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Lawful Interception (LI);
IMS and LTE FAQ and Guidance

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Foreword

This Special Report (SR) has been produced by ETSI Technical Committee Lawful Interception (LI).

Modal verbs terminology

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Introduction

The present document provides a summary of some of the issues that members of ETSI TC LI believe to be important in relation to the Lawful Interception of IMS (IP Multimedia Subsystem) and LTE (Long Term Evolution).

1 Scope

The present document provides guidance to interested parties regarding implementation of Lawful Interception (LI) for LTE, IMS and related services. It covers what is available and how it may be interpreted.

The present document is in the format of a set of Frequently Asked Questions and their accompanying answers, contained within the present document. An Explanatory Note is produced to accompany the present document which contains some observations based on the questions and answers.

The present document covers both Lawful Interception and Data Retention.

2 References

2.1 Normative references

Normative references are not applicable in the present document.

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 are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] GSMA IR.92 v7.0: "IMS Profile for Voice and SMS".

[i.2] GSMA RCC.61: "RCS Common Core 1.1 Service Description Document, Version 2.0".

[i.3] GSMA IR.64: "IMS Service Centralization and Continuity Guidelines".

[i.4] ETSI TS 133 107: "Universal Mobile Telecommunications System (UMTS); LTE; 3G security; Lawful interception architecture and functions (3GPP TS 33.107)".

[i.5] ETSI TS 133 108: "Universal Mobile Telecommunications System (UMTS); LTE; 3G security; Handover interface for Lawful Interception (LI) (3GPP TS 33.108)".

[i.6] 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".

[i.7] ETSI TS 102 232-5: "Lawful Interception (LI); Handover Interface and Service-Specific Details (SSD) for IP delivery; Part 5: Service-specific details for IP Multimedia Services".

[i.8] ETSI TS 102 232-7: "Lawful Interception (LI); Handover Interface and Service-Specific Details (SSD) for IP delivery; Part 7: Service-specific details for Mobile Services".

[i.9] ETSI TS 102 657: "Lawful Interception (LI); Retained data handling; Handover interface for the request and delivery of retained data".

[i.10] Recommendation ITU-T E.164: "The International Public Telecommunication Numbering Plan".

[i.11] IETF RFC 7977: "The Message Session Relay Protocol (MSRP)".

[i.12] IETF RFC 4825: "The Extensible Markup Language (XML) Configuration Access Protocol (XCAP)".

[i.13] ATIS-1000678.v3.2015: "Lawfully Authorized Electronic Surveillance (LAES) for Voice over Internet Protocol in Wireline Telecommunications Networks".

[i.14] ATIS-0700005.v002.2017: "Lawfully Authorized Electronic Surveillance (LAES) for 3GPP IMS-based VoIP and other Multimedia Services".

[i.15] PKT-SP-ES-INF-I04-080425: "PacketCable™ 2.0 Electronic Surveillance Intra-Network Specification".

[i.16] ETSI TS 123 228: "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; IP Multimedia Subsystem (IMS); Stage 2 (3GPP TS 23.228)".

[i.17] ETSI TS 129 228: "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; IP Multimedia (IM) Subsystem Cx and Dx Interfaces; Signalling flows and message contents (3GPP TS 29.228)".

[i.18] ETSI TS 129 229: "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; Cx and Dx interfaces based on the Diameter protocol; Protocol details (3GPP TS 29.229)".

[i.19] ETSI TS 129 230: "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; Diameter applications; 3GPP specific codes and identifiers (3GPP TS 29.230)".

[i.20] ETSI TS 124 229: "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; IP multimedia call control protocol based on Session Initiation Protocol (SIP) and Session Description Protocol (SDP); Stage 3 (3GPP TS 24.229)".

[i.21] ETSI TS 123 003: "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); Numbering, addressing and identification (3GPP TS 23.003)".

[i.22] IETF RFC 7254: "A Uniform Resource Name Namespace for the Global System for Mobile Communications Association (GSMA) and the International Mobile Station Equipment Identity (IMEI)".

[i.23] IETF RFC 7255: "A Uniform Resource Name Namespace for the Global System for Mobile Communications Association (GSMA) and the International Mobile Station Equipment Identity (IMEI)".

[i.24] 3GPP TR 33.827: "Study on Providing for LI in the S8 Home Routing Architecture for VoLTE (Release 14)".

[i.25] ETSI TS 124 607: "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; Originating Identification Presentation (OIP) and Originating Identification Restriction (OIR) using IP Multimedia (IM) Core Network (CN) subsystem; Protocol specification (3GPP TS 24.607)".

[i.26] ETSI TS 124 608: "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; Terminating Identification Presentation (TIP) and Terminating Identification Restriction (TIR) using IP Multimedia (IM) Core Network (CN) subsystem; Protocol specification (3GPP TS 24.608)".

[i.27] ETSI TS 124 610: "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; Communication HOLD (HOLD) using IP Multimedia (IM) Core Network (CN) subsystem; Protocol specification (3GPP TS 24.610)".

[i.28] ETSI TS 124 605: "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; Conference (CONF) using IP Multimedia (IM) Core Network (CN) subsystem; Protocol specification (3GPP TS 24.605)".

[i.29] ETSI TS 124 604: "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; Communication Diversion (CDIV) using IP Multimedia (IM) Core Network (CN) subsystem; Protocol specification (3GPP TS 24.604)".

[i.30] ETSI TS 124 611: "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; Anonymous Communication Rejection (ACR) and Communication Barring (CB) using IP Multimedia (IM) Core Network (CN) subsystem; Protocol specification (3GPP TS 24.611)".

[i.31] ETSI TS 124 615: "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; Communication Waiting (CW) using IP Multimedia (IM) Core Network (CN) subsystem; Protocol Specification (3GPP TS 24.615)".

[i.32] ETSI TS 124 606: "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; Message Waiting Indication (MWI) using IP Multimedia (IM) Core Network (CN) subsystem; Protocol specification (3GPP TS 24.606)".

[i.33] ETSI TS 124 647: "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; Advice Of Charge (AOC) using IP Multimedia (IM) Core Network (CN) subsystem (3GPP TS 24.647)".

[i.34] ETSI TS 124 654: "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; Closed User Group (CUG) using IP Multimedia (IM) Core Network (CN) subsystem, Protocol Specification (3GPP TS 24.654)".

[i.35] ETSI TS 124 239: "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; Flexible Alerting (FA) using IP Multimedia (IM) Core Network (CN) subsystem; Protocol specification (3GPP TS 24.239)".

[i.36] ETSI TS 124 182: "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; IP Multimedia Subsystem (IMS) Customized Alerting Tones (CAT); Protocol specification (3GPP TS 24.182)".

[i.37] ETSI TS 124 183: "Universal Mobile Telecommunications System (UMTS); LTE; IP Multimedia Subsystem (IMS) Customized Ringing Signal (CRS); Protocol specification (3GPP TS 24.183)".

[i.38] ETSI TS 101 671: "Lawful Interception (LI); Handover interface for the lawful interception of telecommunications traffic".

[i.39] IETF RFC 3550: "RTP: A Transport Protocol for Real-Time Applications".

[i.40] IETF RFC 4867: "TP Payload Format and File Storage Format for the Adaptive Multi-Rate (AMR) and Adaptive Multi-Rate Wideband (AMR-WB) Audio Codecs".

[i.41] IETF RFC 4733: "A Mechanism for Transporting User-to-User Call Control Information in SIP".

[i.42] IETF RFC 2833: "RTP Payload for DTMF Digits, Telephony Tones and Telephony Signals".

[i.43] GSMA IR.94: "IMS Profile for Conversational Video Service v10.0".

3 Abbreviations

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

ADSL	Asymmetric Digital Subscriber Line
AMR	Adaptive Multi-Rate Wideband
ANDSF	Access Network Discovery and Selection Function
AS	Application Server
A-SBC	Access Session Border Controller
ASN.1	Abstract Syntax Notation One
ATCF	Access Transfer Control Function
ATGW	Access Transfer Gateway
CBP	Constrained Baseline Profile

CC	Content of Communications
CGI	Cell Global Identifier
CHP	Constrained High Profile
CMTS	Cable Modem Termination System
CS	Circuit Switched
CSCF	Call Session Control Function
CSP	Communication Service Provider
DR	Data Retention
DSR	Dynamic Source Routing
ECGI	E-UTRAN Cell Global Identifier
ENUM	E.164 Number to URI Mapping
EPC	Evolved Packet Core
ePDG	evolved Packet Data Gateway
EPS	Evolved Packet System
eRCS	enhanced RCS
eSRVCC	enhanced SRVCC
E-UTRAN	Evolved-UMTS-Terrestrial Radio Access Network
EVS	Enhanced Voice Services
FFS	For Further Study
GPRS	General Packet Radio Services
GRUU	Globally Routable User agent URI
GSMA	Global System Mobile Association
GW	Gateway
HEVC	High Efficiency Video Coding
HI2	Handover Interface port 2 (for Intercept Related Information)
HI3	Handover Interface port 3 (for Content of Communication)
HPLMN	Home Public Land Mobile Network
HSS	Home Subscriber Server
IAP	Intercept Access Point
ICS	IMS Centralized Service
IMEI	International Mobile Equipment Identity
IMS	IP Multimedia Subsystem
IMSI	International Mobile Subscriber Identity
IoT	Internet of Things
IP	Internet Protocol
IR	GSMA Permanent Reference Document
IRI	Intercept Related Information
LBO	Local Break Out
LEA	Law enforcement agency
LEMF	Law Enforcement Monitoring Facility
LI	Lawful Intercept
LIID	Lawful Interception Identifier
LTE	Long Term Evolution
MCC	Mobile Country Code
MF	Mediation Function
MF/DF	Mediation Function . Delivery Function
MGCF	Media Gateway Control Function
MGW	Media GateWay
MMS	Multimedia Messaging Service
MNC	Mobile Network Code
MRF	Media Resource Function
MSC	Mobile Switching Centre
MSISDN	Mobile Station International Subscriber Directory Number
MSRP	Message Session Relay Protocol
MTAS	Mobile Terminating Access Service
MVNO	Mobile Virtual Network Operator
NAI	Network Access Identifier
NB	Narrow band
PANI	Private-Access-Network-Info
PCC	Policy Control and Charging
P-CSCF	Proxy-CSCF
P-GRUU	Public GRUU

PGW	Packet data network GateWay
PLMN	Public Land Mobile Network
PMN	Public Mobile Network
PS	Packet Switched
PSTN	Public Switched Telephone Network
RCS	Rich Communications Service
RS	Reference Signal
RTP	Real-Time Transport Protocol
S8HR	S8 (interface point) Home Routing
SDP	Session Description Protocol
SEW	Support of Emergency services over WLAN

NOTE: More information available at http://www.3gpp.org/DynaReport/WiCr--690033.htm.

S-GW	Serving GateWay
SIM	Subscriber Identity Module
SIP	Session Initiation Protocol
SM	SIP MESSAGE
SMS	Short Message Service
S-PGW	Serving PGW
SRVCC	Single Radio-VCC
SS	Supplementary Services
TIP	Terminating Identification Presentation
TIR	Terminating Identification Restriction
TLS	Transport Layer Security
UE	User Equipment
UMTS	Universal Mobile Telecommunications System
URI	Uniform Resource Identifier
URL	Uniform Resource Locator
URN	Uniform Resource Name
ViLTE	Video over LTE
VoLTE	Voice over LTE
VoWiFi	Voice over Wireless Fidelity
VPLMN	Visited Public Land Mobile Network
WebRTC	Web Real Time Communications
WLAN	Wireless Local Area Network
XCAP	XML Configuration Access Protocol
XML	eXtensible Markup Language

4 Questions and guidance statements

4.0 Introduction

This clause contains a series of subclauses regarding various themes relating to IMS, LTE and VoLTE; each of the subclauses contains a list of Frequently Asked Questions and Answers.

4.1 General solution architecture

4.1.1 Introduction

This clause provides general information concerning LTE, IMS, and VoLTE.

4.1.2 Question: What is the relationship between LTE and EPS?

Long Term Evolution (LTE) is the radio access to the Evolved Packet System (EPS).

4.1.3 Question: What is new in the EPS/IMS architecture?

In EPS, there are no circuit switched services. The packet network is evolved from the General Packet Radio Services (GPRS) and Universal Mobile Telecommunications System (UMTS) packet systems. The telephony service is a Voice over IP (VoIP) service also known as Voice over LTE (VoLTE). The management of the telephony service in EPS is done by the IP Multimedia Subsystem (IMS). The IMS can handle the call control for a wide variety of multimedia telecommunication services (e.g. telephony/VoLTE, video /ViLTE). The content of the communication (CC) is not handled by the IMS.

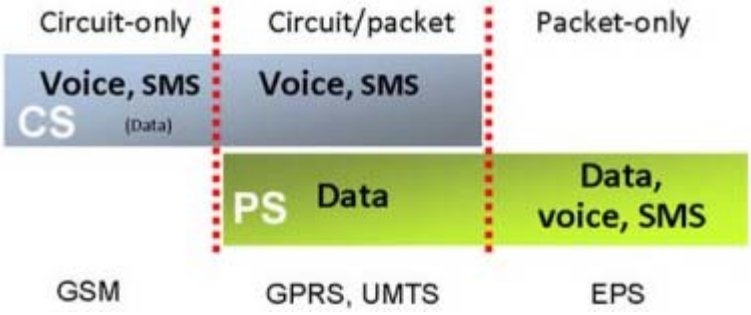

Figure 1: Circuit and packet domains

4.1.4 Question: What is the service definition of VoLTE?

VoLTE is defined in the GSMA specification IR.92 [i.1].

NOTE: This includes Short Message Service (SMS) and Supplementary Services (SS).

4.1.5 Question: What other services are combined with VoLTE?

Since 3GPP Release 10, enhanced Single Radio Voice Call Continuity (eSRVCC), using the Access Transfer Control Function (ATCF)/Access Transfer Gateway (ATGW) as an Intercept Access Point (IAP) is recommended to avoid difficulties in correlating two call legs of the same target's call (one coming from IMS and the other from CS domain) during the handover. The overlap of the two legs may be an issue to look at the implementation.

Without eSRVCC, the LI Identifier (LIID) will be the only correlation information to correlate the same call before and after handover from Packet Switched (PS) to Circuit Switched (CS).

In some regions, there are LI implementations where the second leg of an SRVCC call (i.e. the CS leg) get split into two - the calls remain anchored in IMS but LI is delivered for both IMS and CS, with the latter providing potentially richer location information.

For LI, the handling of Video over LTE (ViLTE) is similar to the handling of VoLTE. Additional signalling (i.e. IRI) can be used and the Content of Communication (CC) bandwidth can differ.

Defined by GSMA in the Rich Communications Service (RCS) Common Core Service Description Document [i.2], RCS is the evolution of SMS and Multimedia Messaging Service (MMS).

There is interest in RCS/Joyn services that may be included later in convergent messaging (including SMS/MMS over IP) based on 3GPP IP-SM-GW and some interconnection functionality between different CSPs.

It should be noted that there is a distinction between pager mode messaging using individual SIP MESSAGE requests (such as SM). That may include SMS over IP and eRCS, and may induce a separate delivery of CC from voice, especially with VoWifi usage.

4.1.6 Question: What types of IMS are there internationally?

IMS Centralized Service (ICS) is defined to make it possible for IMS to act as the single service engine for a VoLTE subscriber regardless of the access to which they are currently attached. Performing the centralization of services into IMS, GSMA IR.64 [i.3] focuses on two variants, of which access via unchanged MSC/media gateway control function using Customized Application for Mobile Networks Enhanced. Logic home routing is currently the most widely adopted solution. The other solution is ICS with Enhanced Mobile Switching Centre Server, which provides a User Network Interface to IMS acting as a SIP user agent on behalf of the circuit-switched user. However, some standardization of LI may have to be made (see Impacts and dependencies on existing CS solutions).

The IMS is access network independent. Therefore, IMS is also a common platform used for fixed line telephony (for example where the Public Switched Telephone Network (PSTN) is migrating to VoIP over Asymmetric Digital Subscriber Line (ADSL)). It is service setting whether the fixed line telephony is only served for a specific network access point or whether it served network access point independent.

The IMS platform can also accept the User Equipment (UE) accessing the core network via a non-3GPP network. The typical example is via a Wireless Local Area Network (WLAN) access point, to provide Voice over WiFi (VoWiFi). (See also clause 4.4.8).

4.1.7 Question: What types of IMS service are of relevance to LEAs?

It has been noted that IMS sessions are typically more verbose than those from traditional telephony, with far more IRI messages (e.g. 120 IRIs where previously there had been 5). However, work undertaken in [i.5] and [i.7] will ensure that all relevant IMS services can be intercepted within the relevant network and that the visited network can always maintain LI capability independently to the home network.

4.2 Applicable international standards

4.2.1 Introduction

The clause answers questions concerning standards.

4.2.2 Question: What are the applicable international LI and DR standards?

The latest releases of 3GPP TS 33.107 [i.4] and 3GPP TS 33.108 [i.5] provide LI solutions. These standards are also transposed by regional partners in 3GPP (e.g. ETSI or ATIS). 3GPP standards typically do not address data retention.

ETSI TS 102 232-1 [i.6], ETSI TS 102 232-5 [i.7], and ETSI TS 102 232-7 [i.8] may also be used by some service providers for an LI solution. See Table 1 for more information.

ETSI TS 102 657 [i.9] provides a handover interface for DR.

Table 1: Overview of international LI standards

Standard	Observations	Potential for further work
3GPP TS 33.107 [i.4] and 3GPP TS 33.108 [i.5]	These standards include the latest development of 3GPP services, even if features such as ANDSF/WLAN or WebRTC or eRCS/Presence services may have to be standardized in the near future.	The Target Identity (ID) is based on TEL URI/SIP URI/IMSI/MSISDN/IMEI/NAI. This constrains the use of the E.164 number [i.10] so this prohibits the usage of 3GPP IMS core to be used from Fixed access (e.g. ADSL, CMTS, Fibber Optic, etc.) or the LI of B Number in some implementations.There is no application keep alive. Descriptions of HI3 content protocol are missing such as MSRP [i.11] for eRCS. This appears to restrict the use of these standards for RCS [i.2] or other IMS services which use session-based messaging.
ETSI TS 102 232-5 [i.7] for IMS (using ETSI TS 102 232-1) [i.6]	Very large scope of HI3 content that is RCS [i.2]/Joyn compatible. MSRP [i.11] is covered. Cell-site and WLAN location information can be represented (using ETSI TS 102 232-1 [i.6] Location structure). Session direction/the party who initiated a session can be represented.	No trigger based on mobile target ID as IMEI or IMSI. XCAP [i.12] is not covered.
3GPP TS 33.108 [i.5] via ETSI TS 102 232-7 [i.8] (using ETSI TS 102 232-1 [i.6])	Designed to deliver intercepted content and IRI in a standardized manner.	Only mobile data is covered. Some calls are not intercepted (i.e. diverted calls). Difficulties to correlate LI made on the CS domain with IMS domain, especially in the call handover.
3GPP TS 33.108 [i.5], ATIS-1000678 [i.13] (mapped and DSR) wireline Voice and ATIS-0700005 [i.14] (Wireless IMS VoIP/VoLTE)	Better management of VoIP delivery; solves the implementation issue with multivendor nodes as it could be based with PacketCable's Electronic Surveillance Intra-Network Specification [i.15] on IMS.	The majority of the versions of PacketCable's Electronic Surveillance Intra-Network Specification [i.15] on IMS are lacking security features related to target ID list or target flow protection.

4.2.3 Question: What are the applicable VoLTE standards?

For LI, 3GPP TS 33.107 [i.4] and 3GPP TS 33.108 [i.5]. ATIS-1000678 [i.13] and ATIS-0700005 [i.14] also provide alternative VoIP LI solutions.

4.2.4 Question: What are the pros and cons of the international LI and DR standards?

Table 1 provides some comparisons.

4.3 Nodes and Intercept Access Points / Points of Intercept

4.3.1 Introduction

This clause provides information concerning LI architecture.

4.3.2 Question: For VoLTE intercept, what are the options for the IAPs and their pros and cons?

Table 2 provides some comparative information.

4.3.3 Question: For IMS intercept, what are the options for the IAPs and their pros and cons?

Table 2 provides some comparative information.

Table 2: Observations of different monitoring points

Standard	Useful	Future Study
LI at the S-GW	Enables ability to monitor, at the access level, any data usages and subsequently can intercept any "non-encrypted" calls or sessions to an IMS core network.	Some calls will not be intercepted such as diverted/transferred call. Only works for unencrypted IMS services.
CSCF + MGCF/MGW or A-SBC/P-CSCF	Monitor any usage except those handled by a non-3GPP access to the AS (web access) or WebRTC access. (Interfunction platform between IMS core and WebRTC may be studied and recommended).	Some eRCS or XCAP [i.12] contents or some encrypted home routed roaming calls will not be intercepted. Some up graded solutions have to be made in case of encryption such an LI function on Key Manager Server.
MTAS or any AS	Any signalling related to a specific service will be intercepted whatever the access is used by the target.	In the majority of cases, content would not be intercepted. (NB: This depends of the definition of content, as buddy list managed at the XCAP [i.12] server may be considered as content). This may not work in the case of local break out roaming of VoLTE. It will help to better manage and correlated some duplicated contents, intercept any XCAP (user profile) management, especially supplementary services or target. LI at the visited network of XCAP [i.12] interaction by the target through the Ut Interface can be made at the S-PGW level as the rest of data access, if no encrypted such as TLS is activated by home network.
A mix of solution 2 (CSCF + MGCF…) and 3 (MTAS or any AS)	Complete view and information of target's usages.	Risk of duplication information sent to the LEMF in HI2.
LI based on MRF	Lower cost solution for basic call.	To be completed by another IAP in case of international roaming by LI function in the HSS/A-SBC/P-CSCF.

4.4 Identities used in IMS and how to target the right identity/identities

4.4.1 Introduction

This clause provides information on the identifiers used to intercept.

4.4.2 Question: What are the available target identities?

Identities include (but not limited to) IMEI, IMSI, MSISDN, SIP-URI, TEL-URI (not all usable in all IMS implementations).

Before the implementation of release 12 of 3GPP TS 33.108 [i.5], LEMFs will have to analyse SIP messages to identify/extract the IMEI if the data is unencrypted.

The SIP URI and TEL URL are preferred identifiers for targeting, but what about other identifiers?

Version 3.4.1 of ETSI TS 102 232-5 [i.7] allows the use of the TEL URI, SIP URI or E.164 number as selectors.

Versions beyond 12.9.0 of 3GPP TS 33.108 [i.5] allow the use of the IMEI, TEL URI and SIP URI as selectors.

Relationship of SIP or TEL URIs to MSISDN

It is expected that, under some circumstances, Communication Service Providers (CSPs) will use SIP or TEL URIs that are based on the E.164 number [i.10] also used in the MSISDNs of their customers. However, there are some reports of CSPs using SIP URIs which use randomly generated numbers as the prefix ([randomly generated number]@provide.example.com).

Mobile number portability is based on proprietary ENUM solutions to resolve E.164 numbers [i.10] to a routable SIP URI). Using this to report to LEA is FFS.

Issues related to reporting SIP and TEL URIs

Two issues related to SIP URI and TEL URI:

- VoLTE, identities reporting may be an issue where there will be reported both SIP URI and TEL URI in the same LI instance - SIP URI from the target and TEL URI to the target.
- TEL-URI will never occur per the 3GPP standards. One example is the Media Description Key is available since it is not a Mobile Terminated service.

Implementation at the Mediation Function (MF) could activate based on the MSISDN based E.164 number [i.10] of the target and at the LEMF side, TEL URI and SIP URI may have to be processed to extract the MSISDN like E.164 number [i.10].

Diameter messages

The standards do not take into account Diameter messages (Diameter CX subscriber info messages of the 3GPP TS 23.228 [i.16], 3GPP TS 29.228 [i.17], 3GPP TS 29.229 [i.18] and 3GPP TS 29.230 [i.19]) at the registration process of the target. The addition of this trusted information reported in the standards is FFS.

Multiple identities are often present e.g. multiple aliases. Implicit registration should be noted. Legal question about whether "related identities" are automatically added to a warrant, and if so what exactly does that include or not? Also reported are issues around a provider generating SIP URIs instead of TEL URIs, using randomly allocated numbers. Particular issue if both parties in a call do this. Advice is to try to obtain P-Asserted-Identity.

4.4.3 Question: Is IMSI and IMEI interception possible for IMS?

IMEI will be based on Instance ID. The observed IMEI URN will be reported as an Instance ID as defined in 3GPP TS 24.229 [i.20]. It will be encoded as an IMEI URN as defined in 3GPP TS 23.003 [i.21], IETF RFC 7254 [i.22] and IETF RFC 7255 [i.23].

Examples have been observed of individual VoLTE calls with multiple IMEIs in its SIP messages. This was a hunt call made by the operator to the customer. This may be an issue that deserves further study.

3GPP TS 33.108 [i.5] may report multiple IMEIs, but what the IMEI is not extracted from the SIP into the ASN.1 in ETSI TS 102 232-5 [i.7] so the IMEI(s) would be present in their native form in the SIP (the "+sip.instance" header).

NOTE: The standards do not address the legal approval process concerning multiple IMEIs and the implications if the selection is based on IMEI? This is no different to non LTE based systems.

Availability of the IMSI

In the IMS specification, the IMSI is currently not used and therefore not supported as formal identifier. At least one vendor has commented that their equipment will provide the IMSI (depending on what release of the equipment is used).

Triggering interception based on the IMSI

The IMSI is only contained in UE signalling to identify the subscription which is reported in the IMS SIP signalling events for SIP session establishment transactions. However, the IMSI is not available in other IMS signalling so there is no observed IMSI reporting possible and there are no events associated with any IMS registration events tied to any Cx signalling (3GPP TS 23.228 [i.16], 3GPP TS 29.228 [i.17], 3GPP TS 29.229 [i.18] and 3GPP TS 29.230 [i.19]).

4.4.4 Question: Is it always possible to determine who initiated an IMS session (or an IMS dialog), and flagging which was targeted?

There are concerns about call direction for VoLTE reporting since various INVITEs and media streams go in various directions. For the CC and IRI to be properly understood, it is important for it to be possible to determine whether it is "to" or "from" target".

There are circumstances under which it is difficult or impossible for the LEMF to determine who initiated an IMS session. Modifications have been made ETSI TS 102 232 family of standards [i.6], [i.7] and [i.8] to introduce parameters that the MF could use to signal the direction of sessions to the LEMF.

4.4.5 Question: How do you define the start, end and duration of a session?

This is available according to [i.5].

4.4.6 Question: How do you define the direction and context of a session?

This is available according to [i.5].

4.4.7 Question: Are device identifiers or P-GRUUs seen or both? Also, is the PANI header available/useful?

Sometimes the PANI headers are seen on LI traffic and do contain relevant information.

P-GRUU and device identifiers are for further study.

4.4.8 Question: Can location information be obtained from IMS?

There are several categories of location information relevant to IMS services:

- Location information at the access level (EPS/PS) is available in HI2 and may be trusted as they are provided by the network (i.e. from the Mobile Management Entity).
- Location information is provided with the PANI Header in some SIP messages. For example, this may be the cell site (CGI or ECGI) or the Media Access Control Address of the WLAN Access Point. If the target and the other party are on the same network, the location information of the other party may be included. Filtering of such information may be required by national regulation.
- Location information is provided by the UE. Network asserted location information need an upgrade of the IMS system. If a country wants to have some trusted value of the cell id, it has either to lock at the LI system at EPC level, but it could request development such architecture based on PCC Based solution provided via Gx/Rx (P-CSCF - Policy and Charging Rules Function - PGW). Such interfaces may not be available at short term.

Location for VoWiFi

Getting the location in a VoWiFi scenario can be an issue. In some situations, the ePDG could intercept on top of content, the information "Terminating address of IP Sec" (i.e. Outer IP and Port source address). This information may not be enough in case of WLAN mesh network. Some networks may not populate PANI header with location information.

In some situations, receiving a comprehensive set of location information is reported with WLAN records, which reduces the need to perform look-ups. Noted the possibility to use information such as pOPIdentifier, pOPIPAddress or targetNetworkID to then make an indirect determination of location. Clear preference that there is an ability to do automatic look-ups (e.g. based on targetNetworkID).

4.4.9 Question: How do we get hold of location information?

This is available according to [i.5].

4.4.10 Question: How do we present location information?

This is provided for according to [i.5].

4.4.11 Question: How do we correlate location information (e.g. from access to service or vice versa)?

This is provided for as per [i.5].

4.4.12 Question: Are login and presence events seen?

Both these are noted as having been seen on some LI traffic.

4.4.13 Question: Is it possible to determine the IP addresses of the participants (e.g. target and non-target)?

The IP addresses presented in ETSI TS 102 232-5 [i.7] for a given SIP message will related to the IP endpoints for that IP transport 'leg' and therefore it is likely that at least one of the A party and B party IP addresses will not be provided.

4.5 Detailed call/sessions flows and guidance with regard to multi-location or multi-country sessions

4.5.1 Question: Is it possible to enforce the use of clear media and clear signalling in the visiting network possible?

Yes. Both roaming agreements and a technical solution to deny inbound roamers the use of the VPLMN for VoLTE services can be used to ensure compliance with local law.

4.5.2 Question: Where is it decided what roaming scenarios are allowed or supported?

There are two roaming models defined: Local Break-Out (LBO) and S8 Home Routed (S8HR). There are some technical challenges to S8HR, including local regulatory compliance (i.e. emergency calls, LI/DR) and interoperability between carriers who implemented S8HR and those having implemented LBO.

It is up to each carrier to select their roaming architecture.

At least one roaming model that is studied by the GSMA, the S8 Home Routed scenario (P-CSCF within the home public land mobile network (HPLMN), can present a problem to intercept at the visited network level, especially if the home IMS enable additional privacy enhancement options for IMS services. This was not taken into account fully when S8HR was designed by GSMA.

If the S8 Home Routing (S8HR) scenario is chosen by the CSP:

- The roaming agreements between VPLMN and HPLMN should contain the additional PE is not enabled.
- The S8HR solutions from 3GPP TS 33.107 [i.4] and 3GPP TS 33.108 [i.5] should be implemented (based on 3GPP TR 33.827 [i.24]).

- If PE is used by the HPLMN, the VPLMN may be forced to reject LTE attach request in order to do LI. LTE networks could return #15 (no suitable cells in tracking area) The #14 (EPS services not allowed in this PLMN) is not recommended as the UE, that received cause code #14, will list (or its forbidden PMN for GPRS service list). The UE could even never initiate a Location Update or a GPRS Attach.

Further notes on roaming

VoWifi based on specifications of GSMA are for the time being not compatible with international roaming and cannot manage emergency calling. However, the works of 3GPP with its "SEW" project for emergency call from WLAN will include roaming usage for VoWIFI and SMS over Wifi. The case of WLAN provider for VoWIFI roaming that is not a mobile operator with an ePDG and IMS core network may be an issue to be studied. Location information from roaming (including MVNO) is of interest.

4.5.3 Question: Do roamers always go back to their home network for their services?

For VoLTE, only if an operator has implemented S8HR.

4.6 Supplementary Services

4.6.1 Introduction

This clause provides information on VoLTE supplementary services (SS).

4.6.2 Question: Will the Supplementary Services change?

Yes, and this is how they change. As it is detailed in CS domain, is it interesting to better develop LI of XCAP [i.12] server? It may induce to process at the MF/DF side and deliver extra information based on:

- Originating Identification Presentation/Restriction, 3GPP TS 24.607 [i.25]
- Terminating Identification Presentation/Restriction, 3GPP TS 24.608 [i.26]
- Communication Hold, 3GPP TS 24.610 [i.27]
- CONFerence Calling, 3GPP TS 24.605 [i.28]
- Communication DIVersion Services, 3GPP TS 24.604 [i.29]
- Communication forwarding unconditional
- Communication Forwarding on busy user
- Communication Forwarding on no-Reply
- Communication Forwarding on not Logged-In
- Communication Forwarding on Subscriber Not Reachable
- Communication Diversion Notification
- Communication Deflection
- Communication Barring, 3GPP TS 24.611 [i.30]
- Barring of All Outgoing Calls
- Barring of Outgoing International Calls
- Barring of Incoming Calls
- Communication Waiting, 3GPP TS 24.615 [i.31]

- Message Waiting Indication, 3GPP TS 24.606 [i.32]
- Explicit Communication Transfer (Legal LI issue as it let establish a call between two parties by the target that will release the call, etc.)
- Malicious Call Identification
- Completion of Communications to Busy Subscriber
- Advice of Charge, 3GPP TS 24.647 [i.33]
- Close User Group, 3GPP TS 24.654 [i.34]
- Flexible Alerting, 3GPP TS 24.239 [i.35]

However, some supplementary services are already standardized:

- Customized Alerting Tone, 3GPP TS 24.182 [i.36]
- Customized Ringing Signal, 3GPP TS 24.183 [i.37]

4.7 Terminals, LEMF capabilities and E2E issues

4.7.1 Introduction

This clause provides information about the LEMF.

4.7.2 Question: Should we put all of the signalling interpretation responsibility on the LEMF?

Depending on national or regional requirements, the CSP may be required to deliver IRI in a manner which enables it to be associated with the communications to which it pertains.

4.7.3 Question: Can the responsibility for the interpretation of the signalling be placed on the LEMF?

The intention is to ensure appropriate IRIs are generated and delivered according to [i.5] and [i.7].

4.8 Correlation

4.8.1 Question: How can different identities for a single party be performed?

Correlation assists the LEA to associate IRI and CC. For each service, different parameters may be used to provide correlation.

4.8.2 Question: How can HI2 and HI3 be correlated?

The LEMF will have to handle SIP contexts (e.g. SDP offer, services tag, Payload Type RTP) to process (to play) CC over HI3. It may induce problem of high performance capacity/complexity of post processing within LEMF. This point may have to be studied. Solutions may exist such as to impose extra processes at the MF/DF side with IRI begin/IRI end as in US standards for any VoLTE call, or to "tag" important SIP messages to help the CC contents.

NOTE: FFS: Can we learn from the ATIS-1000678 [i.13] or from ETSI TS 101 671 [i.38]?

4.8.3 Question: How can you correlate different sessions between different accesses (e.g. CS call and VoLTE call)?

They will be delivered according to the domain within which the call was handled.

4.9 Codecs, codec changes and other issues affecting voice quality

4.9.1 Introduction

Management of SDP messages is a key element for the LEMF when dynamic codecs are used. The LEMF needs to track the relevant SDP messages and implement dynamic mapping properly to process the HI3 correctly. They have to be able to process any of the permitted numbers from the dynamic range as described in IETF RFC 3550 [i.39] and (from AMR codec) IETF RFC 4867 [i.40].

Some issues have been observed when using the 3GPP TS 33.108 [i.5] for delivery of IMS where the codecs are in the dynamic range as delivery of the HI2 (which includes the SIP which contains the SDP) can sometimes lag behind the delivery of the HI3, thus delaying the LEMF's ability to decode the RTP. This applies for codec change as well as mode change within the codec. Please note that for example AMR-WB has nine modes.

Note that the telephone-event payload as well as tone payload (IETF RFC 4733 [i.41] / IETF RFC 2833 [i.42]) is within the dynamic range of the rtp payload type.

In case of LI activation during an established call, there will be no information sent to the LEMF related to the codec. The LEMF can try to guess the codec and associated information to process the content.

4.9.2 Question: What common codecs are seen?

In principle any codec could be used. However, the CSP will focus on bandwidth efficient codecs. As per GSMA IR.92 [i.1] the following codecs have to be supported:

- AMR-NB
- AMR-WB
- EVS

Although three voice codecs are specified, AMR-NB and AMR-WB are mostly used.

For video, IR.94 [i.43] specifies the following mandatory codecs to be supported:

- H.264 Constrained High Profile (CHP) Level 3.1
- H.264 Constrained Baseline Profile (CBP) Level 3.1

4.9.3 Question: Are there likely to be codecs beyond those specified in the core VoLTE specification which are being used or expected to be used in VoLTE?

Additional voice codecs could be supported such as:

- G.722
- GSM-EFR
- G.729
- AMR-WB+

The following video codecs might be used as well:

- H.265 (HEVC) Main Profile, Main Tier, Level 3.1
- MPEG4 (H.264 part 10)
- H.263

4.9.4 Question: If proprietary codecs are used then appropriate technical details and licenses need to be provided?

For most codecs royalty fees are due.

4.9.5 Question: Can the IMS operators limit the codecs which are used?

Most of the IMS vendors support white/black lists for voice and video codecs. Using this configuration the list of voice and video codecs supported could be limited.

4.10 Impacts and dependencies on existing CS solutions

4.10.1 Introduction

This case provides information on the relationship of LTE and CS services.

4.10.2 Question: Is "double interception" possible?

Double Interception of the same call will happen due to use of the CS+IMS domain without anchoring all the call through IMS core network. The LEMF will have to manage the double content for the following examples:

- Without eSRVCC, i.e. without any ATCF/ATGW, LIID will be the only correlation information to correlate the same call before and after handover from LTE radio access to UMTS/GSM radio access.
- If the AS is modifying the SIP message (case of "Terminating Identification Presentation (TIP) and Terminating Identification Restriction (TIR), or of a modification of the phone number identification by the target), you will have LI IAP not only at the pre service level but also the LI IAP will be triggered at outgoing of the AS, based on a post LI process.
- If User A (VoLTE) calls User B (a target, and a subscriber of VoLTE but under 2G/3G coverage): a double interception in CS and IMS domains will be triggered. The standards have not addressed this scenario.
- VoIP by 3GPP is standardized however, some eRCS services are not. Subsequently, issue may happen at the delivery of intercepted SIP messages. eRCS will provide more SIP messages to be process at the LEMF level, especially when a target uses VoLTE and eRCS at the same time.

4.11 Related or complimentary technologies

4.11.1 Introduction

This clause provides some clarification on the relationship of LTE and VoLTE to other technologies and initiatives.

4.11.2 Question: What are the links or cross-overs with the Internet of Things?

Narrowband/Internet of Things (IoT) have low power requirements for UEs. This is noted to have implications on the security protocols, as low power use means low bandwidth which reduces options for encryption. There is a lot of pressure for networks to provide encryption (e.g. from the Subscriber Identity Module (SIM) card). Sometimes you will have multiple cards that are the slaves of a single card; they talk back to the central card, which then talks to the network. It should be noted that IoT networks may not be 3GPP-based.

4.11.3 Question: What are the links to eCall?

In the event of a serious accident, eCall automatically dials 112 - Europe's single emergency number to establish a voice connection. An emergency message that includes a minimum set of data (e.g. time, location, driving direction and vehicle description) is simultaneously sent with the voice call. At the date of publication of the present document there was a deadline of end of March 2018 for all new cars to have embedded SIM cards. eCall does not necessarily need the vehicle to have an MSISDN (from a technical perspective). This may come down to the regulator.

Annex A:
Change Request history

Status of the present document Dictionary for common parameters		
TC LI approval date	**Version**	**Remarks**
October 2017	1.1.1	First publication of the RS after approval by Remote Consensus after ETSI TC LI#46 Document prepared by Gerald McQuaid (rapporteur)

History

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