EENA Operations Document

Caller Location in Support of Emergency Services

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Contributors to this document

This document was written by members of the EENA Operations Committee (Technological Access Subcommittee):

Members	Organisation
Anderson, Carla	e-Copernicus
Bambrilla, Piero	Areu Lombardia - IT
Banovec Juros, Katja	Administration of the Republic of Slovenia for Civil Protection and Disaster Relief - SI
Bley, Guy	112 Call Centre - LU
Bocchini, Oscar	Beta 80 Group
Bruneteau, Frederic	Ptolemus
Cipriani, Cristina	ATX
Christophe , Ameline	Alcatel-Lucent
Dassi, Gabrielle	Areu Lombardia - IT
Dawson, Martin	Commscope
De Ugarte, Jerónimo	Itasla
Del Rey, Diego	Murcia - Direction General de Protection Civil - ES
Geradin, Laurent	CICADE
Gerber, Moshe	Nice
Gómez, Pedro José	Siemens IT Solutions and Services (SIS)
Gómez, Iratxe	Siemens IT Solutions and Services (SIS)
Gramatikov, Stoyan	Ministry of Emergency Situation - BG
Grososiu, Andrei	Special Telecommunications Service - RO
Herlev Larsen, Steen	Danish National Police - DK
Jänin, Gregor	Disponet / EENA
Kowalczyk, Marek	Ministry of the interior- PL
Lumbreras, Cristina	EENA
Machado, Gary	EENA

Members	Organisation
Maillot, Patrick	BlueSky Positioning
Malenstein, Jan	National Dutch Police Agency - NL
Maroscikas, Tadas	Lithuanian Emergency Response Centre - LT
Martin , Porges	Avaya
Maurin, Denis	Creativity Software
Meulemeester, Arnaud	ATX
Nelson, Marlin	Nice Systems Limited
Paris, Jérôme	EENA
Puertas, Francisco	Itasla
Roger, Hixson	NENA
Rohde, Greg	e-Copernicus
Rojo, Francisco	Murcia - Direction General de Protection Civil - ES
Sarv, Kaur	Emergency Response Centre - EE
Savolainen, Risto	BlueSky Positioning
Scovill, Kim	TeleCommunication Systems TCS
Sherlock, Ita	Creativity Software
Slabe, Romana	Administration of the Republic of Slovenia for Civil Protection and Disaster Relief - SI
Terpstra, Tjerk	EENA
Tiquet, Eric	Cap Gemini
Van Hunnik, Chris	KLPD - NL
Vandedrinck, Jan	Service Public Fédéral Intérieur - DG Sécurité Civile - BE
Varano, Brian	Truepostion
Weynants, Alex	Newtel Essence

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1 Introduction

Being provided with accurate location information via an automated process linked to the communication network being used by the caller is essential for emergency services. The availability of caller location enables dispatching of the right emergency resources and reduces delay before they arrive.

The main objective of the document is to describe EENA operational requirements as a result of the analysis of the available technologies and the existing implementations. These requirements have to be accomplished by the organisations that claim compliancy with this document. The study is focused on the means to acquire location, how this information is delivered to emergency services (automatically or not) and how accurate this location is.

It is worth to mention that in the analysis of existing implementations four main problems have been revealed:

- the excessive amount of time required to deliver location data to emergency services
- the lack of accuracy
- the deficient reliability
- the need for standardisation.

This document also sets out how stakeholders should be involved during the procedure of providing location of the caller to ensure that emergency services are provided electronically, in a minimum timeframe and with accurate location of the caller, irrelevant of the network and access technologies deployed. Challenges have still to be faced in order to obtain location data with acceptable levels of reliability and accuracy.

2 Why is location crucial for emergency services

To know the location of the caller is crucial for emergency services. In many circumstances, citizens reporting an incident requiring urgent assistance are unable to provide emergency services with accurate information about the location of emergency. Furthermore, citizens calling 112 abroad may not be able to give accurate information about their location. To provide emergency services with precise location information will improve travellers and tourist safety.

The conclusions of the Coordination Group on Access to Location Information by Emergency Services (CGALIES)[1] highlights that accurate caller-location is crucial for EU emergency services to intervene and rescue citizens: "Extrapolating the responses received it is estimated that among the 40 million "real" mobile emergency calls handled by the emergency service operators each year in the European Union, considerable time is lost by emergency services during their intervention for approximately 3.5 million calls, due to the fact that the location information provided by the caller is later found to be inaccurate. It was also estimated that emergency services are not able to dispatch a rescue team for approximately 2.5 million calls, due to the absence of sufficient location information".

To establish the exact place of the call helps emergency services to decide the resources needed to provide assistance. This is the main reason why location shall be as accurate as possible. Information about how to access the place where the emergency is can reduce radically the time of the intervention. In the article of the British Medical Journal "Role of ambulance response times in the survival of patients with out-of-hospital cardiac arrest"[2] it was described that one minute reduction in response time was to improve the odds of survival by 24%.

Automatic provision of caller location is also likely to have a welcome positive impact on the reduction of false emergency calls. With this facility, emergency services can compare the automatic location and the one given

[1] CGALIES Final Report: www.esafetysupport.org/download/working_groups/cgaliesfinalreportv1_0.pdf

[2] Article (Abstract Published online 25 August 2010) - British Medical Journal: "Role of ambulance response times in the survival of patients with out-of-hospital cardiac arrest" – emj.bmj.com/content/early/2010/08/25/emj.2009.086363.abstract

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by the caller. If any inconsistency exists between them, the emergency services may have reasons to believe that it is a false call. In addition to this, people can be discouraged from doing false emergency calls if they know that they can be located and eventually prosecuted.

Multiple calls for the same incident can cause unnecessary overload to emergency services. The location of the caller can be also useful to decide if a call refers to an already identified incident.

Emergency services need updated location data independently of the technology the caller is using to contact them (fixed telephony, mobile phone, SMS if possible, voice over IP, etc.) and of the provider who is giving the telecommunication service (all providers, international or national roaming situations, etc.).

3 Abbreviations

The positioning methods specified by 3GPP make use of the following abbreviations:

- A-GNSS Assisted Global Navigation Satellite System
- A-GPS Assisted Global Positioning Systems
- DGPS Differential Global Positioning Systems
- FDD Frequency Division Duplex
- GLONASS GLObal'naya NAvigatsionnaya Sputnikovaya Sistema (Engl.: Global Navigation Satellite System)
- GNSS Global Navigation Satellite System
- GPS Global Positioning System
- IPDL Idle Period Downlink
- LBS Location Based Services
- LMU Location Measurement Unit
- Node B UMTS base station
- OTDOA Observed Time Difference Of Arrival
- QoS Quality of Service
- QZSS Quasi-Zenith Satellite System
- RAN Radio Access Network
- RNC Radio Network Controller
- RTT Round Trip Time
- SAI Service Area Identifier
- SAS Stand-Alone SMLC
- SBAS Satellite Based Augmentation System
- SFN System Frame Number
- SRN Signal-to-Noise Ratio
- SRNC Serving RNC
- TDD Time Division Duplex
- TOA Time Of Arrival
- UE User Equipment
- URA UTRAN Registration Area, is a collection of cells that are used for fast moving UE's in Connected mode when they are not transferring any data
- UMTS Universal Mobile Telecommunication System
- U-TDOA Uplink – Time Difference Of Arrival
- UTRAN Universal Terrestrial Radio Access Network

4 Methods for the provision of the caller location

4.1 Description

Two different methods are used for the provision of the caller location information. In the 'push' mechanism the location of the caller is received by the PSAP with all calls. Caller location information is provided to PSAPs handling 112 calls automatically with every 112 call and is without delay available for the 112 call handler as soon as the call is answered.

In the 'pull' mechanism the PSAP operator asks for the location if needed. Caller location is provided upon specific request by the 112 call handler, by an electronic request to a database or otherwise by a verbal request to the appropriate telecom operator. It is also possible that an automatic call for location information is generated by the information system of the PASP.

'Push' and 'pull' are used all over Europe. Advantages and disadvantages for both methods are well-known. The critical point is time. Both methods are acceptable if the period to make the caller location available is within the beginning of the timeframe of receiving and handling emergency calls, as defined by emergency services.

4.2 EU Existing Implementations

The method chosen by the European countries is described in the following table. The source of the data are the Electronic Communications Committee (ECC) Report 143 "Practical improvements in handling 112 emergency calls: caller location information" (April 2010) and information given by EENA's members.

Country	Method of providing fixed caller location information and time needed to provide it on request	Method of providing mobile caller location and time needed to provide it on request
Austria	Pull by electronic request to the telephone directory or verbal/written request to the respective network operator regarding unlisted numbers. Estimated time needed: less than 2 sec. for electronic requests and up to 30 min. for verbal/written requests	Pull – verbal/written request to respective network operator
Belgium	Pull	Pull
Bulgaria	Push	Push
Cyprus	Pull; estimated time: within 1 minute	Push
Czech Republic	Pull; average time needed to provide caller location 0.5 sec, measured in January-October 2008	Push
Denmark	Push	Push
Estonia	Pull; estimated average time 23 sec.	Pull; estimated average time: 23 sec.
Finland	Pull by electronic request to a database; estimated time 2 sec. and up to 10 sec in times of the heavy traffic	Pull- by electronic request to a centralised mobile positioning database; estimated average time: 6 sec. or 3 to 30 seconds depending on operator and traffic
France	Pull; estimated time : a few seconds	Pull; estimated time needed: about 10 min. during working hours and less than 30 min. outside working hours.
Germany	Pull; estimated average time 90 sec.	Pull; measured average 5 min. (in 2 Federal States)

Greece	Pull; estimated time from 3 to 7 minutes	Pull; estimated time from 7 to 60 min.
Hungary	Push	Push
Ireland	Pull; average time 30 sec; location provided for 100% calls within 1 min.	Pull
Italy	Push, in the province of Salerno only	Push, in the province of Salerno, only
Latvia	Pull, location information is provided immediately	Pull, (for two operators is Push); average measured time for 7361 requests:10.3 sec. ; caller location provided within 1 min. for 98.17% requests
Lithuania	Pull. Fixed line users database is provided to Emergency response centre. Database is input into ERC Information System integrally. In case of 112 call from fixed line address data matching the number is displayed instantly, less than 1 sec. Database is standardized and updated monthly. Databases are provided individually by every fixed line operator, but they are conjoined in the ERC Information System. Location isn't possible for private PBX calls.	Push & Pull (in Vilnius and Klaipėda PSAPs), provided within 1 sec. (excl. SIMless). Use of Pull is possible to renew location unlimited times while connection is active
Luxembourg	Pull, provided in less than 1 sec.	Push
Malta		
Netherlands	Push based on ZIP code and house number.	Push and Push/Pull combination depending on the provider. Provided within 1 second. Accuracy based on cell-ID different per provider. Accuracy 300m~5000m depending on area coverage
Poland	Pull; estimated average time: 16 sec.	Pull; Estimated average time: 13 sec.
Portugal	Push	Push
Romania	Push	Push
Slovenia	Push, Estimated time: 3 s average	Push, Estimated time: 3 s average
Slovakia	Push	Push in the case of one operator (Telefonica O2). Pull in the case of other two operators. Caller location provided within 1 min. in case of 94.5% of requests; average time from 2-3 sec. to 20 sec. max.
Spain	13 emergency centres Push/ 6 emergency centres Pull Estimated average time: 25 sec.	15 emergency centres Push 2 emergency centres Pull Estimated average time: 30 sec.
Sweden	Pull by automatically retrieving caller location from a database; estimated time : max 1-2 sec.	Pull from a database; estimated time: max. 3-5 sec.
Switzerland	Pull- emergency requests location from a central database	Pull-emergency service requests location from a database
United Kingdom	Pull by retrieving caller location from a database to which it is forwarded automatically for every call; estimated time: max. 2 sec.	Pull by retrieving caller location from a database to which it is forwarded automatically for every call; estimated time: max. 2 sec.

4.3 Problems in the existing implementations

The most important problem is the **time needed to provide the location**. Emergency situations require an immediate response and cannot wait to obtain the location data. The location data shall be available as soon as the call reaches the authority handling emergency calls.

We can also conclude from the information given by the countries that **no standardised solutions** are being used. This is actually a significant impairment with respect to many European implementations. It is worth to mention that the lack of standards makes very difficult to forward the location information to another PSAPs even in the same country.

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5 Fixed telephony

5.1 Description of available technologies for the provision of location

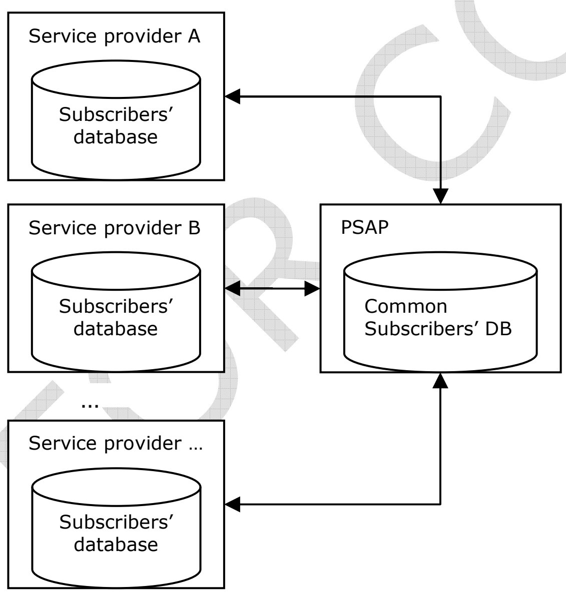
The location of calls coming from fixed telephony is based on data owned by telecommunication companies. As there are many companies, each of them has to make its information accessible.

The following aspects have to be taken into account:

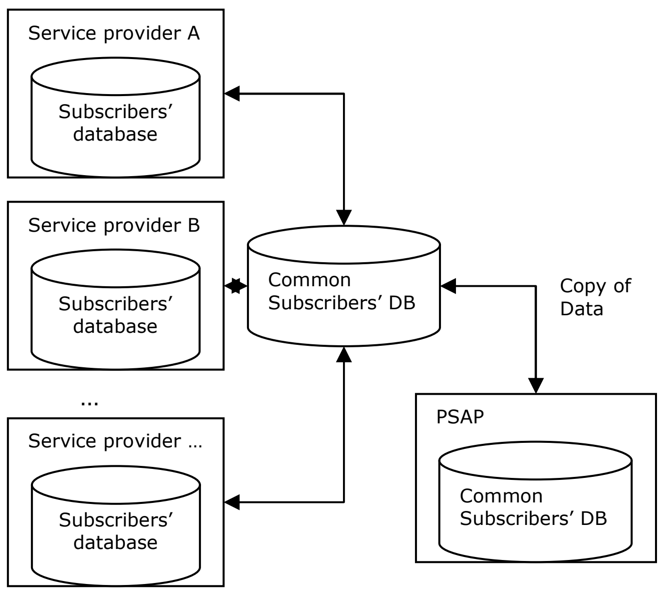
- The centralisation or decentralisation of data coming from all telecommunication companies: in some countries a central database comprises data from subscribers from all companies, in other cases there are different databases, normally one for each company.
- Location of the data: the database or databases can be stored in the PSAP or not
- How emergency services access to them: if the database is not located in the PSAP it can be accessed remotely.
- Accuracy of the data:
    - How often they are updated: changes in subscribers' data may occur daily
    - Standard format: it is necessary that all data follows the same structure
    - Correctness of the address (national number portability included)
    - Availability of caller ID and address for calls coming from a campus network
    - Existence of private numbers

The following figures represent an overview of the technologies used in the European countries:

<u>Database stored in the PSAP</u>

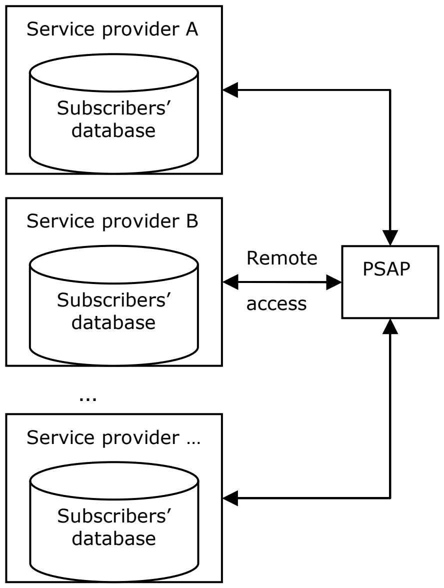


The PSAP receives data from all service providers, creates a database and gathers it in the PSAP. (e.g. Lithuania)

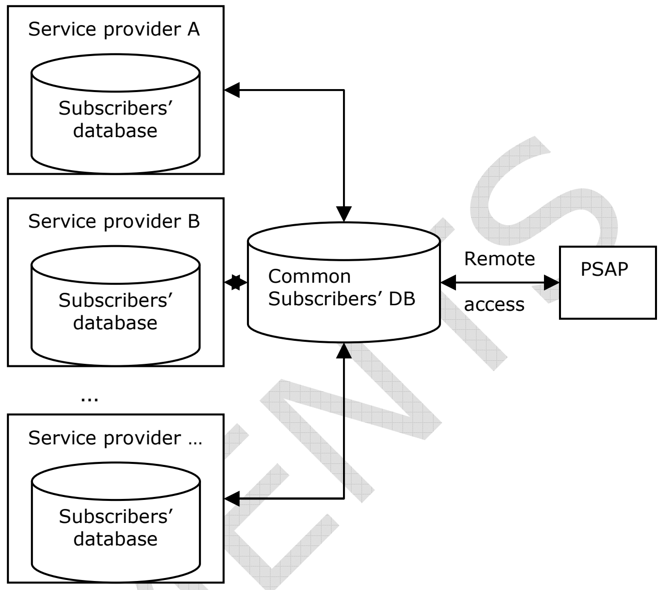


An external organisation creates the databases containing data from all service providers. The PSAP copies this DB and gathers it in the PSAP.

Database not stored in the PSAP



The PSAP accesses the databases of the service providers.



A database with data for all service providers is remotely accessible to the PSAP.

5.2 EU Existing Implementations

Some examples of how access to fixed telephony caller location has been implemented in Europe are shown in this section. The source of the data is the Electronic Communications Committee (ECC) Report 143 "Practical improvements in handling 112 emergency calls: caller location information" (April 2010) and information given by EENA members.

Country	**Source of fixed caller location information**	**Availability of caller location in case of subscribers not listed in directory services**
Austria	Centralised database including all subscribers of fixed Publicly Available Telephone Services – PATS - operators, except unlisted numbers. Frequency of updating: daily	Yes- by verbal/written request to the respective operator
Belgium	The database of the fixed incumbent, which includes also subscribers of some alternatives operators. Frequency of updating: daily	Yes
Bulgaria	Centralised and comprehensive location information database. Frequency of updating: twice a month. For fixed operators we have static data about subscribers administrative addresses. Call takers have the administraive address on the screen immediately on accepting a call from fixed subscribers. The addresses data is updated twice a month. Data format is the same for alll the telecoms.	Yes
Czech Republic	Centralised and comprehensive database administered by Telefonica O2-Czech Republic	Yes
Cyprus		Yes
Denmark	Centralised comprehensive database. Frequency of updating: daily	No

Estonia	Caller location obtained directly from the relevant operator	
Finland	Centralised comprehensive location data base. Frequency of updating: daily	No
France	Centralised database including more than 80% of numbers. Frequency of updating: monthly	No, but work has started to produce a comprehensive directory
Germany	Centralised comprehensive database giving access to databases of individual providers Frequency of updating: daily or weekly depending on provider	Yes
Greece	Caller location obtained directly from the relevant operator	Yes
Hungary	Caller location obtained directly from the relevant operator	Yes
Ireland	Centralised comprehensive database Frequency of updating: daily	Yes
Italy	Caller location obtained directly from the relevant operator	Yes
Latvia	Centralised comprehensive database. Frequency of updating: daily	Yes
Lithuania	Caller location obtained directly from the relevant operator	Yes, database contains absolutely all numbers and addresses
Luxembourg	Caller location obtained directly from the relevant operator	Yes
Netherlands	Centralised comprehensive database. Frequency of updating: monthly	Yes, 24 h access to national database
Poland	Currently caller location obtained directly from the relevant operator; a centralised database handled by UKE (National regulator) is in preparation. It will be not stored in PSAP.	Yes
Portugal	Centralised comprehensive database. Frequency of updating: until the next working day if changes to subscriber data are made	Yes
Romania	Centralised comprehensive database. Frequency of updating: monthly	Yes
Slovenia	Caller location obtained directly from relevant operator	Yes – by verbal/written request to the respective operator. In this case location is available pending 20 minutes.
Slovakia	Database of the incumbent operator and a centralised database of alternative fixed operators updated once every 3 months	Yes by verbal/written request to the respective operator. In this case location is available pending 20 minutes
Spain	Some emergency centres use CMT database, others the incumbents database. Frequency of updating: overall update every six months partial updates every two weeks.	Yes (in some emergency centres only)
Sweden	Centralised comprehensive database. Frequency of updating: daily	Yes
Switzerland	Central database; the information must be available within seconds	Yes, but with limitations; indication in case of direct dial-in
United Kingdom	Centralised comprehensive database. Frequency of updating: daily	Yes

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5.3 Problems in the existing implementations

Telephone's address location data are **not properly verified** prior to sending them to emergency services. Telephone locations are not compared via computer software to the maps used by emergency service providers of the area being served by a 112 system.

For fixed telephones the address location of the subscriber (mostly but not always the same location as the telephone unit) and telephone number is normally stored and most of **databases are not updated** as frequently as needed. There is no real-time location information used in any European country, i.e. there is no dynamic connexion between PSAPs and operators' database, therefore a great deal of inaccurate location information exists in the fixed line databases.

Databases often do **not include private numbers**, and in fact, most systems only have directory published numbers and locations in them.

When the citizen is **calling from a campus or a building complex** environment the location stored in the database for this phone number is frequently the one of the main building and not the real address of the office or the location where the call is made from.

In some countries emergency services receive the data from the telecommunication companies in different formats. The **standardisation** of this format **is requested**.

5.4 Recommendations to Stakeholders

Many stakeholders should be involved in order to provide location to emergency services. Recommendations of the role to be played by stakeholders are described in the table below.

Stakeholder	Action
European Authorities	Directive mandating to make caller location available to emergency services • in a standard format • available automatically with the call as soon as the call reaches the PSAP • free of charge to the authority handling emergency calls Set up of a network of experts to provide the sharing of experiences and the exchange of best practices Verify the correct implementation
National Government	Law transposing the European Directives, mandating operators to make caller location available to emergency services
National telecommunications regulatory authority	Ensure that telecommunication operators comply with legal requirements for the provision of location information to the PSAPs • caller line identification has to be accessible for emergency calls • availability of subscribers databases for emergency services • update for all telecommunication operators • one standard for all providers
Competent Authorities on Emergency Services (national/regional/local)	Make sure that emergency services have the necessary means (including budget) to adapt their systems to caller location
Telecommunications operators	Ensure clients database availability to National telecommunications regulatory authority or Emergency Services and that these data are regularly updated
Emergency services	Integrate access to the database into the system Verify there are no inconsistencies in data (correct address)
Standardisation organisations	Create a standardised format for structured data

5.5 EENA Requirements

EENA members have concluded that the following features are required:

Update of the Database	At least once every 24 hours
Access to the database	Continuous (7x24) and real-time
Integration with GIS	Available
Time to caller location provision	≤ 3 s average, ≤5 s 90%
Accuracy	Address of fixed line where the caller is
Availability of caller location in case of subscribers not listed in directory services	Yes
Standardised data string for all fixed line operators	Yes, with structured data
Access to database in case of technical failure (fallback facility)	Available
Database availability	99,995%
Data security	Encryption of the database, secure access

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6 Mobile Network

6.1 Provision of the caller location

There are two approaches to deliver caller location automatically from mobile telephony networks to PSAPs:

1. Using IP connectivity between PSAP and the mobile telecommunication network system: software should make the match between the received caller location data and the corresponding voice call.

2. Coding location data in the signalling channel, which delivers 112 calls to the PSAP: PSAPs gets 112 call and caller location at the same time.

6.2 EU Existing Implementations

Some examples of the type of mobile calls location information received by emergency services in European countries are shown in this section of the document. The source of the data are the Electronic Communications Committee (ECC) Report 143 "Practical improvements in handling 112 emergency calls: caller location information" (April 2010) and information given by EENA members:

Country	Type of caller location information
Austria	Cell ID/ Sector ID
Belgium	Cell ID/Sector ID
Bulgaria	Cell ID
Cyprus	Cell ID/ Sector ID
Czech Republic	Depending on the network operator, the caller location provided is area with radius from 1 Km/70% to 5 km/70% or the Best Server Base Transceiver Station
Denmark	Cell ID. It is asked to the caller to give the GPS coordinates if it is available.
Estonia	Coordinates
Finland	Cell ID/ Sector ID and also more accurate information based on the best available calculation method depending on the operator
France	Postal code of the local community of the relevant cell base Transceiver Station (BTS). This provides for accuracy of a few km.
Germany	Cell ID/Sector ID
Greece	Cell ID
Hungary	Cell ID/Sector ID
Ireland	Cell ID
Italy	Cell ID
Latvia	Cell ID/ Sector ID
Lithuania	Cell ID
Luxembourg	Cell ID
Hungary	Cell ID / Sector ID
Netherlands	Cell ID
Poland	Cell ID/ Sector ID Timing advance technology with accuracy of 100 m to 1 km
Portugal	Cell ID
Romania	Cell ID/ Sector ID
Slovenia	RF pattern with three levels of probability
Slovakia	Cell ID/ Sector ID
Spain	Cell ID /Sector ID
Sweden	Cell ID, with or without timing advance
Switzerland	Time and ellipse plus optional information
United Kingdom	Cell ID, with or without timing advance

6.3 Functional needs defined in different countries

Bulgaria

For mobile calls, PSAPs operarators receive the cell id immediately after accepting a call. Call takers have cell coverage immediately displayed on the screen. According to the legislation, the accuracy should be 100m in urban areas and 1000m in the rural areas

Lithuania

In Lithuania Cell ID accuracy is required from mobile operators. Two out of three mobile operators also additionally provide short textual description of the vicinity alongside with coordinates and bias radius (X, X, R). There are not any accuracy requirements defined by law. Back in 2008 national 112 Emergency Response Centre provided mobile operators with Cell IS/Enhanced Cell ID accuracy requirement after having considered it's human, financial and time resources. At that time implementation of more accurate solutions seemed to be vague due to unclear technological and financial perspective.

Other requirements for the provision of the location of 112 mobile caller location information. Solutions shall:

- be based on ETSI TS 102 164 V1.2.2 (2004-05) standard;
- allow to provide location data using both "Push" & "Pull" methods;
- ensure Cell-ID accuracy of E112 data & shall be compatible to better accuracy technologies, eg. Enhanced Cell-ID, Assisted-GPS, etc.;
- provide location data within 60 seconds;
- function for number 112 as well as for other national emergency numbers 101, 102, 103, 011, 022, 033;
- cover "virtual operators" operating within the core networks of signatory MNOs as well as roaming users;
- ensure priority for the provision of E112 location data over commercial localization services.
- be redundant and shall ensure 97% data delivery reliability.

The Netherlands:

In the table an example of the functional needs in the emergency process defined by the Netherlands PSAP-organisation.

Activity	Organisation	Functionality	Needed accuracy
Channeling	112-PSAP, 1st level	Queing based on geographic characteristics	1000-3000 m
Calltaking	112-PSAP, 1st level	Verification emergency call Identification dispatch to 2nd level PSAP	500 m – 1000 m(1)
Intake emergency organisation (Police, Firebrigade, Ambulance)	112-PSAP 2nd level	Verification emergency call Identification emergency organisation/unit	300 m – 500 m 500 m – 1000m
Emergency unit	112	Plotting accurate route emergency unit	25 m – 50 m

Accuracy of location information contributes to timesaving in the emergency process.
Time saved=lives saved. Increased uncertainty of the estimated location means more time needed to define the emergency location.

(1) In extreme emergency situations, e.g. caller is victim of a crime and in a situation impossible to talk or unknown with her/his location, an accuracy of 25-50 m is needed.

Poland

Polish law has to be updated to make it conform with Directive 2009/136/EC of European Parliament and of the council of 25 November 2009. In the Article 26, p. 5 is stated: " …Competent regulatory authorities shall lay down criteria for the accuracy and reliability of the caller location information provided."

Authorities handling emergency calls have agreed, that that they would require an accuracy at least 50 m in urban areas and at least 500 m in rural areas. This is only the proposal, and it is no guarantee that this requirement will be approved.

United States

High-accuracy location has been implemented within the United States for a large majority of calls made to the North-American emergency number 911 since the regulatory authority (FCC) has defined caller-location accuracy requirements for e9-1-1[3]:

- For network-based location solutions: 100 meters for 67 percent of calls, 300 meters for 95 percent of calls;
- For handset-based location solutions: 50 meters for 67 percent of calls, 150 meters for 95 percent of calls.

6.4 Problems in existing implementations

Currently most European countries are using a basic Cell-ID solution with or without timing advance. It is important to mention that the statistical average **accuracy** of this system is more than 500 meters (considering urban and rural areas). However, there are now more sophisticated Cell-ID based methods, which would provide much higher accuracy.

According to the COCOM's "Report on the Implementation of 112"[4], automatic caller location information provided to emergency centres is currently limited to Cell-ID only. This technology is highly inaccurate (precise to a range of 40km in some areas) and is of dubious value in locating callers in need of assistance. In addition, the delay in delivering location information is, in some countries, as high as 150 minutes

Delivery of caller location from telecommunication operators to the PSAPs should be **standardised**. That will help interoperability and data exchange between different PSAPs.

The method that operators actually use to determine the location of devices should be completely **transparent** to the emergency services.

The **time** needed to provide caller location has to be in keeping with the emergency services needs. It has to be possible to **update** the location information.

Location technology has evolved and accuracy and reliability possibilities have been improved. The distance between what is technologically feasible and the current implementations in the PSAPs continues to grow. Furthermore, private companies are developing application for smartphones and they are able to transfer GPS data to the 112 PSAP's. How this information should be delivered to emergency services has to be urgently standardised.

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[3] http://www.fcc.gov/pshs/services/911-services/enhanced911/Welcome.html

[4] http://ec.europa.eu/information_society/activities/112/docs/cocom_report2010.pdf

6.5 Description of Available Standards

The standard positioning methods supported within Universal Terrestrial Radio Access Network – UTRAN - are:

- Cell ID based method
- Observed Time Difference of Arrival - OTDOA - method that may be assisted by network configurable idle periods
- network-assisted Global Navigation Satellite System – GNSS - methods
- Uplink Time Difference Of Arrival - U-TDOA
- Radio Frequency Pattern Matching – RF Pattern Matching

Document		Description
3GPP TS 43.059 V9.0.0	"Functional stage 2 description of Location Services (LCS) in GERAN (Release 9)"	describes how standards-based positioning methods are seamlessly added within GSM (2G) RAN
3GPP TS 25.305 V9.0.0	"Stage 2 functional specification of User Equipment (UE) positioning in UTRAN (Release 9)"	describes how standards-based positioning methods are seamlessly added with UMTS (3G) RAN
ETSI TS 102 164 V1.2.2	"Telecommunications and Internet Converged Services and Protocols for Advanced Networking (TISPAN); Emergency Location Protocols"	specifies the protocol that is used by the local emergency operator to obtain the location information that is registered on the operator location server

NOTE Please check regularly standardisation updates.

6.6 Description of Available Technologies

An overview of location methods is described in the following sections. The aim of this document is not to describe them in depth but to give some examples of the available technologies which could be used to improve the existing implementations in Europe.

There are mainly three types of technologies: network based, handset based and hybrid solutions. Network based techniques use the service provider's network infrastructure to identify the location of the handset. They can be implemented without affecting the mobile phones. Handset based technology requires the installation of client software or special hardware on the handset to determine its location.

6.6.1 Cell ID

The Cell ID is the identity number associated with a cell, which is designated by the network operator. This information is used in the network during normal operation to identify the connection point of the mobile to the network. The operator knows the co-ordinates of each cell site and can therefore provide the approximate position of the connected mobile.

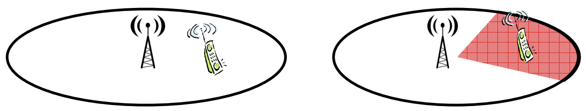
The Cell ID positioning considers the location of the base station to be the location of the caller and communicates the sector information. The network cannot guarantee that the serving cell, which is used to estimate the handset location, is the closest to the caller. The accuracy of this method depends of the size of the cell. It can vary from a few meters in urban locations to 10 to 30 km especially in the flat countryside and water surfaces. The underlying issue is that mobile phone networks are optimised for coverage, capacity and call handling with minimum number of cells rather than locating phones. This method can be used regardless of the type of phone but the provided accuracy and reliability are not according to emergency services needs.

6.6.2 Cell ID with Timing Advance

The measured time between the start of a radio frame and the arrival from a data to the cell of the mobile network can be added to the data of the cell identification. This period of time is called Timing Advance (TA). Information derived from the wireless network can also be incorporated to the Cell ID based method. This way accuracy can be improved.

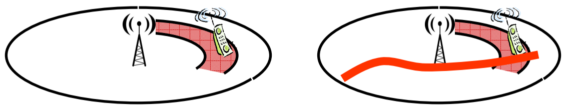
6.6.3 Cell ID with Timing Advance and Received Signal Strength

Advanced systems determine the sector in which the mobile phone resides and approximately estimate also the distance to the base station. Further approximation can be done by interpolating signals between adjacent antenna towers. Qualified services may achieve a precision of down to 50 meters in urban areas where mobile traffic and density of antenna towers (base stations) is sufficiently high. Rural and desolate areas may see kilometres between base stations and therefore determine locations less precisely.



A. Cell ID

B. Cell ID with sector



C. Cell ID with sector and Timing Advance

D. Cell ID with sector, Timing Advance and Supplementary information

6.6.4 RF Pattern matching method

RF Pattern Matching technology is based on the observation that the radio environment and signal strength varies from location to location due to features such as terrain, buildings and cellular signal coverage. If enough elements of the radio environment can be measured with sufficient accuracy, each set of measured values provides a radio signature that uniquely identifies a particular location. RF Pattern Matching can provide high accuracy location information.

6.6.5 Uplink measurement methods

Some examples of the available uplink measurement methods are described in this section:

- Time of Arrival Method (ToA): This technology uses the absolute time of arrival at a certain base station. The time of arrival (ToA) means the travel time of a radio signal from a single transmitter to a remote single receiver. The time is a measure for the distance between transmitter and receiver. Time of arrival data from two base stations will narrow a position to two circles and data from a third base station is required to resolve the precise position with the third circle when matching in a single point.

- Angle of Arrival (AoA): Angle of arrival mechanism locates the mobile phone at the point where the lines along the angles from each base station intersect. AOA (Angle of Arrival) requires specialised receivers at the base stations in addition to the construction of directional antenna arrays on the existing cell tower.

- Uplink-Time Difference of Arrival (U-TDOA): It is a real time locating technology for mobile phone networks that uses multilateration (hyperbolic positioning) based on timing of received signals. Location Measurement Units (LMUs) are co-located at the Base Transceiver Stations (BTSs) to calculate the time difference measurements used to determine the location of a mobile phone. The technique is a network-based location technology, so it can locate any phone. It can also locate any phone in any environment – including indoors and in urban areas with tall buildings. The accuracy is within 50 metres. Typically, the time to first fix is about 6 or 7 seconds in GSM and about 10 or 11 seconds for UMTS.

6.6.6 Downlink measurement technologies

- Enhanced Observed Time Difference (E-OTD): The location is estimated using measurements made by the mobile phone, rather than by the base station. The location method works by multilateration.

- OTDOA-IPDL Method with network configurable idle periods: The OTDOA-IPDL method involves measurements made by the user equipment and Location Measurement Unit of the UTRAN frame timing (e.g. SFN-SFN observed time difference). These measures are then sent to the SRNC and, in networks which include an SAS, may be forwarded to the SAS. Depending on the configuration of the network, the position of the UE is calculated in the SRNC or in the SAS. Alternatively, the user equipment may perform the calculation of the position using measurements and assistance data.

6.6.7 Global Navigation Satellite System based technologies

- Assisted GPS (A-GPS): Standalone GPS operation uses radio signals from satellites alone. A-GPS additionally uses network resources to locate and also uses the satellites faster as well as better in poor signal conditions. In very poor signal conditions, for example in a city, these signals may suffer multipath propagation where signals bounce off buildings, or be weakened by passing through atmospheric conditions, walls or tree cover. When first turned on in these conditions, some standalone GPS navigation devices may not be able to work out a position due to the fragmentary signal, rendering them unable to function until a clear signal can be received continuously. In the case of mobile phones, if GPS signal cannot be received, or if the handset does not have an G-GPS chip in it, there needs to be a fall back to network based location methods.

- A-GPS SIM: is a hybrid positioning solution comprising A-GPS, GPS, RF Pattern and Cell ID methods to ensure performance both outdoors and indoors. The assisted GPS receiver module is embedded in a standard size SIM card for legacy, new GSM and 3G phones. For retrieving the assistance data from the server and for transmitting the location data to PSAP, A-GPS SIM can use GPRS, like A-GPS phones do, but also USSD and SMS to support mid tier and low tier phone models. Although USSD and SMS are not as fast as GPRS, those can be used concurrently with voice call, which is important in case of emergency call. No software or hardware modifications are needed for the phones and no or only minimal modifications for the network. A-GPS SIM supports both automatic transmission of location information to PSAP when 112 is called and PSAP or network initiated requests. The smart card security features of the SIM can be used to encrypt the location data and to prevent unauthorised tracking of the citizens.

- Hybrid positioning systems: are systems for finding the location of a mobile device using several different positioning technologies. Usually GPS (Global Positioning System) is one major component of such systems, combined with cell tower signals, wireless internet signals or local positioning systems. These systems are specifically designed to overcome the limitations of GPS, which is very exact in open areas, but works poorly indoors or between tall buildings. Wi-Fi signals may give very exact positioning, but only in urban areas with high Wi-Fi density - and depend on a comprehensive database of Wi- Fi access points. There are situations where A-GPS could fall back to another high-accuracy location technology like U-TDOA. In fact, in optimal situations where A-GPS and U-TDOA can work, both location technologies can be employed, and the calculations can be combined to offer location accuracies superior to either technologies working individually.

6.6.8 Other technologies

- Indoor proximity detection: where operators deployed indoor coverage infrastructure using distributed antenna systems (DAS), it is possible to add "proximity sensors" which can identify which DAS port a device is using and isolate it's potential location to a specific part of the building (office, airport, stadium). This provides 100% indoor yield to GPS type accuracy in environments where GPS often fails to work.

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6.7 Recommendations to Stakeholders

There are many stakeholders who have to be involved in order to provide the location to the emergency services. In this section of the document recommendations for the roles to be played by them are described.

Stakeholder	Action
European Authorities	Directive mandating to make caller location available to emergency services • in a standard format • available automatically with the call as soon as the call reaches the PSAP • with accuracy requirements • free of charge to the authority handling emergency calls Setup a target schedule for implementation of the accurate emergency call positioning service for covering 100% of EU mobile phone users and geographical area Set up of a network of experts to provide the sharing of experiences and the exchange of best practices Verify the correct implementation
National / Regional Authorities	Law transposing directives, mandating operators to make caller location available to emergency services Setup a financial plan for setting up the required solution for providing accurate caller location for PSAPs Setup national implementation schedule no longer than the EU requirement.
National Telecommunications Regulatory Authority (NTRA)	Check that telecommunication operators comply with legal requirements for the provision of location information to the PSAPs (also for roaming) Setup national accuracy requirements as least as accurate as EU requirements
Competent Authorities on Emergency Services	Make sure that emergency services have the necessary means (including budget) to adapt their systems to caller location
Telecommunications operators	Provide the location information to the PSAP (also for roaming cases) in conformance with the technical requirements (accuracy, latency, etc.)
Emergency services	Integrate location information into their systems Verify that location information is correctly received

6.8 EENA Requirements

Analysing the different positioning methods and technologies for emergency services, many aspects have to be taken into account. Some of the major ones are summarised as follows:

- The selection of any location method should take into account the balance between benefits and complexity of implementing and operating the technology in the telecommunications network, the impact in the user's device, and in the PSAP operations centre.
- The cost and complexity of location technologies might have significant impact in the operator's network so it would be helpful that such technologies could bring to network operator the possibility to provide Location Based Services to make profitable investments in their networks.
- Preferred location methods will fully support standards and the evolution of telecom networks, i.e. UMTS, LTE, and beyond.
- The location method should also take into account how many wireless subscribers will have access to the high performance location technologies. Additionally, the location method should work in the areas where the majority of 112 calls are made.

EENA members have concluded that the following features are required:

Requirements	
Integration with GIS	Available
Possibility to additionally obtain the registered address of the subscription	Yes
Availability of caller location in case of users of international roaming	Yes
Possibility to update the caller position (caller on the move)	Yes
Accuracy:	Success rate: % of calls — 67% — 95% 1. First estimate location Urban accuracy — <200m — <350m Rural accuracy — <500m — <1000m Latency time — <5s — <10s 2. Accurate location Urban accuracy — <50m — <150m Rural accuracy — <150m — <300m Latency time — <30sec — <60sec
Accurate location information received by PSAP should include:	Latitude, Longitude, Altitude (optional), Street address (optional), Accuracy estimate (RMS), Speed, Direction, Timestamp,
Data security	Encryption, secured connections

7 SMS Location

In some countries the access to emergency services using SMS is possible but it is restricted to people with disabilities; in some others it is available to all citizens. In the countries where SMS is being used the need of location data is exactly the same as for voice calls.

The main difficulty of getting SMS location is that it is a store and forward and a non guaranteed delivery mechanism. SMS is store and forward between two phones, not necessarily between phone and a host. The delivery of SMS to the destination can also be acknowledged. Anyone who sends an SMS cannot know whether it has been received or how long it will take to be received. There are no standards that describe how location could be automatically delivered with an SMS.

This will be discussed in the 112 SMS EENA operations document.

8 IP based communications

8.1 Current situation

8.1.1 Service categories

The European Regulators Group ERG (now replaced by the Body of European Regulators for Electronic Communications - BEREC) has differentiated four categories of VoIP services[5]:

1. A service where international public telecommunication numbering plan numbers – E.164 numbers - are not provided and from which there is no access to or from the public switched telephone network - PSTN. This case however includes different implementations: from pure *peer-to-peer*, based on VoIP software which uses users' computers as nodes of the connection to more centralized architectures based on call management servers, data bases and routers provided by the VoIP operator.

2. Outbound voice: a service where there is outgoing access to the PSTN only and E.164 numbers are not provided.

3. Inbound voice: a service where there is incoming access from the PSTN, mobile networks or via IP and E.164 numbers are provided. A service belonging to this category does not provide outbound calls (whether to the PSTN, mobile or otherwise).

4. Voice telephony: a service where there is incoming and outgoing access to the PSTN, mobile network, and E.164 numbers are provided. This category includes traditional publicly available telephone services - PATS, other services which can generally be regarded as a substitute for PATS (like most VoB offers) and ECS VoIP services.

8.1.2 Current regulation

ERG considered that all providers of public VOIP services which permit calls to be made to the PSTN should permit users to access the emergency services.
In practice, national regulation authorities report that all "category 4" VOIP providers are expected to provide access to emergency services. But "category 2" providers are only obliged to provide access in about half the member states.

[5] ERG (07) 56rev2 "ERG common position on VoIP", December 2007
ERG (09) 19 "VoIP – Action plan to achieve conformity with ERG common positioning", June 2009

The ERG published in its report "VoIP – action plan to achieve conformity with ERG common position" the answer of the national telecommunication regulation authorities to their conformity of some relevant aspects about the access to emergency services:

Questions	Answers of the national telecommunication regulator authorities
All category 2 and 4 VoIP Telephony Service providers should be obliged to provide access to emergency services	There is full conformity for VoIP category 4. 14 Member States are non compliant in the case of VoIP category 2. The main reason is the need to change the national law in order to consider VoIP category 2 as telephony services or the impossibility to provide localisation. Generally VoIP category 2 non conformity cases are expected to be removed after a change in national legislation to implement the new regulatory framework.
Routing should be provided to the locally responsible PSAP to the extent allowed by the technology (this question refers to both calls from fixed or potentially nomadic terminals)	All Member States except one conform fully to this element. One national regulation authority - NRA - has reported conformity only for PATS VoIP services.
Information about the caller's location should be provided to the extent allowed by the technology	All Member States except 4 conform fully to this statement. In 4 cases there is conformity only for PATS VoIP services. In practice the distinction seems to be of no significance at present
Telephony service providers should be obliged to provide the emergency response centre with information on whether the call originates from a fixed or a potentially nomadic.	The level of conformity is good, non-conformity being recorded in only 5 Member States (of which 2 are reviewing legislation). In some case nomadic is not allowed with geographical numbers so there is no need to flag the possibility of nomadic use of the terminal.
Telephony service providers should be obliged to clearly inform subscribers about any limitations in the services as compared to the traditional telephony service.	A good level of conformity is reported with only 6 non-conforming member states of which 1 will be in conformity very shortly and 2 are considering a change to national legislation.
Emergency calls should be setup with the priority, quality and availability to the extent allowed by the technology	A reasonable level of conformity is reported. 8 Member States do not conform but firm action is underway in 3 of these and the matter is under review by the Ministry in others. In the remaining cases, calls to emergency services are treated with the same QoS of standard PATS calls which may prove sufficient in practice. Generally non conformity is caused by the need to change the current national legislative framework where access to emergency services is a government responsibility.

8.1.3 Description of available technologies

It can be concluded from the ERG report that location of some types of call is now available. For the emergency services this location is not accurate enough.

- Send the location made from services linked to a PSTN number: calling line identification and originating identification shall be forwarded to the emergency services and the address associated to this number has to be available to the PSAPs.

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- Flag nomadic numbers: it is possible to have a PSTN number for a fixed line that can be also used as a nomadic service. The service provider has to flag the calls coming from these numbers. This way the emergency services will know that the location received from this call is not totally trustable.

- Information to users: Telephony service providers should be obliged to clearly inform subscribers about any limitations in the services as compared to the traditional telephony service

International standardisation groups have developed standards to obtain the location of the caller. The exhaustive study of this technology is out of scope of this document. This work is done in the framework of NG112 in the EENA NG112 Technical Committee. The standards are listed for information purposes.

The Internet Engineering Task Force (IETF) has developed standards and technological emergency services architectures. Here is the list of applicable standards:

- Location Retrieval: Various protocols standardised for different with suitability for different environments:
    - HTTP-Enabled Location Delivery (HELD): RFC 5989 http://tools.ietf.org/html/rfc5985
    - DHCP Civic Location: RFC 4676 http://datatracker.ietf.org/doc/rfc4676/
    - DHCP Geodetic Location: http://datatracker.ietf.org/doc/rfc3825/
    - With a number of extensions, see http://datatracker.ietf.org/wg/geopriv/.
- Emergency Call Routing:
    - Requirements: RFC 5012 http://datatracker.ietf.org/doc/rfc5012/
    - Security Threat Analysis: RFC 5069 http://datatracker.ietf.org/doc/rfc5069/
    - RFC 5222 (LoST) http://tools.ietf.org/html//rfc5222
    - Architecture: RFC 5582http://datatracker.ietf.org/doc/rfc5582/
    - Discovery of LoST Servers: http://datatracker.ietf.org/doc/rfc5223/
    - Support for Holes in Service Boundaries: http://datatracker.ietf.org/doc/rfc5964/
- Considerations for Trustworthy Location Information:
    - http://datatracker.ietf.org/doc/draft-ietf-ecrit-trustworthy-location/
- Considerations for Dealing with Imprecise Location
    - http://datatracker.ietf.org/doc/draft-ietf-ecrit-location-hiding-req/
    - http://tools.ietf.org/html/draft-ietf-ecrit-rough-loc-03

The National Emergency Number Association (NENA) has made big progress with definition and description of standards for the reception in the PSAPs of 9-1-1 calls over IP.

08-002 v1	Functional & Interface Standards for NG9-1-1 (i3)
08-003 (Draft)	NENA i3 Solution NOTE: NENA 08-003, Version 1, is in the NENA review process. The public review comments are being addressed by the LTD WG.
08-501 v1	Network Interface to IP Capable PSAP
08-502 v1	E9-1-1 Requirements
08-503 v1	VoIP Characteristics
08-504 v1	VoIP Standards Development Organizations (SDOs)
08-505 v1	Location Determination: IP-Based Emergency Services
08-751 v1	i3 Requirements (Long Term Definition)
08-752 v1	Location Information to Support IP-Based Emergency Services
08-DRAFT	Emergency Services IP Network Design for NG9-1-1 NOTE: NENA 08-XXX, Version 1, is continuing to be developed by the ESIND WG.

NOTE Please check regularly standardisation updates.

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8.1.4 Existing Implementations

In the United Kingdom 112 calls can be made using Skype, a well known software application that allows users to make voice calls over the Internet. It is checked if the IP address of the user is in the United Kingdom using Geo IP. Detailed location information is not available and calling back is not possible.

In Slovenia the system described under Category 4 of VoIP services is used.

In Denmark it is possible to access 112 using VoIP. These calls are flagged; this way the emergency centre knows that the accuracy of the address information is not totally trustable.

8.1.5 Recommendation to stakeholders

In many of the member states, the national law is an obstacle to conformity with the Common Position of ERG. This should be addressable in new legislation implementing the results of the Framework Review.

Stakeholder	Action
European Authorities	Directives mandating to make caller location available to emergency services • in a standard format • available automatically with the call as soon as the call reaches the PSAP • with accuracy requirements • free of charge to the authority handling emergency calls Set up of a network of experts to provide the sharing of experiences and the exchange of best practices Verify the correct implementation
National Government	Law transposing European directives, mandating operators to make caller location available to emergency services
National Telecommunications regulatory authority (NTRA)	Check that telecommunication operators comply with legal requirements for the provision of location information to the PSAPs
Competent Authorities of Emergency Services	Make sure that emergency services have the necessary means (including budget) to adapt their systems to caller location
Telecommunications operators	Provide the location information to the PSAP in conformance with legal requirements
Emergency services	Integrate location information into their systems Verify that location information is correctly received

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8.2 EENA Requirements

EENA members have concluded that the following features are required:

Requirement	
Integration with GIS	Available
Latency: time to caller location provision	≤ 5 s average, ≤10 s 90% all
Possibility to additionally obtain the registered address of the subscription	Yes
Availability of caller location in case of users of international roaming	Yes
Possibility to update the caller position (caller on the move)	Yes
Accuracy	≤100 m
Data security	Encryption, secured connections
Availability	99,95%

8.3 Target future state

Citizens expect to be able to contact emergency services with technologies they use to communicate every day. This includes text-messaging, video and other means of communication that have become commonplace. EENA Next Generation Committee is dealing with these issues. The target future state should be:

- Citizens should be able to reach emergency services by calls using all types of VoIP, text messaging, instant messaging, pictures and videos.
- It should be achieved without causing additional delays which would have potentially disastrous consequences.
- Location of the citizen has to available for emergency services independently of the technology being used.

9 Satellite callers

Providing the satellite caller location to the PSAP should be affordable because many of the satellite handsets are fitted with a GPS receiver so this issue seems to be more legal than technical.

By the time Mobile Satellite Systems (MSS) do not support caller location for 112 emergency calls in Europe. The Global MSS providers that include Western Europe coverage are as follows,

Iridium provides voice, sms and data services for mobile handsets. Iridium has a product range of tracking portable devices for tracking applications using the GPS.

Iridium support 112 emergency calls using the Location Area Code (LAC) to identify large geographical areas on the earth. In a 112 call the LAC code is sent to the serving gateway mobile switching centre that maps the location area code to a routing number to deliver the call to a local emergency centre via public land networks.

Globalstar delivers voice, SMS and low-speed data services. 112 emergency calls can be made in satellite mode but caller location is not available to European PSAPs.

Globalstar has a handset-based proprietary location service available on the handset display. This feature is currently supported by a single device fitted with special software that makes an approximate estimate of the x,y coordinates. The location method requires completing a call in order to obtain the time, angle, and distance data information from the satellites. Globalstar claims to have a location accuracy of 10 Km.

The **Inmarsat** land mobile service provides satellite voice, text-to-text, text-to-email and GPS location data that can be displayed on the handset screen and transmitted via text/email but the satellite provider does not make available to PSAPs for 112 calls.

Thuraya provides voice communications, short message service and low-speed data services. It is remarkable that all Thuraya mobile and fixed devices are fitted with a GPS receiver that provides the device location to the Thuraya's Primary Gateway for network access control and tariff management.

112 calls can be dialled via GSM and Satellite mode of operation but in the SAT mode the caller location is not available to European PSAPs.

We believe that emergency calls delivered by satellite operators must be regulated in the EU as it is for fixed, mobile and IP accesses.

10 References

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11 Annex A - Network architecture for mobile caller-location

The network architecture for location services (LCS) has to comply with existing standards and has to evolve with new standards as and when they are defined. In LCS two network elements are necessary to provide Location Services. Serving Mobile Location Centre (SMLC). This unit is responsible for the collection and co-ordination of all the necessary information in the network to give a position estimate of the mobile subscriber.

Gateway Mobile Location Centre (GMLC). This unit manages the external interface to LCS clients and Emergency Service Providers. It performs authorisation and privacy functions as well as provisioning and billing.

There is also an optional unit called the Location Measurement Unit (LMU) which takes timing measurements on the uplink for location determination purposes. The LMU can be deployed anywhere but typically would be deployed at a cell site and is co-ordinated from the SMLC.

The interface between the GMLC and LCS clients (Le interface) has to be standardised for the use of emergency services and has to support any standardised LCS technology. It is the Le interface that could be used for connection with the emergency services.

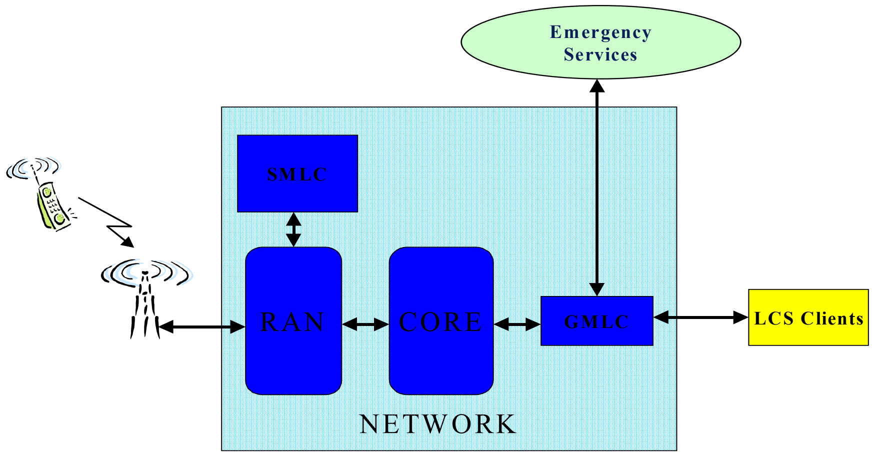
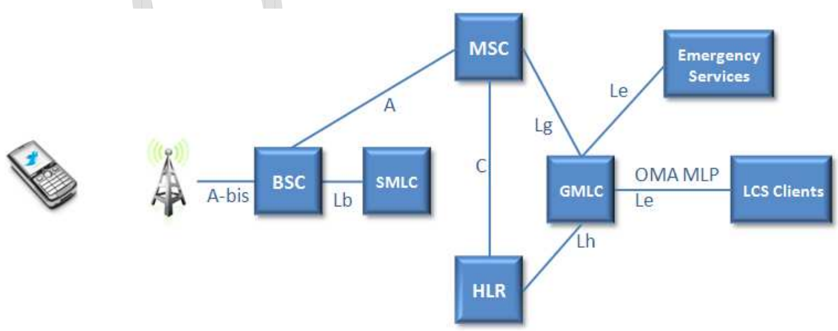


Figure 1. Standard Compliant LCS Architecture



12 Annex B - Network-induced location request (NI-LR)

The standards quite specifically define what a mobile switch should do to obtain the location of the device that is initiating the emergency call. All switch vendors implement this because it is absolutely required for the US market – so it's very safe to assume that every switch in Europe has the inherent ability to do it also. Because the switch initiates the location request, the request is termed a "network-induced location request (NI-LR)". That is, the network itself is generating the location request, not some application outside the network. The procedures go on to describe how this location is then automatically reported to the GMLC where it can be held ready to provide on demand to the emergency call centre. Further, by these standards, the GMLC memorizes the identity of the anchor switch for the full duration of the call. This allows the call centre to request a location update at any time during the call. There should never be a need for a HLR to be queried to find out where location requests should be sent in the network. This is extremely important; it's designed so that location is provided for all emergency calls whether they are from inbound roamers, SIMless, unregistered or devices with any other subscription state. There never needs to be any concerns about systems such as mobile number portability databases or interactions with foreign roamer networks during an emergency call.

There is often an incorrect assumption that a request for location in an emergency call is exactly like one made for a commercial location-based service. This is the standard "mobile-terminated location request (MT-LR)". The very first thing that happens in such a request is that the GMLC needs to work out which part of the network the location procedure should be directed to. This involves querying the HLR to determine the current serving switch. As above, in the context of an emergency call, this is completely unnecessary. Using standard MT-LR for emergency calls means that the already known information about the identity of the anchor switch has been thrown away. In the case of a foreign roamer, it means the foreign network (HLR) and any associated number portability systems has to become involved in the emergency procedure just to find out again this thrown away identity of the serving switch. This adds delay and unnecessary failure points to the process. This is what a number (most/all?) of the jurisdictions in Europe have actually done; in some of them (the UK for example) it means location isn't available for inbound roamers at all. This is a terrible limitation in a place like Europe. It's also terribly unnecessary since the standard emergency mechanisms are already built into every network; it's just a matter of operators making use of them.

Section 9.1.5 of the 3GPP TS 23.271 "Functional stage 2 description of Location Services (LCS) Release 9 V9.0.0" describes the Network-Induced Location Request (NILR) as applied to emergency calls. Step 4 of the signalling flows shows where the
location request is directed to the radio access network (RAN) where the necessary location determination (typically E-CID at a minimum) is performed[6]. Section 9.1.3 "CSMT-LR (circuit switch Mobile-terminated location request) without HLR Query"
describes how further requests for location, at prescribed accuracy, are supported throughout an emergency call without the signalling overhead associated with a typical commercial service MT-LR that would be required if the standard emergency application was not implemented.

[6] 3GPP TS 43.059 V9.0.0 "Functional stage 2 description of Location Services (LCS) in GERAN (Release 9)" describes how standards-based positioning methods are seamlessly added within GSM (2G) RAN. 3GPP TS 25.305 V9.0.0 "Stage 2 functional specification of User Equipment (UE) positioning in UTRAN (Release 9)" describes how standards-based positioning methods are seamlessly added with UMTS (3G) RAN.

13 Annex C - Technology categories

	Telephony	Association with a specific fixed network termination point	Possibility to move to another Network termination point	Associated telephone number/ Assignation of the SIP URI from the operator
Fixed terminals	IP-Based	May not	No	Yes
	Internet	May not	Yes	No
Mobile terminals	IP-Based	No. Related to the mobile subscription.	Yes	Yes
	Internet	No. Not related to the mobile subscription.	Yes	No
Nomadic terminals	IP-Based	No	Yes	Yes
	Internet	No	Yes	No

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