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TECHNICAL SPECIFICATION

Lawful Interception (LI);
Internal Network Interfaces;
Part 1: X1

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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Lawful Interception (LI).

The present document is part 1 of a multi-part deliverable covering the Internal Network Interfaces for Lawful Interception (LI), as identified below:

Part 1: "X1";

Part 2: "X2/X3".

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

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1 Scope

The present document defines an electronic interface for the exchange of information relating to the establishment and management of Lawful Interception. Typically, this interface would be used between a central LI administration function and the network internal interception points.

Typical reference models for LI define an interface between Law Enforcement Agencies (LEAs) and Communication Service Providers (CSPs), called the handover interface. They also define an internal network interface within the CSP domain between administration and mediation functions for lawful interception and network internal functions, which facilitates the interception of communication. This internal network interface typically consists of several sub-interfaces: initial configuration of the network internal elements of lawful interception (X0), administration (X1), transmission of intercept related information (X2) and transmission of content of communication (X3). The present document specifies the administration interface X1.

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found in the ETSI docbox.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long-term validity.

The following referenced documents are necessary for the application of the present document.

[1] ETSI TS 133 107: "Universal Mobile Telecommunications System (UMTS); LTE; Digital cellular telecommunications system (Phase 2+) (GSM); 3G security; Lawful interception architecture and functions (3GPP TS 33.107)".

[2] IETF RFC 4122: "A Universally Unique IDentifier (UUID) URN Namespace", (July 2005).

[3] W3C® Recommendation 28 October 2004: "XML Schema Part 2: Datatypes Second Edition".

[4] ETSI TS 103 280: "Lawful Interception (LI); Dictionary for common parameters".

[5] Recommendation ITU-T E.212: "The international identification plan for public networks and subscriptions".

[6] ETSI TS 123 003: "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; 5G; Numbering, addressing and identification (3GPP TS 23.003)".

[7] IETF RFC 3261: "SIP: Session Initiation Protocol", (June 2002).

[8] IETF RFC 3966: "The tel URI for Telephone Numbers", (December 2004).

[9] IETF RFC 3508: "H.323 Uniform Resource Locator (URL) Scheme Registration", (April 2003).

[10] IETF RFC 7542: "The Network Access Identifier", (May 2015).

[11] IETF RFC 2865: "Remote Authentication Dial In User Service (RADIUS)", (June 2000).

[12] IETF RFC 2818: "HTTP over TLS", (May 2000).

[13] IETF RFC 7230: "Hypertext Transfer Protocol (HTTP/1.1): Message Syntax and Routing", (June 2014).

NOTE: Obsoleted by IETF RFC 9110, IETF RFC 9112.

[14] IETF RFC 5246: "The Transport Layer Security (TLS) Protocol Version 1.2", (August 2008).

NOTE: Obsoleted by IETF RFC 8446.

[15] Void.

[16] IETF RFC 7525: "Recommendations for Secure Use of Transport Layer Security (TLS) and Datagram Transport Layer Security (DTLS)", (May 2015).

NOTE: Obsoleted by IETF RFC 9325.

[17] IETF RFC 6125: "Representation and Verification of Domain-Based Application Service Identity within Internet Public Key Infrastructure Using X.509 (PKIX) Certificates in the Context of Transport Layer Security (TLS)", (March 2011).

[18] IETF RFC 4519: "Lightweight Directory Access Protocol (LDAP): Schema for User Applications", (June 2006).

[19] ETSI TS 103 221-2: "Lawful Interception (LI); Internal Network Interfaces; Part 2: X2/X3".

[20] IETF RFC 8446: "The Transport Layer Security (TLS) Protocol Version 1.3", (August 2018).

[21] IETF RFC 7540: "Hypertext Transfer Protocol Version 2 (HTTP/2)", (May 2015).

NOTE: Obsoleted by IETF RFC 9113.

[22] ETSI TS 133 127: "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; 5G; Lawful Interception (LI) architecture and functions (3GPP TS 33.127)".

[23] IETF RFC 6530: "Overview and Framework for Internationalized Email", (February 2012).

[24] W3C® Recommendation 21 March 2017: "XPath and XQuery Functions and Operators 3.1".

[25] IETF RFC 6920: "Naming Things with Hashes", (April 2013).

[26] FIPS PUB 202: "SHA-3 Standard: Permutation-Based Hash and Extendable-Output Functions".

[27] IETF RFC 7042: "IANA Considerations and IETF Protocol and Documentation Usage for IEEE 802 Parameters", (October 2013).

[28] ETSI TS 103 120: "Lawful Interception (LI); Interface for warrant information".

[29] IETF RFC 5280: "Internet X.509 Public Key Infrastructure Certificate and Certificate Revocation List (CRL) Profile", (May 2008).

[30] ETSI TS 104 000: "Lawful Interception (LI); Internal Network Interface X0".

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long-term validity.

The following referenced documents may be useful in implementing an ETSI deliverable or add to the reader's understanding, but are not required for conformance to the present document.

[i.1] OWASP: "Transport Layer Security Cheat Sheet".

[i.2] ETSI TR 103 308: "CYBER; Security baseline regarding LI and RD for NFV and related platforms".

[i.3] ETSI GS NFV-SEC 009: "Network Functions Virtualisation (NFV); NFV Security; Report on use cases and technical approaches for multi-layer host administration".

[i.4] ETSI GS NFV-SEC 012: "Network Functions Virtualisation (NFV) Release 3; Security; System architecture specification for execution of sensitive NFV components".

[i.5] OWASP: "XML Security Cheat Sheet".

[i.6] GSMA RCC.07: "Rich Communication Suite - Advanced Communications Services and Client Specification".

[i.7] ETSI TS 102 232-1: "Lawful Interception (LI); Handover Interface and Service-Specific Details (SSD) for IP delivery; Part 1: Handover specification for IP delivery".

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the following terms apply:

destination: point to which xIRI and/or xCC is delivered by the NE

Destination IDentifier (DID): identifier to uniquely identify a Destination internally to the X1 interface

Destination Set: collection of DIDs and their associated preference of use

Destination Set IDentifier (DSID): identifier to uniquely identify a Destination Set internally to the X1 interface

Network Element (NE): element performing the LI operations such as interception, or mediation and delivery

NOTE: The NE may be embedded in an NF or standalone.

Network Function (NF): function that contains an associated or embedded NE

protocol error: error at the X1 protocol level (rather than any fault with ADMF or NE)

NOTE: In the present document, the term "error" in general refers to a protocol error, whereas issues with systems not behaving correctly are called "faults".

task: continuous instance of interception at a single NE carried out against a set of target identifiers, identified by an X1 Identifier, starting from an activate command and ending with a deactivate command or terminating fault

terminating fault: fault signalled from NE to ADMF which terminates the specific Task

X1: LI interfaces internal to the CSP for management tasking

X1 Context: portion of Controlled Function ("NE") state associated with the X1 operations controlled by a specific Controlling Function ("ADMF")

NOTE: When multiple ADMFs operate on an NE, the NE maintains a separate independent X1 Context for each of the ADMFs. System-wide, a X1 Context is uniquely identified by a combination of ADMF ID and NE ID.

X1 IDentifier (XID): identifier to uniquely identify a Task internally to the X1 interface as well as across related X2 and X3 interfaces

NOTE: The XID is also either associated to only one LIID or can be allowed to be associated to multiple LIIDs.

X1 Transaction ID: identifier used to identify a specific request/response pair

X2: LI interfaces internal to the CSP for xIRI delivery

X3: LI interfaces internal to the CSP for xCC delivery

3.2 Symbols

Void.

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

ADMF	ADMinistration Function
AVP	Attribute-Value Pair
AXRI	Additional XID Related Information
CC	Content of Communication
CIDR	Classless Inter Domain Routing
CIN	Communication Identity Number
CSP	Communication Service Provider
DID	Destination IDentifier
DSID	Destination Set IDentifier
EUI	Extended Unique Identifier
FQDN	Full Qualified Domain Name
GTP-C	GPRS Tunnel Protocol (Control plane)
GTP-U	GPRS Tunnel Protocol (User plane)
HI	Handover Interface
HI1	Handover Interface 1 (for administrative information)
HI2	Handover Interface 2 (for IRI)
HI3	Handover Interface 3 (for CC)
HTTP	HyperText Transfer Protocol
HTTPS	HTTP over TLS
IMEI	International Mobile Equipment Identity
IMEISV	International Mobile Equipment Identity Software Version
IMPI	IP Multimedia Private Identity
IMPU	IP Multimedia PUblic identity
IMSI	International Mobile Station Identity
IP	Internet Protocol
IRI	Intercept Related Information
LEA	Law Enforcement Agency
LEMF	Law Enforcement Monitoring Facility
LI	Lawful Interception
LIID	Lawful Interception IDentifier
MAC	Media Access Control
MDF	Mediation and Delivery Function
MSISDN	Mobile Station International Subscriber Directory Number
NAI	Network Access Identifier
NAT	Network Address Translation
NE	Network Element

NOTE: The element or function performing the interception.

NF	Network Function
NFV	Network Functions Virtualisation
OID	Object ID
OWASP	Open Web Application Security Project
POI	Point Of Interception
QoS	Quality of Service
RADIUS	Remote Authentication Dial In User Service
RCS	Rich Communication Suite
RDN	Relative Distinguished Name
SAN	Subject Alternative Name
SGSN	Serving GPRS Support Node

SIP	Session Initiation Protocol
SIP-URI	Session Initiation Protocol Uniform Resource Identifier
SNMP	Simple Network Management Protocol
SUCI	SUbscription Concealed Identifier
TCP	Transmission Control Protocol
TEL-URI	Telephony Uniform Resource Identifier
TF	Triggering Function
TISPAN	Telecommunication and Internet converged Services and Protocols for Advanced Networking
TLS	Transport Layer Security
TPM	Trusted Platform Module
UDP	User Datagram Protocol
UID	User IDentifier
URI	Uniform Resource Identifier
URN	Uniform Resource Name
UTF	UCS Transformation Formats
UUID	Universally Unique Identifier
VRF	Virtual Routing and Forwarding
xCC	X3 Content of Communications
XID	X1 IDentifier
xIRI	X2 Intercept Related Information
XML	eXtended Markup Language
XSD	XML Schema Definition

4 Overview

4.1 Reference model

4.1.1 Overview

The X1 interface is based on communication between two entities; the controlling function (e.g. a CSP ADMinistration Function (ADMF)), and the controlled function (e.g. a Network Element performing interception or mediation and delivery). The X1 reference model is shown in figure 4.1.1-1.

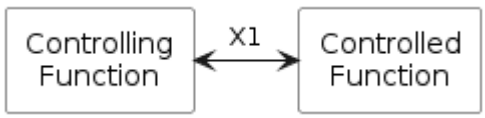

Figure 4.1.1-1: X1 reference model

The X1 model supports "many-to-many" cardinality of the communicating entities. When multiple Controlling Functions operate on a single Controlled Function, the Controlled Function maintains a separate context, called X1 Context, for each Controlling Function it communicates with. All operations and information exchanges related to a specific Controlling Function are executed within the respective X1 Context at the Controlled Function. A Controlling Function shall not be able to determine the existence or contents of X1 Contexts belonging to other Controlling Functions at a Controlled Function via X1.

In the present document the terms "NE" and "ADMF" are used both as respective equivalents to the terms "Controlled Function" and "Controlling Function", and as references to the actual LI network deployment entities. In the latter case, the term Network Element (NE) represents an element of any given Network Function (NF) which performs lawful interception. The NE is given information regarding interception or mediation and delivery. Similarly, the term "ADMF" represents the CSP's LI Administration Function that controls interception or mediation and delivery in NEs.

4.1.2 ADMF deployment model

Figure 4.1.2-1 shows a deployment model for X1 where a CSP ADMF uses X1 to provision a number of NEs to perform interception.

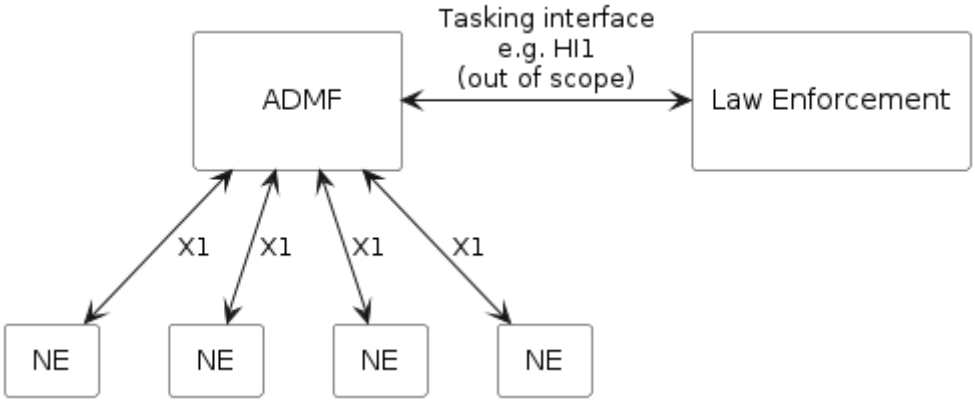

Figure 4.1.2-1: X1 Model for CSP ADMF Deployment

Onward delivery of information from the NE is called X2 (for xIRI) and X3 (for xCC). X2 and X3 are defined in ETSI TS 103 221-2 [19].

While in a typical CSP deployment there is only one ADMF, some deployments may involve multiple ADMFs for redundancy or other purposes.

ADMF and NE shall implement time synchronization where possible; in situations where it is not possible, the ADMF shall maintain knowledge of the timing offset between the ADMF and NE.

NOTE: The present document may be used in direct delivery scenarios, in which the NE delivers directly to the LEMF. Any consequences of using direct delivery are out of scope of the present document.

4.1.3 Triggering deployment model

Figure 4.1.3-1 shows another possible deployment model for X1, where the X1 protocol is used to trigger interception in an NE present in a different network function. In this deployment model, the "Triggering Function" (TF) takes on the role of the ADMF in the previous deployment model, while the "Triggered Function" takes on the role of the NE.

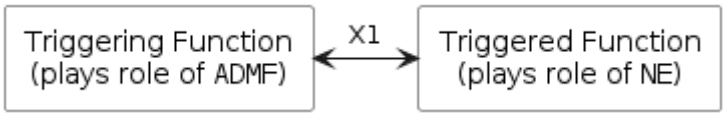

Figure 4.1.3-1: X1 deployment model for Triggering Functions

If this deployment model is used, then in the following clauses references to the ADMF should be interpreted as applying to the Triggering Function, while references to the NE should be interpreted as references to the Triggered Function.

4.1.4 Mediation and delivery function deployment model

Figure 4.1.4-1 shows another possible deployment model for X1, where the X1 protocol is used to manage a CSP mediation and delivery function. In this deployment model, the MDF takes on the role of the NE in the previous deployment model.

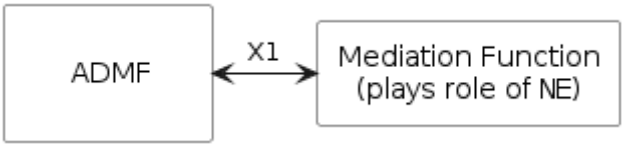

Figure 4.1.4-1: X1 deployment model for Mediation and Delivery Functions

If this deployment model is used, then in the following clauses references to the NE should be interpreted as applying to the MDF.

4.2 Reference model for X1: requesting and responding

X1 transactions consist of a request followed by a response.

Requests may be sent in either direction i.e. with the ADMF or NE initiating the request. The side initiating the request is called the "Requester"; this term is used when it is not specified whether it is the ADMF or NE making the request. The other side is called the "Responder".

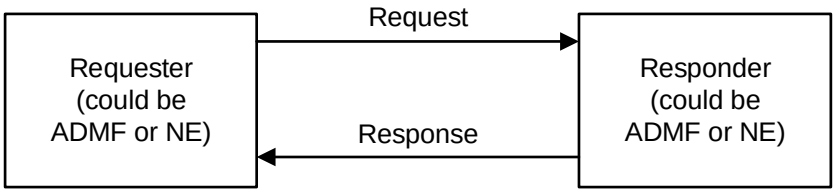

Figure 4.2-1: Showing generic terminology

It is likely that in most situations, the ADMF will initiate the message i.e. to distribute information or request status. However, it is possible that the NE will initiate the request in order to deliver fault reports, etc.

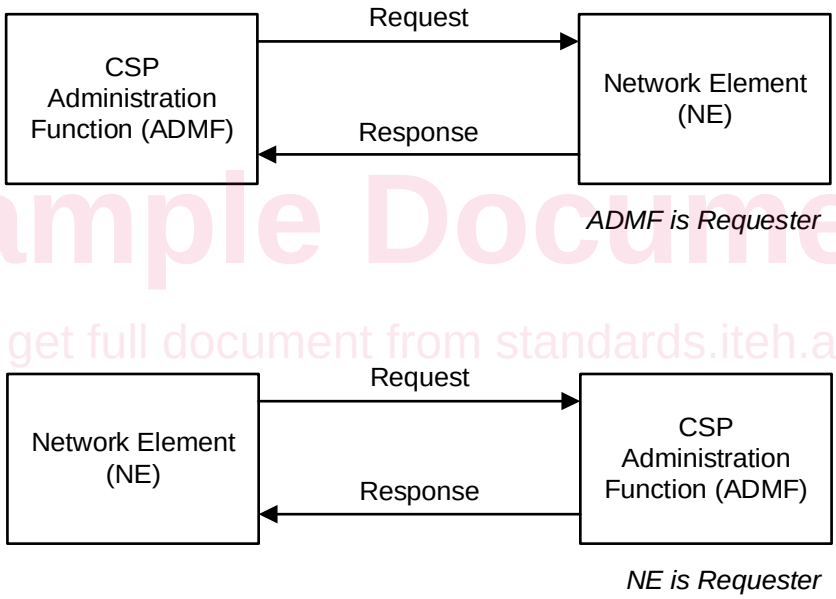

Figure 4.2-2: Showing two situations with either ADMF or NE as the requester

4.3 Overview of security

Security is based on creating public/private keys for the ADMF and each NE for which it is responsible. All transactions over X1 are performed using the security procedures in clause 8, which provide assurance that communication only takes place between an NE and ADMF which have been populated with the relevant key material.

NE implementers are strongly discouraged from exposing additional interfaces for controlling the LI functionality of the NE other than by X1 e.g. via a local administrative interface at the NE. If such additional interfaces exist, any such action performed on the NE shall be captured on the NE audit/logging, and any consequences of such actions shall be able to be seen and controlled by the ADMF that is responsible for the NE i.e. the ADMF shall be able to use the X1 interface to stop or undo any changes made over a local administrative interface. There may be broader consequences that are not covered by the present document if an NE is tasked independently of the X1 interface (e.g. security concerns).

4.4 Relationship to other standards

The present document forms part of a family of internal interface documents covering all of X0, X1, X2 and X3 which are handled as separate standards.

Some models of LI (e.g. 3GPP TS 33.107 [1] and 3GPP TS 33.127 [22]) define interfaces for the purposes described in clause 4.1 (e.g. X1_1, X1_2 and X1_3 defined by 3GPP TS 33.107 [1]; or LI_X1 defined by 3GPP TS 33.127 [22]). The present document is designed to fulfil the requirements for those interfaces.

The present document also specifies the configuration details to be used when ETSI TS 104 000 [30] is used to configure the X1 interface through X0.

4.5 Release management

This clause describes the release management requirements. The requirements are:

- The version of the present document is defined as <major>.<minor>.<patch>.
- The major version should be incremented when making a backwards incompatible change.
- The minor version should be incremented when adding backwards compatible functionality.
- The patch version should be incremented when fixing a backwards compatible bug.

Once a major version has been incremented, the previous major version will be supported for 2 years after publication of the new version. Change requests issued to a version that is no longer supported will need to be issued for the latest supported major version.

5 Basic concepts

5.1 The lifecycle of a Task

5.1.1 Start and end of a Task

A Task relates to a single target identifier, and goes from the point an ActivateTask Request is sent by the ADMF to the time a DeactivateTask Request is sent by the ADMF, a "terminating fault" occurs, or (for Tasks with the "ImplicitDeactivationAllowed" flag set) the NE determines that it has completed.

The present document does not define which situations are categorized as "terminating faults". Local recovery procedures should be followed before a Task is ended with a "terminating fault". In general, irrecoverable failures with an interception, or major security issues at an NE should be considered terminating faults, and certain outcomes with keepalives are also terminating faults (where defined in clause 6.6.2).

5.1.2 Identification of a Task

Each Task on X1 is uniquely identified by an X1 Identifier (XID) and it is handled independently of all others. The ADMF shall assign the XID as a version 4 UUID as per IETF RFC 4122 [2]. The ADMF is responsible for correlating the XID to any LI instance identifiers used to communicate with Law Enforcement. When used between the ADMF and the MDF, the entire LI system may support one of several possibilities:

1) an XID may only map to a single LIID; or

2) an XID may map to multiple LIIDs.

In the first case, each intercept is separately provisioned for a target ID at a given POI. In either case, the ADMF shall provide the XID to LIID(s) mapping to the MDF.

In addition, the XID is released once the Task has ended.