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Functional architecture to support European requirements on emergency caller location determination and transport

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Foreword

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Modal verbs terminology

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1 Scope

The present document describes the unified functional architecture to support requirements as outlined in European Commission (EC) mandate M/493 [i.4] on emergency caller location determination and transport, in particular for the case where the VoIP service provider and one or several network operators - all serving the customer in the establishment of an emergency call - are independent enterprises needing to co-operate to determine the location of the (nomadic) caller. The architecture identifies all necessary interfaces, which are needed to fulfil the requirements outlined in EC Mandate M/493 [i.4], and provides a basis for the specification of the protocols to be used on those interfaces.

The present document is applicable to both NGN and pre-NGN IP-based networks. The architecture defined in the present document is intended to be compatible with IMS-based deployments but does not require compliance to IMS specifications.

This architecture does not intend to replace existing deployed solutions. It should enable operators and undertakings providing services to realize transmission of location information to the Public Safety Answering Point.

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 reference document (including any amendments) applies.

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

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2.2 Informative references

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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] ETSI TS 123 167: "Universal Mobile Telecommunications System (UMTS); LTE; IP Multimedia Subsystem (IMS) emergency sessions (3GPP TS 23.167)".

[i.2] IETF RFC 6967: "Analysis of Potential Solutions for Revealing a Host Identifier (HOST-ID) in Shared Address Deployments".

[i.3] Draft-boucadair-intarea-host-identifier-scenarios-03 (March 2013): "Host Identification: Use Cases".

[i.4] M/493: "Standardisation Mandate to the European Standards Organisations (ESO) in support of the location enhanced emergency call service".

[i.5] IETF RFC 6753: "A Location Dereference Protocol Using HTTP-Enabled Location Delivery (HELD)".

[i.6] ETSI TS 102 181: "Emergency Communications (EMTEL); Requirements for communication between authorities/organizations during emergencies".

[i.7] ETSI TS 102 650: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); Analysis of Location Information Standards produced by various SDOs".

[i.8] Directive 2002/22/EC of the European Parliament and of the Council of 7 March 2002 on universal service and users' rights relating to electronic communications networks and services (Universal Service Directive).

[i.9] Commission Recommendation 2003/558/EC of 25 July 2003 on the processing of caller location information in electronic communication networks for the purpose of location-enhanced emergency call services (notified under document number C(2003)2657).

[i.10] IETF RFC 5222: "LoST: A Location-to-Service Translation Protocol".

[i.11] IETF RFC 4848: "Domain-Based Application Service Location Using URIs and the Dynamic Delegation Discovery Service (DDDS)".

3 Definitions and abbreviations

3.1 Definitions

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

access network: portion of the telecommunications network that provides access to the switching function and terminates the user access signalling

Access Network Provider (ANP): service provider that provides physical and IP connectivity to a user equipment (UE) via a fixed or mobile access

NOTE: The access network may be provided by a single organization or it may be provided by a number of different organizations, BUT the interfaces between these organizations are not relevant to the scope of the present document as it is matter of contractual relations between the parties.

emergency: urgent need for assistance or relief

emergency call: call from a user to an emergency call centre, PSAP or similar agency charged with routeing calls to the relevant emergency response organization

emergency call facilities: mechanisms provided by public or private communications networks, emergency telephone stanchions/boxes, fire alarms, etc. the use of which enables emergency calls to be made

Emergency Call Service Provider (ECSP): service provider that acts as a mediator between the voice service providers and the public safety answering point service providers

emergency caller: individual placing an emergency call to reach the suitable PSAP

emergency response organization: local or national force established to provide assistance to citizens in the event of their being involved in an emergency situation and requiring specialized help, for example, the police, fire service and emergency medical services

emergency service: service that provides immediate and rapid assistance in situations where there is a direct risk to life or limb, individual or public health or safety, to private or public property, or the environment but not necessarily limited to these situations

emergency situation: abnormal situation of serious nature that develops suddenly and unexpectedly, of which the evolution is uncertain and which may turn into a crisis or cause damage and casualties

FlowChanger: device in an IP flow, which changes the packet flow identity, for example changing the IP address and/or port, so the UE can no longer be identified in the original access network

location identifier: public network identifier, which provides a location value

EXAMPLE: A cell ID or line ID (see ETSI TS 123 167 [i.1]).

NOTE: A location value can be obtained from a location identifier by applying a static mapping or the location identifier may be encoded in such a way that it contains a location value (e.g. a ZIP code).

location information: location value, and/or a location identifier and/or a location reference

location reference: identifies a location server and provides sufficient information to allow the location server to provide the location value for the UE

EXAMPLE: https://ls.example.com:49152/uri/w3g61nf5n66p0, IETF RFC 6753 [i.5].

location value: civic or geodetic position

network-provided location information: any location information pertaining to the calling device that is determined, provided or verified by the ANP

Next Generation Network (NGN): packet-based network able to provide telecommunication services and able to make use of multiple broadband, QoS-enabled transport technologies and in which service-related functions are independent from underlying transport-related technologies

nomadic: having the ability to move across network access points

NOTE: A nomadic user can make calls from different locations. However, unlike a mobile user, the location of a nomadic user cannot change during a specific call.

originating network: access network in which the emergency call was placed

packet flow identity: all network parameters, which unambiguously identify a IP flow

PSAP address: URI or an E.164 number identifying a PSAP or a group of PSAPs

PSAP Service Provider: service provider that provides connectivity to Public Safety Answering Points (PSAPs) and directs emergency calls from the ECSP to the PSAP

Public Safety Answering Point (PSAP): physical location where emergency calls are received under the responsibility of a public authority

NOTE: See Commission Recommendation C(2003)2657 [i.9] and ETSI TS 102 181 [i.6].

regulatory domain: geographical area where a set of regulatory rules applies

telecommunication: any transmission, emission, or reception of signs, signals, writing, images, sounds or intelligence of any nature, by wire, radio, optical fibre or other electromagnetic system

user access: point of connection to a telecommunication network from which a call can be placed

NOTE: This includes public telephones and "emergency call facilities".

user equipment: device allowing a user access to network services

user-provided location information: any location information originating from user-equipment that is not independently verified by the ANP

Voice Service Provider (VSP): specific type of application service provider that provides voice related services and optionally text and video-related services, on IP

VSP Aggregation Provider (VAP): provider that a VSP or group of VSPs can use to support call routing to remote ECSPs and for the generation of related call data records

3.2 Abbreviations

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

ANP	Access Network Provider
AP	Access Point
CGN	Carrier Grade NAT
DHCP	Dynamic Host Configuration Protocol
DNS	Domain Name Server
EC	European Commission
ECSP	Emergency Call Service Provider
ESO	European Standards Organization
ESRF	Emergency Service Routing Function
ESRP	Emergency Service Routeing Proxy
ETSI	European Telecommunications Standards Institute
FID	Flow Identity
FID-N	N^{th} Flow Identity
FQDN	Fully Qualified Domain Name
IETF	Internet Engineering Task Force
IMS	IP Multimedia Subsystem
IP	Internet Protocol
ISDN	Integrated Services Digital Network
LS	Location Server
LS-N	N^{th} Location Server
NAPTR	Naming Authority Pointer
NAT	Network Address Translation
NGN	Next Generation Network
PAT	Port and Address Translation
PBX	Private Branch Exchange
PCRF	Policy and Charging Rules Function
PSAP	Public Safety Answering Point
PSP	PSAP Service Provider
PSTN	Public Switched Telephone Network
RFC	Request For Comment
SIP	Session Initiation Protocol
TCP	Transmission Control Protocol
UDP	User Datagram Protocol
UE	User Equipment
URI	Uniform Resource Identifier
VAE	VSP Aggregating Entity
VAP	VSP Aggegation Provider
VoIP	Voice over Internet Protocol
VPN	Virtual Private Network
VSP	Voice Service Provider

4 Descriptions and assumptions

4.1 Introduction

ETSI TS 102 650 [i.7] states that:

"In order to effectively deliver emergency services to the location of a reported incident, it is essential for the emergency response organization to have timely and accurate information that enables them to correctly identify the location of the incident.

The ability to initiate an emergency communication to summon help when needed is regarded by the European Commission as a right of all citizens and this ability should ideally be independent of the network and access technologies deployed or the physical abilities of the citizen.

The rights of individual users to privacy shall be adhered to according to European regulations and it is therefore essential that all information derived from emergency calls shall only be used for management of the related incident. Location information for non-emergency calls is out of scope of the present document.

In many circumstances, citizens reporting an incident requiring urgent assistance are unable to provide the emergency service with accurate information about the location of the emergency. This may be due either due to the nature of the emergency, the callers' lack of local knowledge, their disabilities or lack of linguistic ability, etc. Young children or cognitively impaired people may not have the language skills to explain their location, speech and/or hearing impaired users may not be able to use voice terminals, visually impaired or otherwise disabled people may not be able to use text terminals, elderly or confused people may not be able to use any form of terminal, etc. For these significantly large categories of users the successful outcome of an emergency call could make the difference between life and death. It is therefore essential for the emergency responders to be provided with accurate location information via an automated process based on the communications network being used by the caller.

Implementation of caller location systems is also likely to result a welcome positive impact on the reduction of malicious calls made by criminal or anti-social persons when they realize that the automatic provision of their location information to the emergency services could enable their almost instant apprehension."

The M/493 standardization mandate [i.4] is issued on the basis of the European Regulatory Framework for the electronic communication networks and services. The Universal Service Directive, Article 26, Paragraph 2 states, that "Member States ... shall ensure that undertakings providing end-users with an electronic communications service for originating national calls to a number or numbers in a national telephone numbering plan provide access to emergency services". This includes providing emergency caller location.The service addressed by the Universal Service Directive includes telephony and any publicly available voice service using E.164 numbers, independently from the specific network technology (i.e. traditional or VoIP network technologies). The architecture in the present document includes provisions for the universal service directive obligations as described above and emergency calling using emergency service URNs.

The scope of the M/493 mandate [i.4] is directly reproduced in annex B.

4.2 Location information descriptions

4.2.1 General

Location information is crucial in emergency calling in determining which PSAP needs to receive the call and also where to dispatch emergency crews to ensure that help is received where it is needed. The definition clause of the present document defines three types of location information, a location value, a location identifier and a location reference. Each of the location information types represents a different kind of information about the caller's location and each can be used by the emergency call service in a different way.

4.2.2 Location value

A location value describes a physical area in which the caller is likely to be present. This may be a civic location, which describes some kind of street address, or it may be represented as a geodetic location, which uses latitude, longitude and uncertainty parameters that result in the defining of an area or volume.

However, a location value that is accurate enough to allow routeing of a call to the correct PSAP may not be good enough to enable dispatch of responders to provide assistance to those in need. Further discussions on accuracy are beyond the scope of the present document.

The location value describes where the caller is as a consequence of this a location value needs to be considered private and only made available to authorized entities.

4.2.3 Location identifier

A location identifier is a datum that is public or semi-public and is used to derive a serving area where the UE is present or the position of a network termination point to which the UE is attached. The area and prescribed identifier may be associated with the physical access network, such as a mobile Cell-ID, WiFi AP or line identifier. However, the location identifier does not have to be tied to an access network termination point, provided that the defined area includes the termination point to which the UE is attached.

A location value derived from a location identifier can be accurate enough to allow routeing to occur to the correct PSAP but is often not good enough to allow accurate dispatch or emergency responders to provide assistance to those in need. Further discussions on accuracy are beyond the scope of the present document.

Since a location identifier can be translated into a physical area in which a caller is likely to be they should be used with care to ensure that the physical location of the caller is not inadvertently provided to an unauthorized entity.

4.2.4 Location reference

A location reference is a key, often a URI, which identifies a location server and provides sufficient information to allow the location server to provide the location value of the UE. The location reference does not explicitly represent a physical location, the location is returned when the reference is used allowing a location reference to be accessed multiple times resulting in location updates being provided. This is not possible with a location value or location identifier.

Unlike a location value or location identifier, a location reference does not in and of itself contain the location of the caller. This attribute allows a location reference to be used in a range of network environments as long as suitable authentication and authorization policies are implemented on the location server.

5 Functional architecture to support European requirements on emergency caller location determination and transport

5.1 Overview

The functional architecture to support EC requirements on emergency caller location determination and transport identifies four service provider roles as represented in figure 5.1:

- Access network provider (ANP);
- Voice service provider (VSP);
- Emergency call service provider (ECSP); and
- PSAP service provider (PSP).

The ANP, ECSP and PSP are in the same regulatory domain. The VSP can be inside or outside this domain.

NOTE: On the basis of the European Regulatory Framework the emergency services provision inside a country is in charge of its administration; so the term "regulatory domain" typically coincides with a single country. In some cases a specific agreement can be defined between neighbouring countries to correctly manage the provision of the emergency services, for example in areas close to the common border.

This architecture is neutral regarding deployment and business models. It defines the functional roles of different network segments. Multiple roles can be played by a single actor or by multiple actors, each actor managing its own resources to fulfil a role.

Clause 5.2 specifies the functional requirements to be fulfilled by a service provider when playing these roles.

Clause 5.3 specifies the interfaces used to support communication between these roles and interfaces with user equipment and PSAPs.

For each interface the functional description is provided in clause 5.3.1, while clause 5.3.2 provides, without going into the details of the protocols, the description of the information flows that the functional entities need to exchange to implement the service.

The communication is specified with reference to the functional entities, defined in clause 5.4, that each role needs to implement and are explicitly evidenced in figure 5.1.

Clause 5.5 finally provides the information flow diagrams needed to implement the service in different conditions, with reference to the information elements defined in clause 5.3 and without addressing protocol aspects.

The architecture covers two methods for transmission of location values to the PSAPs, the push and the pull method:

- In the push method the location values are transmitted via the ii or ij interface as part of the call setup signalling information or via the ik or im interface directly to the PSAP as soon as the emergency call request is sent to the PSAP.
- In the pull method the PSAP receives via the ii or ij interface the information required to acquire a location value from the LS or the LS Proxy via the ik, il or im interface. The request is triggered manually by the PSAP operator on a case by case basis or automatically in the PSAP entity with every emergency call request received.

The method, or combination of methods, for getting a location value from the ECSP to a PSAP is decided via prior agreement between the ECSP and the PSAP authority.

As a general remark, if an interface is internal to an operator (e.g. the "in" interface as presently depicted in figure 5.1), its functional description does not mandate the implementation of the corresponding protocols, provided this does not impact on the functionality of the external interfaces.

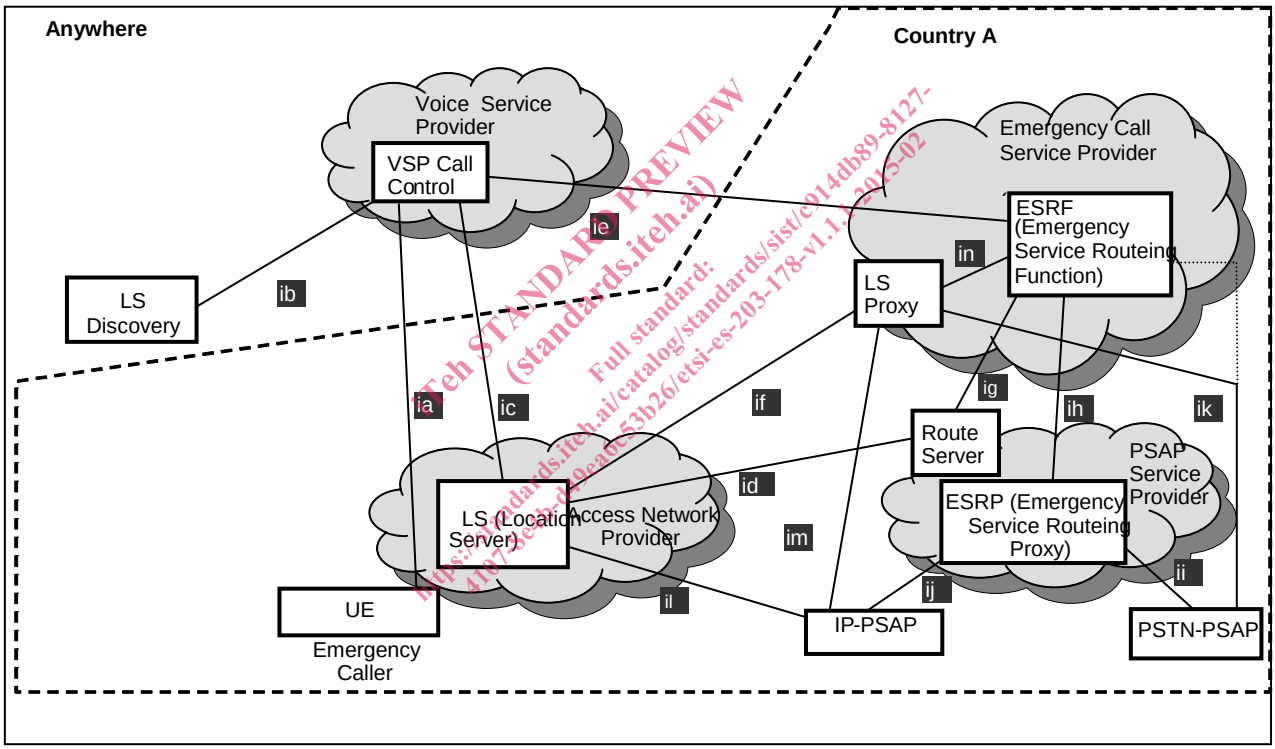

Figure 5.1: High level Functional Architecture

5.2 Architectural requirements

5.2.1 General

The following technical requirements describe the set of actions performed by the different roles that can be involved in the provision of an emergency service. It is the responsibility of national Administrations and Governments to decide on national implementations for emergency services. Specific attention ought to be paid to the roles that have access to sensitive end user information like caller identity and caller location.