X capable UEs, in the DIRECT LINK ESTABLISHMENT ACCEPT message indicating the same PLMN as the serving PLMN of the target UE.

6.4.2.1.3 target UE selecting located UE for network-based operation or network-assisted operation

If the located UE selection is triggered by supplementary service message from the LMF with the indication of target UE selecting located UE to the target UE, the target UE shall select the located UE(s) from

a) the UE(s) as specified in clause 6.4.2.1.2; and

b) the candidate located UE list if received from the LMF.

The target UE shall send the selected located UE(s) based a) and b) above to the LMF.

6.4.2.2 LMF selecting located UE

The located UE selection is performed by LMF if the UE is authorised to act as a target UE as specified in clause 5.2.3, the located UE selection is performed by LMF when the LMF is involved, network-based operation or network-assisted operation for ranging and sidelink positioning is used and the LMF determines the located UE selection is performed by the LMF.

If the located UE selection is triggered by supplementary service message from the LMF with the indication of LMF selecting located UE to the target UE, the target UE shall determine the UE(s) as candidate located UE list to be provided to the LMF from the UE(s) which are discovered using:

a) the monitoring procedure for UE discovery as specified in clause 6.2.2.1 or clause 6.2.2.3 when located UE acts as announcing UE;

NOTE: How the located UE can be triggered to perform the announcing procedure for UE discovery as specified in clause 6.2.2.1 or clause 6.2.2.3 is up to UE implementation.

b) the discoverer procedure for UE discovery as specified in clause 6.2.2.2 or clause 6.2.2.4 when located UE acts as discoveree UE;

c) the procedure for ranging and sidelink positioning UE discovery with V2X capable UEs as specified in clause 6.3; or

d) both a) and b).

The UE shall be included as located UE candidate from target UE sent to LMF if:

a) the UE role in the RSPP metadata in the PROSE PC5 DISCOVERY message or, for V2X capable UEs, in the DIRECT LINK ESTABLISHMENT ACCEPT message indicates that the UE supports UE role as a located UE (see 3GPP TS 38.355 [12]);

b) the serving PLMN ID in the PROSE PC5 DISCOVERY message or, for V2X capable UEs, in the DIRECT LINK ESTABLISHMENT ACCEPT message indicating the same PLMN as the serving PLMN of the target UE; and

c) the UE is included candidate located UE list from the LMF, if available.

The target UE shall send the candidate located UE list to the LMF in the corresponding response supplementary service message for located UE selection. The LMF may select the UE(s) as located UE(s) from:

a) the candidate located UE list if received from the target UE; and

b) the locally configured candidate located UE list.

Editor's note: It is FFS whether and how to consider the "required QoS parameters of the UE in the candidate located UE list" for UE selection.

6.5 SL positioning server UE selection

6.5.1 General

When ranging and sidelink positioning service is applied, SL positioning server UE is required in the following case:

a) When LMF is not involved, in case of out-of-coverage or for UE-only operation if the serving network does not support ranging and sidelink positioning, SL positioning server UE can be discovered and selected by the target UE; or

b) When LMF is involved, for network-assisted operation, the LMF can decide a SL positioning server UE from the target UE, SL reference UE or located UE involved in the ongoing ranging and sidelink positioning service.

In any case requiring SL positioning server UE, the SL positioning server UE discovery is performed by the target UE.

For the SL positioning server UE selection, the following are considered:

a) Selecting the target UE capable of performing SL positioning server UE functionalities as the SL positioning server UE.

b) Selecting the SL reference UE or located UE capable of performing SL positioning server UE functionalities as the SL positioning server UE.

Editor's note: It is FFS whether and how to consider the "UE's information including whether UE is in coverage or not" for UE selection.

Editor's note: It is FFS whether and how to consider the "related positioning methods" of another UE for UE selection.

If LMF performs the SL positioning server UE selection, the LMF sends the selected SL positioning server UE info to the target UE.

6.5.2 Target UE selecting SL positioning server UE

The target UE shall trigger the target UE selecting SL positioning server UE operation if the following conditions are met:

a) the UE is authorised to act as a target UE for ranging and sidelink positioning as specified in clause 5.2.3 and the target UE is not capable of performing SL positioning server UE functionalities; and

b) a list of SL positioning server UE candidate(s) is available based on the following:

1) the monitoring procedure for UE discovery as specified in clause 6.2.2.1 or clause 6.2.2.3 when SL positioning server UE acts as announcing UE;

NOTE: How the SL positioning server UE can be triggered to perform the announcing procedure for UE discovery as specified in clause 6.2.2.1 or clause 6.2.2.3 is up to UE implementation.

2) the discoverer procedure for UE discovery as specified in clause 6.2.2.2 or clause 6.2.2.4 when SL positioning server UE acts as discoveree UE; or

3) the ranging and sidelink positioning UE discovery with V2X capable UEs as specified in clause 6.3.

If there is only one SL positioning server UE candidate, then that SL positioning server UE is selected. If there are more than one SL positioning server UE candidate, the SL positioning server UE is selected in the following order of decreasing precedence:

a) any SL reference UE or located UE for the ranging and sidelink positioning service capable of performing SL positioning server UE functionalities; and

b) a UE other than the SL reference UE or located UE for the ranging and sidelink positioning service capable of performing SL positioning server UE functionalities.

6.6 SL reference UE selection

6.6.1 General

When ranging and sidelink positioning service is applied, SL reference UE discovery and selection may be triggered in a SL-MO-LR, SL-MT-LR, 5GC-MO-LR or 5GC-MT-LR procedure as specified in clause 5.2.x of 3GPP TS 23.586 [2].

SL reference UE selection is performed by the target UE.

6.6.2 Procedures

6.6.2.1 Target UE selecting SL reference UE

The target UE shall select SL reference UE(s) from the UE(s) which are discovered using:

a) the monitoring procedure for UE discovery as specified in clause 6.2.2.1 or clause 6.2.2.3 when SL reference UE acts as announcing UE;

b) the discoverer procedure for UE discovery as specified in clause 6.2.2.2 or clause 6.2.2.4 when SL reference acts as discoveree UE;

c) the procedure for ranging and sidelink positioning UE discovery with V2X capable UEs as specified in clause 6.3; or

d) both a) and b).

Editor’s note: Whether and how the SL reference UE can be triggered to perform the announcing procedure for UE discovery as specified in clause 6.2.2.1 or clause 6.2.2.3 is FFS.

A discovered UE can be selected as a SL reference UE if the UE role in the RSPP metadata in the PROSE PC5 DISCOVERY message or, for V2X capable UEs, in the DIRECT LINK ESTABLISHMENT ACCEPT message indicates that the UE supports the SL reference UE role (see 3GPP TS 38.355 [12]).

Editor's note: It is FFS whether and how to consider the "Capabilities of the candidate SL reference UE(s), which include the supported Sidelink Positioning methods" for UE selection.

Editor's note: It is FFS whether and how to consider the "UE's information including whether UE is in coverage or not" for UE selection.

Editor's note: It is FFS whether and how to consider the "required QoS parameters of the UE in the candidate SL reference UE list" for UE selection.

7 Ranging and sidelink positioning communication

7.1 Overview

7.2 Ranging and sidelink positioning direct communication over PC5

7.2.1 General

Depending on type of the UE (e.g. V2X capable or 5G ProSe capable), V2X communication procedures as defined in TS 24.587 [4] or 5G ProSe direct communication procedures as defined in 3GPP TS 24.554 [6] are used for ranging and sidelink positioning communication over PC5.

For the RSPP transport between UEs over PC5, the following modification is applied:

a) For V2X capable UEs, V2XP is used to determine the corresponding transport configurations for the RSPP signalling. The V2X service identifier shall take the value(s) defined for "ranging and sidelink positioning Protocol".

b) For 5G ProSe capable UEs, ProSeP is used to determine the corresponding transport configuration for the RSPP signalling. The ProSe identifier shall take the value(s) defined for "ranging and sidelink positioning Protocol".

NOTE: For a UE with both V2X capability and 5G ProSe capability, separate RSPP transport links per the capability are used, i.e., the RSPP transport link over V2X communication is independent with the RSPP transport link over 5G ProSe direct communication.

The RSP layer supports broadcast mode, groupcast mode, and unicast mode PC5 communication depending on the policy and parameter configuration in the UE.

"Non-IP" layer-3 protocol data unit type for V2X capable UEs and "Unstructured" layer-3 protocol data unit type for 5G ProSe capable UEs are used for the transport of RSPP payload. For the transport of RSPP payload by "Non-IP" layer-3 protocol data unit type for V2X capable UEs, the non-IP type field of the non-IP PDU format shall indicate "SLPP" as specified in 3GPP TS 24.587 [4] clause 9.2. For the transport of supplementary RSPP signalling message by "Non-IP" layer-3 protocol data unit type for V2X capable UEs, the non-IP type field of the non-IP PDU format shall indicate "Supplementary RSPP signalling" as specified in 3GPP TS 24.587 [4] clause 9.2.

7.2.2 Unicast mode ranging and sidelink positioning direct communication over PC5

7.2.2.1 Unicast mode communication over PC5 with 5G ProSe capable UEs

This clause describes the PC5 signalling protocol procedures between two UEs for unicast mode of 5G ProSe communication for ranging and sidelink positioning. The following PC5 signalling protocol procedures are supported:

a) PC5 unicast link establishment procedure with 5G ProSe capable UEs as specified in 3GPP TS 24.554 [6] clause 7.2.2;

b) PC5 unicast link modification procedure with 5G ProSe capable UEs as specified in 3GPP TS 24.554 [6] clause 7.2.3;

c) PC5 unicast link release with procedure 5G ProSe capable UEs as specified in 3GPP TS 24.554 [6] clause 7.2.6;

d) PC5 unicast link identifier update procedure with 5G ProSe capable UEs as specified in 3GPP TS 24.554 [6] clause 7.2.4; and

e) PC5 unicast link keep-alive procedure with 5G ProSe capable UEs as specified in 3GPP TS 24.554 [6] clause 7.2.5.

7.2.2.2 Unicast mode communication over PC5 with V2X capable UEs

This clause describes the PC5 signalling protocol procedures between two UEs for unicast mode of V2X communication for ranging and sidelink positioning. The following PC5 signalling protocol procedures are supported:

a) PC5 unicast link establishment procedure with V2X capable UEs as specified in 3GPP TS 24.587 [4] clause 6.1.2.2;

b) PC5 unicast link modification procedure with V2X capable UEs as specified in 3GPP TS 24.587 [4] clause 6.1.2.3;

c) PC5 unicast link release with procedure V2X capable UEs as specified in 3GPP TS 24.587 [4] clause 6.1.2.4;

d) PC5 unicast link identifier update procedure with V2X capable UEs as specified in 3GPP TS 24.587 [4] clause 6.1.2.5; and

e) PC5 unicast link keep-alive procedure with V2X capable UEs as specified in 3GPP TS 24.587 [4] clause 6.1.2.8.

7.3 Ranging and sidelink positioning communication on LCS aspect

The UE or the network initiates the ranging and sidelink positioning communication utilizing the location services signaling messages defined in 3GPP TS 23.273 [11] to obtain the location information including one or more of the following:

a) absolute location of the UE;

b) absolute velocity of the UE;

c) range and direction between a pair of UEs (see clause 5.10 of 3GPP TS 23.032 [16]);

d) relative location between a pair of UEs; (see clause 5.11 and 5.12 of 3GPP TS 23.032 [16]); and

e) relative velocity between a pair of UEs (see clause 8.4a of 3GPP TS 23.032 [16]).

In order to obtain the absolute location the absolute velocity, or both of the target UE, the following procedures defined in 3GPP TS 23.273 [11] are applied:

a) (SL-MO-LR) procedure;

b) MO-LR using sidelink positioning;

c) SL-MT-LR procedure;

d) SL-MT-LR for periodic and triggered Location events procedure; and

e) MT-LR using sidelink positioning.

NOTE: In order to estimate the location of the UE, the network can decide to utilize the ranging and sidelink positioning during the MO-LR procedure (i.e., MO-LR using sidelink positioning) and the MT-LR procedure (i.e., MT-LR using sidelink positioning).

In order to obtain one or more among the relative location, the range and direction, and the relative velocity between a pair of UEs, the following procedures defined in 3GPP TS 23.273 [11] are applied:

a) (SL-MO-LR) procedure;

b) SL-MT-LR procedure;

c) SL-MT-LR for periodic and triggered Location events procedure.

7.4 Supplementary RSPP signaling over PC5-U

7.4.1 General

This clause describes interactions to exchange supplementary RSPP signaling messages among UEs over PC5-U as defined in TS 23.586 [2], including:

a) the sidelink positioning service request/sidelink positioning service response; and

b) the sidelink positioning SLPP transport message between the SL positioning server UE and the target UE or SL reference UE for ranging and sidelink positioning.

The supplementary RSPP signalling is transferred over PC5-U as specified in clause 7.2.

7.4.2 sidelink positioning service request procedure

7.4.2.1 General

This procedure is applied to the following:

a1) between the sidelink SL positioning client UE and the target UE or SL reference UE or located UE for ranging and sidelink positioning service exposure through PC5 as defined in clause 6.7.1.1 of 3GPP TS 23.586 [2];

a2) between the target UE or SL reference UE and the SL positioning server UE for UE-only operation in the ranging and sidelink positioning control procedure as defined in clause 6.8 of 3GPP TS 23.586 [2]; and

a3) between the target UE and the located UE to request the absolute location from a located UE for ranging and sidelink positioning during the Sidelink Mobile Originated Location Request (SL-MO-LR) procedure as defined in 3GPP TS 23.273 [11].

For a1), the sidelink positioning client UE acts as an "initiating UE" and the target UE or SL reference UE or located UE for ranging and sidelink positioning acts as a "target UE"; for a2), the target UE or SL reference UE for ranging and sidelink positioning acts as an "initiating UE" and the SL positioning server UE for ranging and sidelink positioning acts as a "target UE" and for a3), the target UE for ranging and sidelink positioning acts as an "initiating UE" and a located UE for ranging and sidelink positioning acts as a "target UE".

The purpose of the sidelink positioning service request procedure is:

- for a1), to enable a SL positioning client UE to request the ranging and sidelink positioning result from a target UE or SL reference UE or located UE for ranging and sidelink positioning upon a request from upper layers.

- for a2), to enable a target UE or SL reference UE or located UE to request the ranging and sidelink positioning result from a SL positioning server UE for ranging and sidelink positioning upon a request from upper layers or a request from a SL positioning client UE.

- for a3), to enable a target UE for ranging and sidelink positioning to request absolute location from a located UE for ranging and sidelink positioning during the Sidelink Mobile Originated Location Request (SL-MO-LR) procedure as defined in 3GPP TS 23.273 [11].

7.4.2.2 sidelink positioning service request procedure initiation

When a ranging and sidelink positioning service is triggered by the upper layer in initiating UE, or a request from a SL positioning client UE to request the ranging and sidelink positioning result from a target, the initiating UE performs the sidelink positioning service request procedure while the following pre-conditions are met:

a) for a1), tthe initiating UE has discovered and selected the target UE from a list of SL reference UE(s) or a list of located UE(s) and target UE for ranging and sidelink positioning to receive SL positioning service request as described in clause 6,

b) for a2), the initiating UE has discovered and selected the target UE from a list of candidate SL positioning server UE(s) for ranging and sidelink positioning to receive SL positioning service request as described in clause 6,

c) for a3), the initiating UE has discovered and selected the target UE from a list of located UE(s) for ranging and sidelink positioning as described in clause 6, and

d) the initiating UE has direct PC5 link established with the target UE as described in clause 7.2.

The UE shall initiate the sidelink positioning service request procedure by sending a sidelink positioning service request message, the UE:

a) shall include a new transaction ID;

b) shall include the source user info set to the initiating UE's application layer ID with its corresponding UE role received from upper layers;

c) shall include the user info of target UE and info of SL reference UE(s) including associated application layer ID and UE role for each UE for a1) ;

d) shall include the requested ranging location results, including absolute locations, relative locations or ranges and directions related to the UEs for ranging and sidelink positioning for a2) and a3). The requested ranging location results is set to absolute locations for a3);

e) shall include the information of the related UEs, including application layer ID(s) and optional the UE role of each UE for a2); and

f) may include the required QoS for ranging and sidelink positioning a2) and a3).

7.4.2.3 Sidelink positioning service request procedure completion

Upon receiving the sidelink positioning service request message, the target UE shall:

- for a1), requests either the LMF or SL positioning server UE performing the ranging and sidelink positioning operation to obtain the ranging and sidelink positioning result;
- for a2), act as SL positioning server UE performing the ranging and sidelink positioning operation to obtain the ranging and sidelink positioning result;
- for a3), trigger 5GC-MO-LR procedure to acquire its own absolute location if not available; and
- send sidelink positioning service response message including the sidelink positioning result to the initiating UE.

Editor's Note: For case a3), the need for a privacy check depends on SA2/SA3 output.

7.4.2.4 Sidelink positioning service request procedure not accepted by target UE

If the SL positioning service request message cannot be accepted, then the target UE shall send a SL positioning service reject message to the initiating UE. The SL positioning service reject message contains a sidelink positioning protocol cause IE.

Editor's Note: The cause codes and the respective failure conditions are FFS.

7.4.3 Sidelink positioning SLPP transport procedure

7.4.3.1 General

The sidelink positioning SLPP transport procedure is used by the SL positioning server UE and the target UE or SL reference UE for ranging and sidelink positioning to send embedded SLPP message(s) and the associated UE's application layer ID(s) of the SLPP message(s) as specified in clause 6.8 of 3GPP TS 23.586 [2].

7.4.3.2 Sidelink positioning SLPP transport initiation

When an initiating UE needs to transport SLPP message(s) for other UE(s) to the target UE or SL reference UE for ranging and sidelink positioning or to the SL positioning server UE as specified in clause 6.8 of 3GPP TS 23.586 [2], the initiating UE shall generate a sidelink positioning SLPP transport message, and the sidelink positioning SLPP transport message shall include embedded SLPP message(s) for other UE(s) and the associated UE's application layer ID(s) of the SLPP message(s)where the SLPP message is either for sidelink positioning capability, sidelink positioning assistance data, sidelink positioning location measurement request, or sidelink positioning reference signaling measurement data as specified in 3GPP TS 38.355 [12].

7.4.3.3 Sidelink positioning SLPP transport reception

Upon receiving the sidelink positioning SLPP transport message,

a) if the receiving UE is the SL positioning server UE, the UE proceeds with the ranging and sidelink positioning control procedure for the received SLPP message(s) and its associated application layer ID(s), as specified in clause 6.8 of 3GPP TS 23.586 [2]; or

b) if the receiving UE is the target UE or SL reference UE for ranging and sidelink positioning, the UE sends SLPP message(s) as specified in 3GPP TS 23.586 [2] based on the received sidelink positioning SLPP transport message.

8 Security for ranging and sidelink positioning

8.1 Overview

Security mechanisms are defined in 3GPP TS 33.533 [5] to provide protection for **r**anging and sidelink positioning UE discovery and ranging and sidelink positioning communication for both ProSe capable UE and V2X capable UE.

For ProSe capable UEs, the security mechanisms using long-term credentials provided by applications when ranging and sidelink positioning services are provided by application providers as defined in clause 8.2.2 and clause 8.3.2, and the security mechanisms with interaction between UE and the SideLink Positioning Key Management Function (SLPKMF), where the interface is PC8* for generation and provisioning of security materials used for ranging and sidelink positioning services when the ranging and sidelink positioning services are provided by network operators as are defined in clause 8.2.1 and clause 8.3.1.

For V2X capable UE, the security mechanisms used for ranging and sidelink positioning services are defined in clause 8.2.2 and clause 8.3.2.

8.1.1 Overview for procedures over PC8* interface

The UE and SLPKMF shall use HTTP 1.1 as specified in IETF RFC 9110 [13] and IETF RFC 9112 [14] as the transport protocol for PC8* messages over the PC8* interface. The PC8* messages described here shall be included in the body of either an HTTP request message or an HTTP response message.

The following rules apply for UE-initiated procedures over PC8*:

a) the UE initiates 5G ProSe transactions with an HTTP request message containing the PC8* request(s);

b) the SLPKMF responds to the requests with an HTTP response message containing the PC8* response(s) for the PC8* request(s); and

c) HTTP POST methods are used for 5G ProSe procedures over PC8* interface.

The UE may use UE local configuration or URSP, as defined in 3GPP TS 24.526 [15], to establish a PDU session for reaching the HPLMN SLPKMF:

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

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

The SLPKMF address can be pre-configured in the UE or provided in the RSLPP by the PCF. The UE shall use the SLPKMF address in the following order of decreasing precedence:

a) provided in the RSLPP by the PCF;

b) pre-configured in the ME.

8.2 Security for ranging and sidelink positioning UE discovery

8.2.1 Security for ranging and sidelink positioning UE discovery with 5G ProSe capable UE

8.2.1.1 General

For ranging and sidelink positioning services provided by network operators, the security procedure for ranging and sidelink positioning UE discovery with 5G ProSe capable UE include the following:

- the ranging and sidelink positioning discovery key request procedure as defined in clause 8.2.1.2.

8.2.1.2 Ranging and sidelink positioning discovery key request procedure

8.2.1.2.1 General

The purpose of the ranging and sidelink positioning discovery key request procedure is for the 5G ProSe capable UE:

- to obtain the ranging and sidelink positioning UE discovery security parameters for 5G ProSe capable UE, applicable when the UE acts as any UE role for ranging and sidelink positioning over user plane as specified in 3GPP TS 33.533 [5].

8.2.1.2.2 Ranging and sidelink positioning discovery key request procedure initiation

The UE shall initiate the ranging and sidelink positioning discovery key request procedure if the UE is authorized to act as any UE role for ranging and sidelink positioning and uses the security procedure over user plane as specified in 3GPP TS 33.533 [5]:

1) when the UE has no ranging and sidelink positioning UE discovery security parameters for 5G ProSe capable UE and the UE is in NG-RAN coverage; or

2) after expiration of timer Tx1, when in NG-RAN coverage or when entering NG-RAN coverage; or

The UE shall initiate the ranging and sidelink positioning discovery key request procedure by sending a PROSE_SECURITY_PARAM_REQUEST message with the <RangingSl-discovery-security-parameters-request> element. In the < RangingSl-discovery-security-parameters-request> element, the UE:

a) shall include a new transaction ID;

b) shall indicate the UE role(s) of the UE requesting the ranging and sidelink positioning UE discovery security parameters for 5G ProSe capable UE;

c) shall include the PC5 UE security capabilities indicating ciphering algorithms supported by the UE;

d) may indicate the requested model indicating the model of the ranging and sidelink positioning UE discovery over PC5 interface for which security parameters are requested, set to "model A" or "model B"; and

e) shall include the ranging and sidelink positioning application identifier.

NOTE: If the requested model is not included in the PROSE_SECURITY_PARAM_REQUEST message, security parameters are requested for both model A and model B of the ranging and sidelink positioning UE discovery over PC5 interface.

Figure 8.2.1.2.2.1 illustrates the interaction of the UE and the SLPKMF in the Discovery key request procedure.

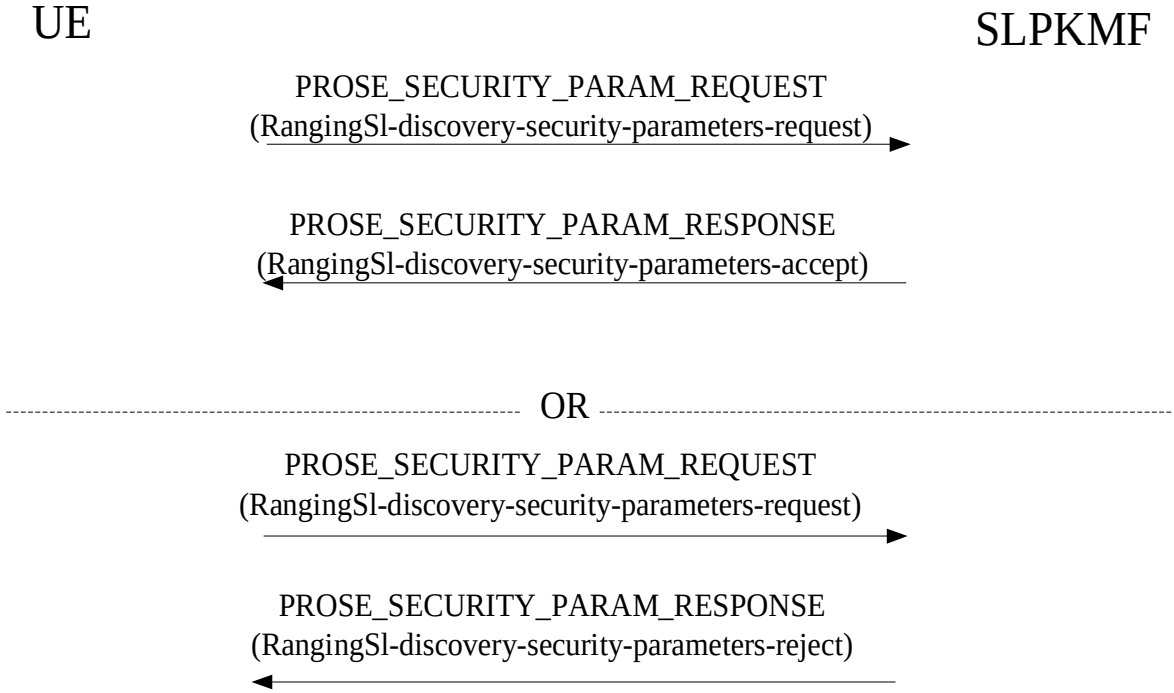

Figure 8.2.1.2.2.1: Discovery key request procedure

8.2.1.2.3 Ranging and sidelink positioning discovery key request procedure accepted by the SLPKMF

Upon receiving a PROSE_SECURITY_PARAM_REQUEST message with the <RangingSl-discovery-security-parameters-request> element, if the PROSE_SECURITY_PARAM_REQUEST message is received over a TLS tunnel established by a UE authorized to act as any UE role for ranging and sidelink positioning the SLPKMF shall send a PROSE_SECURITY_PARAM_RESPONSE message containing a <RangingSl-discovery-security-parameters-accept> element. In the <RangingSl-discovery-security-parameters-accept> element, the SLPKMF:

a) shall include the transaction ID set to the value of the transaction ID received in the PROSE_SECURITY_PARAM_REQUEST message;

b) shall include the expiration timer of the ranging and sidelink positioning UE discovery security parameters for 5G ProSe capable UE;

c) for the received ranging and sidelink positioning application identifier for which the UE is authorized to act as any UE role for the ranging and sidelink positioning:

   1) if the requested model is not indicated in the PROSE_SECURITY_PARAM_REQUEST message or is set to "model A", may include the code-receiving security parameters for model A containing one or more of DUSK, DUIK and DUCK with associated encrypted bitmask;

   2) if the requested model is not indicated in the PROSE_SECURITY_PARAM_REQUEST message or is set to "model B", may include the code-receiving security parameters for model B containing one or more of DUSK, DUIK and DUCK with associated encrypted bitmask and the code-sending security parameters for model B containing one or more of DUSK, DUIK and DUCK with associated encrypted bitmask; and

   3) shall include the selected ciphering algorithm;

d) shall include the current time set to the current UTC-based time at the SLPKMF and the max offset.

The SLPKMF of the monitoring or discoverer UE discovers the SLPKMF(s) of potential announcing or discoveree UE(s) supporting the ranging and sidelink positioning based on a configured list of PLMNs supporting the corresponding ranging and sidelink positioning.

8.2.1.2.4 Ranging and sidelink positioning discovery key request procedure completion by the UE

Upon receipt of the PROSE_SECURITY_PARAM_RESPONSE message with the <RangingSl-discovery-security-parameters-accept>, if the transaction ID contained in the <RangingSl-discovery-security-parameters-accept> element matches the value sent by the UE in a PROSE_SECURITY_PARAM_REQUEST message with the <RangingSl-discovery-security-parameters-request> element, the UE:

a) shall store the ranging and sidelink positioning UE discovery security parameters for 5G ProSe capable UE, shall stop timer Tx1 if running, and shall start timer T5x1 with the value of the expiration timer indicated in the ranging and sidelink positioning UE discovery security parameters for 5G ProSe capable UE; and

b) shall set a ProSe clock (see 3GPP TS 33.533 [5]) to the value of the received current time parameter and store the received max offset.

8.2.1.2.5 Ranging and sidelink positioning discovery key request procedure not accepted by the SLPKMF

If the PROSE_SECURITY_PARAM_REQUEST message with the <RangingSl-discovery-security-parameters-request> element cannot be accepted by the SLPKMF, the SLPKMF shall send a PROSE_SECURITY_PARAM_RESPONSE message containing a <RangingSl-discovery-security-parameters-reject> element. In the <RangingSl-discovery-security-parameters-reject> element, the SLPKMF shall include the transaction ID set to the value of the transaction ID received in the PROSE_SECURITY_PARAM_REQUEST message and shall include an appropriate PC8 control protocol cause value.

Upon receipt of the PROSE_SECURITY_PARAM_RESPONSE message with the <RangingSl-discovery-security-parameters-reject> element, if the transaction ID contained in the <RangingSl-discovery-security-parameters-reject> element matches the value sent by the UE in a PROSE_SECURITY_PARAM_REQUEST message with the <RangingSl-discovery-security-parameters-request> element, the UE shall consider the Discovery key request procedure as rejected.

8.2.1.2.6 Abnormal cases in the UE

The following abnormal cases can be identified:

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

   The UE shall close the existing secure connection to the SLPKMF, establish a new secure connection and then restart the Discovery key request procedure.

b) No response from the SLPKMF after the PROSE_SECURITY_PARAM_REQUEST message has been successfully delivered (e.g. TCP ACK has been received for the PROSE_SECURITY_PARAM_REQUEST message)

   The UE shall retransmit the PROSE_SECURITY_PARAM_REQUEST message.

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

8.2.1.2.7 Abnormal cases in the SLPKMF

The following abnormal cases can be identified:

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

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

8.2.2 Security for ranging and sidelink positioning UE discovery with V2X capable UE

For V2X capable UE, the security mechanisms used for ranging and sidelink positioning services are defined in clause 6.1.2 of 3GPP TS 24.587 [4]

8.3 Security for ranging and sidelink positioning communication

8.3.1 Security for ranging and sidelink positioning communication with 5G ProSe capable UE

8.3.1.1 Security for unicast direct communication over RSPP

8.3.1.1.1 General

For ranging and sidelink positioning services provided by application providers, long-term credentials provided by applications are assumed available on the UE and the security procedures for unicast communication with long-term credentials are specified in clause 8.3.2.

For ranging and sidelink positioning services provided by network operators, there are no long-term credentials provided by applications on the UE. The security procedures for ranging and sidelink positioning services provided by network include the following:

- the 5G ProSe UE SLP key request procedure as defined in clause 8.3.1.1.2.
- the SLP key request procedure as defined in clause 8.3.1.1.3.

8.3.1.1.2 5G ProSe UE SLP key request procedure

8.3.1.1.2.1 General

The purpose of the UE SLP key request procedure is for the UE authorized to act as any UE role for ranging and sidelink positioning to obtain a SLPK and a SLPK ID. The UE roles for ranging and sidelink positioning include target UE, reference UE, located UE, and sidelink positioning server UE.

Before initiating this procedure, the UE needs to be authorized to perform ranging and sidelink positioning service in the registered PLMN or local PLMN based on the configuration parameters as specified in clause 5.2.5.

8.3.1.1.2.2 UE SLP key request procedure initiation

If the UE is authorized to perform ranging and sidelink positioning service in the registered PLMN or local PLMN, it shall initiate this procedure.

The UE shall initiate the UE SLP key request procedure by sending a PROSE_UE_SLPK_REQUEST message with the <UE-SLPK-request> element. In the <UE-SLPK-request> element, the UE:

a) shall include a new transaction ID not used in any other procedures in PC8* interface; and

b) shall include the SLPK ID set to the SLPK ID associated with the UE stored SLPK, if the UE stores SLPK.

Figure 8.3.1.1.2.2.1 illustrates the interaction of the UE and the SLPKMF in the UE SLP key request procedure.

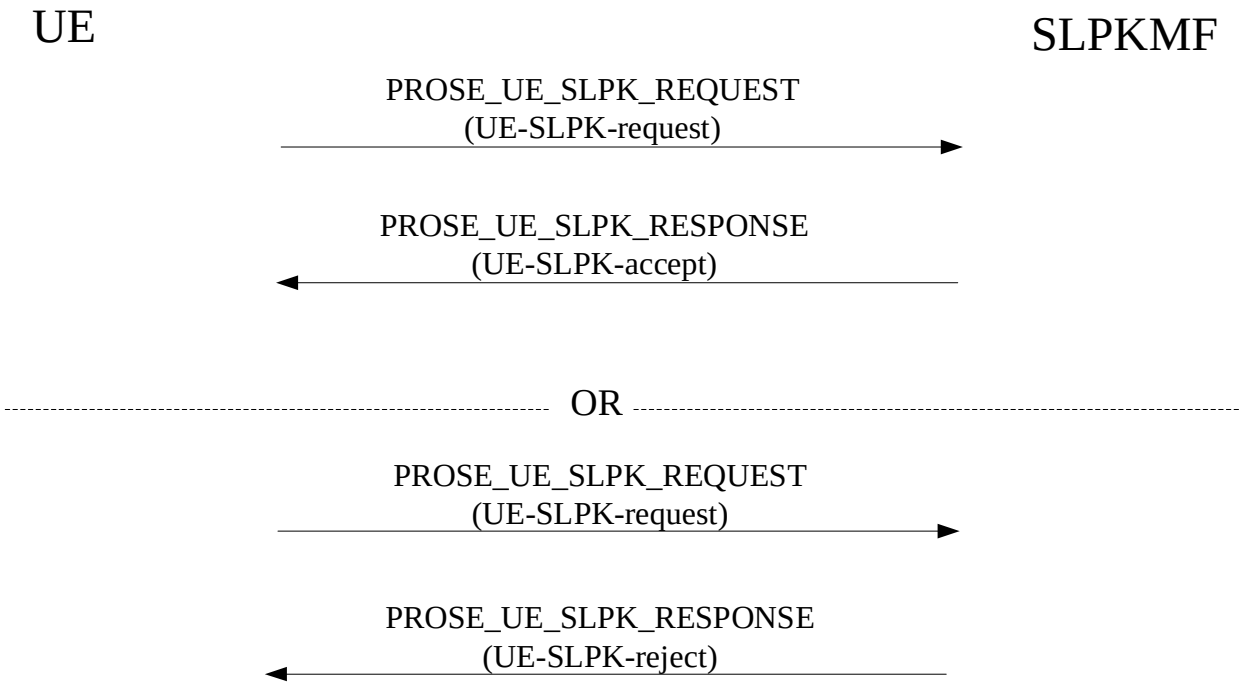

Figure 8.3.1.1.2.2.1: UE SLP key request procedure

8.3.1.1.2.3 UE SLP key request procedure accepted by the SLPKMF

Upon receiving a PROSE_UE_SLPK_REQUEST message, the SLPKMF shall check whether the UE is authorized to act as any UE role for ranging and sidelink positioning. If authorized, the SLPKMF shall then send a PROSE_UE_SLPK_RESPONSE message with the <UE-PRUK-accept> element. In the <UE-PRUK-accept> element, the SLPKMF shall include:

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

b) the SLPK ID set to the value of the SLPK ID associated with the SLPK; and

c) the SLPK set to the value of the allocated SLPK to the UE.

8.3.1.1.2.4 UE SLP key request procedure completion by the UE

Upon receipt of the PROSE_UE_SLPK_RESPONSE message, if the transaction ID matches the value sent by the UE in a PROSE_UE_SLPK_REQUEST message, the UE shall delete any previously stored SLPK and SLPK ID and store the received SLPK and the associated SLPK ID.

8.3.1.1.2.5 5G ProSe UE SLP key request procedure not accepted by the SLPKMF

If the PROSE_UE_SLPK_REQUEST message cannot be accepted by the SLPKMF, the SLPKMF sends a PROSE_UE_SLPK_RESPONSE message containing a <UE-SLPK-reject> element to the UE including an appropriate PC8* control protocol cause value and including the transaction ID set to the value of the transaction ID received in the PROSE_UE_SLPK_REQUEST message.

Upon receipt of the PROSE_UE_SLPK_RESPONSE message containing a <UE-SLPK-reject> element, if the transaction ID matches the value sent by the UE in a PROSE_UE_SLPK_REQUEST message, the UE shall consider the UE SLP key request procedure as rejected.

If the UE is not authorized for acting as any UE role for ranging and sidelink positioning, the SLPKMF shall send the PROSE_UE_SLPK_RESPONSE message containing a <UE-SLPK-reject> element with PC8 control protocol cause value #1 "UE authorization failure".

8.3.1.1.2.6 Abnormal cases in the UE

The following abnormal cases can be identified:

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

The UE shall close the existing secure connection to the SLPKMF, establish a new secure connection and then restart the SLPK request procedure.

b) No response from the SLPKMF after the PROSE_UE_SLPK_REQUEST message has been successfully delivered (e.g., TCP ACK has been received for the PROSE_UE_SLPK_REQUEST message).

The UE shall retransmit the PROSE_UE_SLPK_REQUEST message.

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

8.3.1.1.2.7 Abnormal cases in the SLPKMF

The following abnormal cases can be identified:

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

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

8.3.1.1.3 SLP key request procedure

8.3.1.1.3.1 General

The purpose of the SLP key request procedure is for the UE authorized to act as any UE role for ranging and sidelink positioning to obtain security parameter needed for establishment of 5G ProSe direct link with the UE to be communicated over PC5 and authorized to act as any UE role for ranging and sidelink. The UE roles for ranging and sidelink positioning include target UE, reference UE, located UE, and sidelink positioning server UE.

Before initiating this procedure, the UE needs to be authorized to perform ranging and sidelink positioning service in the registered PLMN or local PLMN based on the configuration parameters as specified in clause 5.2.

8.3.1.1.3.2 SLP key request procedure initiation

The UE shall initiate this procedure when the UE is authorized to perform ranging and sidelink positioning service in the registered PLMN or local PLMN receives a request to establish a 5G ProSe direct link from a UE authorized to perform ranging and sidelink positioning service.

The UE shall initiate the SLP key request procedure by sending a PROSE_SLPK_REQUEST message with the <SLPK-request> element. In the <SLPK-request> element, the UE:

a) shall include a new transaction ID not used in any other procedures in PC8* interface;

b) shall include the service identifier for ranging and sidelink positioning which the 5G ProSe direct link is requested to be established;

c) shall include the SLPK ID of the UE initiating the 5G ProSe direct link establishment, received from the UE initiating the 5G ProSe direct link establishment;

d) shall include the K_{SLP} freshness parameter 1, received from the UE initiating the 5G ProSe direct link establishment; and

e) shall include the PLMN identity of the HPLMN of the UE initiating the 5G ProSe direct link establishment, if received from the UE initiating the 5G ProSe direct link establishment.

Figure 8.3.1.1.3.2.1 illustrates the interaction of the UE and the SLPKMF in the SLP key request procedure.

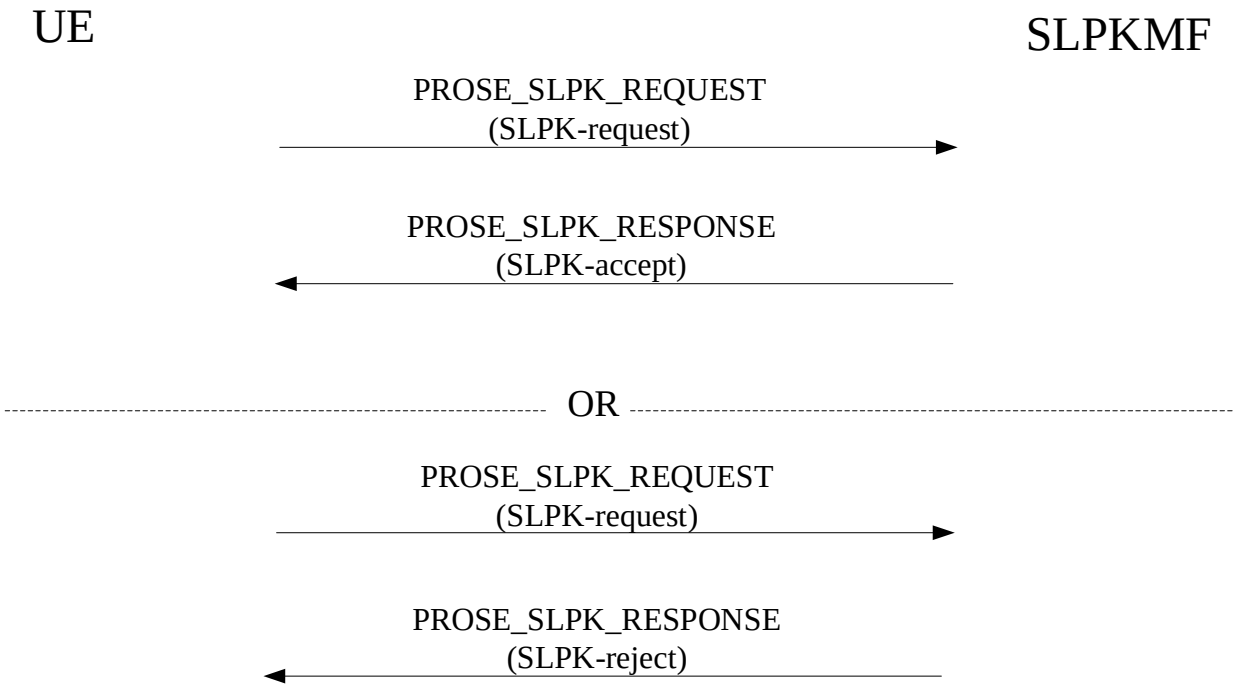

Figure 8.3.1.1.3.2.1: SLP key request procedure

8.3.1.1.3.3 SLP key request procedure accepted by the SLPKMF

Upon receiving a PROSE_SLPK_REQUEST message, the SLPKMF shall check whether the UE is authorized to act as any UE role for the ranging and sidelink positioning service. If authorized, the SLPKMF shall then send a PROSE_SLPK_RESPONSE message with the <SLPK-accept> element. In the <SLPK-accept> element, the SLPKMF shall include:

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

b) the SLK ID of the UE initiating the 5G ProSe direct link establishment;

c) the K_{SLP}; and

d) the K_{SLP} freshness parameter 2.

If the UE initiating the 5G ProSe direct link establishment is served by another SLPKMF, the SLPKMF of the UE initiating the SLP key request procedure requests the SLPKMF of the UE initiating the 5G ProSe direct link establishment to check that the UE initiating the 5G ProSe direct link establishment identified by the SLK ID and the PLMN identity of the HPLMN of the UE initiating the 5G ProSe direct link establishment, if any, indicated in the PROSE_SLPK_REQUEST message, is authorized to act as any UE role for the ranging and sidelink positioning service indicated in the PROSE_SLPK_REQUEST message and to provide the SLP ID of the UE initiating the 5G ProSe direct link establishment, the K_{SLP} and the K_{SLP} freshness parameter 2.

8.3.1.1.3.4 SLP key request procedure completion by the UE

Upon receipt of the PROSE_SLPK_RESPONSE message with the <SLPK-accept> element, if the transaction ID contained in the <SLPK-accept> element matches the value sent by the UE in a PROSE_SLPK_REQUEST message with the <SLPK-request> element, the UE shall use the SLPK ID of the UE initiating the 5G ProSe direct link establishment, the K_{SLP} and the K_{SLP} freshness parameter 2, if received, in the 5G ProSe direct link establishment..

8.3.1.1.3.5 SLP key request procedure not accepted by the SLPKMF

If the PROSE_SLPK_REQUEST message with <SLPK-request> element cannot be accepted by the SLPKMF, the SLPKMF shall send a PROSE_SLPK_RESPONSE message containing a <SLPK-reject> element. In the <SLPK-

reject> element, the SLPKMF shall include the transaction ID set to the value of the transaction ID received in the PROSE_SLPK_REQUEST message and shall include an appropriate PC8* control protocol cause value.

NOTE: The SLPKMF decides to reject the PROSE_SLPK_REQUEST message when e.g. the SLPK is not found in the network.

Upon receipt of the PROSE_SLPK_RESPONSE message with the <SLPK-reject> element, if the transaction ID contained in the <SLPK-reject> element matches the value sent by the UE in a PROSE_SLPK_REQUEST message with the <SLPK-request> element, the UE shall consider the SLP key request procedure as rejected.

8.3.1.1.3.6 Abnormal cases in the UE

The following abnormal cases can be identified:

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

   The UE shall close the existing secure connection to the SLPKMF, establish a new secure connection and then restart the SLP key request procedure.

b) No response from the SLPKMF after the PROSE_SLPK_REQUEST message has been successfully delivered (e.g. TCP ACK has been received for the PROSE_SLPK_REQUEST message)

   The UE shall retransmit the PROSE_SLPK_REQUEST message.

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

8.3.1.1.3.7 Abnormal cases in the SLPKMF

The following abnormal cases can be identified:

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

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

8.3.2 Security for ranging and sidelink positioning communication with V2X capable UE

For V2X capable UE, the security mechanisms used for ranging and sidelink positioning services are defined in clause 6.1.2 of 3GPP TS 24.587 [4]

9. Handling of unknown, unforeseen, and erroneous signalling protocol data

9.1 General

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

This clause also specifies procedures for the handling of unknown, unforeseen and erroneous protocol data by the receiving entity. These procedures are called "error handling procedures", but in addition to providing recovery mechanisms for error situations they define a compatibility mechanism for future extensions of the protocols.

Detailed error handling procedures in the network are implementation dependent and may vary from PLMN to PLMN. However, when extensions of this protocol are developed, networks will be assumed to have the error handling that is indicated in this clause as mandatory ("shall") and that is indicated as strongly recommended ("should").

Also, the error handling of the network is only considered as mandatory or strongly recommended when certain thresholds for errors are not reached during a dedicated connection.

9.2 Handling of unknown, unforeseen and erroneous protocol data in messages sent over the PC8* interface

9.2.1 Unforeseen message type

If the UE receives a PC8* message with a message type corresponding to a ProSe discovery or a ProSe commuication for ranging and sidelink positioning that the UE is not authorised to use by the network, the UE shall discard the message.

If the SLPKMF receives a PC8* message, whose message type indicates that this corresponds to a ProSe discovery or a ProSe communication for ranging and sidelink positioning the sending UE is not authorised to support, the SLPKMF shall discard the message.

9.3 Handling of unknown, unforeseen and erroneous protocol data in messages sent over the PC5 interface

For V2X capable UE, the handling of unknown, unforeseen, and erroneous PC5 signalling protocol data defined in clause 6A of 3GPP TS 24.587 [4] is applied.

For 5G ProSe capable UE, the the handling of unknown, unforeseen, and erroneous PC5 signalling protocol data defined in clause 9.3 of 3GPP TS 24.554 [6] is applied.

10. Message functional definition and contents

10.1 Overview

This clause contains the definition and contents of the messages used in the procedures described in the present document.

10.2 5G ProSe direct discovery for ranging and sidelink positioning procedure messages

10.2.1 Message definition

This message is sent by the UE over the PC5 interface for 5G ProSe direct discovery for ranging and sidelink positioning procedure.

Message type: PROSE PC5 DISCOVERY

Significance: dual

Direction: UE to peer UE

Table 10.2.1.1: PROSE PC5 DISCOVERY message for ranging and sidelink positioning UE discovery announcement

IEI	Information Element	Type/Reference	Presence	Format	Length
	ProSe direct discovery PC5 message type (NOTE)	ProSe direct discovery PC5 message type 11.2.1	M	V	1
	RSPP metadata	RSPP metadata 11.2.2	M	LV-E	3-4
	Announcer info	Application layer ID 11.2.3	M	LV	2-256
xx	Serving PLMN ID	PLMN ID 11.2.4	O	TLV	5
NOTE: The discovery type is set to "Restricted discovery", the content type is set to "Ranging and sidelink positioning UE discovery announcement" as defined in clause 11.2.1 of 3GPP TS 24.554 [6].					

Table 10.2.1.2: PROSE PC5 DISCOVERY message for ranging and sidelink positioning UE discovery solicitation

IEI	Information Element	Type/Reference	Presence	Format	Length
	ProSe direct discovery PC5 message type (NOTE)	ProSe direct discovery PC5 message type 11.2.1	M	V	1
X1	RSPP metadata	RSPP metadata 11.2.2	O	TLV-E	4-5
X2	Discoveree user info	Application layer ID 11.2.3	O	TLV	3-257
xx	Discoverer user info	Application layer ID 11.2.3	O	TLV	3-257
NOTE: The discovery type is set to "Restricted discovery", the content type is set to "Ranging and sidelink positioning UE discovery solicitation" as defined in clause 11.2.1 of 3GPP TS 24.554 [6].					

Table 10.2.1.3: PROSE PC5 DISCOVERY message for ranging and sidelink positioning UE discovery response

IEI	Information Element	Type/Reference	Presence	Format	Length
	ProSe direct discovery PC5 message type (NOTE)	ProSe direct discovery PC5 message type 11.2.1	M	V	1
	RSPP metadata	RSPP metadata 11.2.2	M	LV-E	TBD
	Discoveree user info	Application layer ID 11.2.3	M	LV	2-256
xx	Serving PLMN ID	PLMN ID 11.2.4	O	TLV	5
NOTE: The discovery type is set to "Restricted discovery", the content type is set to "Ranging and sidelink positioning UE discovery response" as defined in clause 11.2.1 of 3GPP TS 24.554 [6].					

Table 10.2.1.4: PROSE PC5 DISCOVERY message group member discovery announcement for ranging and sidelink positioning

IEI	Information Element	Type/Reference	Presence	Format	Length
	ProSe direct discovery PC5 message type (NOTE)	ProSe direct discovery PC5 message type 11.2.1	M	V	1
	Application layer group ID	Application layer group ID	M	LV	2-256
	Announcer info	Application layer ID 11.2.3	M	LV	2-256
	RSPP metadata	RSPP metadata 11.2.2	M	LV-E	3-4
xx	Serving PLMN ID	PLMN ID 11.2.4	O	TLV	5
NOTE: The discovery type is set to "Restricted discovery", the content type is set to "Group member discovery announcement for ranging and sidelink positioning" as defined in clause 11.2.1 of 3GPP TS 24.554 [6].					

Table 10.2.1.5: PROSE PC5 DISCOVERY message for group member discovery solicitation for ranging and sidelink positioning

IEI	Information Element	Type/Reference	Presence	Format	Length
	ProSe direct discovery PC5 message type (NOTE)	ProSe direct discovery PC5 message type 11.2.1	M	V	1
	Application layer group ID	Application layer group ID	M	LV	2-256
	Discoverer info	Application layer ID 11.2.3	M	V	2-256
X1	RSPP metadata	RSPP metadata 11.2.2	O	TLV-E	4-5
28	Target user info	Application layer ID 11.2.3	O	TLV	3-257
NOTE: The discovery type is set to "Restricted discovery", the content type is set to "Group member discovery solicitation for ranging and sidelink positioning" as defined in clause 11.2.1 of 3GPP TS 24.554 [6].					

Table 10.2.1.6: PROSE PC5 DISCOVERY message for group member discovery response for ranging and sidelink positioning

IEI	Information Element	Type/Reference	Presence	Format	Length
	ProSe direct discovery PC5 message type (NOTE)	ProSe direct discovery PC5 message type 11.2.1	M	V	1
	Application layer group ID	Application layer group ID	M	LV	2-256
	Discoveree info	Application layer ID 11.2.3	M	LV	2-256
	RSPP metadata	RSPP metadata 11.2.2	M	LV-E	3-4
xx	Serving PLMN ID	PLMN ID 11.2.4	O	TLV	5
NOTE: The discovery type is set to "Restricted discovery", the content type is set to "Group member discovery response for ranging and sidelink positioning" as defined in clause 11.2.1 of 3GPP TS 24.554 [6].					

10.3 Coding of Security for ranging and sidelink positioning messages

10.3.1 General

This clause defines the XML schema and MIME type related to 5G Prose security messages for ranging and sidelink positioning.

10.3.2 application/vnd.3gpp-rangingsl-pc8*+xml

The MIME type is used to carry information related to the 5G ProSe security operation for ranging and sidelink positioning. It shall be coded as an XML document containing one of the following 5G ProSe security messages for ranging and sidelink positioning:

a) a PROSE_UE_SLPK_REQUEST message;

b) a PROSE_UE_SLPK_RESPONSE message;

c) a PROSE_SLPK_REQUEST message; and

d) a PROSE_SLPK_RESPONSE message.

Each of those messages is presented in the XML document as an XML element named after the corresponding message.

10.3.3 XML schema

Implementations in compliance with the present document shall implement the XML schema defined below for messages used in 5G ProSe security procedures for ranging and sidelink positioning over PC8* interface.

```
<?xml version="1.0" encoding="UTF-8"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema"
           xmlns="urn:3GPP:ns:Ranging_SL:Security:2024"
           elementFormDefault="qualified"
           targetNamespace="urn:3GPP:ns:Ranging_SL:Security:2024">
        <xs:annotation>
            <xs:documentation>
                Info for Ranging_SL Security Control Messages Syntax
            </xs:documentation>
        </xs:annotation>

  <xs:complexType name="empty-type"/>

<!-- Complex types defined for transaction-level -->
  <xs:complexType name="UE-SLPK-request-type">
    <xs:sequence>
      <xs:element name="transaction-ID" type="xs:integer"/>
      <xs:element name="SLPK-ID" type="xs:string" minOccurs="0" />
      <xs:element name="anyExt" type="anyExtType" minOccurs="0"/>
      <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>

  <xs:complexType name="UE-SLPK-accept-type">
    <xs:sequence>
      <xs:element name="transaction-ID" type="xs:integer"/>
      <xs:element name="SLPK-ID" type="xs:string"/>
      <xs:element name="SLPK" type="xs:hexBinary"/>
      <xs:element name="anyExt" type="anyExtType" minOccurs="0"/>
      <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>

  <xs:complexType name="UE-SLPK-reject-type">
    <xs:sequence>
      <xs:element name="transaction-ID" type="xs:integer"/>
      <xs:element name="PC8x-control-protocol-cause-value" type="xs:integer"/>
      <xs:element name="anyExt" type="anyExtType" minOccurs="0"/>
      <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>

  <!-- Complex types defined for Message-level -->
  <xs:complexType name="PROSE_UE_SLPK_REQUEST-type">
    <xs:sequence>
     <xs:element name="UE-SLPK-request" type="UE-SLPK-request-type" minOccurs="0"
maxOccurs="unbounded"/>
     <xs:element name="anyExt" type="anyExtType" minOccurs="0"/>
     <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
```

```
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>

  <xs:complexType name="PROSE_UE_SLPK_RESPONSE-type">
    <xs:sequence>
     <xs:element name="UE-SLPK-accept" type="UE-SLPK-accept-type" minOccurs="0"
maxOccurs="unbounded"/>
     <xs:element name="UE-SLPK-reject" type="UE-SLPK-reject-type" minOccurs="0"
maxOccurs="unbounded"/>
     <xs:element name="anyExt" type="anyExtType" minOccurs="0"/>
     <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>

  <xs:complexType name="SLPK-request-type">
    <xs:sequence>
      <xs:element name="transaction-ID" type="xs:integer"/>
      <xs:element name="rangingsl-application-ID" type="xs:hexBinary"/>
      <xs:element name="SLPK-ID" type="xs:string" minOccurs="0" />
      <xs:element name="Kslp-freshness-parameter-1" type="xs:hexBinary"/>
      <xs:element name="HPLMN-ID" type="xs:hexBinary"/>
      <xs:element name="anyExt" type="anyExtType" minOccurs="0"/>
      <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>

  <xs:complexType name="SLPK-accept-type">
    <xs:sequence>
      <xs:element name="transaction-ID" type="xs:integer"/>
      <xs:element name="SLPK-ID" type="xs:string"/>
      <xs:element name="Kslp" type="xs:hexBinary"/>
      <xs:element name="Kslp-freshness-parameter-2" type="xs:hexBinary"/>
      <xs:element name="anyExt" type="anyExtType" minOccurs="0"/>
      <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>

  <xs:complexType name="SLPK-reject-type">
    <xs:sequence>
      <xs:element name="transaction-ID" type="xs:integer"/>
      <xs:element name="PC8x-control-protocol-cause-value" type="xs:integer"/>
      <xs:element name="anyExt" type="anyExtType" minOccurs="0"/>
      <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>

  <!-- Complex types defined for Message-level -->
  <xs:complexType name="PROSE_SLPK_REQUEST-type">
    <xs:sequence>
     <xs:element name="SLPK-request" type="SLPK-request-type" minOccurs="0" maxOccurs="unbounded"/>
     <xs:element name="anyExt" type="anyExtType" minOccurs="0"/>
     <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>

  <xs:complexType name="PROSE_SLPK_RESPONSE-type">
    <xs:sequence>
     <xs:element name="SLPK-accept" type="SLPK-accept-type" minOccurs="0" maxOccurs="unbounded"/>
     <xs:element name="SLPK-reject" type="SLPK-reject-type" minOccurs="0" maxOccurs="unbounded"/>
     <xs:element name="anyExt" type="anyExtType" minOccurs="0"/>
     <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:anyAttribute namespace="##any" processContents="lax"/>
  </xs:complexType>

  <!--  XML attribute for any future extensions  -->
  <xs:complexType name="anyExtType">
    <xs:sequence>
      <xs:any namespace="##any" processContents="lax" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
  </xs:complexType>
```

```
<!--  Top level Security Message definition  -->
  <xs:element name="rangingsl-security-message">
    <xs:complexType>
      <xs:choice>
        <xs:element name="PROSE_UE_SLPK_REQUEST" type="PROSE_UE_SLPK_REQUEST-type"/>
        <xs:element name="PROSE_UE_SLPK_RESPONSE" type="PROSE_UE_SLPK_RESPONSE-type"/>
        <xs:element name="PROSE_SLPK_REQUEST" type="PROSE_SLPK_REQUEST-type"/>
        <xs:element name="PROSE_SLPK_RESPONSE" type="PROSE_SLPK_RESPONSE-type"/>
        <xs:any namespace="##other" processContents="lax"/>
      </xs:choice>
    </xs:complexType>
  </xs:element>

</xs:schema>
```

10.3.4 Semantics

10.3.4.1 General

The <rangingsl-security-message> element is the root element of this XML document and it can be one of the following elements:

a) <PROSE_UE_SLPK_REQUEST>;

b) <PROSE_UE_SLPK_RESPONSE>;

c) <PROSE_SLPK_REQUEST>; and

d) <PROSE_SLPK_RESPONSE>.

10.3.4.2 Semantics of <PROSE_UE_SLPK_REQUEST> element

The <PROSE_UE_SLPK_REQUEST> element contains:

a) zero or more <UE-SLPK-request> elements which contain transactions sent from the UE to the SLPKMF;

b) zero or one <anyExt> element containing elements defined in future releases;

c) zero or more elements from other namespaces defined in future releases; and

d) zero or more attributes defined in future releases.

The <UE-SLPK-request> element contains:

a) a <transaction-ID> element containing the parameter defined in clause 11.3.1;

b) zero or one <SLPK-ID> element containing the parameter defined in clause 11.3.3;

c) zero or one <anyExt> element containing elements defined in future releases;

d) zero or more elements from other namespaces defined in future releases; and

e) zero or more attributes defined in future releases;

10.3.4.3 Semantics of <PROSE_UE_SLPK_RESPONSE> element

The <PROSE_UE_SLPK_RESPONSE> element contains:

a) zero or more <UE-SLPK-accept> elements which contain the accepted transactions;

b) zero or more <UE-SLPK-reject> elements which contain the rejected transactions;

c) zero or one <anyExt> element containing elements defined in future releases;

d) zero or more elements from other namespaces defined in future releases; and

e) zero or more attributes defined in future releases.

The <UE-SLPK-accept> element contains:

a) a <transaction-ID> element containing the parameter defined in clause 11.3.1;

b) a <SLPK-ID> element containing the parameter defined in clause 11.3.3;

c) a <SLPK> element containing the parameter defined in clause 11.3.2;

d) zero or one <anyExt> element containing elements defined in future releases;

e) zero or more elements from other namespaces defined in future releases; and

f) zero or more attributes defined in future releases.

The <UE-SLPK-reject> element contains:

a) a <transaction-ID> element containing the parameter defined in clause 11.3.1;

b) a <PC8x-control-protocol-cause-value> element containing the parameter defined in clause 11.3.4;

c) zero or one <anyExt> element containing elements defined in future releases;

d) zero or more elements from other namespaces defined in future releases; and

e) zero or more attributes defined in future releases.

10.3.4.2 Semantics of <PROSE_SLPK_REQUEST> element

The <PROSE_SLPK_REQUEST> element contains:

a) zero or more < SLPK-request> elements which contain transactions sent from the UE to the SLPKMF;

b) zero or one <anyExt> element containing elements defined in future releases;

c) zero or more elements from other namespaces defined in future releases; and

d) zero or more attributes defined in future releases.

The <SLPK-request> element contains:

a) a <transaction-ID> element containing the parameter defined in clause 11.3.1;

b) a <rangingsl-application-ID> element containing the parameter defined in clause 11.3.8;

c) a <SLPK-ID> element containing the parameter defined in clause 11.3.3;

e) a <Kslp-freshness-parameter-1> element containing the parameter defined in clause 11.3.6;

f) zero or one <HPLMN-ID> element;

i) zero or one <anyExt> element containing elements defined in future releases;

j) zero or more elements from other namespaces defined in future releases; and

k) zero or more attributes defined in future releases.

10.3.4.3 Semantics of <PROSE_SLPK_RESPONSE> element

The <PROSE_SLPK_RESPONSE> element contains:

a) zero or more <SLPK-accept> elements which contain the accepted transactions;

b) zero or more <SLPK-reject> elements which contain the rejected transactions;

c) zero or one <anyExt> element containing elements defined in future releases;

d) zero or more elements from other namespaces defined in future releases; and

e) zero or more attributes defined in future releases.

The <SLPK-accept> element contains:

a) a <transaction-ID> element containing the parameter defined in clause 11.3.1;

b) a <SLPK-ID> element containing the parameter defined in clause 11.3.3;

c) a <Kslp> element containing the parameter defined in clause 11.3.5;

d) a <Kslp-freshness-parameter-2> element containing the parameter defined in clause 11.3.7;

f) zero or one <anyExt> element containing elements defined in future releases;

g) zero or more elements from other namespaces defined in future releases; and

h) zero or more attributes defined in future releases.

The <SLPK-reject> element contains:

a) a <transaction-ID> element containing the parameter defined in clause 11.3.1;

b) a <PC8x-control-protocol-cause-value> element containing the parameter defined in clause 11.3.4;

c) zero or one <anyExt> element containing elements defined in future releases;

d) zero or more elements from other namespaces defined in future releases; and

e) zero or more attributes defined in future releases.

10.4 Supplementary RSPP signaling over PC5-U messages

10.4.1 sidelink positioning service request procedure messages

10.4.1.1 Message definition

This message is sent by the initiating UE to request the ranging and sidelink positioning result from a target UE over the PC5-U interface.

Message type: SIDELINK POSITIONING SERVICE REQUEST

Significance: dual

Direction: UE to peer UE

Table 10.4.1.1 SIDELINK POSITIONING SERVICE REQUEST message

IEI	Information Element	Type/Reference	Presence	Format	Length
	SIDELINK POSITIONING SERVICE REQUEST message identity	PC5-U message type 11.4.1	M	V	1
	Transaction ID	Transaction ID 11.4.2	M	V	2
	Source user info	Related user info 11.4.3	M	LV	3-257
y1	Target UE	Related user info 11.4.3	O	TLV	4-258
y2	SL reference UE list	List of related user info 11.4.4	O	TLV-E	TBD
y3	Requested sidelik results	Requested sidelik results 11.4.5	O	TV	2
y4	Related UE list	List of related user info 11.4.4	O	TLV-E	TBD
y5	Location QoS	Location QoS 11.4.6	O	TV	12

10.4.1.2 Target UE

The UE shall include this IE to indicate the user info of target UE for ranging and sidelink positioning if the message is exchanged between the sidelink SL positioning client UE and the target UE or SL reference UE or located UE for ranging and sidelink positioning service exposure through PC5.

10.4.1.3 SL reference UE list

The UE shall include this IE to indicate the info of SL reference UE(s) for ranging and sidelink positioning if the message is exchange between the sidelink SL positioning client UE and the target UE or SL reference UE or located UE for ranging and sidelink positioning service exposure through PC5.

10.4.1.4 Requested sidelik results

The UE shall include this IE to indicate the requested ranging location results, including absolute locations, relative locations or ranges and directions related to the UEs for ranging and sidelink positioning for the following:

- if the message is exchanged between the target UE or SL reference UE and the SL positioning server UE for UE-only operation in the ranging and sidelink positioning control procedure as defined in clause 6.8 of 3GPP TS 23.586 [2]; or
- if the message is exchanged between the target UE and the located UE to request the absolute location from a located UE for ranging and sidelink positioning during the Sidelink Mobile Originated Location Request (SL-MO-LR) procedure as defined in 3GPP TS 23.273 [11], and the requested ranging location results is set to absolute locations in the case.

10.4.1.5 Related UE list

The UE shall include this IE including application layer ID(s) and optional the UE role of each UE if the message is exchanged between the target UE or SL reference UE and the SL positioning server UE for UE-only operation in the ranging and sidelink positioning control procedure as defined in clause 6.8 of 3GPP TS 23.586 [2].

10.4.1.6 Location QoS

The UE may include this IE including the required QoS for ranging and sidelink positioning if the requested sidelik results is included.

10.4.2 sidelink positioning service response procedure messages

10.4.2.1 Message definition

This message is sent by a UE to another peer UE to response the received SIDELINK POSITIONING SERVICE RESPONSE message over the PC5-U interface. See table 10.4.2.1.1.

Message type: SIDELINK POSITIONING SERVICE RESPONSE

Significance: dual

Direction: UE to peer UE

Table 10.4.2.1.1 SIDELINK POSITIONING SERVICE RESPONSE message

IEI	Information Element	Type/Reference	Presence	Format	Length
	SIDELINK POSITIONING SERVICE RESPONSE message identity	PC5-U message type 11.4.1	M	V	1
	Transaction ID	Transaction ID 11.4.2	M	V	2
	Sidelink positioning result	List of sidelink positioning results 11.4.7	M	V	TBD

10.4.3 Sidelink positioning SLPP transport message

10.4.3.1 Message definition

This message is sent by a UE to another peer UE to transport the SLPP message(s) and the associated UE's application layer ID(s) of the SLPP message(s) as specified in clause 6.8 of 3GPP TS 23.586 [2]. See table 10.4.3.1.1.

Message type: SIDELINK POSITIONING SLPP TRANSPORT

Significance: dual

Direction: UE to peer UE

Table 10.4.3.1.1:SIDELINK POSITIONING SLPP TRANSPORT message content

IEI	Information Element	Type/Reference	Presence	Format	Length
	SIDELINK POSITIONING SLPP TRANSPORT message identity	PC5-U message type 11.4.1	M	V	1
	SLPP PDU list	List of SLPP PDUs 11.4.8	M	LV-E	TBD

11. Information elements coding

11.1 Overview

11.2 PC5 direct discovery message formats

11.2.1 ProSe direct discovery PC5 message type

This parameter is used to indicate the type of ProSe direct discovery message over PC5 interface as specified in clause 11.2.1 of 3GPP TS 24.554 [6].

11.2.2 RSPP metadata

This parameter carries the metadata information.

The RSPP metadata information element is coded as shown in Figure 11.2.2.1 and Table 11.2.2.1.

The RSPP metadata is a type 6 information element.

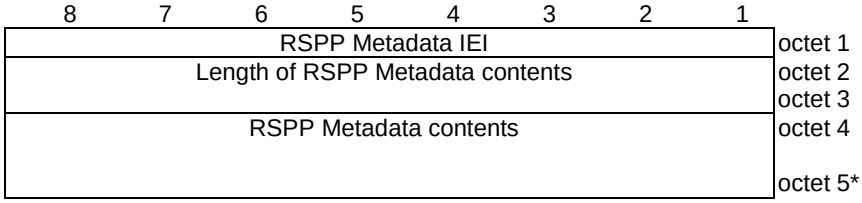

Figure 11.2.2.1: RSPP metadata information element

Table 11.2.2.1: RSRP metadata information element

The length of RSPP metadata contents field contains the binary coded representation of the length of the Metadata contents field. The RSPP Metadata contents field contains the octets indicating the RSPP metadata parameter. The format of the RSPP metadata parameter is coded as RSPP-Metadata as specified in clause 6.11 of 3GPP TS 38.355 [12].

11.2.3 Application layer ID

The user info ID parameter carries an application layer ID as specified in clause 11.2.15 of 3GPP TS 24.554 [6].

11.2.4 PLMN ID

The PLMN ID information element is coded as the PLMN identity information element specified in clause 9.11.3.85 of 3GPP TS 24.501 [3].

11.2.5 Application layer group ID

This parameter carries an identifier of an application layer group that the UE belongs to as specified in clause 11.2.6 of 3GPP TS 24.554 [6].

11.3 Security for ranging and sidelink positioning message formats

11.3.1 Transition ID

This parameter is used to uniquely identify a PC8* control protocol for Ranging_SL security transaction when it is combined with other PC8* control protocol for Ranging_SL security transactions in the same transport message. The UE shall set this parameter to a new number for each outgoing new key request. The transaction ID is an integer in the 0-255 range.

11.3.2 SLPK

This parameter is used to indicate the SLPK allocated by the SLPKMF. The calculation of the SLPK is defined in 3GPP TS 33.533 [5].

11.3.3 SLPK-ID

This parameter is used to indicate the identifier of the UE stored SLPK.

11.3.4 PC8* control protocol cause value

This parameter is used to indicate the particular reason why a PROSE_UE_SLPK_REQUEST message from the UE has been rejected by the SLPKMF. It is an integer in the 0-255 range encoded in Table 11.3.4.

Table 11.3.4: PC8* control protocol cause value

0 Reserved
3 UE authorization failure
1, 2, 4-255 Unused

11.3.5 K_{SLP}

This parameter is used to provide a 256-bit K_{SLP} as specified in 3GPP TS 33.533 [5].

11.3.6 K_{SLP} freshness parameter 1

This parameter is used to indicate 128-bit long K_{SLP} freshness parameter 1 as specified in 3GPP TS 33.533 [5].

11.3.7 K_{SLP} freshness parameter 2

This parameter is used to indicate 128-bit long K_{SLP} freshness parameter 2 as specified in 3GPP TS 33.533 [5].

11.3.8 rangingsl-application-ID

This parameter is used to identify the particular application that triggers the security operation for ranging and sidelink positioning. This information element is coded as the ProSe identifier specified in clause 11.3.3 of 3GPP TS 24.554 [6].

11.4 Supplementary RSPP signaling message formats

11.4.1 PC5-U message type

The purpose of the PC5-U message type information element is to indicate the type of messages used over PC5 user plane.

The value part of the PC5-U message type information element is coded as shown in table 11.4.1.1.

The PC5-U message type is a type 3 information element, with the length of 1 octet.

Table 11.4.1.1: PC5-U message type

Bits								
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**	
0	0	0	0	0	0	0	1	SIDELINK POSITIONING SERVICE REQUEST
0	0	0	0	0	0	1	0	SIDELINK POSITIONING SERVICE RESPONSE
0	0	0	0	0	0	1	1	SIDELINK POSITIONING SERVICE REJECT
0	0	0	0	0	1	0	0	SIDELINK POSITIONING SLPP TRANSPORT
The other values are reserved.								

11.4.2 Transaction ID

This parameter is used to uniquely identify a PC5-U transaction when it is combined with other PC5-U transactions in the same transport message. The transaction ID is an integer in the 0-255 range.

11.4.3 Related user info

The purpose of the related user info parameter information element carries an application layer ID as specified in clause 11.2.5 and the associated UE role of the UE acts in the ongoing ranging and sidelink positioning service.

The related user info information element is coded as shown in figure 11.4.3.1 and table 11.4.3.1.

The related user info is a type 4 information element.

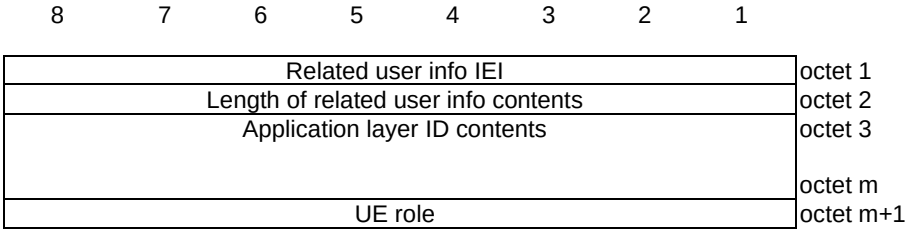

Figure 11.4.3.1: Related user info information element

Table 11.4.3.1: Related user info information element

The length of related user info contents field contains the binary coded representation of the length of the related user info contents field. Application layer ID (octet 2 to m) The Application layer ID field contains the user info ID parameter carries an application layer ID as specified in clause 11.2.15 of 3GPP TS 24.554 [6]. UE role (octet m+1) The UE role field contains the role the UE acts in the ongoing ranging and sidelink positioning service.

Table 11.4.3.2: UE role

Bits								
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**	
0	0	0	0	0	0	0	1	LOCATED_UE
0	0	0	0	0	0	1	0	SL REFERENCE_UE
0	0	0	0	0	0	1	1	TARGET_UE
0	0	0	0	0	1	0	0	SL POSITINING SERVER_UE
0	0	0	0	0	1	0	1	SL POSITINING CLIENT_UE
All other values reserved								

11.4.4 List of related user info

The List of related user info contains a list of related user info as specified in clause 11.4.3.

The list of related user info information element is coded as shown in figure 11.4.4.1 and table 11.4.4.1.

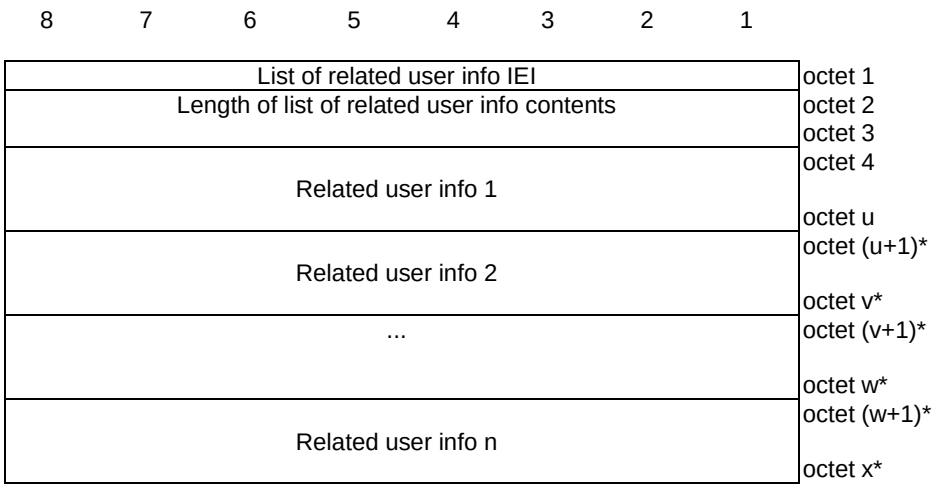

Figure 11.4.4.1: List of related user info information element

Table 11.4.4.1: List of Related user info information element

The length of list of related user info contents field contains the binary coded representation of the length of the list related user info contents field. Related user info (octet 4 u) The related user info field contains an application layer ID and the associated UE role as specified in clause 11.4.3.

11.4.5 Requested sidelink results

The requested sidelink results contains the sidelink result type(s).

The requested sidelink results information element is coded as shown in figure 11.4.5.1 and table 11.4.5.1.

8	7	6	5	4	3	2	1	
Requested sidelink results IEI								octet 1
0 Spare	RelVel	Velocity	Direction	Range	Range Dir	RelLoc	AbLoc	octet 2

Table 11.4.5.2: Ranging sidelink result

Requested sidelink results (octet 2)
Absolute location requested (octet 2, bit 8)
0 The absolute location of the target UE not requested
1 The absolute location of the target UE requested
Relative location requested (octet 3, bit 7)
0 The position of the target UE relative to other UEs not requested
1 The position of the target UE relative to other UEs requested
Range and direction requested (octet 3, bit 6)
0 The distance and the direction between two UEs or more UEs not requested
1 The distance and the direction between two UEs or more UEs requested
Range requested (octet 3, bit 5)
0 The distance between two UEs or more UEs not requested
1 The distance between two UEs or more UEs requested
Direction requested (octet 3, bit 4)
0 The direction between two UEs or more UEs not requested
1 The direction between two UEs or more UEs requested
Velocities requested (octet 3, bit 3)
0 The velocities of the target UE not requested
1 The velocities of the target UE requested
Relative velocities requested (octet 3, bit 2)
0 The velocities of the target UE relative to other UEs not requested
1 The velocities of the target UE relative to other UEs requested

11.4.6 Location QoS

The location QoS is used to indicate the required QoS of the result requested for ranging and sidelink positioning.

The location QoS information element is coded as shown in figure 11.4.6.1 and table 11.4.6.1.

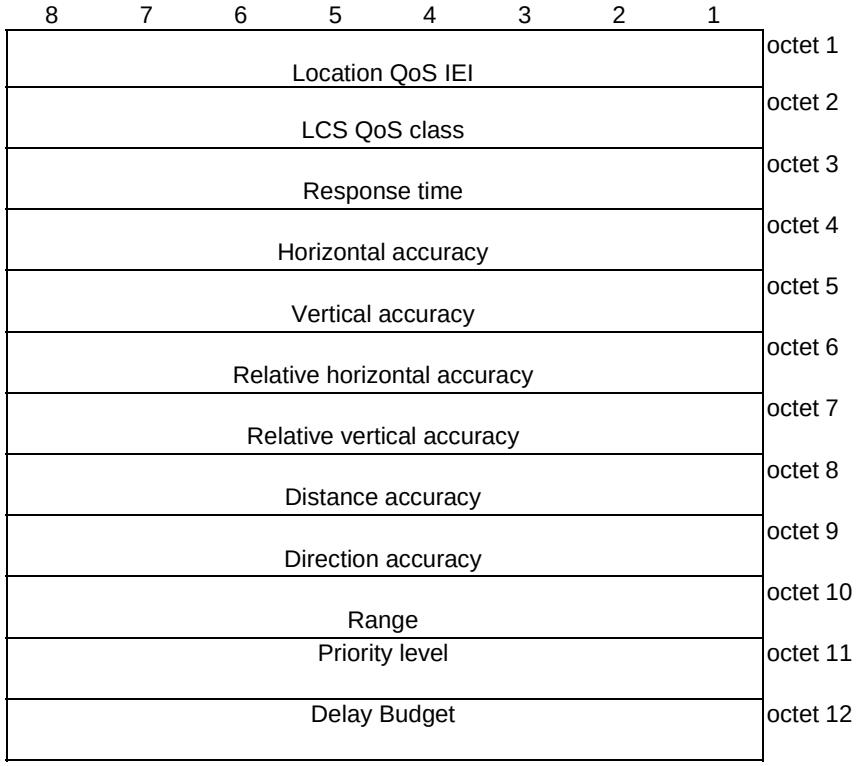

Figure 11.4.6.1: Location QoS information element

Table 11.4.6.1: Location QoS information element

LCS QoS class (octet 2):
Bits
8 7 6 5 4 3 2 1
0 0 0 0 0 0 0 0 Reserved
0 0 0 0 0 0 0 1 Best effort class
0 0 0 0 0 0 1 0 Multiple QoS class
0 0 0 0 0 0 1 1 Assured class
The other values are spare.

Response time (octet 3):
Bits
8 7 6 5 4 3 2 1
0 0 0 0 0 0 0 0 Reserved
0 0 0 0 0 0 0 1 No delay
0 0 0 0 0 0 1 0 Low delay
0 0 0 0 0 0 1 1 Delay tolerant
The other values are spare.

Accuracy (octet 4/5/6/7/8/9):
The accuracy field is a binary encoded value of the accuracy.

Range (octet 10):
The range field indicates a binary encoded value of the range in meters. The range indicates the applicability of the QoS parameters over PC5.

Priority level (octet 11):
The priority level field indicates the SL-PRS priority, same as the number of priority levels for SL-SCH.

Delay Budget (octet 12):
The delay budget field indicates the ranging and sidelink positioning service latency.

11.4.7 List of sidelink positioning results

The purpose of the list of sidelink positioning results parameter information element carries one absolute location or a list of relative locations.

The list of sidelink positioning results information element is coded as shown in figure 11.4.7.1 and table 11.4.7.1.

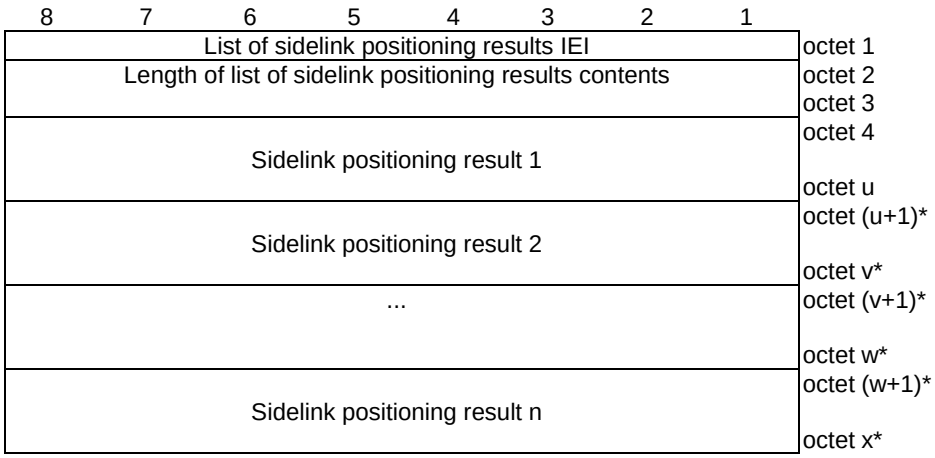

Figure 11.4.7.1: List of sidelink positioning results information element

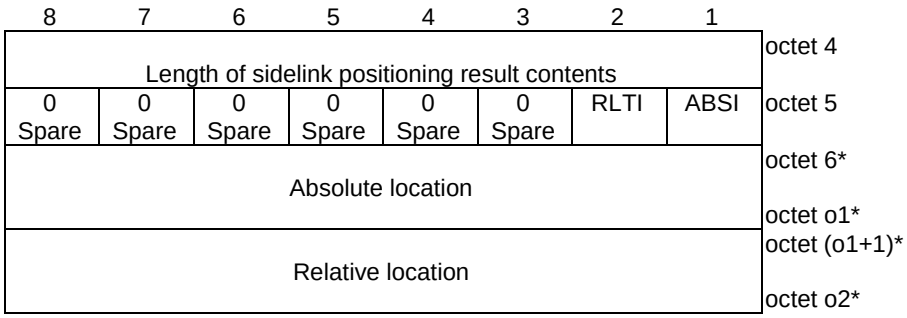

Figure 11.4.7.2: Sidelink positioning result information element

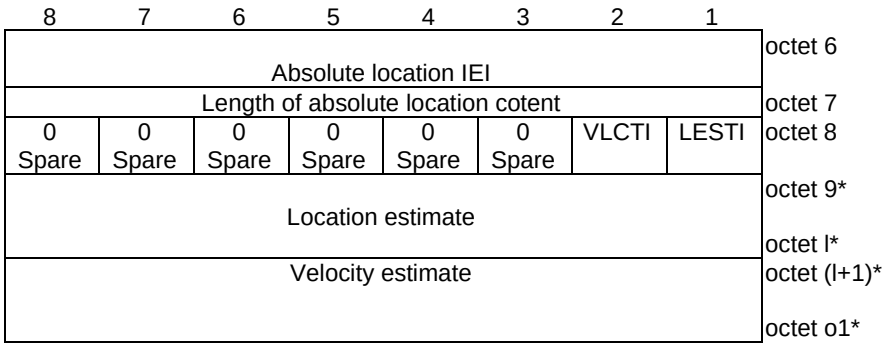

Figure 11.4.7.3: Absolute location information element

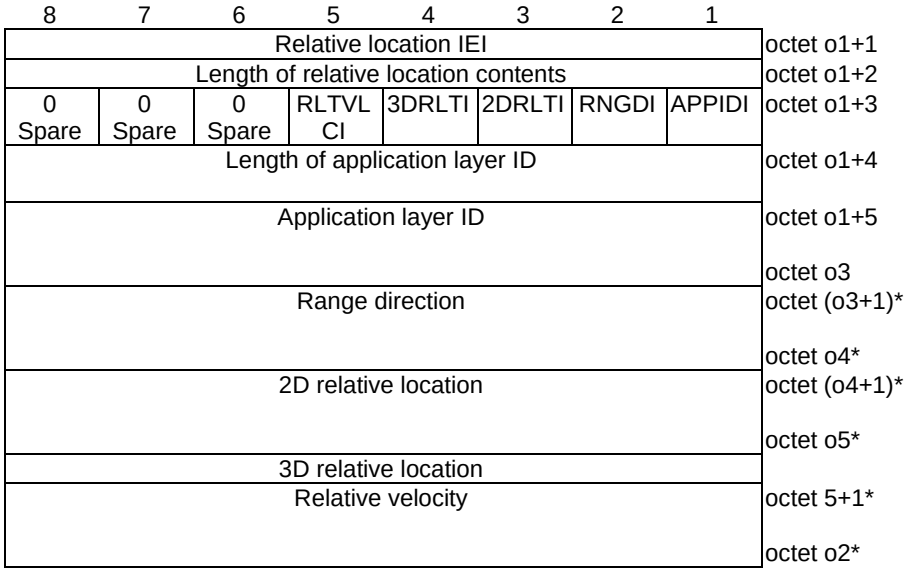

Figure 11.4.7.4: Relative location information element

Table 11.4.7.1: List of sidelink positioning results information element

Absolute location indication (octet 5, bit 1) (NOTE 1) Bit **1** 0 Absolute location does not exist 1 Absolute location exists
Relative location indication (octet 5, bit 1) (NOTE 1) Bit **2** 0 Relative location does not exist (octet 5, bit 1) ion does not exist 1 Relative location exists
Location estimate (octet 7 to l) The Location estimate field contains the content of absolute location of a UE as specified in 3GPP TS 23.273 [11].
Location estimate (octet 7 to l) The Velocity estimate field contains the content of absolute velocity of a UE as specified in 3GPP TS 23.273 [11].
Location estimate indication (octet 8, bit 1) (NOTE 2) Bit **1** 0 Location estimate does not exist 1 Location estimate exists
Velocity estimate indication (octet 8, bit 2) (NOTE 2) Bit **2** 0 Velocity estimate does not exist 1 Velocity estimate exists
Application layer ID indication (octet o1+3, bit 1) Bit **1** 0 Application layer ID does not exist 1 Application layer ID exists
Range direction indication (octet o1+3, bit 2) (NOTE 3) Bit **2** 0 Range direction does not exist 1 Range direction exists
2D relative location indication (octet o1+3, bit 3) (NOTE 3) Bit **3** 0 2D relative location does not exist 1 2D relative location exists
3D relative location indication (octet o1+3, bit 4) (NOTE 3) Bit **4** 0 3D relative location does not exist 1 3D relative location exists
Relative velocity indication (octet o1+3, bit 5) (NOTE 3) Bit **5** 0 Relative velocity does not exist 1 Relative velocity exists
Application layer ID (octet o1+3 to o3) The Application layer ID field contains the user info ID parameter carries an application layer ID as specified in clause 11.2.15 of 3GPP TS 24.554 [6]. The Range direction field contains a range and direction from a point A to a point B, comprising a range, an azimuth direction, and an elevation direction from the target UE to a UE identified with the application layer ID as specified 3GPP TS 23.273 [11].
The 2D relative location field contains a relative 2D location with uncertainty ellipse, characterised by a point described in 2D local co-ordinates with origin corresponding to another known point identified with the application layer ID, distances r1 and r2 and an angle of orientation A as specified 3GPP TS 23.273 [11].

The 3D relative location field contains a relative 3D location with uncertainty ellipsoid, characterised by a point described in 3D local co-ordinates with origin corresponding to another known point identified with the application layer ID, distances r1 (the "semi-major uncertainty"), r2 (the "semi-minor uncertainty") and r3 (the "vertical uncertainty") and an angle of orientation A (the "angle of the major axis"). as specified 3GPP TS 23.273 [11].

The Relative velocity field contains UE velocity relative to the UE identified with the application layer ID as specified 3GPP TS 23.273 [11].

NOTE 1: Absolute location or Relative location exists for one sidelink positioning result.
NOTE 2: Location estimate or Velocity estimate exists for one absolute location.
NOTE 3: One of Range direction, 2D relative location, 3D relative location or Relative velocity exists for one relative location.

11.4.8 List of SLPP PDUs

The list of SLPP PDUs parameter is to indicate a list of SLPP messages and the associated UE's application layer ID for each SLPP message.

The list of SLPP PDUs information element is a type 6 information element with the minimum length of x1 octets and the maximum length of x2 length.

The list of SLPP PDUs information element is coded as shown in figure 11.4.8.1 and table 11.4.8.1.

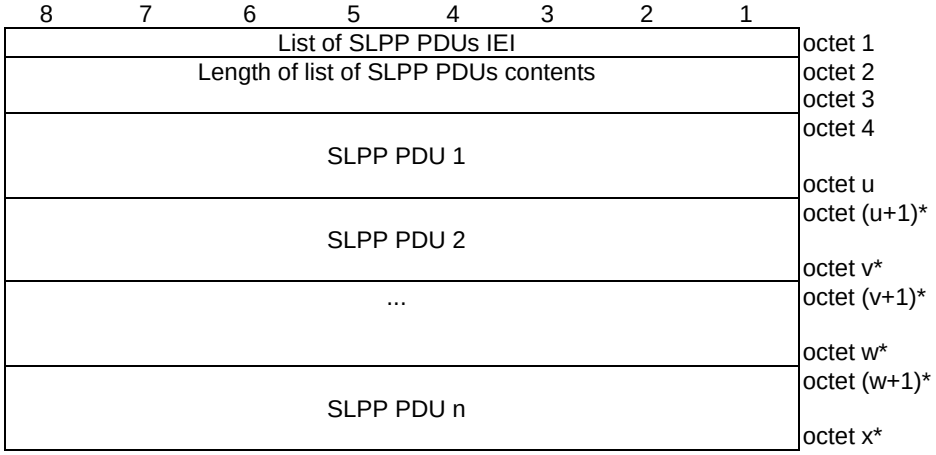

Figure 11.4.8: List of SLPP PDUs information element

Table 11.4.8: List of SLPP PDUs information element

SLPP PDU (octet 4 to u)
The SLPP PDU field contains the SLPP message and its associated UE's application layer ID and is coded as figure 11.4.8.2 and table 11.4.8.2.

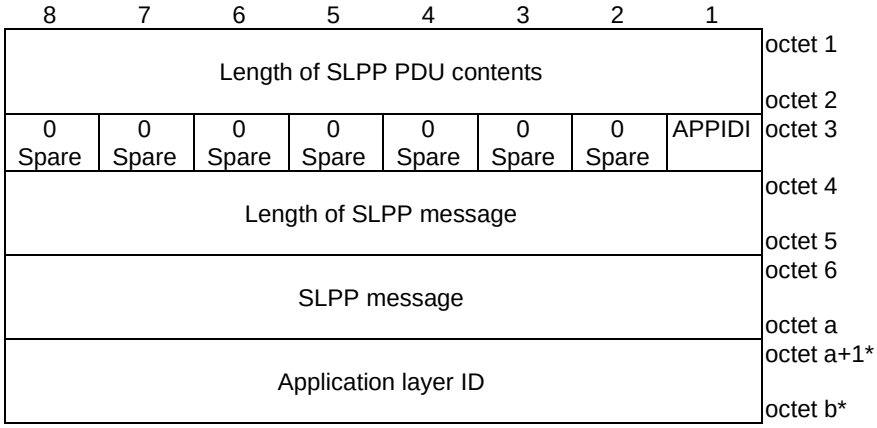

Figure 11.4.8.2: SLPP PDU

Table 11.4.8.2: SLPP PDU

Application layer ID indication (APPIDI) (octet 3 bit 1): Bit **2** 0 Application layer ID does not exist 1 Application layer ID exists
SLPP message (octet 3 to a) The SLPP message field contains the content of the SLPP message as specified in 3GPP TS 38.355 [12]. Application layer ID (octet a+1 to b) The Application layer ID field contains the user info ID parameter carries an application layer ID as specified in clause 11.2.15 of 3GPP TS 24.554 [6].

12 Encoding of UE policies for ranging and sidelink positioning

12.1 General

The UE policies for ranging and sidelink positioning are provided to the UE in a UE policy part using the UE policy delivery service as specified in 3GPP TS 24.501 [3] annex D.

The UE policies for ranging and sidelink positioning are coded in clause 12.2.

12.2 Information elements coding

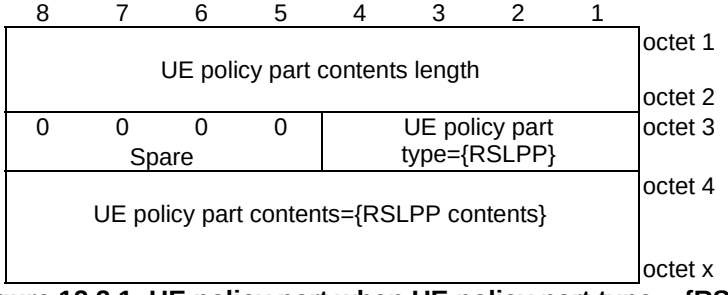

Figure 12.2.1: UE policy part when UE policy part type = {RSLPP}

Table 12.2.1: UE policy part when UE policy part type = {RSLPP}

UE policy part type field is set to '0110' (=RSLPP) as specified in 3GPP TS 24.501 [3] annex D. RSLPP contents (octets 4 to x): The RSLPP contents field is encoded in Figure 12.2.2 and Table 12.2.2.

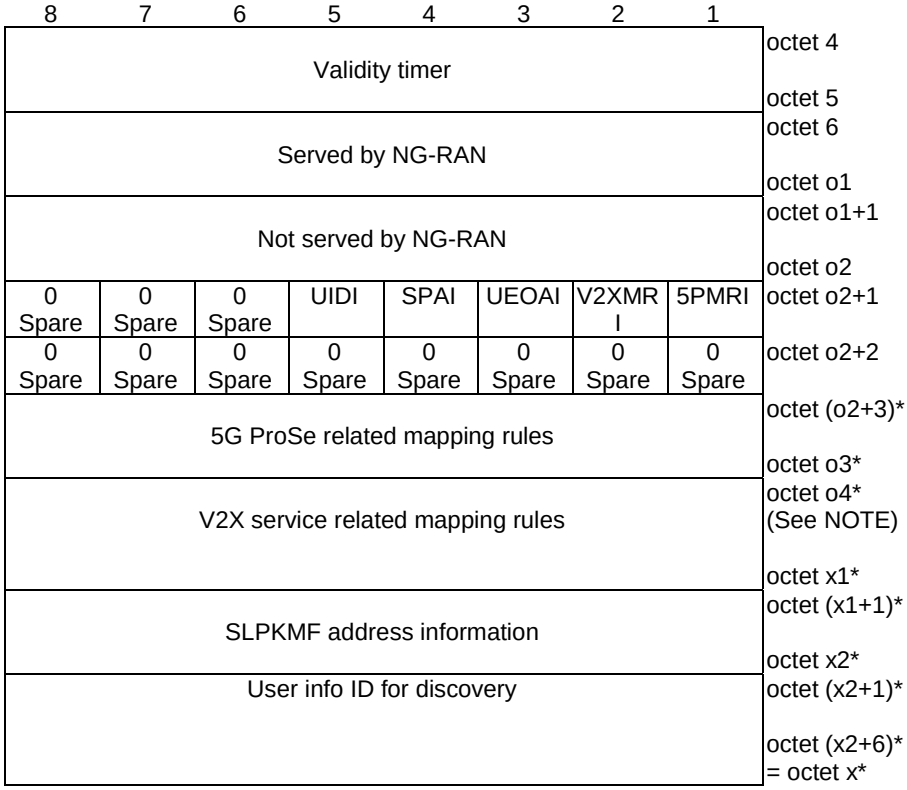

Figure 12.2.2: RSLPP contents

NOTE: The field is placed immediately after the last present preceding field.

Table 12.2.2: RSLPP contents

Validity timer (octet 4 to 5):
The validity timer field provides the expiration time of validity of the UE policies for ranging and sidelink positioning. The validity timer field is a binary coded representation of a UTC time, in seconds since midnight UTC of January 1, 1970 (not counting leap seconds).

Served by NG-RAN (octet 6 to o1):
The served by NG-RAN field is coded according to figure 12.2.3 and table 12.2.3, and contains configuration parameters for ranging and sidelink positioning when the UE is served by NG-RAN.

Not served by NG-RAN (octet o1+1 to o2):
The not served by NG-RAN field is coded according to figure 12.2.x and table 12.2.x, and contains configuration parameters for ranging and sidelink positioning when the UE is not served by NG-RAN.

5G ProSe related mapping rules indication (5PMRI) (octet o2+1 bit 1):
Bit
1
0 5G ProSe related mapping rules field is absent
1 5G ProSe related mapping rules is present

V2X service related mapping rules indication (V2XMRI) (octet o2+1 bit 2):
Bit
2
0 V2X service related mapping rules is absent
1 V2X service related mapping rules is present

UE-only operation authorization indication (UEOAI) (octet o2+1 bit 3):
Bit
3
0 UE-only operation is not authorized when the UE is served by NG-RAN and network-based operation not supported
1 UE-only operation is authorized when the UE is served by NG-RAN and network-based operation not supported by the network

SLPKMF address indication (SPAI) (octet o1+1 bit 4)
The SPAI indicates whether the SLPKMF address information is included in the IE or not
Bit
4
0 SLPKMF address information is not included
1 SLPKMF address information is included

User info ID for discovery indication (PAI) (octet o1+2 bit 5)
Bit
4
0 User info ID for discovery is not included
1 User info ID for discovery is included

5G ProSe related mapping rules (octet o2+3 to o3):
The 5G ProSe related mapping rules field is coded according to figure 12.2.7 and table 12.2.7 and includes the 5G ProSe related mapping rules.

V2X service related mapping rules (octet o4 to x1):
The V2X service related mapping rules field is coded according to figure 12.2.13 and table 12.2.13 and includes the V2X service related mapping rules.

SLPKMF address information (octet (x1+1) to x2)
SLPKMF address information contains the IPv4 address(es), IPv6 address(es) and/or FQDN of the SLPKMF and is coded according to Figure 12.2.19, Figure 12.2.20, Figure 12.2.21 and Table 12.2.19. At least one of the address parameters (FQDN, IPv4 address list or IPv6 address list) shall be included.

User info ID for discovery (octet (x2+1) to octet(x2+6)):
The value of the User info ID parameter is a 48-bit long bit string. The format of the User info ID parameter is out of scope of this specification.

If the length of RSLPP contents field is bigger than indicated in figure 12.2.2, receiving entity shall ignore any superfluous octets located at the end of the RSLPP contents.

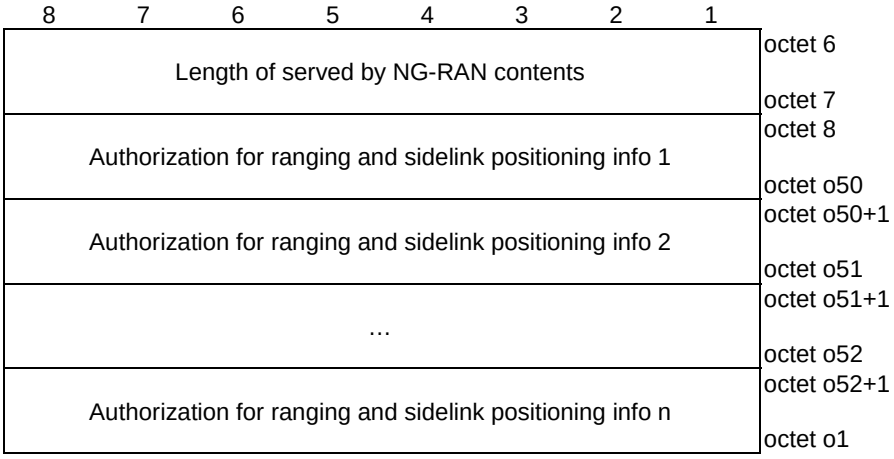

Figure 12.2.3: Served by NG-RAN

Table 12.2.3: Served by NG-RAN

Authorization for ranging and sidelink positioning info:
The authorization for ranging and sidelink positioning info field is coded according to figure 12.2.4 and table 12.2.4.

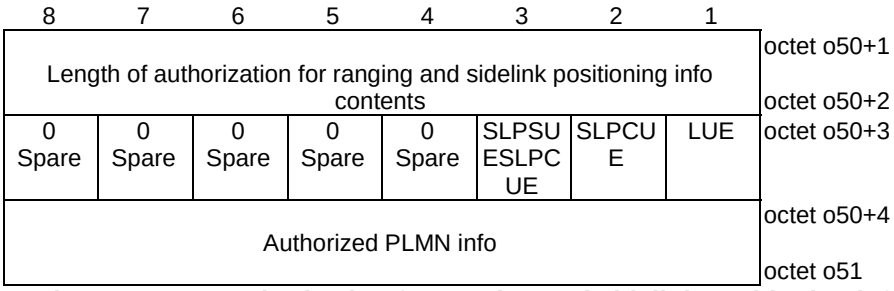

Figure 12.2.4: Authorization for ranging and sidelink positioning info

Table 12.2.4: Authorization for ranging and sidelink positioning info

Authorized PLMN info (octet o50+4 to o51): The authorized PLMN info field is coded according to figure 12.2.5 and table 12.2.5.   Located UE (LUE) (octet o51+1 bit 1): Bit **1** 0 Located UE is not authorized 1 Located UE is authorized SL positioning client UE (SLPCUE) (octet o50+3 bit 2): Bit **2** 0 SL positioning client UE is not authorized 1 SL positioning client UE is authorized SL positioning server UE (SLPSUE) (octet o50+3 bit 3): Bit **3** 0 SL positioning server UE is not authorized 1 SL positioning server UE is authorized If the length of authorization for ranging and sidelink positioning info field is bigger than indicated in figure 12.2.4, receiving entity shall ignore any superfluous octets located at the end of the authorization for ranging and sidelink positioning info.

8	7	6	5	4	3	2	1	
Length of authorized PLMN info contents								octet o50+4 octet o50+5
Authorized PLMN 1								octet (o50+6)* octet (o50+8)*
Authorized PLMN 2								octet (o50+9)* octet (o50+11)*
...								octet (o50+12)* octet o150*
Authorized PLMN n								octet (o150+1)* octet o51*

Figure 12.2.5: Authorized PLMN info

Table 12.2.5: Authorized PLMN

Authorized PLMN: The authorized PLMN field is coded according to figure 12.2.6 and table 12.2.6.

8	7	6	5	4	3	2	1	
MCC digit 2				MCC digit 1				octet o50+6
MNC digit 3				MCC digit 3				octet o50+7
MNC digit 2				MNC digit 1				octet o50+8

Figure 12.2.6: PLMN ID

Table 12.2.6: PLMN ID

Mobile country code (MCC) (octet o50+5, octet o50+6 bit 1 to 4): The MCC field is coded as in ITU-T Recommendation E.212 [7], annex A. Mobile network code (MNC) (octet o50+6 bit 5 to 8, octet o50+7): The coding of MNC field is the responsibility of each administration but BCD coding shall be used. The MNC shall consist of 2 or 3 digits. If a network operator decides to use only two digits in the MNC, MNC digit 3 shall be coded as "1111".

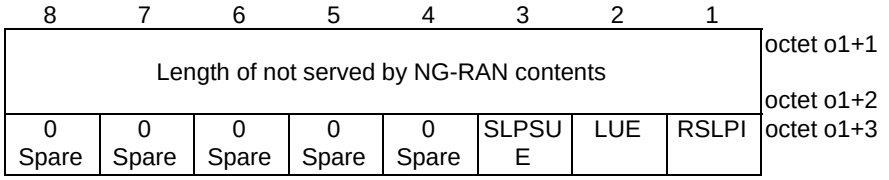

Figure 12.2.x: Not served by NG-RAN

Table 12.2.x: Not served by NG-RAN

Ranging and sidelink positioning indicator (RSLPI) (octet o1+3 bit 1): Bit **1** 0 Ranging and sidelink positioning is not authorized (NOTE) 1 Ranging and sidelink positioning is authorized Located UE (LUE) (octet o1+3 bit 2): Bit **2** 0 Located UE is not authorized 1 Located UE is authorized SL positioning server UE (SLPSUE) (octet o1+3 bit 3): Bit **3** 0 SL positioning server UE is not authorized 1 SL positioning server UE is authorized NOTE: If the RSLPI bit is set to 0, the other bits in octet o1+3 shall also be 0.

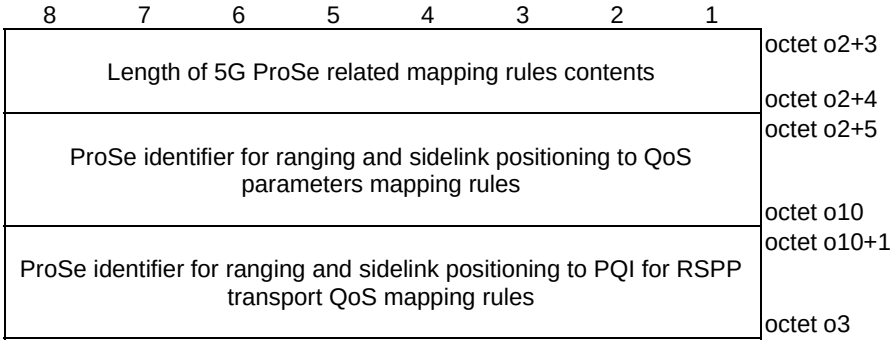

Figure 12.2.7: 5G ProSe related mapping rules

Table 12.2.7: 5G ProSe related mapping rules

ProSe identifier for ranging and sidelink positioning to QoS parameters mapping rules (octet o1+5 to o10): The ProSe identifier for ranging and sidelink positioning to ranging and sidelink positioning QoS parameters mapping rules field is coded according to figure 12.2.8 and table 12.2.8 and includes the ProSe identifier for ranging and sidelink positioning to QoS parameters mapping rules. ProSe identifier for ranging and sidelink positioning to PQI for RSPP transport QoS mapping rules (octet o10+1 to o2): The ProSe identifier for ranging and sidelink positioning to PQI for RSPP transport QoS mapping rules field is coded according to figure 12.2.8 and table 12.2.8 and includes the ProSe identifier for ranging and sidelink positioning to PQI for RSPP transport QoS mapping rules.

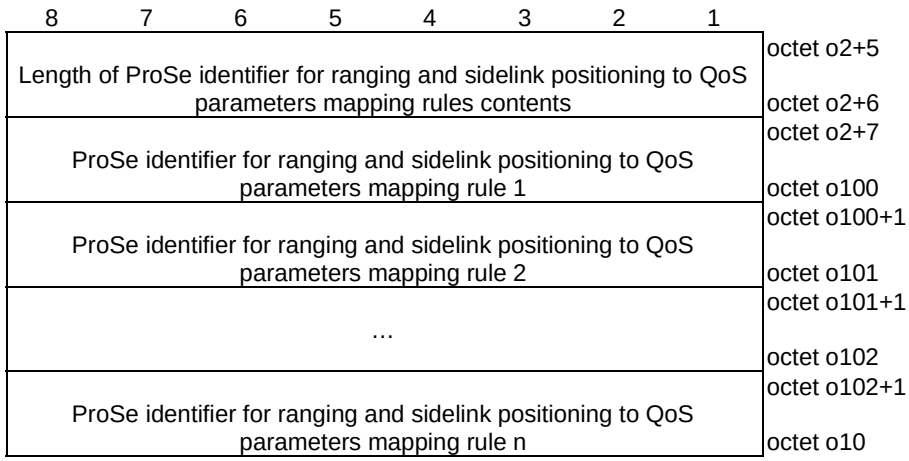

Figure 12.2.8: ProSe identifier for ranging and sidelink positioning to QoS parameters mapping rules

Table 12.2.8: ProSe identifier for ranging and sidelink positioning to QoS parameters mapping rules

ProSe identifier for ranging and sidelink positioning to QoS parameters mapping rule: The ProSe identifier for ranging and sidelink positioning to QoS parameters mapping rule field is coded according to figure 12.2.9 and table 12.2.9 and includes the ProSe identifier for ranging and sidelink positioning to QoS parameters mapping rule.

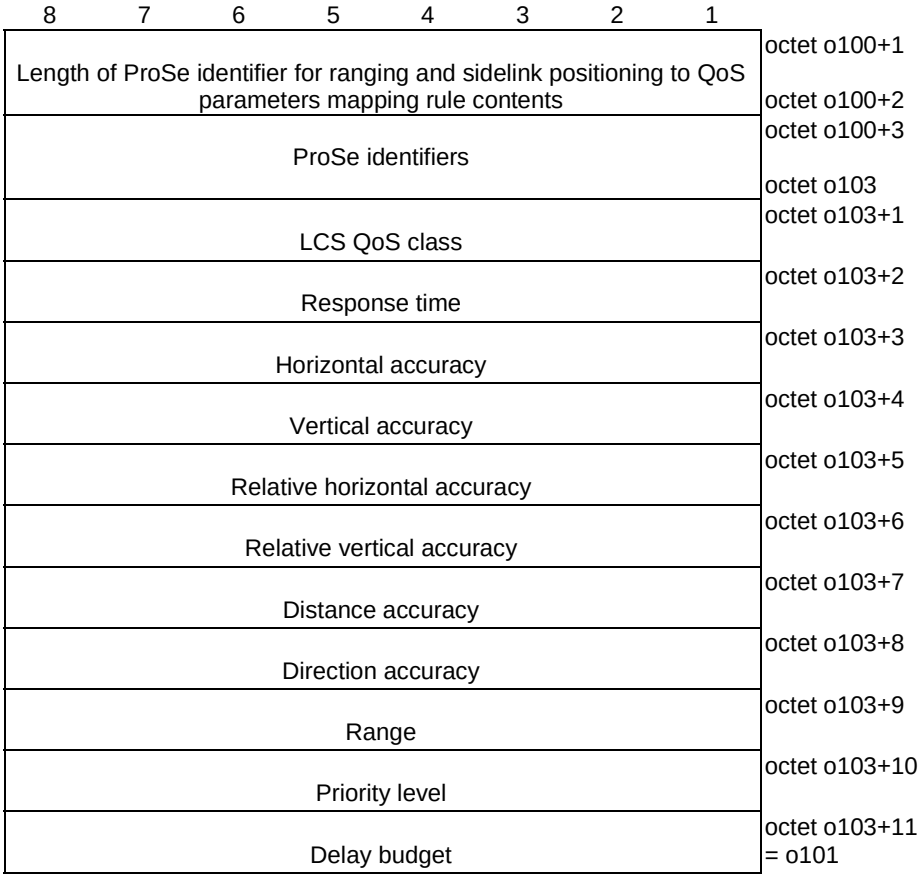

Figure 12.2.9: ProSe identifier for ranging and sidelink positioning to QoS parameters mapping rule

Table 12.2.9: ProSe identifier for ranging and sidelink positioning to QoS parameters mapping rule

ProSe identifiers (octet o100+3 to o103): The ProSe identifiers field is coded according to figure 12.2.10 and table 12.2.10 and includes the ProSe identifiers. LCS QoS class (octet o103+1): Bits **8 7 6 5 4 3 2 1** 0 0 0 0 0 0 0 0 Reserved 0 0 0 0 0 0 0 1 Best effort class 0 0 0 0 0 0 1 0 Multiple QoS class 0 0 0 0 0 0 1 1 Assured class The other values are spare. Response time (octet o103+2): Bits **8 7 6 5 4 3 2 1** 0 0 0 0 0 0 0 0 Reserved 0 0 0 0 0 0 0 1 No delay 0 0 0 0 0 0 1 0 Low delay 0 0 0 0 0 0 1 1 Delay tolerant The other values are spare. Accuracy: The accuracy field is a binary encoded value of the accuracy. Range (octet o103+9): The range field indicates a binary encoded value of the range in meters. The range indicates the applicability of the QoS parameters over PC5.
Priority level (octet o103+10): The priority level field indicates binary encoded value of the priority level. Delay budget (octet o103+11): The delay budget field indicates binary encoded value of the ranging and sidelink positioning service latency in millisecond.

Editor's note: The detailed description on the priority level is FFS.

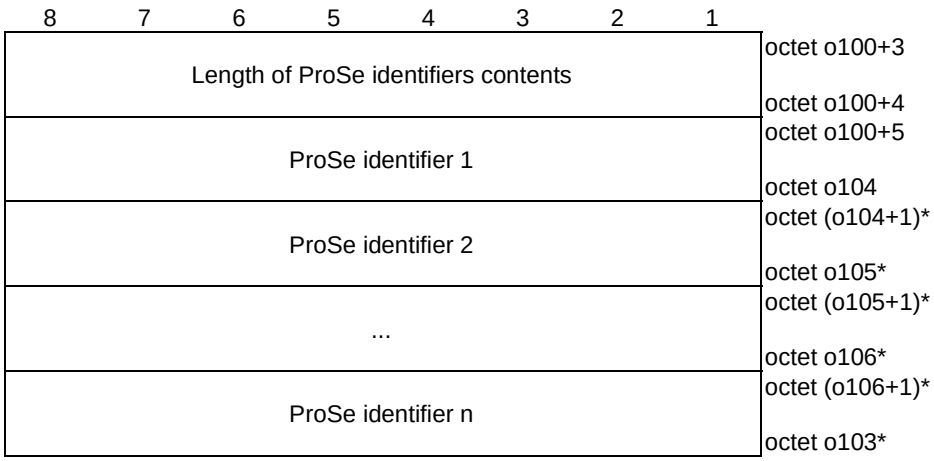

Figure 12.2.10: ProSe identifiers

Table 12.2.10: ProSe identifiers

ProSe identifier: The ProSe identifier field contains a sequence of a sixteen octet OS Id field, a one octet OS App Id length field, and an OS App Id field. The OS Id field shall be transmitted first. The OS Id field contains a Universally Unique IDentifier (UUID) as specified in IETF RFC 4122 [8].
NOTE: Further definition of the format of OS App ID is beyond the scope of this specification.

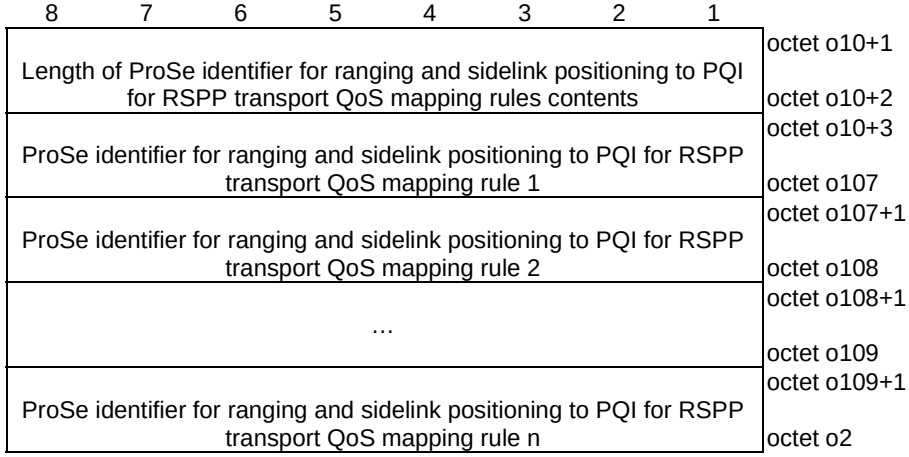

Figure 12.2.11: ProSe identifier for ranging and sidelink positioning to PQI for RSPP transport QoS mapping rules

Table 12.2.11: ProSe identifier for ranging and sidelink positioning to PQI for RSPP transport QoS mapping rules

ProSe identifier for ranging and sidelink positioning to PQI for RSPP transport QoS mapping rule: The ProSe identifier for ranging and sidelink positioning to PQI for RSPP transport QoS mapping rule field is coded according to figure 12.2.12 and table 12.2.12 and includes the ProSe identifier for ranging and sidelink positioning to PQI for RSPP transport QoS mapping rule.

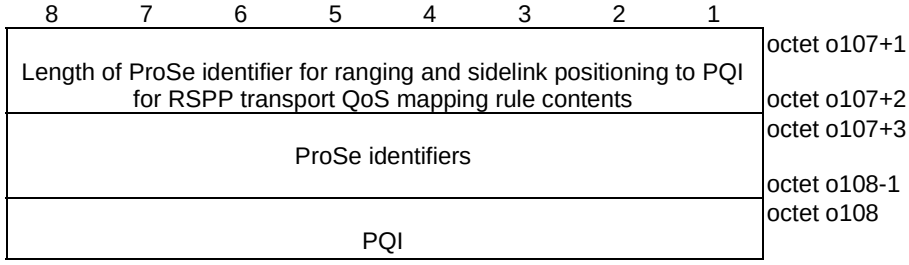

Figure 12.2.12: ProSe identifier for ranging and sidelink positioning to QoS parameters mapping rule

Table 12.2.12: ProSe identifier for ranging and sidelink positioning to QoS parameters mapping rule

ProSe identifiers (octet o107+3 to o108-1):
The ProSe identifiers field is coded according to figure 12.2.10 and table 12.2.10 and includes the ProSe identifiers.

PQI (octet o108):

Bits **8 7 6 5 4 3 2 1**	
0 0 0 0 0 0 0 0	Reserved
0 0 0 0 0 0 0 1 to	Spare
0 0 0 1 0 1 0 0	
0 0 0 1 0 1 0 1	PQI 21
0 0 0 1 0 1 1 0	PQI 22
0 0 0 1 0 1 1 1	PQI 23
0 0 0 1 1 0 0 0	PQI 24
0 0 0 1 1 0 0 1	PQI 25
0 0 0 1 1 0 1 0	PQI 26
0 0 0 1 1 0 1 1 to	Spare
0 0 1 1 0 1 1 0	
0 0 1 1 0 1 1 1	PQI 55
0 0 1 1 1 0 0 0	PQI 56
0 0 1 1 1 0 0 1	PQI 57
0 0 1 1 1 0 1 0	PQI 58
0 0 1 1 1 0 1 1	PQI 59
0 0 1 1 1 1 0 0	PQI 60
0 0 1 1 1 1 0 1	PQI 61
0 0 1 1 1 1 1 0 to	Spare
0 1 0 1 1 0 0 1	
0 1 0 1 1 0 1 0	PQI 90
0 1 0 1 1 0 1 1	PQI 91
0 1 0 1 1 1 0 0	PQI 92
0 1 0 1 1 1 0 1	PQI 93
0 1 0 1 1 1 1 0 to	Spare
0 1 1 1 1 1 1 1	
1 0 0 0 0 0 0 0 to	Operator-specific PQIs
1 1 1 1 1 1 1 0	
1 1 1 1 1 1 1 1	Reserved

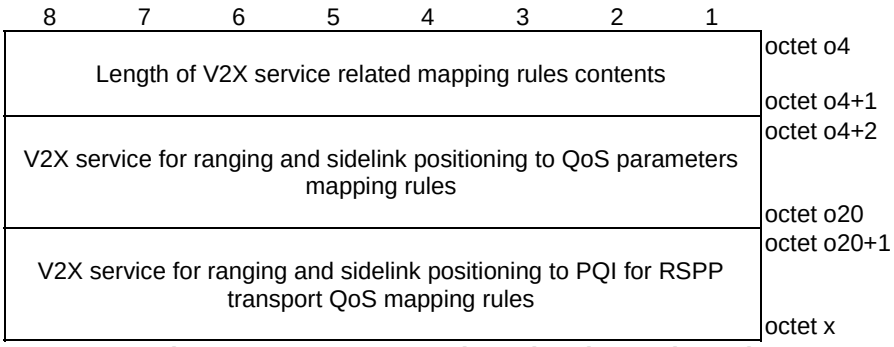

Figure 12.2.13: V2X service related mapping rules

Table 12.2.13: V2X service related mapping rules

V2X service for ranging and sidelink positioning to QoS parameters mapping rules (octet o3+2 to o20): The V2X service for ranging and sidelink positioning to ranging and sidelink positioning QoS parameters mapping rules field is coded according to figure 12.2.8 and table 12.2.8 and includes the V2X service for ranging and sidelink positioning to QoS parameters mapping rules. V2X service for ranging and sidelink positioning to PQI for RSPP transport QoS mapping rules (octet o20+1 to x): The V2X service for ranging and sidelink positioning to PQI for RSPP transport QoS mapping rules field is coded according to figure 12.2.8 and table 12.2.8 and includes the V2X service for ranging and sidelink positioning to PQI for RSPP transport QoS mapping rules.

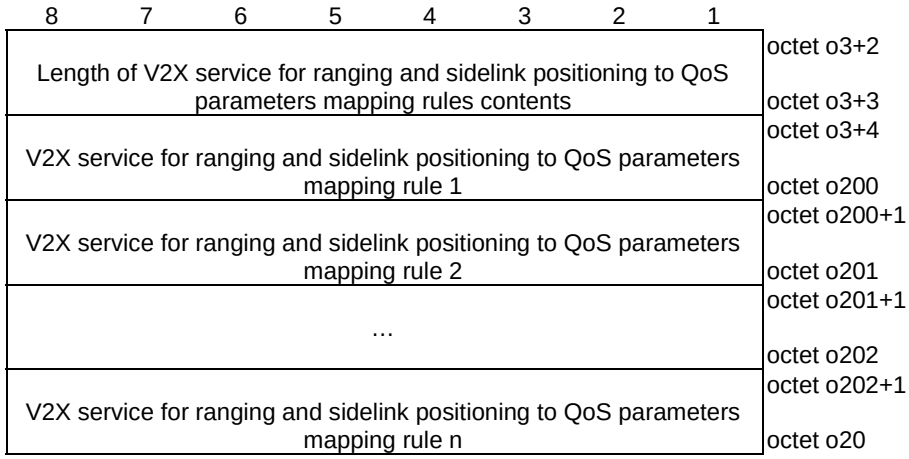

Figure 12.2.14: V2X service for ranging and sidelink positioning to QoS parameters mapping rules

Table 12.2.14: V2X service for ranging and sidelink positioning to QoS parameters mapping rules

V2X service for ranging and sidelink positioning to QoS parameters mapping rule: The V2X service for ranging and sidelink positioning to QoS parameters mapping rule field is coded according to figure 12.2.15 and table 12.2.15 and includes the V2X service for ranging and sidelink positioning to QoS parameters mapping rule.

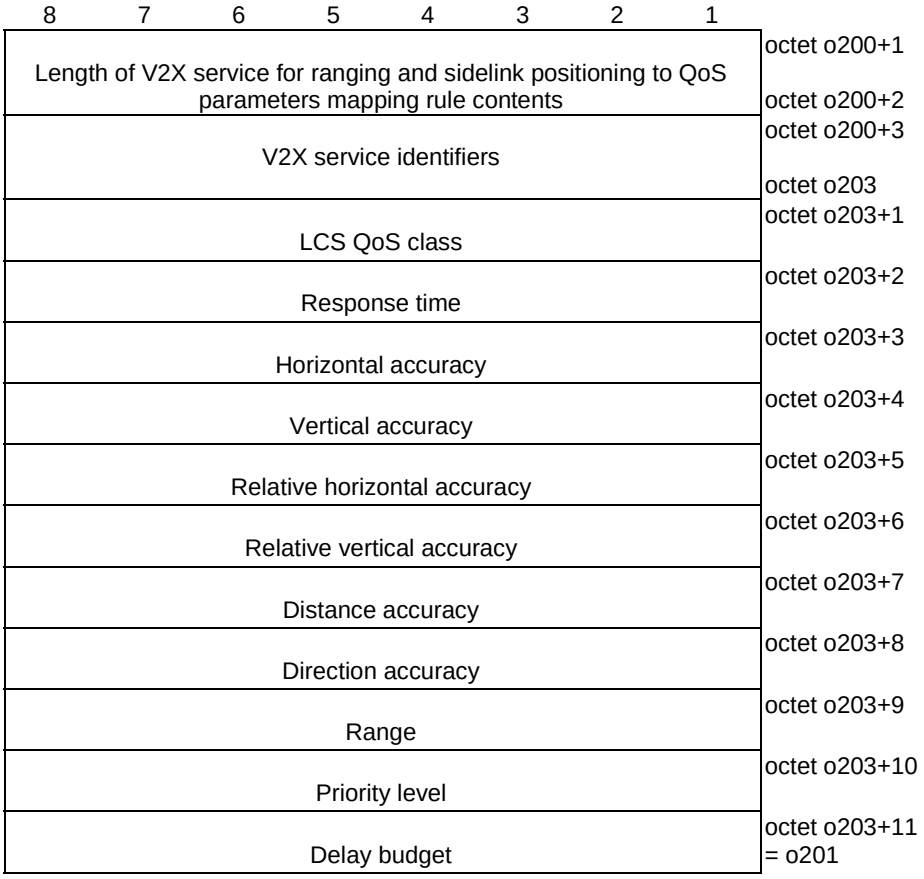

Figure 12.2.15: V2X service for ranging and sidelink positioning to QoS parameters mapping rule

Table 12.2.15: V2X service for ranging and sidelink positioning to QoS parameters mapping rule

V2X service identifiers (octet o200+3 to o203): The V2X service identifiers field is coded according to figure 12.2.16 and table 12.2.16 and includes the V2X service identifiers. LCS QoS class (octet o203+1): Bits **8 7 6 5 4 3 2 1** 0 0 0 0 0 0 0 0 Reserved 0 0 0 0 0 0 0 1 Best effort class 0 0 0 0 0 0 1 0 Multiple QoS class 0 0 0 0 0 0 1 1 Assured class The other values are spare. Response time (octet o203+2): Bits **8 7 6 5 4 3 2 1** 0 0 0 0 0 0 0 0 Reserved 0 0 0 0 0 0 0 1 No delay 0 0 0 0 0 0 1 0 Low delay 0 0 0 0 0 0 1 1 Delay tolerant The other values are spare. Accuracy: The accuracy field is a binary encoded value of the accuracy. Range (octet o203+9): The range field indicates a binary encoded value of the range in meters. The range indicates the applicability of the QoS parameters over PC5. Priority level (octet o103+10): The priority level field indicates binary encoded value of the priority level. Delay budget (octet o103+11): The delay budget field indicates binary encoded value of the ranging and sidelink positioning service latency in millisecond.

Editor's note: The detailed description on the priority level is FFS.

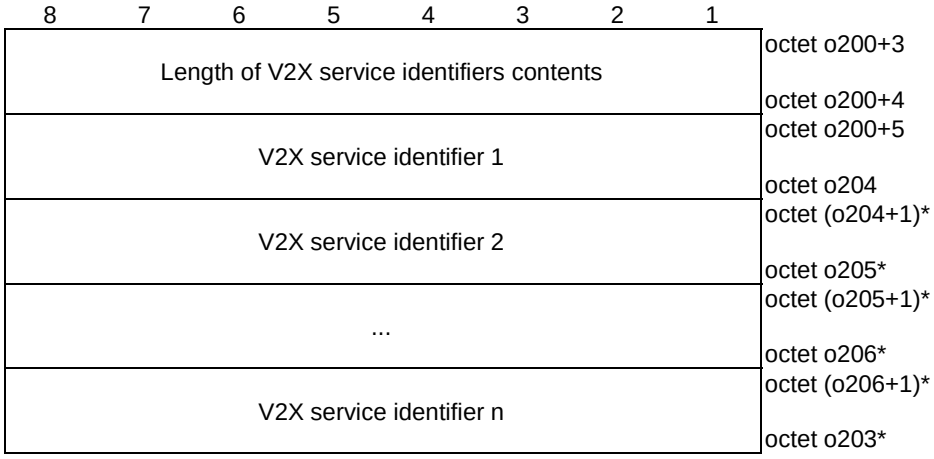

Figure 12.2.16: V2X service identifiers

Table 12.2.16: V2X service identifiers

V2X service identifier: The V2X service identifier field contains a binary coded V2X service identifier as specified in ISO TS 17419 ITS-AID AssignedNumbers [9].

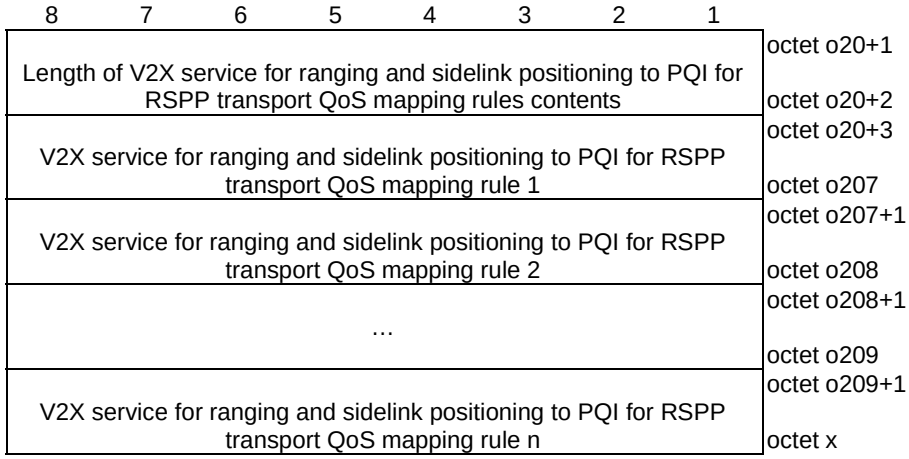

Figure 12.2.17: V2X service for ranging and sidelink positioning to PQI for RSPP transport QoS mapping rules

Table 12.2.17: V2X service for ranging and sidelink positioning to PQI for RSPP transport QoS mapping rules

V2X service for ranging and sidelink positioning to PQI for RSPP transport QoS mapping rule: The V2X service for ranging and sidelink positioning to PQI for RSPP transport QoS mapping rule field is coded according to figure 12.2.18 and table 12.2.18 and includes the V2X service for ranging and sidelink positioning to PQI for RSPP transport QoS mapping rule.

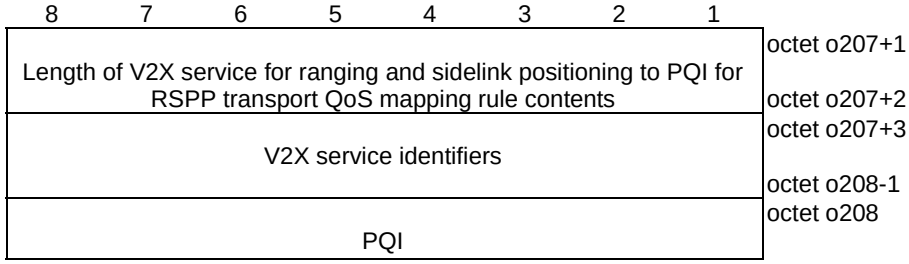

Figure 12.2.18: V2X service for ranging and sidelink positioning to QoS parameters mapping rule

Table 12.2.18: V2X service for ranging and sidelink positioning to QoS parameters mapping rule

V2X service identifiers (octet o207+3 to o208-1):
The V2X service identifiers field is coded according to figure 12.2.16 and table 12.2.16 and includes the V2X service identifiers.

PQI (octet o208):
Bits
8 7 6 5 4 3 2 1
0 0 0 0 0 0 0 0 Reserved
0 0 0 0 0 0 0 1
to Spare
0 0 0 1 0 1 0 0
0 0 0 1 0 1 0 1 PQI 21
0 0 0 1 0 1 1 0 PQI 22
0 0 0 1 0 1 1 1 PQI 23
0 0 0 1 1 0 0 0
to Spare
0 0 1 1 0 1 1 0
0 0 1 1 0 1 1 1 PQI 55
0 0 1 1 1 0 0 0 PQI 56
0 0 1 1 1 0 0 1 PQI 57
0 0 1 1 1 0 1 0 PQI 58
0 0 1 1 1 0 1 1 PQI 59
0 0 1 1 1 1 0 0
to Spare
0 1 0 1 1 0 0 1
0 1 0 1 1 0 1 0 PQI 90
0 1 0 1 1 0 1 1 PQI 91
0 1 0 1 1 1 0 0
to Spare
0 1 1 1 1 1 1 1
1 0 0 0 0 0 0 0
to Operator-specific PQIs
1 1 1 1 1 1 1 0
1 1 1 1 1 1 1 1 Reserved

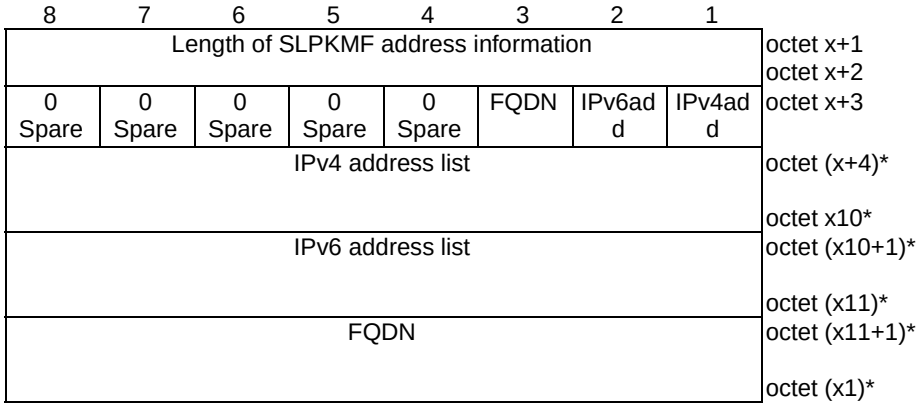

Figure 12.2.19: SLPKMF address information

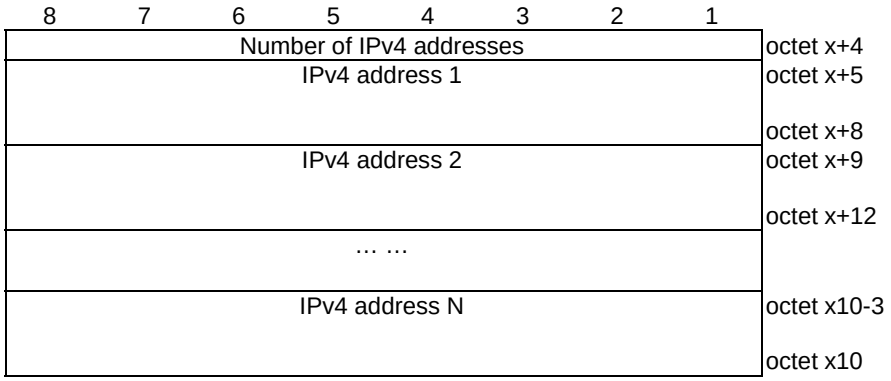

Figure 12.2.20: IPv4 address list

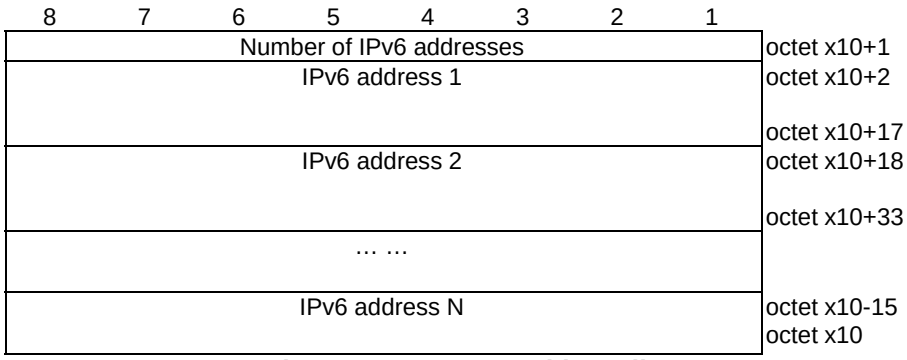

Figure 12.2.21: IPv6 address list

Table 12.2.19: SLPKMF address information

IPv4 addresses (IPv4add) (octet x+2 bit 1): (NOTE 1)
Bit
1
0 IPv4 address list is not present
1 IPv4 address list is present

IPv6 addresses (IPv6add) (octet x+2 bit 2): (NOTE 1)
Bit
2
0 IPv6 address list is not present
1 IPv6 address list is present

FQDN (octet x+3 bit 3): (NOTE 2)
Bit
3
0 FQDN is not present
1 FQDN is present

IPv4 address list (octet x+4 to octet o160)
IPv4 address list contains the IPv4 address(es) of the SLPKMF and shall be encoded as defined in figure 12.2.x2.

IPv6 address list (octet x10+1 to octet x10)
IPv6 address list contains the IPv6 address(es) of the SLPKMF and shall be encoded as defined in figure 12.2.x3.

FQDN (octet x10+1 to l)
FQDN field contains a sequence of one octet FQDN length field and a FQDN value of variable size. The FQDN value field shall be encoded as defined in clause 28.3.2.1 in 3GPP TS 23.003 [10].

NOTE 1: If multiple IPv4 addresses and/or IPv6 addresses are included, which one of these addresses is selected is implementation dependent.
NOTE 2: If the SLPKMF supports the SLPKMF Services with "https" URI scheme (i.e. use of TLS is mandatory), then the FQDN shall be used to construct the target URI.

13 List of system parameters

13.1 Overview

The description of timers in the following tables should be considered a brief summary. The precise details are found in clauses 4 to 8, which should be considered the definitive descriptions.

13.2 Timers of provisioning of parameters for ranging and sidelink positioning configuration procedures

Timers of provisioning of parameters for ranging and sidelink positioning configuration are shown in table 13.2.1.

NOTE: Timer T5040 is defined in 3GPP TS 24.587 [4].

Table 13.2.1: Timers of provisioning of parameters for ranging and sidelink positioning configuration – UE side

TIMER NUM.	TIMER VALUE	CAUSE OF START	NORMAL STOP	ON EXPIRY
T5aaa	Validity timer value for UE policies for ranging and sidelink positioning over PC5 (see clause 5.2).	Start using the new UE policies for ranging and sidelink positioning over PC5 received in MANAGE UE POLICY COMMAND message	Stop using the old UE policies for ranging and sidelink positioning over PC5	Initiate the UE-requested RSLPP provisioning procedure (NOTE)
NOTE: The timers expire only once.				

Annex A (informative): Change history

Change history							
Date	**Meeting**	**TDoc**	**CR**	**Rev**	**Cat**	**Subject/Comment**	**New version**
2023-04	CT1#141e	C1-232663				TS skeleton proposed by the rapporteur	0.0.0
2023-04	CT1#141e	C1-232639 C1-232665 C1-232783				Implementing the following p-CR agreed by CT1: C1-232639, C1-232665, C1-232783; and Editorial change from the rapporteur.	0.1.0
2023-05	CT1#142	C1-234000 C1-234011 C1-234207 C1-234208 C1-234209				Implementing the following p-CR agreed by CT1: C1-234000, C1-234011, C1-234207, C1-234208, C1-234209; and Editorial change from the rapporteur.	0.2.0
2023-08	CT1#143	C1-235869 C1-236094 C1-236095 C1-236101 C1-236102 C1-236348 C1-236367				Implementing the following p-CR agreed by CT1: C1-235869, C1-236094, C1-236095, C1-236101, C1-236102, C1-236348, C1-236367; and Editorial change from the rapporteur.	0.3.0
2023-10	CT1#144	C1-237080 C1-238141 C1-238142 C1-238143 C1-238144 C1-238146 C1-238148 C1-238215 C1-238216				Implementing the following p-CR agreed by CT1: C1-237080, C1-238141, C1-238142, C1-238143, C1-238144, C1-238146, C1-238148, C1-238215, C1-238216; and Editorial change from the rapporteur.	0.4.0
2023-11	CT1#145	C1-238572 C1-238574 C1-238710 C1-239449 C1-239451 C1-239452 C1-239453 C1-239456 C1-239457 C1-239458				Implementing the following p-CR agreed by CT1: C1-238572, C1-238574, C1-238710, C1-239449, C1-239451, C1-239452, C1-239453, C1-239456, C1-239457, C1-239458; and Editorial change from the rapporteur.	0.5.0
2024-02	CT1#146e	C1-240104 C1-240322 C1-240341 C1-240342 C1-240367 C1-240369 C1-240370 C1-240371 C1-240372 C1-240373 C1-240374 C1-240400				Implementing the following p-CR agreed by CT1: C1-240104, C1-240322, C1-240341, C1-240342, C1-240367, C1-240369, C1-240370, C1-240371, C1-240372, C1-240373, C1-240374, C1-240400; and Editorial change from the rapporteur.	0.6.0
2024-03	CT1#147	C1-240697 C1-240698 C1-240703 C1-241522 C1-241523 C1-241578 C1-241579 C1-241583 C1-241584 C1-241586 C1-241587 C1-241606 C1-241607 C1-241637 C1-241639 C1-241611 C1-241624 C1-241580 C1-241588				Implementing the following p-CR agreed by CT1: C1-240697, C1-240698, C1-240703, C1-241522, C1-241523, C1-241578, C1-241579, C1-241583, C1-241584, C1-241586, C1-241587, C1-241606, C1-241607, C1-241637, C1-241639, C1-241611, C1-241624, C1-241580, C1-241588; and Editorial change from the rapporteur.	1.0.0
2024-03	CT#103	CP-240232				Presentation to CT Plenary for information and approval	1.0.0
2024-03	CT#103					Approved in CT#103	18.0.0
2024-06	CT#103					Correction of the change history table. Other contents remain the same as version 18.0.0.	18.0.1

History

Document history		
V18.0.1	June 2024	Publication