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Security Aspects of Proximity based Services (ProSe)
in the 5G System (5GS)
(3GPP TS 33.503 version 17.10.0 Release 17)

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Contents

Foreword

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- y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
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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 security and privacy aspects of the Proximity based Services (ProSe) in the 5G System (5GS). 5G ProSe security features include: 5G ProSe Direct Discovery security, 5G ProSe Direct communication security, and 5G ProSe UE-to-Network Relay security.

2 References

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

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

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

[2] 3GPP TS 23.304: "Proximity based Services (ProSe) in the 5G System (5GS)".

[3] 3GPP TS 33.501: "Security architecture and procedures for 5G system".

[4] 3GPP TS 33.303: "Proximity-based Services (ProSe); Security aspects".

[5] 3GPP TS 33.535: "Authentication and Key Management for Applications (AKMA) based on 3GPP credentials in the 5G System (5GS)".

[6] 3GPP TS 33.536: "Security aspects of 3GPP support for advanced Vehicle-to-Everything (V2X) services".

[7] 3GPP TS 23.503: "Policy and charging control framework for the 5G System (5GS); Stage 2".

[8] 3GPP TS 33.220: "Generic Authentication Architecture (GAA); Generic Bootstrapping Architecture (GBA)".

[9] 3GPP TS 33.223: "Generic Authentication Architecture (GAA); Generic Bootstrapping Architecture (GBA) Push function".

[10] 3GPP TS 23.502: "Procedures for the 5G System".

[11] 3GPP TS 33.102: "3G security; Security architecture".

[12] Void

[13] Void

[14] IETF RFC 7542: "The Network Access Identifier".

[15] IETF RFC 9048: " Improved Extensible Authentication Protocol Method for 3rd Generation Authentication and Key Agreement (EAP-AKA')".

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].

For the purposes of the present document, the following terms given in 3GPP TS 23.304 [2] apply:

5G ProSe Direct Communication
5G ProSe Direct Discover
5G ProSe-enabled UE
5G ProSe Remote UE
5G ProSe UE-to-Network Relay
Direct Network Communication
Discovery Filter
Discovery Query Filter
Discovery Response Filter
Indirect Network Communication
Mode of communication
Model A
Model B
Open ProSe Discovery
ProSe Application Code
ProSe Application ID
ProSe Application Mask
ProSe Query Code
ProSe Response Code
ProSe Restricted Code
Restricted ProSe Application User ID
Restricted ProSe Discovery

3.2 Symbols

Void.

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in 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 TR 21.905 [1].

5G DDNMF	5G Direct Discovery Name Management Function
5G PKMF	5G ProSe Key Management Function
CP-PRUK	Control Plane ProSe Remote User Key
AF	Application Function
AKMA	Authentication and Key Management for Applications
AV	Authentication Vector
BSF	Bootstrapping Server Function
CP	Control Plane
DCR	Direct Communication Request
DUCK	Discovery User Confidentiality Key
DUIK	Discovery User Integrity Key
DUSK	Discovery User Scrambling Key
GBA	Generic Bootstrapping Architecture
GPI	GBA Push Info
GPS	Global Positioning System
MIC	Message Integrity Check

NAI	Network Access Identifier
NITZ	Network Identity and Time Zone
NRPEK	NR PC5 Encryption Key
NRPIK	NR PC5 Integrity Key
NTP	Network Time Protocol
PAnF	Prose Anchor Function
ProSe	Proximity-based Services
RPAUID	Restricted ProSe Application User ID
RSC	Relay Service Code
SBI	Service Based Interface
UP	User Plane
UP-PRUK	User Plane Prose Remote User Key
UTC	Universal Time Coordinated

4 Overview

4.1 General

The overall architecture for 5G ProSe is given in TS 23.304 [2]. 5G ProSe includes several features that may be deployed independently of each other. For this reason, no overall security architecture is provided and each feature describes its own architecture.

Security for the 5G ProSe common procedures is described in clause 5, while the overall security of the 5G ProSe features is described in clause 6.

4.2 Reference points and functional entities

4.2.1 Functional entities

4.2.1.1 General

Architectural reference model is specified in clause 4.2.1, 4.2.2, 4.2.3, and 4.2.7 of TS 23.304 [2].

4.2.1.2 5G ProSe Key Management Function

In addition to the architectural reference model specified in TS 23.304 [2], the architectural reference model shall support the functional entity 5G ProSe Key Management Function (5G PKMF) which is the logical function handling network related actions required for the key management and the security material for discovery of a 5G ProSe UE-to-Network Relay by a 5G ProSe Remote UE, and for establishing a secure PC5 communication link between a 5G ProSe Remote UE and 5G ProSe UE-to-Network Relay.

The 5G ProSe Remote UE and the 5G ProSe UE-to-Network Relay know from which 5G ProSe Key Management Function(s) to get the needed discovery security materials for protecting discovery messages and UP-PRUK(s) for establishing a secure PC5 link between the 5G ProSe Remote UE and the UE-to-Network Relay as the address of the 5G PKMF(s) is either pre-provisioned or provided by the 5G DDNMF (or the PCF) in the HPLMN of the 5G ProSe Remote UE to the 5G ProSe Remote UE, and by the 5G DDNMF (or the PCF) in the HPLMN of the 5G ProSe UE-to-Network Relay to the 5G ProSe UE-to-Network Relay.

The 5G PKMF interacts with the 5G ProSe-enabled UE using procedures over PC8 reference point defined in clause 4.2.2. The protection for the key request/response messages are described in clause 5.2.5.

The 5G PKMF of the 5G ProSe Remote UE shall request the discovery security materials from the 5G PKMFs of the potential 5G ProSe UE-to-Network Relays from which the 5G ProSe Remote UE gets the relay services.

The 5G PKMF of the 5G ProSe UE-to-Network Relay shall request the security materials (e.g. Knrp and Knrp freshness parameter) from the 5G PKMF of the 5G ProSe Remote UE for PC5 communication.

4.2.1.3 Prose Anchor Function

In addition to the architectural reference model specified in TS 23.304 [2], the architectural reference model shall support the functional entity Prose Anchor Function (PAnF) which is the logical function handling network related actions required for the key management and the security material for establishing a secure PC5 communication link between a 5G ProSe Remote UE and 5G ProSe UE-to-Network Relay over Control Plane.

The PAnF shall store the Prose context info (i.e. SUPI, RSC, CP-PRUK, CP-PRUK ID) for a 5G ProSe Remote UE.

The PAnF interacts with AUSF using procedures over Npc11 reference point defined in clause 4.2.2. The PAnF interacts with UDM using procedures over Npc12 reference point defined in clause 4.2.2.

4.2.2 Reference points

In addition to the reference points are specified in clause 4.2.5 of TS 23.304 [2], the 5G Prose architectural reference model shall support the following reference points:

PC8: The reference point between the UE and the 5G ProSe Key Management Function (5G PKMF). PC8 relies on 5GC user plane for transport (i.e. an "over IP" reference point). It is used to transport security material to UEs for 5G ProSe UE-to-Network Relay discovery and communication.

Npc9: The reference point between the 5G PKMF of the 5G ProSe Remote UE and the 5G PKMF of the 5G ProSe UE-to-Network Relay. It is used to transport security material between two 5G PKMFs.

Npc10: The reference point between the UDM and the 5G PKMF. It is used to de-conceal SUCI to gain SUPI, obtain a GBA Authentication Vector (AV) for a UE, or request relay service authorization information from the UDM.

Npc11: The reference point between the AUSF and Prose Anchor Function (PAnF). It is used to store the Prose context info for a 5G ProSe Remote UE.

Npc12: The reference point between the PAnF and UDM. It is used to check with the UDM whether the Remote UE is authorized to use the UE-to-Network Relay service.

Npc13: The reference point between the SMF and PKMF. It is used to obtain the SUPI of Remote UE from PKMF.

Npc14: The reference point between the SMF and PAnF. It is used to obtain the SUPI of Remote UE from PAnF.

5 Common security procedures

5.1 General

This clause describes the security requirements and procedures that are commonly applied to different modes of ProSe communication, including unicast mode ProSe Direct Network Communication and unicast mode ProSe Indirect Network Communication via the 5G ProSe UE-to-Network Relay.

5.2 Network domain security

5.2.1 General

5G Prose uses several interfaces between network entities, e.g. Npc4 between the 5G DDNMF and the UDM, Npc8 between the 5G DDNMF and the PCF (see TS 23.304 [2]). This clause describes the security for those interfaces.

5.2.2 Security of Npc2 reference point

5.2.2.1 General

Npc2 is the reference point between the ProSe Application Server and the 5G DDNMF as specified in clause 4 of TS 23.304 [2]. When the ProSe Application Server is in a 3rd party's network, the Npc2 comprises two interfaces, i.e. the service-based interface between the 5G DDNMF and the NEF, and the N33 interface between the NEF and the Prose Application Server. When the Prose Application Server is in a MNO's network, the Npc2 is a purely service-based interface.

5.2.2.2 Security requirements

When the ProSe Application Server is controlled by a 3rd party, requirements on security aspects of NEF are captured in clause 5.9.2.3 of TS 33.501 [3].

5.2.2.3 Security procedures

When the ProSe Application Server is controlled by a 3rd party, security procedures specified in clause 12 of TS 33.501 [3] is applicable.

When the Prose Application Server is controlled by a MNO, security procedures specified in clause 13 of TS 33.501 [3] is applicable.

As specified in TS 23.304 [2], the 5G System architecture supports the service based Npc2 interface between 5G DDNMF and ProSe Application Server and optionally supports PC2 interface between the 5G DDNMF and the ProSe Application Server. The security of PC2 reference point specified in TS 33.303 [4] shall be reused.

5.2.3 Security of UE - 5G DDNMF interface

5.2.3.1 General

PC3a is the reference point between the 5G Prose-enabled UE and the 5G DDNMF as specified in clause 4.2.5 of TS 23.304 [2].

5.2.3.2 Security requirements

3rd parties shall not be allowed to provide configuration data impacting the 5G ProSe-related network operations to the 5G ProSe-enabled UE. The 5G ProSe-enabled UE and the 5G DDNMF shall mutually authenticate each other.

The transmission of the material for 5G Prose discovery between the 5G DDNMF and the 5G ProSe-enabled UE shall be integrity protected.

The transmission of the material for 5G Prose discovery between the 5G DDNMF and the 5G ProSe-enabled UE shall be confidentiality protected.

The transmission of the material for 5G Prose discovery between the 5G DDNMF and the 5G ProSe-enabled UE shall be protected from replays.

5.2.3.3 Security procedures for configuration transfer to UICC

See clause 5.3.3.1 in TS 33.303 [4].

5.2.3.4 Security procedures for PC3a using GBA

For the security procedures for protecting data transfer between the UE and the 5G DDNMF on the PC3a interface, the use of either TLS v1.2 or TLS v. 1.3, as described in clause 5.3.3.2 in TS 33.303 [4] applies with the following modifications:

- The ProSe function is replaced by the 5G DDNMF.

- Confidentiality protection shall be enabled.

5.2.3.5 Security procedures for PC3a using AKMA

Security procedures specified in clause B.1.3.2 of TS 33.535 [5] is applicable with the additional changes:

- The 5G DDNMF takes the role of AF.
- Confidentiality protection shall be enabled.

5.2.3.6 Privacy issue in PC3a interface

PC3a interface will be used to transfer the configuration data that is used to perform 5G ProSe Direct Discovery. According to clause 6.3.1.4 of TS 23.304 [2], the UE identity is included in the Discovery Request message. Privacy of UE identity is ensured by the confidentiality protection over PC3a interface.

5.2.4 Security of service-based interfaces used in 5G Prose

5.2.4.1 Security requirements

The 5G Prose network entities shall be able to authenticate the source of the received data communications.

The transmission of data between 5G Prose network entities shall be integrity protected.

The transmission of data between 5G Prose network entities shall be confidentiality protected.

The transmission of data between 5G Prose network entities shall be protected from replays.

5.2.4.2 Security procedures

Npc4, Npc6, Npc7, Npc8, Npc9 and Npc10 specified in clause 4.2.5 of TS 23.304 [2], Npc11 and Npc12 specified in clause 4.2.2 are realized by corresponding NF service-based interfaces, therefore security procedures specified in clause 13 of TS 33.501 [3] apply to these interfaces.

5.2.5 Security for UE - 5G PKMF interface

5.2.5.1 General

The 5G ProSe-enabled UEs have interactions with the 5G PKMF over the PC8 interface in the ProSe features described in clause 4.2.2.

5.2.5.2 Security requirements

The 5G PKMF for commercial services and for public safety services provides the security keys and security material affecting the 5G ProSe-related network operations to the 5G ProSe-enabled UE for discovery of a 5G ProSe UE-to-Network Relay and PC5 communication with a 5G ProSe UE-to-Network Relay.

The 5G ProSe-enabled UE and the 5G PKMF shall mutually authenticate each other.

The 5G System shall support that the transmission of the security keys and security material between the 5G PKMF and the 5G ProSe-enabled UE shall be integrity protected.

The 5G System shall support that the transmission of the security keys and security material between the 5G PKMF and the 5G ProSe-enabled UE shall be confidentiality protected.

The 5G System shall support that the transmission of the security keys and security material between the 5G PKMF and the 5G ProSe-enabled UE shall be protected from replays.

The 5G System shall support that the transmission of the UE identity on the PC8 interface shall be confidentiality protected.