CEPT ECC
Electronic Communications Committee

# ECC Report 225

Establishing Criteria for the Accuracy and Reliability of the Caller Location Information in support of Emergency Services

Approved 21 October 2014

# 0 EXECUTIVE SUMMARY

The ability to initiate an emergency communication to summon help when needed is regarded by the European Union as a right of all citizens and when emergency assistance is needed it is essential that emergency services organisations are able to determine the location of the caller with a high degree of confidence in the shortest possible period of time. High quality accurate and reliable caller location information is vital for enabling the emergency services organisations to provide a timely response to an emergency incident.

In order to achieve this objective in Europe, Article 26(5)[1] of the Universal Service Directive requires Member States to ensure that *"undertakings concerned make caller location information available free of charge to the authority handling emergency calls as soon as the call reaches that authority".* Furthermore, competent regulatory authorities at the national level are required to *"lay down criteria for accuracy and reliability of the caller location information provided."*

This ECC Report provides an analysis of the caller location solutions available in order to implement the relevant legislative provisions of the Universal Service Directive by competent regulatory authorities in CEPT countries. The Report also aims to:

- Establish a common understanding of the terms "accuracy" and "reliability" in the context of caller location.
- Evaluate the requirements for "accuracy" and "reliability" as articulated by the emergency services organisations.
- Propose ways to improve the "accuracy" and "reliability" of caller location information in the future.

The Report is technical in nature and investigates emerging and existing technologies, transmission techniques and existing implementations used to make caller location information available from different types and generations of electronic communications networks in every context including where calls originate from fixed, mobile and nomadic services. The Report does not aim to mandate specific regulatory measures but may be used to inform future policies with the objective of improving the accuracy and reliability of caller location information.

As part of the process of developing this ECC Report a detailed pan-European survey of relevant stakeholders was carried out. The main objective of this data gathering exercise was to ascertain the requirements and expectations of emergency services organisations in terms of accuracy and reliability of caller location information. It also aimed at understanding the electronic communications industry's perspective on the various positioning techniques, their implementation challenges and potential benefits.

The emergency services organisations would ideally like to have very accurate caller location information at their disposal which essentially means a location given within only a few metres of the caller. The technology exists to provide such accuracy in most scenarios but some technical challenges remain. While solutions exist and continue to be developed, they are not yet widely implemented and the vast majority of emergency services organisations are currently not provided with caller location information with a sufficient level of accuracy or reliability.

Responses from PSAPs and emergency services organisations indicate that this is a major problem for mobile calls in particular and a vast improvement on the currently available level of accuracy is needed. Chapter 7 contains an explanation and comparison on the accuracy, reliability and cost of the various mobile positioning methods. A summary of this analysis is provided in Table 5. Based on this analysis, the use of GNSS co-ordinates provided by the end user terminal along with better quality location information provided by electronic communication networks would be favoured.

The Report draws conclusions on the impact of the various methods and solutions in terms of the benefits they could provide as well as the possible cost and impact of deployment on existing networks.

[1] Directive 2002/22/EC on Universal Service and User's Rights relating to Electronic Communications Networks and Services (Universal Service Directive) as amended by Directive 2009/136/EC

The Report stops short of drawing any conclusions or making any recommendations to establish numerical targets similar to those mandated in the United States at this juncture. Instead, an overall programme for improvement of caller location accuracy is recommended to address the particular challenges of calls originating on mobile networks as well as fixed networks and nomadic situations. In order to ensure a reasonable and proportionate regulatory response the Report identifies a need for statistics to be gathered and analysed in the future to determine the overall quality of caller location information provided. Such data is necessary to identify where regulatory and implementation gaps remain. This type of information will provide an evidence-based justification for the provision of suitable accuracy and reliability criteria and incentivise further investment for improvement in the future.

*Inter-alia* the Report makes the following conclusions:

- Improving accuracy and reliability of the caller location information provided by electronic communications networks is feasible. This improvement should be based on close collaboration, on an ongoing basis, between PSAPs, emergency services organisations, network and service providers and the competent national authorities.

- A **harmonised** European approach for the implementation of the caller location solutions (specifically for the different implementation options in the A-GNSS standards) would be beneficial for a number of reasons including achieving consistent interfaces and at least minimum results and an efficient and widespread improvement of caller location implementations for emergency calls throughout Europe.

- Any investment made to improve the accuracy and reliability of caller location information provided by the network and the handset may also need to be met by a corresponding investment in the PSAP's capabilities (including training of staff in order to enable the effective receipt, interpretation, use and evaluation of caller location information). It is recommended that PSAP's and emergency services organisations have a holistic approach to caller location handling when planning to invest in training and solutions to handle eCall or more accurate caller location information from other means.

- For mobile networks, A-GNSS-based positioning stands out of the list of available positioning methods in terms of accuracy, reliability and cost and should be implemented as a positioning method for emergency calls, as the first step of an overall programme for improvement, to complement the existing network-based methods rather than replacing them. Because of the somewhat limited availability of A-GNSS, network-based location methods will remain a critical component and ongoing improvements in the performance of the network-based caller location methods are likely to be necessary.

- Statistical feedback from emergency services organisations and PSAPs is vital in order to determine the benefits that such solutions are providing and to derive targets for any national criteria. Therefore relevant data-gathering systems should be implemented as part of an overall programme for improvement.

- With respect to nomadic (VoIP) services it should be possible to significantly improve on the provision of caller location information once the ETSI M/493 standardisation work has been successfully completed.

- A procedure should be established in order to be able to pinpoint the location of calls made to emergency services within corporate networks. This could be achieved by requiring the owner of a corporate network with multiple locations connected internally to properly assist the public service provider to uniquely localise, provide timely location update and route the emergency calls to the appropriate PSAPs.

- Criteria for fixed/nomadic and mobile should be different due to differences in the types of methods used for positioning.

- As a target, harmonised criteria should be set in all CEPT member countries, in order to provide the same level of quality of service to all citizens throughout Europe.

Following the analysis of the questionnaire responses and completion of the draft Report, the document was released for public consultation on 6 August 2014. Interested parties were requested to submit their comments on the draft document by 24 September 2014. 10 Responses were received to the public consultation. The respondents were:

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|---|---|
| ▪ British Telecom (BT) Ireland<br>▪ D-everyware Iberia<br>▪ European Emergency Number Association (EENA)<br>▪ European GNSS Agency<br>▪ European Telecommunications Network Operators (ETNO) | ▪ Ministry of Industry, Energy and Tourism of Spain<br>▪ Netherlands Police<br>▪ Swisscom<br>▪ Telecom Italia<br>▪ Telekom Austria |

The responses received were considered and discussed by the Project Team Emergency Services and the draft Report was when appropriate amended accordingly before adoption by the Working Group Numbering and Networks (WG NaN) at its meeting in Oslo on 22-23 October 2014.

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## LIST OF ACRONYMS

| | |
|---|---|
| **3GPP** | 3rd Generation Partnership Project |
| **AECID** | Adaptive Enhanced Cell-ID |
| **A-GNSS** | Assisted Global Navigation Satellite System |
| **ANP** | Access Network Provider |
| **AoA** | Angle of Arrival |
| **ATD** | Absolute Time Difference |
| **BEREC** | Body of European Regulators for Electronic Communications |
| **BTS** | Base Transceiver Station |
| **CEPT** | European Conference of Postal and Telecommunications Administrations |
| **CLI** | Calling Line Identification |
| **COCOM** | Communication Committee |
| **CPICH** | Common PIlot CHannel |
| **DDI** | Device Driver Interface |
| **DHCP** | Dynamic Host Configuration Protocol |
| **DNS** | Domain Name Server |
| **ECC** | Electronic Communications Committee |
| **ECRIT** | Emergency Context Resolution with Internet Technologies |
| **ECSP** | Emergency Call Service Provider |
| **EMTEL** | Emergency Telecommunications |
| **EOTDOA** | Enhanced Observed Time Difference of Arrival |
| **EENA** | European Emergency Number Association |
| **E-OTD** | Enhanced Observed Time Difference |
| **EPS** | Evolved Packet System |
| **ESRF** | Emergency Service Routing Function |
| **ESO** | European Standards Organisation |
| **ETSI** | European Telecommunications Standards Institute |
| **ETSI E2NA** | ETSI Project End-to-End Network Architectures |
| **ETSI EMTEL** | ETSI Special Committee on Emergency Communications |
| **ETSI ES** | ETSI Standard |
| **ETSI SR** | ETSI Special Report |
| **ETSI TR** | ETSI Technical Recommendation |
| **ETSI TS** | ETSI Technical Specifications |
| **EU** | European Union |
| **E-UTRAN** | Evolved Universal Terrestrial Radio Access Network |
| **FCC** | Federal Communications Commission (USA) |
| **GERAN** | GSM Edge Radio Access Network |
| **GIS** | Geographical Information System |
| **GLONASS** | "GLObalnaya NAvigatsionnaya Sputnikovaya Sistema" |
| **GMLC** | Gateway Mobile Location Centre |
| **GNSS** | Global Navigation Satellite System |

| | |
|---|---|
| **GPRS** | General Packet Radio Service |
| **GPS** | Global Positioning System |
| **GSM** | Global System for Mobile communications |
| **HLR** | Home Location Server |
| **HPLMN** | Home Public Land Mobile Network |
| **HSS** | Home Subscriber Server |
| **HTTP** | HyperText Transfer Protocol |
| **IEEE** | Institute of Electrical and Electronics Engineers |
| **IETF** | Internet Engineering Task Force |
| **IMS** | IP Multimedia Subsystem |
| **IP** | Internet Protocol |
| **ISDN** | Integrated Services Digital Network |
| **ISP** | Internet Service Provider |
| **ITU-T** | International Telecommunications Union - Telecommunications |
| **LCS** | LoCation Services |
| **LMU** | Location Measurement Unit |
| **LRF** | Location Retrieval Function |
| **LS** | Location Server |
| **LTE** | Long Term Evolution |
| **MAC** | Media Access Control data communication protocol |
| **ME** | Mobile Equipment |
| **MME** | Mobility Management Entity |
| **MS** | Mobile Station |
| **MSN** | Multiple Subscriber Number |
| **NENA** | National Emergency Number Association (USA) |
| **NGN** | Next Generation Network |
| **NICC** | Network Interoperability Consultative Committee (UK) |
| **NTP** | Network Termination Point |
| **NRAs** | National Regulatory Authorities |
| **NSSDA** | National Standard for Spatial Data Accuracy |
| **OMA** | Open Mobile Alliance |
| **OMA-SUPL** | OMA Secure User Plane Location |
| **OTDOA** | Observed Time Difference of Arrival |
| **OTT** | Over-The-Top |
| **PATS** | Publicly Available Telephone Services |
| **PLMN** | Public Land Mobile Network |
| **POTS** | Plain Old Telephone Service |
| **PSAP** | Public Safety Answering Point |
| **PSP** | PSAP Service Provider |
| **PSTN** | Public Switched Telephone Network |
| **QZSS** | Quasi Zenith Satellite System |
| **RFC** | Request for Comment |

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|---|---|
| **RFPM** | Radio Frequency Pattern Matching |
| **RSCP** | Received Signal Code Power |
| **RSRP** | Reference Signal Received Power |
| **RSRQ** | Reference Signal Received Quality |
| **RTD** | Real Time Difference |
| **RTT** | Round Trip Time |
| **SAS** | Stand-Alone Serving |
| **SBAS** | Satellite Based Augmentation System |
| **SDCCH** | Stand Alone Dedicated Control Channel |
| **SDO** | Standards Development Organisation |
| **SGSN** | Serving GPRS Support Node |
| **SIM card** | Subscriber Identity Module card |
| **SIP** | Session Initiation Protocol |
| **SLP** | SUPL Location Platform |
| **SMLC** | Serving Mobile Location Centre |
| **SRNC** | Serving Radio Network Controller |
| **SUPL** | Secure User Plane Location |
| **TA, TADV** | Timing Advance |
| **TCH** | Traffic Channel |
| **TISPAN** | Telecommunications and Internet converged Services and Protocols for Advanced Networking |
| **TOA** | Time of Arrival |
| **TTFF** | Time to First Fix |
| **UE** | User Equipment |
| **URA** | Uniform Remote Access |
| **URI** | Uniform Resource Identifier |
| **URN** | Uniform Resource Name |
| **UTDOA** | Uplink Time Difference of Arrival |
| **UTRAN** | Universal Terrestrial Radio Access Network |
| **UMTS** | Universal Mobile Telecommunications System |
| **UTM** | Universal Transverse Mercator coordinate system |
| **UPS** | Universal Polar Stereographic coordinate system |
| **UTC** | Coordinated Universal Time |
| **VMSC** | Visited Mobile Switching Centre |
| **VoIP** | Voice over Internet Protocol |
| **VSP** | Voice Service Provider |

## DEFINITION OF TERMS

| Term | Definition |
|---|---|
| **Mobile Terminal** | For the purpose of this document, a mobile terminal is a mobile equipment used to connect users of mobile services to a mobile network; the corresponding term used in 3GPP standards for GERAN (2G) networks is Mobile Equipment or Mobile Station (ME or MS) while in UTRAN (3G) and E-UTRAN (4G) the corresponding term is User Equipment (UE). |

# 1 INTRODUCTION

The ability to initiate an emergency communication to summon help when needed is regarded by the European Union as a right of all citizens and this ability should ideally be independent of the network and access technologies used to make the call or the physical abilities of the citizen. For example, if an end-user chooses to use a Voice over Internet Protocol (VoIP) for a primary telephony service the ability to access emergency services should not be adversely affected because of their choice of communications service. Competent regulatory authorities must take the necessary steps to require that providers of VoIP services meet the requirement to provide caller location information in the event that an emergency call is made.

When citizens are in need of emergency assistance it is essential that emergency services organisations are able to determine the location of the caller with a high degree of confidence in the shortest possible period of time. In order to achieve this objective, Article 26(5)[2] of the Universal Service Directive requires Member States to ensure that *“undertakings concerned make caller location information available free of charge to the authority handling emergency calls as soon as the call reaches that authority”.* Furthermore, competent regulatory authorities at the national level are required to *“lay down criteria for accuracy and reliability of the caller location information provided.”*

There is a gap between the technological possibilities, and what is currently being provided to the PSAPs throughout Europe, with regards to emergency caller location accuracy. This report attempts to contribute to a process in which this gap can be reduced.

High quality caller location information in terms of accuracy and reliability is vital for enabling the emergency services organisations to provide a timely response to an emergency incident.

Furthermore, it is important to stress the right to privacy of end-users. Caller location information must be used by PSAPs and emergency services organisations in accordance with national and European legislative requirements. It is therefore essential that all information derived from emergency calls is only used by authorised entities for the management of related incidents.

Location information for non-emergency calls is outside of the scope of this document.

[2] Directive 2002/22/EC on Universal Service and User’s Rights relating to Electronic Communications Networks and Services (Universal Service Directive) as amended by Directive 2009/136/EC

## 2 OBJECTIVES OF THE REPORT

This ECC Report provides an analysis of how the relevant legislative provisions of the Universal Service Directive could be implemented by the competent regulatory authorities in CEPT countries.

For the purposes of assisting the competent regulatory authorities in their task, this ECC Report aims to:

a) Establish a common understanding of the terms “accuracy” and “reliability” of Caller location information
b) Evaluate the requirements for “accuracy” and “reliability” of caller location information in support of emergency services performed by emergency services organisations
c) Collect relevant information and provide technical background information
d) Evaluate the available technical solutions for improved “accuracy” and “reliability” of caller location information
e) Outline measures to improve criteria for accuracy and reliability.

The Report is technical in nature and investigates evolving technologies and techniques to make caller location information available from different types and generations of electronic communications networks to emergency services organisations. The report also contains a short analysis of available technologies and existing implementations for the provision of location information in every context. The Report does not aim to mandate specific regulatory measures but may be used to inform future policies with the objective of improving the accuracy and reliability of caller location information.

During the drafting of the report a questionnaire was circulated, with the main objective of gathering data from network operators concerning plans and experiences with more accurate positioning technologies and from PSAP’s and emergency services organisations in order to better understand their needs in terms of accuracy and reliability of caller location information. A summary and analysis of the emergency services organisations’ needs can be found in Chapter 3. The feedback from network operators is mainly covered in Chapter 7.

Prior to the evaluation of the various positioning methods available a clear meaning of the terms accuracy and reliability and the additional terms identified and used in this document have to be established. Also, clarifications of the context in which national criteria should be set need to be provided. The related discussion and the definitions proposed can be found in Chapter 4.

Caller location information can be transmitted to PSAP’s and emergency services organisations in either push or pull fashion. A brief discussion on the alternatives and how they affect the transmission of the caller location information can be found in Chapter 5.

For calls made from residential fixed lines, the caller’s location can usually be provided to the emergency services relatively easily and accurately. However there are still some issues that need to be addressed. Caller location information from fixed networks is discussed in Chapter 6.

In mobile networks, providing a better location for the caller may be addressed by continuing advances in mobile network location technologies. These technologies can provide different levels of accuracy and reliability depending on the method(s) used for estimating the position and the circumstances under which a call is made. Caller location information from mobile networks is discussed in Chapter 7.

The introduction of VoIP services and particularly nomadic voice services – where the user can potentially make calls from any location with Internet access – provides a greater challenge in making available the location of the caller. These challenges are discussed further in Chapter 8.

Finally the report draws general policy conclusions that could be useful to policy makers to assess the implementation of criteria for the accuracy and reliability of caller location information in the future (Chapter 9).

# 3 FUNCTIONAL REQUIREMENTS ON CALLER LOCATION INFORMATION FOR 112 EMERGENCY CALLS

This Chapter covers the responses received to the ECC Questionnaire circulated to relevant stakeholders on 10 October 2013. Chapters 6, 7 and 8 examine the different characteristics of providing caller location information for emergency calls originating on fixed, mobile and nomadic voice services and the merits of the various technologies available. This Chapter focuses on the general functional requirements of the emergency services organisations in order to better understand how the various positioning methods can be implemented to meet those requirements through the provision of caller location information with greater accuracy and reliability other than that currently available. The purpose of the questionnaire was to gain feedback and insights from key stakeholders to assist with the development of this ECC Report. The closing date for responses was 6 December 2013 and 97 responses, from 27 CEPT countries representing all the key stakeholder groups, were received. A full summary of the responses received is contained in Annex 5.

## 3.1 PRACTICAL USE OF CALLER LOCATION INFORMATION IN THE EMERGENCY SERVICES SUPPLY CHAIN

There are 3 key stages in the emergency services supply chain although the order and application of these may vary from country to country depending on how the PSAP infrastructure is designed and implemented.

These are:

- To establish the correct PSAP to route the call to so that it can assess the situation;
- To identify and dispatch the most appropriate emergency response team for an emergency at a particular location;
- To determine the most precise location of the caller so that the emergency response team can arrive to provide assistance as quickly as possible.

Based on the responses received, other potentially beneficial uses of accurate and reliable caller location information include:

- Locating callers who are in situations where they are unable to give an accurate indication of their location. These situations may include calls from very young children, medical emergencies where the caller is incapacitated or disoriented, where there is a language barrier or in situations where the caller needs to remain hidden and/or remain silent for personal safety reasons. Furthermore, citizens calling 112 while abroad may not have the local knowledge to be able to give accurate information about their location.
- Reducing the number of false calls to emergency services as emergency services organisations will be able to compare the location provided automatically with the one given by the caller. If there is an inconsistency between them, the emergency services organisations may have a firm basis on which to decide if the call is false or not. Moreover, as the caller can be located and possibly identified quickly and accurately this may, along with the threat of legal proceedings, act as a deterrent to the deliberate initiation of false emergency calls.
- Identifying multiple calls for the same incident which can cause an overload to emergency call answering services. Establishing a more precise location for the caller may be useful to decide if the call refers to an already identified and reported incident. Having this information can assist in prioritising the answering of emergency calls and evaluating the geographic scope of an emergency situation.
- Identifying facilities, landmarks and resources in the general area of a reported emergency incident where local facilities may have the potential to exacerbate an already dangerous situation (e.g. a warehouse containing stores of ADR[3] goods in the vicinity of a reported fire) or where local facilities may be of assistance to emergency responders (e.g. location of schools, gas stations, banks or nearest defibrillator stores).
- In cases where a vehicle is involved in an emergency incident (or an emergency incident is reported from a moving vehicle e.g. train), the actual course over ground as distinct from heading, can be useful to

[3] ADR (formally, the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR)) is a 1957 United Nations treaty that governs transnational transport of hazardous materials. "ADR" is derived from the French name for the treaty: **A**ccord européen relatif au transport international des marchandises **D**angereuses par **R**oute).

save valuable time in reaching people. The course over ground can be tracked using several sets of co-ordinates provided over a period of time.

### 3.2 ACCURACY REQUIREMENTS

The emergency services organisations would ideally like to have very accurate caller location information at their disposal which essentially means a location given within only a few metres of the caller. The technology exists to provide such accuracy in most scenarios but there are some challenges such as with indoor coverage for mobile calls, particularly in multi-dwelling buildings. While technical solutions exist and continue to be developed, they are not widely implemented and the vast majority of emergency services organisations contend that they are currently not provided with a sufficient level of accuracy. This is a major problem for mobile calls in particular. Furthermore, there are no defined criteria for accuracy in most CEPT countries with only a “best efforts” approach adopted.

In summary this means that, for mobile originated calls, Cell ID is usually the most accurate positioning information currently provided which in large cell areas could be over 35km in radius. For calls originating on fixed networks an installation address is provided although this can be misleading when the call originates from within a corporate network or from nomadic VoIP service. For nomadic VoIP calls using E.164 telephone numbers, a flag is usually applied to the information provided so that the emergency services are aware that the registered address may not be reliable given the nomadic capabilities of such services.

For mobile calls in particular, a vast improvement on the currently available level of accuracy is needed and the use of GNSS location data provided by the end user terminal along with an improvement of location information provided by electronic communication networks would be beneficial. As an example, the Netherlands Police provided information during the public consultation on the PSAP’s operational needs which ranges from 1000metres to 3000 metres for certain work flow management activities to 25metres – 50 metres for actually locating the caller. Full details of these operational needs are provided in Annex 4.

It should be noted that verbal interviewing techniques are also very important in determining the location of an emergency incident (which may not necessarily be the same location as that of the caller) and must continue to be used. Interviewing is also useful to validate the location information provided automatically from the network.

### 3.3 RELIABILITY REQUIREMENTS

According to the responses received, PSAP operators and emergency responders must have confidence in the accuracy of the caller location information provided to them and validation of that information appears to be the best way to establish reliability. Validation of caller location information can be achieved in a number of ways:

- Comparing information from multiple sources: For mobile calls in particular, it would be useful to have more than one source for providing location information. For example, using network-based location information to validate the GNSS co-ordinates provided by the mobile terminal. If multiple sources of caller location information are available then it may be reasonable to expect that the decisions and location components of the PSAPs systems would be able to generate a reliability indicator based on a relative comparison of multiple sources of information;
- Comparing location information over different times (potentially from different sources): Provision of information from multiple sources at different stages of the emergency response is also important thereby allowing the emergency responders to develop a more precise position over time. The protocols and standards for the automatic transmission of location information should control or eliminate the possibility for transmission error. The timestamp of the information provided is also important. In a mobile context it is possible that a caller may have moved from the original location from where the call was initially made and emergency responders must therefore be aware of the timestamp of the information. In a fixed network context, the installation address provided is taken from a database which must be updated at regular intervals;

  Comparing location information with verbally provided information: Interview techniques will continue to be very important in validating the location of an emergency incident (which may not necessarily be the same location as that of the caller).

Most respondents to the questionnaire stated that they did not define any requirements for “reliability” of caller location information and indeed it would seem that measuring the compliance with a defined reliability parameter could be challenging in the absence of benchmarking data. “After the fact” reporting by the PSAP and Emergency Responders is needed or some form of data sampling (by drive testing or other means) could provide some indication that the data provided is compliant with any future defined accuracy and reliability parameters.

While these approaches will add to the cost of PSAP operations it is very difficult for policy makers to establish, implement and enforce accuracy and reliability criteria in the absence of such data. Measured statistics is required to substantiate that the criteria are reasonable and proportionate to the level of investment required and the overall positive impact such an initiative would have on the performance of the emergency services response.

## 3.4 DIFFERENT CRITERIA FOR CALLS ORIGINATING ON DIFFERENT NETWORK TYPES

It is generally accepted that accurate caller location information is required for each emergency incident irrespective of the technology used to initiate the call. Nevertheless, different technologies have different capabilities and use different methods for determining location.

One national network operator/PSAP operator stated that the accuracy and reliability of caller location information associated with calls made from mobile terminals is highly dependent on the technological capabilities of both the mobile terminal and the network itself and the criteria for availability, accuracy and reliability are therefore likely to be complex.

For fixed line services it should be noted that there is a relatively slow installation/deployment/change rate and that in general fixed line, by definition, identifies a static place where that installation is located. It is therefore not unreasonable to expect a very high degree of accuracy and reliability in this scenario notwithstanding that a special arrangement needs to be put in place for calls originating from corporate networks.

For nomadic services such as VoIP, the current arrangement in some European countries of providing a flag which indicates that the service is potentially nomadic is useful but not generally sufficient with respect to either the accuracy or the reliability of location information.

## 3.5 ON THE GROUND EXPERIENCES – PROBLEMS ENCOUNTERED WITH THE ACCURACY OF THE LOCATION INFORMATION PROVIDED

### 3.5.1 Cell ID as a primary location identifier

One of the biggest challenges faced by emergency services organisations relates to the use of Cell ID as a primary location identifier. The error radius within the cell area could be over 35km depending on the specific area, network topology and terrain. A larger error radius reduces the speed of response thereby increasing the risk to those in need of assistance. In certain cases it is also possible that the serving cell tower, which is used to estimate the handset location, is not the closest to the caller. Another issue with large cell coverage areas is that it may intersect several PSAP borders or responsibility zones which may cause calls to be transferred to the wrong PSAP.

In cases where the cell size is large, Cell ID can really only be useful to validate other more accurate sources of caller location information but on its own it is clearly not sufficient to determine a reasonably approximate location of the incident.

There were also some reported cases of mobile operators moving base station towers to other geographical areas without updating important database information which resulted in the provision of false positioning information.

In some situations where the accuracy of the location information varies widely PSAP operators may be put in the precarious situation of having to decide whether or not to trust the provided caller location information or to use alternative sources of information such as the billing address instead.

### 3.5.2 Problems with VoIP calls

In many CEPT countries a VoIP service with a geographic number can be obtained. A geographic number contains inherent location information and is traditionally associated with a physical path to premises in a particular area. For VoIP services using geographic numbers the address associated with the service cannot be fully trusted given the potentially nomadic capabilities of such services and a flag is normally applied to the data set provided with the call so that the PSAP operator is aware that it is a VoIP call. The PSAP operator must then take extra care during the interview process.

### 3.5.3 Respondents suggested solutions to improve accuracy

Many of the respondents to the questionnaire referred to the fact that legislation exists under the Universal Service Directive to lay down requirements for accuracy and reliability but that those requirements have not been implemented widely across the CEPT area. While the location of the majority of callers to emergency services can be established successfully during the interview process, more needs to be done to establish accurate location information for those calls where an interview is not possible. Some respondents suggested that smartphone applications using GNSS is one possible solution and could be enhanced by providing multimedia information such as pictures and instant messaging.

On the fixed side, a longer term and consistent solution to improving accuracy and reliability will require a complete review and enhancement of the information contained in the relevant databases and then making that information promptly available to the PSAPs. This is likely to require harmonisation, standardisation and an obligation to implement.

For mobile originated calls, the use of GNSS location data provided by the mobile terminal and in parallel, an improvement in the location information provided by the mobile network within an acceptable timeframe is a good solution.

Some respondents noted that if more accurate and reliable information is provided to PSAPs then PSAP operators must be trained in how to handle and interpret that information.

## 3.6 ON THE GROUND EXPERIENCES – PROBLEMS ENCOUNTERED WITH THE RELIABILITY OF THE LOCATION INFORMATION PROVIDED

Many respondents stated that there is no information gathered regarding the reliability of caller location information so clear evidence of problems is limited to isolated incidents.

Other respondents shared experiences such as:

- Callers being too far from the presented location area.
- Cell ID received not the same as that of the Base Station hosting the call, due to mobile operators failing to maintain information on Cell ID coverage areas
- Situations where the call originates from a nomadic VoIP service.
- Situations where the call is routed to the wrong PSAP because of a large cell area intersecting different responsibility areas.
- Several respondents reported calls where no location information is provided for calls originating from fixed, mobile and nomadic VoIP services.
- Some respondents attributed reliability issues to technical failures such as delays, data errors, and errors in the protocols, different interpretation of protocols and the number of digits used in the coordinates provided.

### 3.6.1 Respondents suggested solutions to improve reliability

Many respondents pointed to a regulatory solution to mandate reliability requirements on operators while others suggested that there was a need for close collaboration, on an ongoing basis, between the PSAPs and the operators to improve reliability.

#### 3.6.1.1 Statistics

The questionnaire asked emergency services organisations if they measure in any way the impact of accuracy and/or reliability of the 112 caller location information related problems or quantify the impact they have on the performance of emergency service responders.

The overwhelming response was no. This may be due to the structure of the PSAP or the lack of tools in order to measure the performance of the system. One respondent did state that it measures the timings within the anatomy of a call. All timings are examined to ascertain if a more effective way of providing patient care can be devised. This includes response time.

Many respondents did however agree that it would be useful to have tools to automatically track and record this information while noting that it does not make sense to monitor the impact unless the accuracy and reliability is improved first. The use of statistics is important in order to monitor the specific calls where location fails or more accuracy is needed. This might affect the current processes of PSAP operators and emergency response teams to record information on the impact of the provided caller location information and a trial period might be useful to determine the overall effectiveness of the process.

Hard evidence provided by statistics like this would be useful in order to justify the investment in progressive technologies to enhance accuracy and reliability of caller location information. It would also allow the setting of targets or standards for benchmarking the number of calls successfully positioned, their degree of reliability and a comparison between incidents of the same type managed with or without caller location information.

Another respondent stated that it would be very useful to be able to gather such statistics but that the data gathering would need to be from the entire service delivery chain, i.e. from the first approximate position until the helpful resource is in place on the actual position (which requires that the resource actually reports when he arrives on location and not before).

While statistics are considered to be potentially beneficial, many respondents think that a statistics gathering process would be difficult to implement given all the different technologies, systems and processes used in the process. A harmonised approach would require the need for considerable investment in PSAP systems.

Some suggestions were provided on the important information that should be gathered which includes:

- The time needed to provide the location (also in the case of receiving incorrect location information initially).
- Accurate location for the telephone number used in the CLI received.
- Service time at the PSAP and the number of incidents with errors in location provided to the responding services was important.
- Time spent on ascertaining the exact location of the caller, on issuing the dispatch order and on actual arrival of the operational resources on the site.
- The location data that emergency services organisations-data system has used when alarming units.
- Other location information available to dispatcher during the call e.g. cell location.
- Location information from the units at the scene.
- Accuracy/validity of all registered addresses was important.
- The average coverage of a responsibility zone for an intervention team, per geotype, with (yearly) repartition of no. of calls.
- The average cell coverage area for 2G/3G/4G national mobile networks, per geotype, with (yearly) repartition of no. of cells and calls.
- Located call percentage.
- Number of failures in position and origin (source of information, transportation information or receiving information).
- Number of calls with no location information.
- Number of calls where the information received is incorrect.
- Time spent by the operator on locating the emergency when it isn't available by automatic means or when is wrong.
- Percentage of calls with automatic location information.
- Percentage of calls with accurate location information.

### 3.7 CONCLUSIONS ON THE FUNCTIONAL REQUIREMENTS OF THE EMERGENCY SERVICES ORGANISATIONS

- The currently available level of accuracy for calls originating on mobile networks is not adequate and a significant improvement is needed.
- Validation of caller location information derived from multiple sources appears to be the best way of establishing reliability including information derived from the interviewing process which is an important source of caller location information and must continue to be used.
- In most countries no data gathering process is implemented that is specifically related to the accuracy and the reliability of the location information received. Measuring the compliance of caller location information with defined accuracy and reliability parameters could be challenging in the absence of benchmarking data. Methods exist that could help ascertain the compliance with any future defined accuracy and reliability parameters (for example, "after the fact" reporting by the PSAP and emergency services organisations or through "drive test" sampling). However, such methods may place considerable burdens on organisations involved in gathering sufficient data to form definite conclusions.
- Any reporting processes and procedures implemented by the PSAP operator / emergency services organisations will inevitably add to their operational costs.
- Any process to monitor the effectiveness of caller location information should be part of an overall programme of improvement. It does not make sense to monitor the impact of location information in a mobile context unless the accuracy of currently provided information is improved first, as it is acknowledged that the currently available level of accuracy is inadequate.
- For nomadic services such as VoIP, the current arrangement of providing a flag which indicates that the service is potentially nomadic is useful but not sufficient particularly in relation to the reliability parameter.
- Cell ID information (as provided currently) on its own is generally insufficient to pinpoint the location of a caller, particularly in areas where the cell size is very large. However, it can be of value for:
  a) routing the call to the correct PSAP;
  b) selecting the correct dispatch team (thus serving as a "pre alert" or "standby" reference location in advance of more accurate location information being provided.); and
  c) validating other more accurate sources of caller location information, such as verbal information provided by the caller.
- Any investment made to improve the accuracy and reliability of caller location information provided by the network and the handset must be met by a corresponding investment in the PSAP's capabilities (including training of staff) so that it is able to receive, interpret, use and evaluate caller location information effectively.
- A regulatory solution to mandate more efficient accuracy and reliability requirements on electronic communications service providers is preferable but there is also a need for close collaboration, on an ongoing basis, between PSAPs and emergency organisations, service providers and the competent national authorities to improve accuracy and reliability.

# 4 DEFINING THE TERMS "ACCURACY" AND "RELIABILITY"

In current implementations of caller location information while the accuracy of the information provided may depend on the technologies and specific circumstances of the call (e.g. whether the caller is originated on a fixed or mobile network), the information provided is mostly received by the PSAP for every call without fail. When this information is absent (or when the information received is subsequently found to be incorrect) the reasons have to be investigated in order to prevent future re-occurrence. However, as will be highlighted in this report, requirements to improve the levels of accuracy of caller location information may lead to a lowering of the reliability of such information received by the PSAP. This may be due to limitations in callers' mobile devices, network capabilities or topologies, or the use of non-standard, (potentially third party) capabilities. As a result, both the accuracy and reliability of potential approaches must be considered so that a meaningful comparison can be made. In this section the terms 'accuracy' and 'reliability' are defined to help in this analysis.

From a regulatory perspective, the accuracy and reliability obligations set out in the Directive and which must be implemented at a national level by the administrations refers to below mentioned definitions, based on statistics. In other words, they should express a target to be reached by the implemented positioning solutions, helping emergency services organisations responding to emergency incidents.

From network operator/manufacturer perspective, accuracy and reliability are also based on the same definitions provided below, but they are presented as features of the proposed positioning methods or solutions. A positioning solution comprises one or more positioning method(s) or elements of positioning methods, including their respective hardware. From this perspective, accuracy translates into performance of the respective solution and reliability into yield, i.e. degree of trust of the positioning solution. In other words, they express what the market can actually provide at a certain moment.

## 4.1 DEFINING ACCURACY AND RELIABILITY

**Accuracy** represents the difference between the true value (of the real position supposed to be exactly known) and the value of the best estimated position obtained during a set of measurements, the estimation of which is usually represented by the "mean" value. In this report, the term accuracy refers to accuracy of positioning (i.e. no relation with the accuracy of velocity and the accuracy of timing).

From a statistical viewpoint the values obtained in the locating process can be analysed over a normal (Gaussian) distribution. Depending on the positioning system and its intended application, this quantity can be expressed in somewhat different ways:

(i) More commonly used in civil applications are "1-sigma" and "2-sigma" error limits. In the case of position errors that follow Gaussian distributions, these limits express the 68th and 95th percentiles of positioning errors, respectively, for a one-dimensional parameter (e.g., altitude).

Accuracy is obviously a value of paramount importance when selecting among candidate positioning systems and deciding what use can be made of their measurements. Because accuracy defines errors under typical conditions, it expresses what users can expect to experience in normal, everyday use[4].

(ii) The NSSDA uses root-mean-square error (RMSE) to estimate positional accuracy. RMSE is the square root of the average of the set of squared differences between dataset coordinate values and coordinate values from an independent source of higher accuracy for identical points[5].

The accuracy of a given caller location technique can never exceed its resolution. Resolution in this context means the smallest increment or step that can be taken or seen. The resolution of a measurement system or positioning method can therefore limit the quality of the information returned by a location technique. As an example, if a positioning method in a mobile network provides just Cell-ID the accuracy can never be better than the mobile cell coverage area.

[4] http://www.insidegnss.com/auto/sepoct08-gnsssolutions.pdf
[5] https://www.fgdc.gov/standards/projects/FGDC-standards-projects/accuracy/part3/chapter3 (3.2.1 Spatial Accuracy)

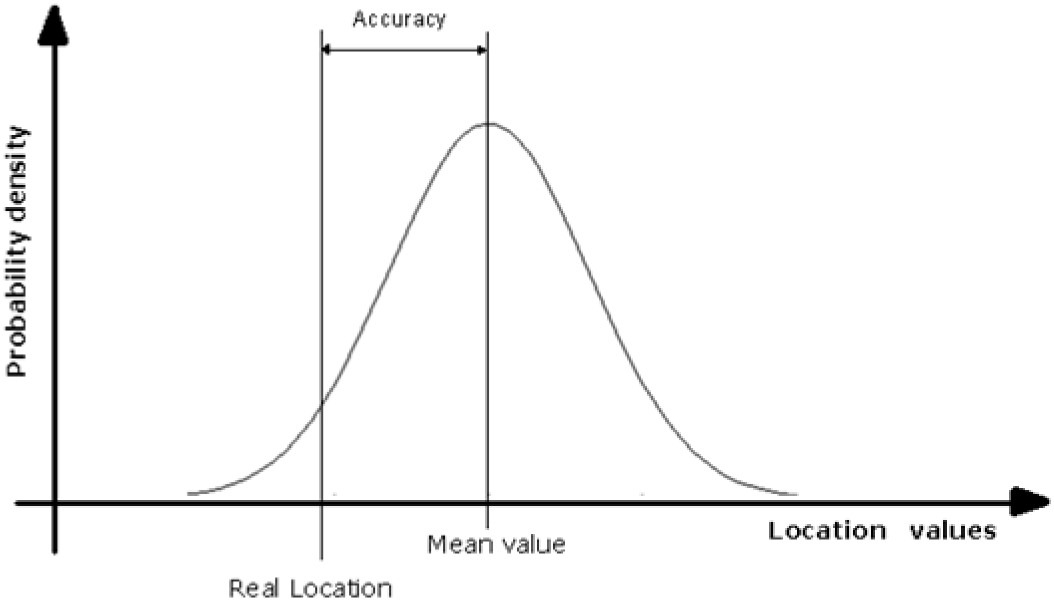


**Figure 1: Accuracy represented graphically on the standard error model (or the Gaussian error model), where the mean value is taken into account like the best estimate of the true value of the real location (for illustrative purposes only)[6]**

Precision is the statistical variation of measurement results if a measurement is repeated several times under unchanged conditions. Figure 2 below illustrates the difference between “Accuracy” and “Precision”.

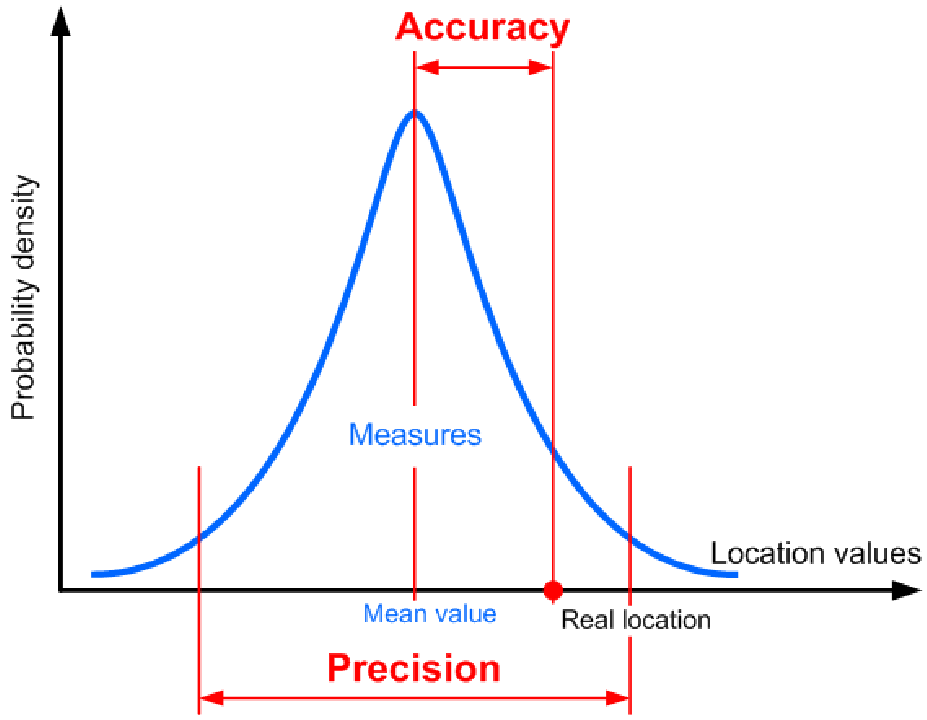


**Figure 2: Difference between “Accuracy” and “Precision”**

(Note: When we use the term “accuracy” in this document, stochastic errors affecting precision are included)

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[6] Based on information obtained from :http://gpsworld.com/gnss-systemalgorithms-methodsinnovation-accuracy-versus-precision-9889/

According with ETSI TS 122 071 V11.0.0 (2012-10) the **reliability** of a location estimate is a measure of how often positioning requests that satisfy the established requirements (e.g. accuracy, response time) are successful.

The reliability feature of the location estimate has also a probabilistic component (i.e. two consecutive measurements may indicate different location estimates). Thus, the reliability of the result depends of a number of factors, depending on the network type. For example, in relation to mobile networks, such as (i) the mobile terminal capabilities to measure different signals and/or send/receive measurement results and/or calculate the location estimate, (ii) the radio access network capabilities to measure different signals and/or send/receive measurement results and/or calculate the location estimate, (iii) transient radio conditions, at the measuring moment (iv) the availability of direct sight between the mobile terminal and the positioning elements, especially in case of satellite positioning. If a positioning attempt fails, e.g. due to interferences or unfavourable radio conditions, another positioning attempt may be made.

Also, for the purpose of this report, the reliability of the location estimate sent to emergency services, should be seen as a measure of (i) the "successfulness" of the location estimate and (ii) the entire transmission path from the location estimate calculation element, through the transmission support, up to the PSAP location handling equipment. This part of the reliability feature is however dependent of the actual national solution implemented for transmitting the location estimate to the PSAP. The entities implementing the transmission should make sure that the solution is designed in such a way that the effect on the reliability of the result received at PSAP side can be neglected. Statistical reporting of the reliability feature of emergency location estimates should be kept.

## 4.2 OTHER RELATED TERMS

### 4.2.1 Availability (of a positioning method)

In the context of providing caller location information for 112 emergency calls, the availability is a feature directly linked with each method/solution implemented.

**Availability** informs whether a method/solution can or cannot be used in specific circumstances or a specific scenario. In the process of evaluating the features of various positioning methods (e.g. availability, accuracy, reliability and response time) the availability of a method is first checked, verifying that the specific characteristics that define a scenario are being met. The availability has a direct impact on the reliability. A positioning method, which has a poor overall availability, cannot be considered as having a good overall reliability.

### 4.2.2 Response time

In the context of providing caller location information for 112 emergency calls, the **response time** is defined by the duration from the moment when an emergency call is initiated to the moment when a location estimate is received by the emergency services organisation.

Thus, the response time is composed of the time needed to calculate the location estimate and the time needed for the information to reach the emergency system. For the purpose of this report when referring to response time comparisons the former element (i.e. time needed to calculate the location estimate) composing the response time will be considered to allow consistent comparisons to be made, although it is the latter element (i.e. time needed for the information to reach the emergency system) that is measurable by the PSAPs.

## 4.3 ESTABLISHING CRITERIA FOR ACCURACY AND RELIABILITY

### 4.3.1 Scope for establishing criteria

Art. 26 (5) of the revised Universal Service Directive asks competent regulatory authorities of EU Member States to lay down criteria for the accuracy and reliability of the caller location information for 112 emergency calls.

As outlined by the relevant parts of the European regulatory framework for electronic communications, the objective pursued is the increased protection of citizens and better assistance offered to emergency services, in the discharge of their duties (recital 39 of Directive 2009/136/EC, modifying, among others, the Universal Service Directive, recital 36 of Directive 2002/22/EC – Universal Service Directive). Thus, drafting any criteria for accuracy and reliability should be made in such a way that it provides a direct, useful and relevant tool to assess any variation of the level of protection of the citizens dialling 112 emergency services (and other emergency services as Member States see fit) and of the impact it made on the emergency services when handling emergency incidents.

### 4.3.2 Establishing national criteria

Taking into account the definitions proposed for the concepts of "accuracy" and "reliability" and the precise aim of the regulatory involvement, an establishment of criteria for accuracy and reliability of caller location information for 112 emergency calls should take into account (i) statistics referring to the accuracy and reliability levels of positioning estimates received, collected by the emergency services (usually the first PSAP receiving the location information) and (ii) information related to the accuracy and reliability needs of emergency services organisations, in specific scenarios/circumstances, for improving their response to emergency incidents. Absence of statistics and absence of clear information related to the accuracy and reliability needs of emergency services organisations will inhibit the ability to make a robust assessment of the effectiveness of different methods and solutions used for the calculation of the location estimate in the emergency services organisations specific national circumstances. Setting criteria in such circumstances will risk affecting both emergency services organisations and service providers by setting targets which may not be adequate in relation to national circumstances.

As outlined in Chapter 3, currently there are no such statistics being collected by PSAPs, and any implementation of systems/processes to generate such statistics, in the context of providing cell ID based location information, would do little to help establish reasonable criteria to be met in the future. Thus, there is a need for preliminary measures in order to improve the quality of the positioning process provided by currently implemented methods which in most cases are limited to Cell-ID. Only after this improvement, starting the collection of evidence of the quality of the location information transmitted to the PSAP makes sense. After a reasonable period of collecting such data, justified assessments could be made related to establishing criteria for accuracy and reliability of the caller location information in the context of emergency services.

When defining criteria for accuracy and reliability one should bear in mind that there is interdependence between those two features, i.e. for a particular positioning method, more stringent requirements on accuracy may lead, to some extent, to deterioration of the reliability (implementing multiple positioning methods or hybrid solution seems to be the only way to cope with this issue).

Based on the methods used to calculate and send a location estimate one can divide the calling to 112 emergency services into three voice service alternatives:

1. Calls over a fixed voice service.
2. Calls over a nomadic voice service.
3. Calls over a mobile voice service.

It can be easily observed that, as outlined in Chapters 6 and 8, the methods for fixed services, as well as for nomadic services, are usually designed around a query of a location information database (administrative location) using a key identifier (e.g. CLI) while the methods for mobile service, as outlined in Chapter 7, generally attempt to calculate a location information based on measurements of various technical parameters related to a specific emergency call. Thus, since the methods are significantly different in nature, and in the output format they deliver, specific criteria for each of these cases should be implemented.

# 5 METHODS FOR TRANSMISSION AND PRESENTATION OF THE CALLER LOCATION INFORMATION

The way in which location information from the electronic communications service providers is provided to the PSAP is different in many Member States due to the technologies used by the organisations involved in the end-to-end chain of emergency call routing and forwarding. In some cases information is forwarded directly to the PSAP ('push') or in other cases the PSAP systems automatically request information ('pull'). In either case, in the majority of situations across Europe, PSAP operators are automatically provided with network-derived location information almost immediately with the call. This facility is required under the relevant EC framework directives[7].

The issue of the approach taken and, consequently, the time to deliver location information could become more relevant as the technology underlying the networks and devices evolves. For example, approaches that are able to provide an extremely accurate location of a caller may take longer to do so than others that are able to quickly obtain a rough estimate of location. This may mean that successive location updates may be necessary in order to provide the emergency authorities with the necessary information to identify and dispatch emergency assistance while providing refinements to this information so as to allow the assistance to quickly locate the caller. Such an approach may result in both 'push' and 'pull' techniques being used to obtain the optimum benefit from the information available.

In this section the 'push' and 'pull' techniques are described, along with their merits and issues as well as a summary of how and where these approaches are implemented across Europe.

## 5.1 TRANSMISSION OF CALLER LOCATION INFORMATION

Two methods are used for the provision of caller location information and guidance is provided on these methods in EC Recommendation 2003/558/03[8]. Member states are free to choose the most appropriate delivery method to suit their needs based on national circumstances. 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 available without delay for the 112 call handler, as soon as the call is received.

Using the "**Pull"** mechanism the PSAP operator asks for the location, if needed. Caller location is provided upon specific request by the 112 call handler, through an electronic request to a database, or, otherwise through 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 PSAP.

**"Push"** and **"Pull"** are used all over Europe. Both methods have advantages and disadvantages, but both methods are acceptable if the time needed to make the caller location available is inside the required timeframe of receiving and handling emergency calls, as defined by emergency services.

## 5.2 PRESENTATION OF CALLER LOCATION INFORMATION

Emergency responder operation (call) centres normally display received location information on Geographical Information Systems (GIS), to help operational staff to dispatch and co-ordinate response teams. The location information provided could be presented in a number of formats depending on the call; for fixed calls this could be the premises address associated with the calling line identity (CLI), whereas for calls from mobiles, this information could be the coordinates of the mast (cell) site, along with an estimate of its coverage area. These different location formats will be converted into a single coordinate system for display on the GIS terminal.

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[7] 2009/136/EC (amended Universal Service Directive 2002/22/EC) (39) "In particular, undertakings should make caller location information available to emergency services as soon as the call reaches that service independently of the technology used."; art.5 "Member States shall ensure that undertakings concerned make caller location information available free of charge to the authority handling emergency calls as soon as the call reaches that authority"

[8] EC Recommendation of 25 July 2003 on the processing of caller location information in electronic communication

As data conversion from one format to another could result in errors, imprecision or data loss, it is recommended that such conversions should be kept to a minimum. While the details of data ownership, formatting and transfer should be agreed between service providers and the emergency responders, we recommend that a single coordinate system for location (e.g. World Geodetic System Datum 84 as defined for eCall) at country level should be used.

As future location acquisition technics may work at different timescales, location information systems may need to be updated and interrogated multiple times for a given call. The ability to support multiple location information interrogations should be made available on relevant systems.

In cases where the location information is expressed in probability values on a GIS, a presentation like a “Heat Map” (see Figures 7 and 8 in Annex 4 for an example) is appropriate.

## 5.3 EXISTING IMPLEMENTATION IN EUROPEAN UNION COUNTRIES

The methods (Push or Pull) chosen by the European countries (including time estimates) are summarised in this subsection. The information provided has been extracted from the Electronic Communications Committee (ECC) Report 143 “Practical improvements in handling 112 emergency calls: caller location information”, April 2010 and COCOM 13-04REV1 “Implementation of the European emergency number 112 - Results of the sixth data-gathering round”, 14 March 2013[9]. Additional, more recent, information is provided where available.

States using ‘Push’ method: **Bulgaria, Cyprus, the Czech Republic, Denmark**, **Estonia**, **Ireland**, **Luxembourg, Portugal, Romania, Slovenia**, **Slovakia, Iceland and Germany.**

States using partial ‘Push’ method (or combination of ‘Push’ and ‘Pull’): **Latvia (**‘Push’ is used by 2 of the mobile operators), **Italy, Lithuania, Cyprus, United Kingdom and Spain** (‘Push’ is used in 19 PSAPs). The **Netherlands** reported the use of a 'Semi-push' system.

States using ‘Automatic Pull’ method: **Belgium, Finland, Latvia, Lithuania, Sweden, the United Kingdom, Switzerland** and **Norway**. These reported near instant average times to provide caller location (i.e. within 15 sec.), which in practical terms render the performance of their caller location systems similar to that of ‘Push’ systems. **Malta** reported that it will implement an Automatic Pull system in the near future.

Longer times to provide caller location information was reported by **Poland**, **Hungary, Austria**, **Greece** and France, with timescales reported between tens of seconds to tens of minutes.

## 5.4 PRIVACY CONSIDERATIONS

According with recital (36) and Art.10 of the Directive on privacy and electronic communications (Directive 2002/58/EC) Member States may restrict the users' and subscribers' rights to privacy with regard to calling line identification where this is necessary to trace nuisance calls and with regard to calling line identification and location data where this is necessary to allow emergency services to carry out their tasks as effectively as possible. In doing so, Member States shall ensure that there are transparent procedures governing the way in which a provider of a public communications network and/or a publicly available electronic communications service may override the elimination of the presentation of calling line identification and the temporary denial or absence of consent of a subscriber or user for the processing of location data, on a per-line basis for organisations dealing with emergency calls and recognised as such by a Member State, including law enforcement agencies, ambulance services and fire brigades, for the purpose of responding to such calls. For these purposes, Member States may adopt specific provisions to entitle providers of electronic communications services to provide access to calling line identification and location data without the prior consent of the users or subscribers concerned.

Using any methods to determine the caller location information for calls to emergency services will help emergency services organisations to better locate the caller and thus provide a timely an appropriate

[9] http://ec.europa.eu/digital-agenda/en/news/implementation-european-emergency-number-112-%E2%80%93-results-sixth-data-gathering-round

response to the emergency situation. However, when considering the necessary measures, confidentiality of the information transmitted and user's right to privacy need to be properly addressed.

Thus the solution implemented must insure that the location information generated cannot be obtained by other parties without the clear consent of the user, if at all, throughout the whole emergency service supply chain.

Additionally, the solution implemented should transmit the caller location information in such a way that the association between the call and the location information can only be made by the PSAP operator. In the case the information is pulled, the location information should be available from the network operator to the PSAP and the emergency services organisations for a limited, short time frame, also observing the needs of emergency services organisations, starting from the moment of receiving an emergency call. The implementation of the mechanism should be made in such a way that access to location information is not possible without an emergency call.

# 6 LOCATION INFORMATION FOR THE FIXED SERVICE

## 6.1 GENERAL CONSIDERATIONS

Historically, access to the emergency services was designed for conventional PSTN and then ISDN fixed telephony networks. Since the location and owner of every telephone connection are static and known with precision by the telephone service provider, it is easy for the latter to route the call to the appropriate emergency centre. The information of the call origination can therefore be accurately established by the PSAP operator.

For fixed telephony network obtaining the location of a call is usually a quite simple operation based on the installation address location and is linked with CLI – Calling Line Identification – which is a simple, reliable and available method for static location.

However business telecommunications and private networks with multiple internally linked entities, increasingly with the introduction of VoIP technology, today allow only the main connection and its location to be correctly identified. Consequently only those PSAPs located in the area of the main connection will get emergency calls, and will have little information about the caller or indeed whether or not the case concerns them directly.

## 6.2 FIXED LOCALISATION METHOD

The network operator usually has the civic location information of the customer premises where it has installed a certain network termination point (NTP). This data is stored into a database and should be regularly updated.

When providing the fixed telephony service operators assign E.164 subscriber numbers to NTPs. These numbers identify the NTP and are passed to the network for every call placed from the specific NTP as part of the call establishment procedure. The assigned subscriber numbers are also included in the operator's customer civic location information database.

Having the E.164 number of the calling NTP a query over the customer civic location information database can return in (almost) real-time the civic location information of the calling NTP. This operation can be done either by the operator or by the PSAP software or operator, provided that it has access to the database. This is the CLI-Caller Line Identification either pushed with each emergency call in some member states, or pulled when needed by the PSAP.

The location information can reach the PSAP either in a "pull" fashion (the location values are transmitted to the PSAP after a 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) or in a "push" fashion (the location values are transmitted as part of the call setup signalling information as soon as the emergency call request is sent to the PSAP).

As location information for calls originating on fixed telephony networks are based on data owned by telecom companies each of them has to make its location information accessible for emergency calls purpose.

The information received by the PSAP from the database can include:

- Surname and first name, or company name.
- Location of the user's connection (street, number, postal code, town).
- "Roaming use" flag[10], in the case of a VoIP connection which can be used in roaming mode, without correct routing and location being guaranteed.
- The name or identification code of the telephony service provider.
- Service type code (e.g. (Single Line, Primary access with DDI, Basic access with DDI/MSN, Public Payphone etc.).

[10] This will indicate that the presented address might differ from the actual location (which is the case when VoIP is used nomadically). This will tell the PSAP operators that it is especially important to ask the callers for their actual position.

There are some aspects which have to be taken into account for fixed location method:

- Centralisation or decentralisation of required data from all telecom companies: in some countries a unique and common central database contains the data from the subscribers from all operators, in other cases there are different databases, normally one for each operator. A combination of the two solutions is also used in some countries.
- Location of the data: the databases can be located in the PSAP or not, in which case it has to be accessed remotely.
- Reliability of the data:
- Data updating - How often are the data updated, subscriber data can change daily. It is absolutely necessary that the subscriber data are regularly updated to ensure a good reliability of the information available for the PSAPs. Unfortunately there is a large disparity between Member States: some require a daily updating while others accept a biannual update. Current technology should allow an almost real time update but its implementation can be costly.
- Data standard format - It is necessary that the format and presentation of the output data of the different databases are harmonised in order to facilitate the interoperability between the different actors.
- Correctness and precision of the address location - Determining a specific geographical point can be done in many ways: geographic coordinates (latitude/longitude in one of the international or national geodesic systems), geographic data (geometric, descriptive, graphic, metadata), street, postal or cadastral address and postcode where available. The location information should be standardised in order to guarantee a perfect interoperability between PSAPs systems and networks, and facilitate the emergency operation. It is indeed essential that all players use the same standard for determining location in order to avoid any kind of conversion between different types of location coordinates (e.g. latitude/longitude to UTM/UPS, or cadastral to national geodesic ) and guarantee a perfect reliability of location information

Figures 3 and 4 below represent an overview of various databases configurations used in the European countries.

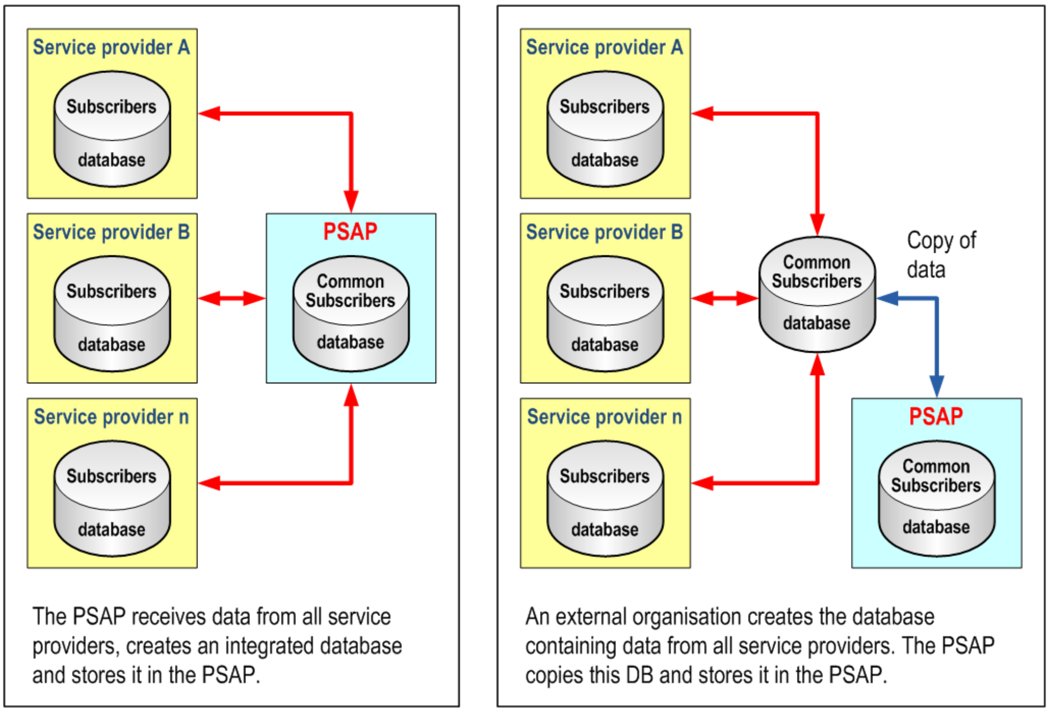


**Figure 3: Data stored in the PSAP**

A solution with the common database located in the PSAP itself is appropriate for national structures with a limited number of PSAP operators as well as a restricted number of suppliers managing their own data-base. The reliability of the common database is essential, redundancy is absolutely necessary.

If the common database installed in the PSAP is itself a copy of the centralised database managed by an external entity it is necessary to ensure an update in real time between the two databases.

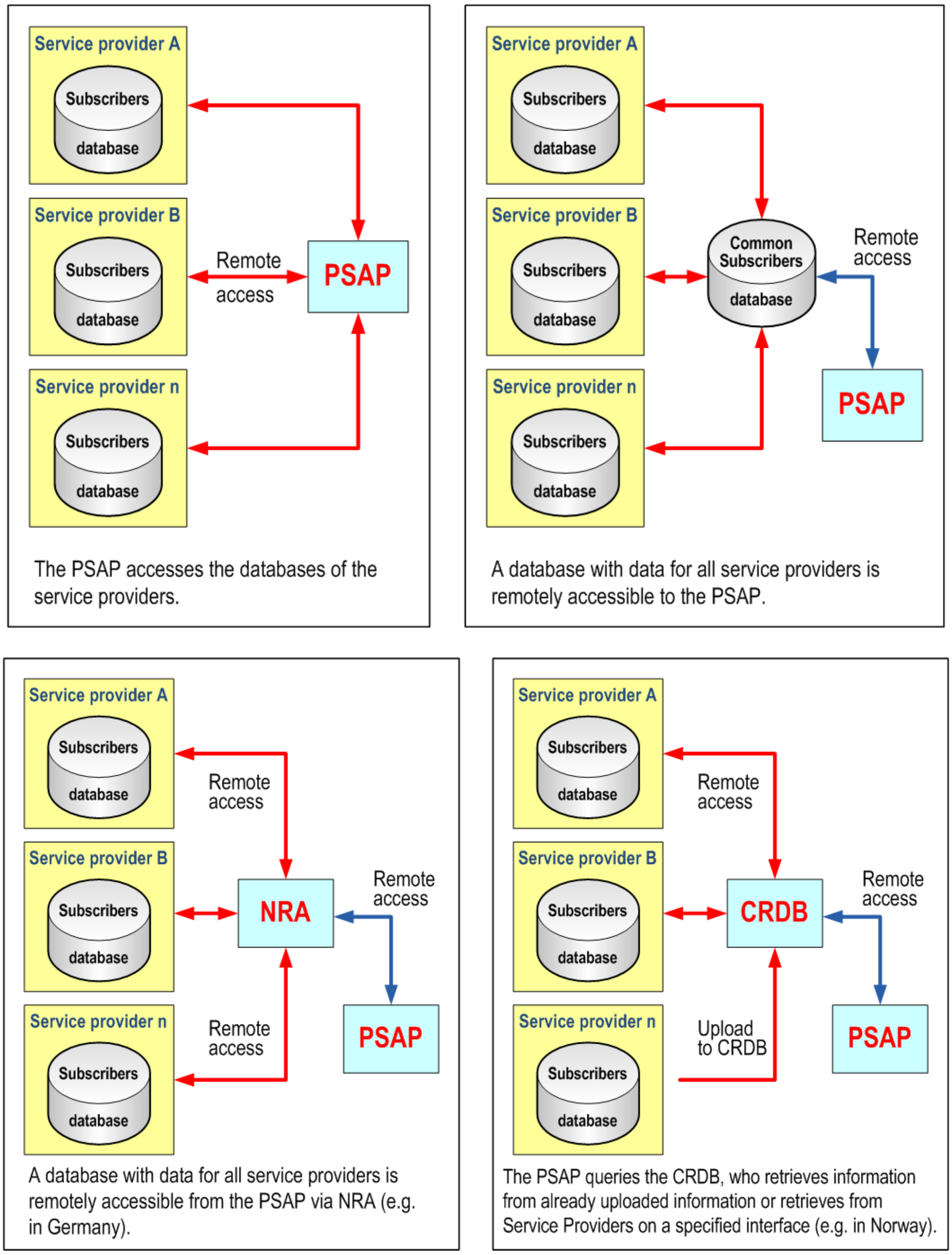


**Figure 4: Data not stored in the PSAP**

The structure with databases located outside the PSAP is appropriate for national structures having multiple PSAPS operators, by limiting the scattering of databases difficult to manage. Only one common database with remote access from several PSAPs is well suited for such organisations. In this case a telecom-munication network specifically dedicated to data traffic between databases and PSAPs is an advan-tage in term of reliability and security.

## 6.3 EXISTING IMPLEMENTATIONS IN EUROPEAN COUNTRIES

From recent surveys conducted by both the ECC[11] and COCOM[12], the ability to provide caller location information from fixed services to the emergency authorities has been almost universally implemented across Europe. However, for VoIP services this information can be provided only when the VoIP service has been connected to fixed address, so that a registered address can be used. In contrast, for so-called 'nomadic' VoIP services, in which no registered address is available (or is very likely to be inaccurate) no caller location information is generally available. The methodologies to improve caller location information for nomadic VoIP services are discussed in Chapter 8. In many cases, on receipt of a VoIP call at a PSAP, whether fixed or nomadic in nature, the operator is notified that the caller location indicated may be inaccurate and that confirmation of address or location should be made (this notification is sometimes referred to as a 'VoIP flag').

Data are based on the Electronic Communications Committee (ECC) Report 143 *"Practical improvements in handling 112 emergency calls: caller location information"*, April 2010 and COCOM 13-04REV1 *"Implementation of the European emergency number 112 - Results of the sixth data-gathering round"*, 14 March 2013. Country specific information has been updated in accordance with positions expressed within the ECC.

**Table 1: Existing Implementation in EU countries**

| Country | Source of fixed caller location information | Availability of caller location in case of subscribers not listed in directory services | Availability of caller location in case of subscribers of VoIP operators providing PATS/ Availability of caller location for nomadic VoIP |
|---|---|---|---|
| **Austria** | Centralised database including all subscribers of fixed PATS operators, except unlisted numbers | Yes by verbal/written request to the respective network operator | Yes, in case of voice over broadband it is the actual caller location and in case of nomadic VoIP it is the registered address |
| **Belgium** | For operators having an agreement with the former incumbent, all caller location can be found in a centralised database; for others through a hotline available to the emergency services | Yes, registered address | |
| **Bulgaria** | Centralised comprehensive. Location information database. Frequency of updating : twice a month | Yes | If VoIP subscribers are fixed, caller location information is provided. For nomadic VoIP users caller location information is not available. |
| **Croatia** | Centralised location information database on the main server | Yes | Yes / n/a |
| **Cyprus** | Caller location obtained directly from the relevant operator | Yes | Yes<br>Refers to the registered address/no caller location |
| **Czech Republic** | Centralised and comprehensive database (INFO 35)<br>The database is updated in fortnight bases | Yes | TO2 doesn't provide nomadic VoIP service-it is known if there is any such provider. This claim is posed to all PATS operators independently to used technology.<br>In case of nomadic VoIP systems |

[11] Electronic Communications Committee (ECC) Report 143 "*Practical improvements in handling 112 emergency calls: caller location information*", April 2010
[12] COCOM 13-04REV1 "*Implementation of the European emergency number 112 - Results of the sixth data-gathering round*", 14 March 2013.

| Country | Source of fixed caller location information | Availability of caller location in case of subscribers not listed in directory services | Availability of caller location in case of subscribers of VoIP operators providing PATS/ Availability of caller location for nomadic VoIP |
|---|---|---|---|
| | | | available location information refers only to the registered subscriber address. |
| **Denmark** | Centralised comprehensive database | Yes | Some VoIP operators provide the actual caller location, while other VoIP operators provide the registered subscriber address (billing data). |
| **Estonia** | Upgrade in progress in the caller location system.<br>Implementation with the new GIS 112 system | Yes | Available is only registered address actual caller location is not available |
| **Finland** | Centralised directory services database is used<br>Frequency of updating: daily | Yes, by contacting directly the operator | Yes, the registered subscriber address |
| **France** | Database of each operator | Yes | Yes, not Skype Out |
| **Germany** | Centralised comprehensive point of contact (NRA) having access to the decentralised databases of individual providers. In case of access networks based on ISDN, this is the only way PSAP can get location information. In case of other network access technologies, location information is pushed to the PSAP at call setup time | Yes | Yes<br>Refers to the registered address |
| **Greece** | The emergency call centre, requests information data directly from the relevant operator originating the emergency calls | Yes. it is possible upon request | In case of VoIP systems the available location information refers to the registered subscriber address |
| **Italy** | Fixed caller location is retrieved directly by the PSAP querying the operator location platform with the subscriber Calling Line Identity (i.e. E.164 number) of the established emergency service call. In fact operators and PSAPs are interconnected through a secure IP-based national centralized VPN that is operated by the Administration (so called “CED Interforze” operated by the Ministry of the Interior Affair) | Yes. | Yes. PATS VoIP service in Italy use the geographic numbers (with nomadicity restricted to the district area). |
| **Luxembourg** | Caller location obtained directly from the relevant operator | Yes | Yes (EPT)<br>Orange: In case nomadic VoIP subscribers, it corresponds to the registered subscriber address |
| **Malta** | National comprehensive directory. In the case of ex-directory numbers, this | Yes, currently this information is obtained | Yes. In the case of nomadic systems, the location information would refer to the registered |

| Country | Source of fixed caller location information | Availability of caller location in case of subscribers not listed in directory services | Availability of caller location in case of subscribers of VoIP operators providing PATS/ Availability of caller location for nomadic VoIP |
|---|---|---|---|
| | information is obtained from the relevant operator originating the call.<br>Frequency of updating: in real time upon registration of new subscribers | directly from the relevant operator originating the call | subscriber address. |
| **Netherlands** | Centralised database: Name, Address, City, ZIP-code | Yes, manual request at the central database of the Ministry of Justice | Yes<br>To the subscriber's address |
| **Norway** | Centralised comprehensive database<br>Frequency of updating: daily | Yes | Yes<br>Billing address is provided. In case of nomadic or potentially nomadic VoIP calls, the emergency call is marked/flagged |
| **Poland** | Emergency services are going to use a centralised location information database from third quarter of 2012 | Yes | No (in Polish law not specified VoIP issues) |
| **Portugal** | Centralised comprehensive database<br>Frequency of updating: daily | Yes | Yes for fixed VoIP PATS |
| **Romania** | Comprehensive centralised location database handled by SNECS operator<br>Frequency of updating: Bi-Monthly | Yes, according to the current regulation | Yes, caller location provided by fixed VoIP PATS operators.<br>Concerning nomadic VoIP systems, location information refers to the Registered subscriber address |
| **Slovakia** | Database of the incumbent operator and a centralised database of alternative fixed operators updated once every 3 months | Yes | Yes |
| **Slovenia** | Centralised location information database on the main server<br>Frequency of updating: daily | Yes | Yes for fixed.<br>In the case of nomadic VoIP systems operator providing services is obliged to communicate beside registered subscriber address also a note that it is nomad user |
| **Spain** | Information database provided to the NRA. Some centres complement this with additional databases | Yes, in accordance of the regulation of Universal Service | Yes<br>In the case of nomadic VoIP systems the information available is the subscriber's contract residence |
| **Sweden** | Centralised database operated by a company providing directory enquiry services.<br>Frequency of updating: daily | Yes<br>(if secret numbers are meant) | Registered subscriber's address |
| **Switzerland** | Centralised comprehensive database | Yes | Yes, in the case of nomadic VoIP systems the location is the address mentioned in the contract |
| **United Kingdom** | Centralised comprehensive location database operated by each Stage 1 PSAP that is fed by all the CPs that use that | Yes | Yes, but usually only for those providing VoIP services used at fixed locations. Location is the registered address |

| Country | Source of fixed caller location information | Availability of caller location in case of subscribers not listed in directory services | Availability of caller location in case of subscribers of VoIP operators providing PATS/ Availability of caller location for nomadic VoIP |
|---|---|---|---|
| | Stage 1 PSAP for its emergency calls.<br>Frequency of updating: at least daily | | |

## 6.4 PROBLEMS WITH EXISTING IMPLEMENTATIONS

Determining caller location for emergency calls originating on fixed networks is based on the installation address location (and/or in some cases the billing address which may differ from the installation address) and is linked with CLI – Caller Line Identification - which is a simple, reliable and available method. It has proved to be very reliable in most of the cases and for a long time, compared to the problematic of location for mobile networks and VoIP telephony. Nevertheless some problems prevent location for fixed networks to be considered totally reliable: the address of the location depends on the underlying system (considered in Section 6.2 above), databases are not updated as frequently as required and caller location can be often unclear, or absent, for some multi-site corporate networks.

### 6.4.1 Fixed telephony address location

The location of an NTP may be different depending on the address information considered: postal, civic, cadastral, infrastructure (e.g. railway tracks, industrial compounds, road networks etc.).

The administrative structure also influences the accuracy of the location and varies from one country to another. The geographical areas considered as well as the population density can indirectly lead to variations in the accuracy when determining the caller location. Urban areas are generally well documented and land registered, allowing a good location granularity for emergency services, with the exception of some high-density areas (estates, building bars, condominiums) where localisation is sometimes imprecise due to the vertical component (multi-storey), interlocking or lack of identification of different buildings. It has to be noted that the database of civic addresses for emergency calls can only be as good as the general databases of civic addresses managed by relevant public authorities. Situations where these authorities make changes to elements of civic addresses should be carefully managed and the communication with operators and PSAPs and emergency services organisations should be ensured in order not to affect the functioning of the emergency services.

On the other hand rural areas have sometimes a very large granularity (for example, a single property address may represent a large area of land), the identification of the places is sometimes vague (localities) and known only from the locals.

A fine granularity at address level could reasonably improve the accuracy of the localisation.

However the installation address information is sometimes not properly verified prior to sending them to the emergency services. Address information associated with physical telephone locations should be in a format that it can be processed electronically in a GIS.

The use of exact geographic locations (longitude coordinate and latitude coordinate) instead of addresses could, in some circumstances, significantly improve the accuracy of the location and avoid uncertainties, in particular when the emergency services staff is unfamiliar with the locality.

### 6.4.2 Database updating

For fixed telephony the address location of the subscriber and the telephone number are normally stored in databases but most of the databases are not updated as frequently as needed. There is almost no real–time location information used in any European country i.e. there is no dynamic connection between PSAPs and operator databases, resulting in some inaccurate location information existing in the fixed line databases.

### 6.4.3 Corporate networks and building complexes

Databases often do not include private numbers (corporate networks) and most systems only have numbers and locations of published directories.

Thus one caller number (CLI) can hide a large number of unidentified and not localised potential callers. It can be a small company with a few buildings, but also a multinational covering several countries or even continents. Therefore the location information within a private network should be made available when possible and comply with the requirements of the corresponding emergency authorities in the country/area, in which the site or premises of the company are installed. For large private networks, attention must be paid to the fact that this requirement may be of importance when designing the architecture of the private network.

The private network owner and the network provider should cooperate so that the architecture allows correct routing of the emergency calls. Further, this cooperation should aim to ensure correct location information presented at the PSAPs.

The problem is the same when a citizen is calling from a campus and a building complex: the location stored in the database for this phone number is also frequently the one of the main building and not the real address of the office or the location where the call was initiated.

One possible solution might be to establish a procedure to pinpoint calls from business networks, for example by requiring the owner of a corporate network with multiple locations connected internally to properly assist the public service provider to uniquely localise, provide a timely location update and route the emergency calls to the appropriate PSAPs. For example it is possible for the management of the corporate network to manage his own caller location database and provide the appropriate information to the public service provider to route the emergency call to the correct PSAP.

Any problems encountered in relation to fixed location should be adequately documented in order to identify the right solutions to be implemented.

## 6.5 GUIDELINES FOR CRITERIA FOR FIXED VOICE SERVICE

In the fixed voice service the procedure of obtaining a location is usually based on a simple and straightforward procedure that returns the result in the form of an administrative address. In special situations, e.g. large private networks, campus networks, more complex solutions, resulting in the same format of the location information, may be implemented.

Therefore, national criteria related to accuracy and reliability for emergency calls over a fixed voice service should refer to the exact administrative address from where the call is placed.

However, due to the lack of statistics related to accuracy and reliability of caller location information for 112 emergency calls (see Chapter 3) it is not possible, at this moment, to consider concrete figures. To do that, statistics need to be established and kept by the emergency services organisations.

Based on emergency services organisations needs and taking into account statistics implemented over a reasonable period of time (e.g. 1-2 years), target values related to reliability of the location information provided and a deadline term to comply with the target value should be set. A reliability target value of over 99% can be considered as achievable i.e. if you are receiving location information then in over 99% of calls the location information received is the actual one.

The location information provided should be considered as accurate if the administrative address received is actually the address from where the 112 emergency call was placed.

Additionally, maximum response time (time to receive the location) value (in seconds) and availability of the information (as percentage from total number of calls) could be set.

A mechanism for monitoring the evolution of the above parameters, ensuring the convergence, in time, towards the established target values should also be implemented.

Ideally, identical values for the above parameters should be set in all Member States in order to provide the same level of quality of the service throughout EU.

## 6.6 CONCLUSIONS ON CALLER LOCATION INFORMATION FOR FIXED SERVICE

Even though locating and routing processes for emergency calls on fixed telephony networks are relatively simple and reliable, some improvements are possible to further increase the efficiency of the interventions with more accurate and reliable data transmitted to the PSAPs. In this sense, one can make some basic recommendations:

- Data transfer to PSAPs: give priority to the push method making for data to be displayed on PSAPs screens without staff intervention
- Data available for PSAPs: information from databases and available to emergency services must be as precise as possible and include at least:
  - Caller Line Identification (CLI).
  - Location of the user's terminal equipment or the network termination point.
- Additional data available for PSAPs (depending on national laws and implementations)
  - Surname and first name, or company name.
  - Flag for nomadic voice service.
  - Name or identification code of telephony service provider.
- Location data: preferably use a single coordinate system for correspondence on the map of the administrative location (e.g. World Geodetic System Datum 84) in addition to the postal or cadastral address, by avoiding imprecision and differences of interpretation between the various actors.
- Data updating: as a minimum the databases used for the location of emergency calls should be updated on a daily basis with immediate updates being preferred
- Corporate networks: establish a procedure to pinpoint calls from business networks, for example by requiring the owner of a corporate network with multiple locations connected internally to properly assist the public service provider to uniquely localise, provide timely location update and route the emergency calls to the appropriate PSAPs.
- Although many of the above recommendations can be relatively easily implemented, it is important to consider the evolution of telecommunications networks before undertaking modifications or major adjustments in the location and routing processes for fixed telephony. While the networks considered in this chapter are of fixed PSTN / ISDN type, it is certain that telephone services will mainly call on all-IP networks (PSTN / ISDN to NGN / All-IP migration) by the end of the present decade. Hence in very short time emergency calls will largely be made from fixed or nomadic devices using VoIP applications or services such as discussed in Chapter 8.
- For each emergency call, where problems are encountered, a log should be made of these problems and reported accordingly (e.g. the Service Provider or National Health and Safety Authority) in order to analyse and resolve these issues in the future.

# 7 LOCATION INFORMATION FOR MOBILE SERVICE

## 7.1 GENERAL CONSIDERATIONS

The terms mobile positioning and mobile location are sometimes used interchangeably, but they are really two different things. Mobile positioning refers to the process of determining the position of the mobile terminal. Mobile location refers to the location estimate derived from the mobile positioning process.

The scope of positioning the mobile terminal is to provide location based services, both for commercial and non-commercial purposes. The mobile terminal location used in case of emergency calls classifies as one of the non-commercial purposes. The location of a mobile terminal user is sensitive information in regard to the demand for data privacy. Any measure to estimate the caller location should be closely linked to the event of an emergency call.

According to 3GPP definitions, Location Information consists of a number of relevant data such as geographic location estimate of the mobile terminal, its velocity, horizontal and vertical accuracy of the location and the time needed to provide the location estimate.

The geographic location estimate of the mobile terminal is usually done by measuring specific parameters associated with radio signals exchanged between the mobile terminal and the mobile radio access network or the satellite system. Some alternative methods have been developed, driven by the market, using radio signals other than those standardised for the use of the mobile radio access network or the satellite system (e.g. Wi-Fi related radio signals).

The accuracy of the location estimate is network-implementation dependent (chosen by the network operator) and dependent on the geographical topology. It may vary between networks as well as from one area within a network to another. If the positioning method used involves actions from the mobile terminal, the accuracy may also depend on the capabilities of this equipment.

The accuracy of the location information is also dependent on the method used and the position of the user equipment within the coverage area. Several design options of the system (e.g. size of cell, adaptive antenna techniques, path loss estimation, and response time) allow the choice of a suitable and cost effective location method.

In developing this Chapter, responses received to the ECC questionnaire from mobile network operators were considered. Mainly, mobile network operators do not have experience in Europe with more advanced positioning technologies in order to provide more accurate caller location information. In the vast majority of cases, only Cell-ID is currently provided and no plans and considerations are being given to improving accuracy at this time.

This Chapter describes the 3GPP/ETSI standardised mobile positioning methods (Section 7.2) and their related network architecture (Section 7.3), other non-standard methods which are used in practice (Section 7.4), illustrates the current situation in European countries (Section 7.5), analyses and compares the different positioning methods from a number of viewpoints (Section 7.6), considers privacy in mobile networks (Section 7.7), formulates some guidelines for setting criteria for mobile voice service (Section 7.8) and draws conclusions related to the various positioning methods from a technical and operational perspective, keeping in mind the regulatory needs in implementing article 26(5) of the Universal Service Directive (Section 7.9).

## 7.2 STANDARDISED MOBILE POSITIONING METHODS

The described mobile positioning methods in this section are based on the latest version available of the corresponding 3GPP/ETSI standards. The standards consulted are as follows:

| Document number | Document title |
|---|---|
| (3GPP) ETSI TS 143 059 v11.0.0 (2012-10) | Digital cellular telecommunications system (Phase 2+);<br>Functional stage 2 description of Location Services (LCS) in GERAN<br>(3GPP TS 43.059 version 11.0.0 Release 11) |
| (3GPP) ETSI TS 125 305 V11.0.0 (2012-09) | Universal Mobile Telecommunications System (UMTS);<br>Stage 2 functional specification of User Equipment (UE) positioning in UTRAN<br>(3GPP TS 25.305 version 11.0.0 Release 11) |
| (3GPP) ETSI TS 136 305 v11.3.0 (2013-04) | LTE;<br>Evolved Universal Terrestrial Radio Access Network (E-UTRAN);<br>Stage 2 functional specification of User Equipment (UE) positioning in E-UTRAN<br>(3GPP TS 36.305 version 11.3.0 Release 11) |
| (3GPP) ETSI TS 123 271 V11.2.0 (2013-04) | Digital cellular telecommunications system (Phase 2+);<br>Universal 8Mobile Telecommunications System (UMTS);<br>LTE;<br>Functional stage 2 description of Location Services (LCS)<br>(3GPP TS 23.271 version 11.2.0 Release 11) |
| (3GPP) ETSI TS 122 071 V11.0.0 (2012-10) | Digital cellular telecommunications system (Phase 2+);<br>Universal Mobile Telecommunications System (UMTS);<br>LTE;<br>Location Services (LCS);<br>Service description; Stage 1<br>(3GPP TS 22.071 version 11.0.0 Release 11) |
| 3GPP TR 25.923 V1.0.0 (1999-04) | 3rd Generation Partnership Project (3GPP);<br>Technical Specification Group (TSG) RAN;<br>Working Group 2 (WG2);<br>Report on Location Services (LCS) |
| ETSI TR 125 907 V9.0.1 (2010-02) | Universal Mobile Telecommunications System (UMTS);<br>Evaluation of the inclusion of path loss based location technology in the UTRAN<br>(3GPP TR 25.907 version 9.0.1 Release 9) |

According to the relevant standards above taken into consideration the positioning methods used for locating a mobile terminal are similar, regardless of the technical type of the network (i.e. GSM/UMTS/LTE or in other words 2G/3G/4G).

From a practical implementation point of view and in order to properly implement a positioning method, the support of mobile network equipment manufacturers, and in some cases mobile terminal manufacturers, is of utmost importance in order to obtain best results.

### 7.2.1 Cell ID (2G, 3G, 4G)

In the Cell ID based (i.e. cell coverage) method, the position of a mobile terminal is estimated with the knowledge of the geographic position of its serving radio equipment (BTS/NodeB/eNodeB). Many location based services applications establish the location of the user by simply identifying which base station the user is connected to when making the emergency call. This basic form of location tracking is independent of the mobile terminal.

In 3G networks the information about the serving cell may be obtained by paging, locating area update, cell update, URA (UTRAN Registration Area) update, or routing area update. The cell coverage based positioning information can be indicated as the Cell Identity of the serving cell, the Service Area Identity (as specified with the PSAP operator) or as the geographical co-ordinates of a position related to the serving cell. When geographical co-ordinates are used as the position information, the estimated position of the mobile terminal can be a fixed geographical position within the serving cell (e.g. position of the serving Node B), the geographical centre of the serving cell coverage area, or some other fixed position (e.g. city centre) within the cell coverage area.

Although not explicitly described in the standard, a procedure similar to the above described 3G networks case is applicable also in 4G networks case.

### 7.2.2 Enhanced Cell ID positioning methods (2G, 3G, 4G)

Additional mobile terminal and/or mobile access network radio resource related measurements can be used in order to improve the accuracy of the Cell ID mobile location. They usually refer to calculations between timestamps of different events, the strength of certain signals or the angle under which a signal is received.

#### *7.2.2.1 Cell ID with Timing Advance – TA/TADV (2G, 4G)*

In 2G networks the TA is based on the existing Timing Advance parameter. It measures the time between the emission of a radio wave from mobile terminal and its arrival to the BTS of the mobile network. The TA value is known for the serving BTS. The Cell ID of the serving cell and the TA is returned as the result of the TA measurement procedure. TA may be used to assist all positioning mechanisms, but the network does not store this kind of information without additional software. The TA parameter is only available for the serving cell and not for any other cells that the mobile terminal might see.

In 4G networks a Timing Advance parameter (TADV) can be measured for helping improve the accuracy in a similar way.

#### *7.2.2.2 Cell ID with RTT (3G)*

This variant uses in addition NodeB measurements of the signal Round-Trip-Time (RTT). These measurements can be made for all NodeBs in the active set. If RTT measurements to several geographically dispersed NodeBs are available, the mobile terminal location may be found via trilateration. The RTT measurements may be complemented by the mobile terminal measurement of the Rx-Tx Time Difference. In case of TDD mode, the distance measurement may be based on RX Timing Deviation and/or Timing Advance. The RTT parameter is only available for the serving cell and not for any other cells that the mobile terminal might see.

#### *7.2.2.3 Cell ID with Path loss and Related Measurements (3G, 4G)*

This variant uses in addition several mobile terminal measurements for the serving and neighbouring cells related to path loss or Signal-Noise Ratio (e.g. measurements related to Path loss, Common PIlot CHannel Received Signal Code Power (CPICH RSCP) (FDD) – for 3G; Reference Signal received Power (RSRP), Reference Signal Received Quality (RSRQ) – for 4G).

#### *7.2.2.4 RF Pattern Matching (RFPM) (3G, 4G)*

The RF Pattern Matching positioning method is based on radio link measurements collected from the network and/or the mobile terminal. The method relies on predictions or models of the radio environment against which it performs an algorithmic comparison of the measurements to determine a best match estimation of the mobile terminal location. RFPM may utilise measurements other than the path loss measurements noted above, e.g. RTT or TA.

From a practical implementation point of view, the RF Pattern Matching positioning method can be implemented in three ways:

- The most simple and cost effective way is to use a shadow map of each antenna, which automatically eliminates all areas from the localisation, where it is impossible the cell phone can see and connect to the antenna. The accuracy of this position method depends on the geographic structure of the area. In a flat area with nearly no shadowing effects the accuracy improvement by using this method will be low.

- The next method is to use a shadow map and field strength predictions and take into account cell phones usually connect to the antenna with the stronger field strength. A probability calculation does result in probability maps, which not only have eliminated the areas according method 1 above, but also all areas, where the cell phone would have connected to stronger antennas. Annex 4 provides example and shows how one mobile operator utilises this technology. The accuracy depends on the structure of the area like in method 1, and will be even better where there are antennas nearby, as in method 3. In flat areas and without any antennas nearby, accuracy will be low.

- The third method relies on real-time radio link measurements collected from the network and/or mobile terminal. They are compared to predictions or models of the radio environment. The algorithms may utilise measurements other than path loss measurements noted above. The accuracy is good if high field strengths can be measured. The accuracy will be low for all areas where the received field strengths from all antennas are low, as the received low field strengths can be the result of a long distance to the antenna or anything which does shade the signal much closer to the antenna. For example when the call does come from inside a car.

The RFPM method is strong in combination with TA and RTT, as it does eliminate from the shadow maps, field strength maps or fingerprint maps all areas outside the distance obtained from TA and RTT.

When RFPM can utilise measurements from multiple cells, the accuracy of this method is improved significantly.

#### *7.2.2.5 Cell ID with Angle of Arrival (3G, 4G)*

This variant uses NodeB angle-of-arrival measurements, usually together with distance related measurements obtained via timing advance to estimate the mobile terminal location. It requires typically a hardware (antenna) upgrade of each mobile radio base station.

### 7.2.3 Uplink Time Difference of Arrival (U-TDOA) (2G, 3G, 4G)

The 2G U-TDOA positioning method is based on network measurements of the Time of Arrival (TOA) of a known signal sent from the mobile terminal and received at three or more LMUs. The known signal is the normal bursts generated by a mobile terminal while in the dedicated mode, either on the Stand Alone Dedicated Control CHannel (SDCCH) or Traffic CHannel (TCH). The method requires LMUs in the geographic vicinity of the mobile terminal to be positioned to accurately measure the TOA of the bursts. Since the geographical coordinates of the measurement units are known, the mobile location can be calculated via hyperbolic trilateration. This method will work with all existing mobile terminals without any modification.

In 3G the U-TDOA positioning method is based on an almost identical process to that of 2G networks, but requiring at least four LMUs. This method will work with existing mobile terminals without any modification. The U-TDOA method calculates the location of a transmitting mobile terminal by using the difference in time of arrival of signals at different LMUs. The time required for a signal transmitted by a mobile terminal to reach a U-TDOA capable LMU is proportional to the length of the transmission path between the mobile terminal and the U-TDOA capable LMU. The U-TDOA method does not require knowledge of the time the mobile terminal transmits nor does it require any new functionality in the UE.

In 4G the uplink positioning method makes use of the measured timing at multiple LMUs of uplink signals transmitted from mobile terminal. The LMU measures the timing of the received signals using assistance data received from the positioning server, and the resulting measurements are used to estimate the location of the mobile terminal. In the uplink positioning method, the mobile terminal position is estimated based on timing measurements of uplink radio signals taken at different LMUs, along with knowledge of the geographical coordinates of the LMUs. The time required for a signal transmitted by a mobile terminal to reach a LMU is proportional to the length of the transmission path between the terminal and the LMU. A set of LMUs is tasked to sample the mobile terminal signal at the same time.

### 7.2.4 Observed Time Difference of Arrival (OTDOA) (2G, 3G, 4G)

The 2G E-OTD method is based on measurements in the mobile terminal of the Enhanced Observed Time Difference of arrival of bursts of nearby pairs of BTSs. For E-OTD measurement synchronisation, normal and dummy bursts are used. When the transmission frames of BTSs are not synchronised, the network needs to measure the Real or Absolute Time Differences (RTDs or ATDs) between them. To obtain accurate trilateration, E-OTD measurements and, for non-synchronised BTSs, RTD or ATD measurements are needed for at least three distinct pairs of geographically dispersed BTSs. Based on the measured E-OTD values the location of mobile terminal can be calculated either in the network or in the terminal itself, if all the needed information is available.

In 3G the OTDOA method is based on measuring the difference in time of arrival of downlink signals received at the mobile terminal. These measurements, together with information concerning the surveyed geographic location of the base stations and the relative time difference (RTD) of the actual transmissions of the downlink signals enables an estimate of the position of the mobile terminal to be calculated. The OTDOA method may be operated in two modes: network based and terminal-assisted and/or network assisted and terminal-based. The two modes differ in where the actual position calculation is carried out. In the terminal-assisted mode, the mobile terminal measures the difference in time of arrival of several cells and signals the measurement results to the network, where the Serving Radio Network Controller (SRNC) or the Stand-Alone Serving mobile location centre (SAS) carries out the position calculation. In the terminal-based mode, the mobile terminal makes the measurements and also carries out the position calculation, and thus requires additional information (such as the position of the measured Node B's) that is required for the position calculation.

In 4G, the downlink positioning method makes use of the measured timing of downlink signals received from multiple eNodeBs at the mobile terminal. The mobile terminal measures the timing of the received signals using assistance data received from the positioning server, and the resulting measurements are used to locate the terminal in relation to the neighbouring eNodeBs. In the downlink positioning method, the positioning is estimated based on measurements taken at the mobile terminal of downlink radio signals from multiple eNodeBs, along with knowledge of the geographical coordinates of the measured eNodeBs and their relative downlink timing.

### 7.2.5 GNSS (2G, 3G, 4G)

Global Navigation Satellite System (GNSS) refers to satellite systems that are set up for positioning purposes. A GNSS consists of three functional elements: Space Segment (satellites), User Segment (receivers), and Control Segment (maintenance etc.). The GNSS receiver calculates its own position based on the received time differences for at least three satellites. Systems belonging to this category, that are operational today or will be in the near future are e.g., GPS, Galileo and GLONASS. Moreover regional augmentation systems such as EGNOS and WAAS, respectively operating in U.S.A. and Europe, further improves GNSS positioning capabilities by integrating differential corrections.

The mobile terminal may support one or several GNSSs. In particular, a recent market trend refers to the employment of multi-GNSS receivers (i.e. receivers able to simultaneously track different GNSS). Such trend, enabled by the entering into the market of additional GNSS is justified by the fact that multi-GNSS receivers allow for a greater accuracy and availability of the achieved position in challenging situations (e.g. dense urban, deep forest, challenging mountainous environments), being more satellites in view. Multi-GNSS receivers may be used in both GNSS stand-alone and A-GNSS cases.

A terminal with GNSS measurement capability may operate in an autonomous mode (GNSS) or in an assisted mode (A-GNSS). In autonomous mode the mobile terminal determines its position based on signals received from GNSS without assistance from network. In assisted mode, the terminal receives assistance data from network. The assistance data content may vary depending on this capability.

### 7.2.6 A-GNSS (2G, 3G, 4G)

The method uses mobile terminals which are equipped with radio receivers capable of receiving GNSS signals. Different GNSS constellations can be used separately or in combination to obtain the location of a mobile terminal.

Network-assisted GNSS (A-GNSS) methods provide additional data to GNSS-enabled handsets through the network to assist with speeding up the fixing of satellites and the positioning calculations. The aim of such combination is to improve the availability of the location service, the accuracy of the position, the sensitivity to e.g. fading, the integrity of the signal, the reliability of the signal, the in-building functioning and, most importantly, the time needed to get results from the positioning calculation (Time to first fix).

The network-assisted GNSS methods rely on signalling between mobile terminal GNSS receivers (possibly with reduced complexity) and a continuously operating GNSS reference receiver network, which has clear sky visibility of the same satellites as the assisted terminal. Two assisted modes are supported:

- **Terminal-Assisted**: The mobile terminal performs GNSS measurements (pseudo-ranges, pseudo Doppler, etc.) and sends these measurements to the location server where the position calculation takes place, possibly using additional measurements from other (non GNSS) sources;
- **Terminal-Based**: The mobile terminal performs GNSS measurements **and** calculates its own location, possibly using additional measurements from other (non GNSS) sources.

The assistance data signalled to the mobile terminal can be broadly classified into:

- data assisting the measurements: e.g. reference time, visible satellite list, satellite signal Doppler, code phase, Doppler and code phase search windows and information provided by satellite based augmentation systems such as EGNOS;
- Data providing means for position calculation: e.g. reference time, reference position, satellite ephemeris, clock corrections.
- Additional information that may be transferred from the location server to the mobile terminal to increase accuracy such as: Reference Time, Reference Location, Ionospheric Models, Earth Orientation Parameters, GNSS-GNSS Time Offsets, Differential GNSS Corrections, Ephemeris and Clock Models, Real-Time Integrity, Data Bit Assistance, Acquisition Assistance, Almanac, UTC Models.

With the availability of this assistance data the GNSS receiver can very quickly determine position, even under poor signal conditions. With weak signals this is often the only way to get a position fix. Depending on the complexity and completeness of the assistance data the reduction of the start-up time can be significant. The start-up time remains dependent on certain factors including the reference time and the strength of the GNSS signal. It is generally true that the higher the availability and the accuracy of assistance data, the faster the start-up time.

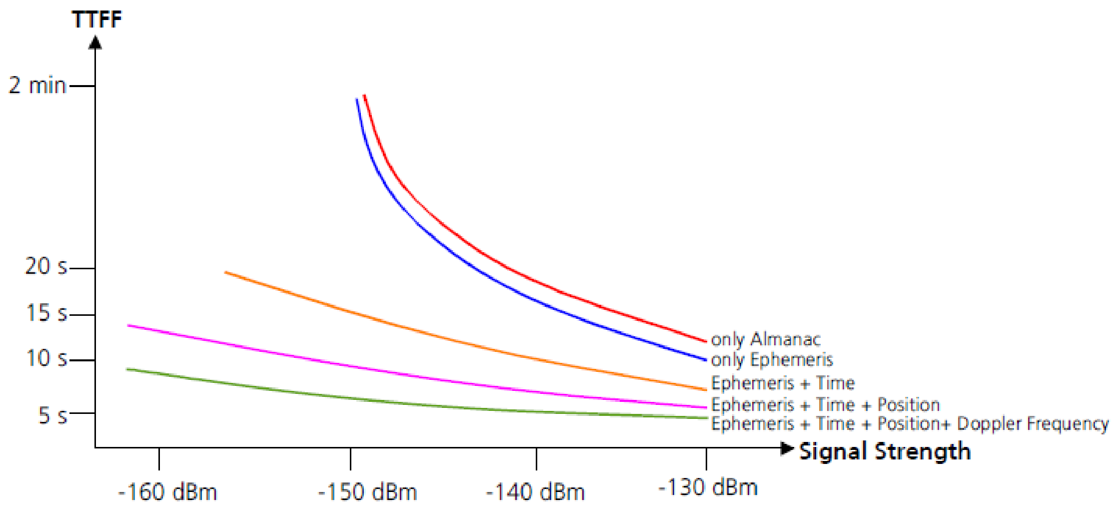


**Figure 5: Time to First Fix (TTFF) with different assistance data as a function of signal strength (Source: uBlox AG "GPS Essentials of Satellite Navigation Compendium", 2009)**

In order to transmit the assistance data, there are two possible architectures:

- Control Plane Architecture
- User Plane Architecture

#### *7.2.6.1 Control plane architecture*

With Control Plane based A-GNSS method, the server and mobile terminal communicate over communication signal channels (e.g. Signalling System No.7) in mobile radio and switching networks. For this, the necessary interfaces and protocols are available throughout the entire network. Control Plane architecture implementation might require some alterations of the network infrastructure based on 3GPP Location Services Standards. It is important to mention that, in the context of emergency calls, control plane A-GNSS implementations allow operators to provide the location information of the mobile terminal, to the PSAPs, regardless of the existence of a valid data subscription. This means that a mobile terminal without a data subscription can still be located as the data service it is not used in the positioning process.

#### *7.2.6.2 User plane architecture*

In a User Plane A-GNSS method implementation communications between the Location Server and the mobile terminal take place over a standard data connection. For the integration of User Plane solutions, the existing protocols and interfaces of the mobile radio and switching networks are used. Additionally, a Location Server is integrated into the mobile network.

The server communicates directly with the mobile end devices over an IP Connection (Internet Protocol Connection), for which the radio and switching networks require no modification. The Open Mobile Alliance (OMA), an association of Mobile Network service providers and manufacturers, has produced a Standard for location technology (OMA-SUPL). This means that a mobile terminal uses the data service to be located.

### 7.2.7 Mobile Hybridisation (2G, 3G, 4G)

The concept of hybridisation or hybrid positioning refers to the possibility of using several positioning methods to obtain a location estimate of a mobile terminal for a given positioning request. Although mentioned in all three technology related standards (2G, 3G, 4G), some differences can be perceived.

The possibility of invoking several positioning methods is present in all three technology related standards. The hybrid positioning may be done by running several procedures (involving either different methods or multiple instances of the same method) and (i) selecting the result which best suits the requirements, or by (ii) combining the different estimates to obtain the best result possible. Only the 4G related specifications seem to accommodate the latter case.

However, it is important to note that by now there is no standard 3GPP/ETSI solution which can use elements from several different positioning methods to calculate one position estimate (e.g. use TA parameter from one cell with signal strength from other cell, both cells being “seen” by the mobile terminal).

Also, the usage of elements from different technologies (2G, 3G, 4G) in calculating a solution estimate (e.g. use TA parameter from one 2G cell with signal strength from other 3G cell, both cells being “seen” by the 2G/3G capable mobile terminal) or the combination of the results obtained after applying several procedures/methods on different technologies seems not to be standardised by 3GPP/ETSI. Although the standards do not define how all these techniques could be used concurrently, there is no obstacle to these techniques being used independently and/or consecutively. However, this may mean that PSAPs will need to be able to receive and interpret more information as a result.

## 7.3 STANDARDISED MOBILE POSITIONING SOLUTION ARCHITECTURE

The description below, taken from ETSI TS 123 271 V11.2.0 (2013-04), shows the general arrangement of the Location Service feature in GSM, UMTS and LTE networks.

### 7.3.1 Gateway Mobile Location Centre, GMLC

The Gateway Mobile Location Centre (GMLC) contains functionality required to support LCS (LoCation Services). In one PLMN (Public Land Mobile Network), there may be more than one GMLC, depending mostly on the magnitude of the mobile network. For European networks, given the fact that the size of the network is limited to the national territory of a country, a typical implementation with only one GMLC is normal practice.

A GMLC is the first node an external LCS client accesses in a PLMN (i.e. the Le reference point is supported by the GMLC). The GMLC may request routing information from the HLR (Home Location Register) via the Lh interface or HSS (Home Subscriber Server) via the SLh/Lh interface. After performing registration authorisation, it sends positioning requests to either VMSC (Visited MSC), SGSN (Serving GPRS Support Node), MSC Server or MME (Mobility Management Entity) and receives final location estimates from the corresponding entity via the Lg or SLg interface. Information needed for authorisation, location service requests and location information may be communicated between GMLCs, located in the same or different PLMNs, via the Lr interface. The target mobile terminal's privacy profile settings shall always be checked in the terminal's home PLMN prior to delivering a location estimate. In order to allow location request from a GMLC outside the HPLMN (Home PLMN) while having privacy check in the HPLMN, the Lr interface is needed.

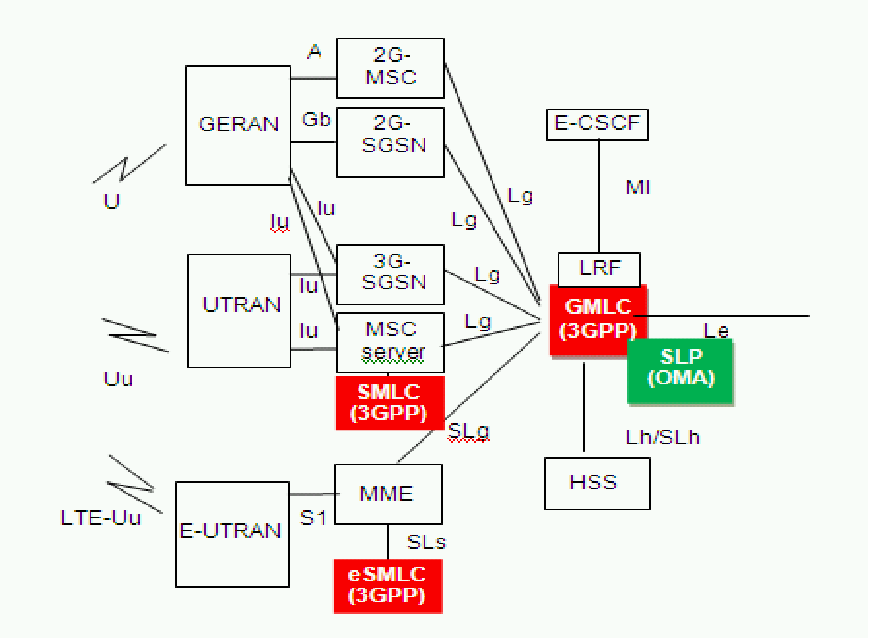


**Table 2: Location Servers in Standards (source: Alcatel-Lucent)**

This illustrates, generally, the relation of Location Services (LCS) Clients and servers in the core network with the GERAN, UTRAN and E-UTRAN Access Networks. The LCS entities within the Access Network communicate with the Core Network (CN) across the A, Gb, Iu and S1 interfaces. Communication among the Access Network LCS entities makes use of the messaging and signalling capabilities of the Access Network.

As part of their service or operation, the LCS Clients may request the location information of the mobile terminal. There may be more than one LCS client. These may be associated with the GSM/UMTS/EPS (Evolved Packet System) networks or the Access Networks operated as part of a mobile terminal application or accessed by the terminal through its access to an application (e.g. through the Internet).

The clients make their requests to a LCS Server. There may be more than one LCS Server. The client must be authenticated and the resources of the network must be co-ordinated including the mobile terminal and the calculation functions, to estimate the location and optionally, velocity of the terminal and return the result to the client. As part of this process, information from other systems (other Access Networks) can be used.

As part of the location information returned to the client, an estimate of the accuracy of the location estimate and the time-of-day the measurement was made may be provided.

Given the above standardised architecture it can be assumed that the Gateway Mobile Location Centre (GMLC) – the positioning server, may serve as such for all three types of mobile networks. Also, unless SUPL protocols used, 2G/3G/4G methods may not be compatible at transmission level (different protocols used in 2G/3G/4G to carry the data).

## 7.4 OTHER POSITIONING METHODS

In addition to the various standardised approaches described above, a number of alternative solutions have become, and indeed may continue to be, available. These solutions generally take advantage of the functionality of the mobile terminal and of third-party applications and services, which may mean that their reliability and availability may not be guaranteed, and could be outside of the normal regulatory jurisdiction of NRAs to set and enforce applicable criteria. Nevertheless, they may offer useful benefits in addition to, or in conjunction with, standardised approaches.

In this section two such solutions are presented; other solutions may exist or arise over time.

### 7.4.1 Wi-Fi positioning method

Wi-Fi positioning method refers to a non-standardised positioning method which relies on the fixed wireless IEEE 802.11 access point's features to calculate a location estimate.

Wi-Fi access points were not designed or deployed for the purpose of positioning. However, the measurements of signal strength of the signal transmitted by either Access Point or mobile terminal imply the possibility of finding the location estimate of the terminal.

There are essentially two categories of such techniques[13]:

One uses a signal propagation model and information about the geometry of the building to convert signal strength to a distance measurement. Using 'Trilateration' the location of the mobile terminal can then be calculated. This approach is simple to implement, but it does have difficulties in building a sufficiently good model of signal propagation that is adequate for real world applications since many factors affect the signal propagation. Other variations based on different measurements than signal strength could be applied, similar to mobile positioning (e.g. time of arrival, time difference of arrival).

The other category of Wi-Fi positioning is 'Location Fingerprinting'. The basis of location fingerprinting is first to establish a database that contains:

i) information regarding Access Points Wi-Fi coverage (it is assumed that wireless routers usually stay in place for long periods of time) and
ii) measurements of wireless signals at some reference points in the area of each Access Point Wi-Fi coverage.

The database should be managed by the entity responsible for providing this positioning method.

Then the location of the mobile terminal can be identified by comparing its signal strength measurements with the reference data.

Due to its functioning premises (very short range, normal usage in correlation with IT devices) the fact that it is most useful in dense urban areas means that it provides a useful complement to methods which struggle in these locations (e.g. GNSS based methods in indoor environments).

[13] http://www.gnss.com.au/JoGPS/v7n1/JoGPS_v7n1p18-26.pdf

### 7.4.2 Hybrid Solutions

The term hybrid solution is used to designate the ability to combine Wi-Fi (or other radio access transmission technologies, like Bluetooth), mobile and non-mobile GNSS location methods in order to calculate a location estimate.

Ideally, such non-standardised solutions can combine best features from each type of method in order to achieve better overall results, e.g. faster time to first fix (improvement for GNSS method), better accuracy (improvement for mobile), etc.

The non-standardised solutions available on smartphone operating systems seem to use OSI Layer 7 Application Programming Interfaces (APIs) to connect to their respective platform database containing a wide range of useful location information, using them to calculate the location estimate and return it, via the same API, to the respective application.

In case of Android platform, the application does not have any direct access at the location database itself, nor is it aware of the location elements used to calculate the location estimate received. Only three classes of accuracy are defined, from low to high, the application being able only to order the required level of accuracy.

Usually location data such as Cell IDs or Received Signal Strength (RSS) and Timing Advance (TA) of mobile cell sites in range, Wi-Fi MAC Addresses/Wi-Fi identifiers, and GNSS data are used to calculate the location estimate. In terms of positioning methods used, a wide range of methods seem to be used, including methods similar to those described above, standardised by 3GPP/ETSI, based on the terminal status data gathered on mobile terminal side, via the platform/operating system's interfaces. Also, advanced hybridisation techniques, based on specific calculation algorithms, not covered by 3GPP/ETSI (see 6.2.7), seem to be implemented, also in relation with methods not covered by 3GPP/ETSI (e.g. Wi-Fi positioning).

For illustrative purposes a possible flow for obtaining user location might be as follows[14]:

1. Start application.
2. Sometime later, start listening for updates from desired location providers.
3. Maintain a "current best estimate" of location by filtering out new, but less accurate fixes.
4. Stop listening for location updates.
5. Take advantage of the last best location estimate.

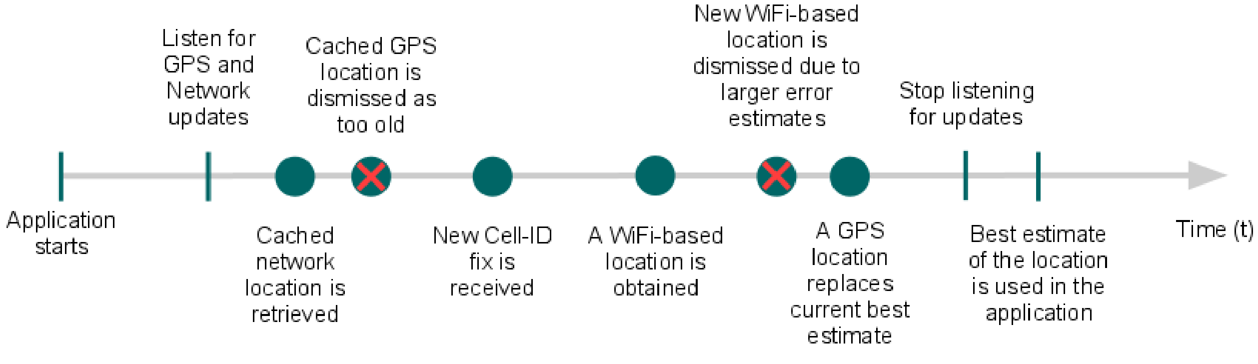


**Figure 6: A timeline representing the window in which an application listens for location updates**

## 7.5 SITUATION IN EUROPE

The information contained in this section of the Report is based on information from COCOM13-04REV1 - Implementation of the European emergency number 112 – Results of the sixth data-gathering round. The situation in individual countries may have changed since the publication of the COCOM report. Any updates provided to PT ES in preparing this document have been noted.

[14] http://developer.android.com/guide/topics/location/strategies.html

### 7.5.1 Current methods used for the provision of the mobile caller location information

In their replies to the first two questionnaires, most Member States indicated mobile network Cell ID and/or Sector ID as the available mobile caller location information. Accordingly, this type of caller location currently appears to be the 'technically feasible' minimum caller location information which all mobile operators within the EU should be able to provide. Consequently, the revised regulatory framework does not provide for technical feasibility as a condition for the provision of caller location. In order to be understandable and usable by the emergency services, it must be possible to link the Cell ID/Sector ID to a particular geographical area on a map, and appropriate technical arrangements should usually exist in the Member States for this purpose.

The accuracy of mobile caller location in the case of Cell ID/Sector ID highly depends on the mobile cell or sector coverage that varies considerably between urban and rural areas. The Member States were therefore invited to indicate the availability of any 'enhanced' mobile location technologies that allow for better results than Cell ID/Sector ID.

Out of the **31** respondent countries, (**28** EU Member States, **Iceland, Liechtenstein** and **Norway)**, all countries report Cell ID and/or Sector ID (or similar) as the available mobile caller location information. Among these countries, **Denmark**, **Poland, Finland, the United Kingdom, Croatia** and **Norway** indicated the existence of additional facilities to increase accuracy of mobile caller location, based on measurements and calculations ('timing advance information'). As for the remaining countries, the **Czech Republic** uses specific area and Best Server Base Transceiver Station ID.

In **Norway**, timing advance is used at one operator. The accuracy shall be at least equal to that obtained by combining the base station intended coverage area, sector entry and calculation of the terminal's distance from the base station (TA and RTT).

In United Kingdom an implementation making use of GNSS and Wi-Fi positioning methods has been successfully trialled. Results indicate that for around 80% of calls made using suitable handsets, high accuracy location information can be made available to PSAPs[15].

In **Switzerland**, one operator has implemented advanced Cell-ID methods (described in detail Annex 4) based on TA/RTT and probability maps based on predicted signal strengths, obtaining accuracy results which allow proper dispatch of intervention teams.

### 7.5.2 Possibility to additionally obtain the registered address of the mobile subscription

The possibility of obtaining the registered address of the mobile subscriber appears as a useful additional facility, especially in the light of the fact that more and more customers eliminate their fixed lines and use mobile telephones also at home, thus increasing the chance that the mobile customer's registered home address is also the place from which the 112 call is being made.

Out of the **31** countries providing information, 23 reported that it was possible for PSAPs to obtain the address of the subscription. Nevertheless, in some countries the registered address is not always available for prepaid subscriptions.

### 7.5.3 Mobile caller location in case of roaming (international and national)

The users of intra-EU and/or national 112 roaming services still cannot be located when calling 112 in several EU Member States. However, the fact that these services are now available in the majority of countries shows that it is technically feasible within the meaning of the EU regulatory framework.

As regards the first category of mobile users (intra-EU roaming), out of the **31** countries providing information, **Belgium, Hungary and Ireland**[16] replied negatively while **Sweden** has a formal requirement in

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[15] 112 – Improving Precision for Mobile Calls – Presentation by John Medland (British Telecom) at EENA Conference 2014 - https://www.dropbox.com/sh/sk6vsgqcrlsmzcj/AAA30kvsVsaTFtMinFxD9g6ta/Day%202/Day%202%20-%20Plenaries/Plenary%20-%20UK%20Caller%20Location%20trial/Medland.pdf?dl=0

[16] The situation has changed in Ireland. CellID is provided from all mobile networks for all Calls (regardless of the national and international roaming status of the caller). CellID is provided as a function of the mobile networks and is not dependent on the caller.

place but still under implementation. In **Slovakia** is subject to relevant contractual relation with the caller's home operator. In **Finland** it is available upon specific request to the operator.

As regards mobile users in the situation of 'national 112 roaming', out of the **31** countries providing information, **eight** countries (**Austria, Belgium, the Czech Republic**, **Estonia**, **Hungary, Latvia, Netherlands and Poland**) reported that caller location is not provided for such users. In **Finland** and the **United Kingdom** the caller location information is available in most cases, by specific request.

### 7.5.4 Mobile caller location for SIM-less mobile terminals (where such calls are possible)

Calls to the emergency services made by mobile terminals without SIMs may not be supported in a number of Member States (known as SIM-less calls[17]). Information on the availability of caller location information in case of SIM-less calls to 112 (in those Member States where such calls are possible) was also sought. Out of **31** countries providing information, **17** confirmed the availability of this facility: the **Czech Republic**, **Cyprus, Denmark, Estonia, Finland, Greece, Hungary, Ireland**, **Italy, Lithuania, Luxembourg, Netherlands, Poland, Portugal, Slovakia, Spain and Iceland**.

## 7.6 DISCUSSION / EVALUATION REGARDING THE DIFFERENT POSITIONING METHODS

In order to "lay down criteria for the accuracy and reliability of the caller location information" as per Art.26(5) of the Universal Service Directive at first stage the described mobile positioning methods need to be carefully assessed, based on a number of features.

In addition to (horizontal) accuracy and reliability, which are of obvious importance, another important attribute of positioning technologies from an emergency services perspective is the time needed to make the measurements, calculate and transmit to the PSAP the location estimate (response time).

A proper analysis of the positioning methods is necessary to be based on a trade-off between accuracy, reliability, response time and the implementing costs of these methods. Other factors like a long term estimate of the evolution, in time, of the main mobile technologies with impact in positioning may also be of importance. Last but not least, the issue of covering the positioning in case of indoor mobile calls should be evaluated.

### 7.6.1 (Horizontal) Accuracy

Traditionally, accuracy has tended to refer to horizontal location with little if any expectations for vertical measurements. However, Ii the USA the FCC has, this year, issued a "Notice of proposed rule making[18]" for comment on a policy proposal for the provision of more accurate vertical information in support of emergency services calls.

In this document the focus is on horizontal accuracy.

The cell density and cell size is usually dependent on the expected traffic demand and coverage requirements of the radio access network in a particular area. Thus, usually in densely populated urban areas the radio access network deployed is characterised by high density of smaller size cells, while in sparsely populated rural areas the radio access network is made of low density of large size cells.

Based on the type and number of elements involved in the location process the positioning methods covered by the 3GPP/ETSI standards can be divided into the following categories:

1. One-cell based positioning methods: Cell ID, Enhanced Cell ID (Cell ID + TA/Cell ID+RTT; Cell ID+Pathloss/RFPM; Cell ID+AoA);
2. Multiple-cell based positioning methods: E-OTD/OTDOA, UTDOA, EOTDOA;
3. Satellite based positioning methods: GNSS, A-GNSS;

[17] ETSI defines a SIM-less emergency call as follows: the emergency call that is originated from a mobile terminal which does not have a SIM or USIM." ETSI TS 123 271 V7.8.0 (2007-03); for the purpose of this document, the usage of an expired SIM/USIM is also considered as a SIM-less call;
[18] http://www.fcc.gov/document/proposes-new-indoor-requirements-and-revisions-existing-e911-rules (Feb 2014)

4. Methods based on technologies other than those specified by 3GPP/ETSI standards (e.g. Wi-Fi fingerprinting).

| Positioning method/type | Dense urban/urban (high cell density; small size cells) | Rural (low cell density; large size cells) |
|---|---|---|
| Single-cell<br><br>Cell ID, Enhanced Cell ID | pros: always available, accuracy highly dependent on the cell dimension, usually small cells in this geotype; accuracy in the range of tens to hundreds of meters; cons: also highest radio pollution environment (interferences, reflections), dynamic environment (highest rate of new buildings construction) thus challenging in terms of accuracy and reliability | pros: always available, especially with cell enhancing features (however, accuracy is affected, compared to previous geotype); cons: larger cells, affecting proportionally the horizontal accuracy |
| Multiple-cell<br><br>E-OTD/OTDOA, UTDOA, EOTDOA | pros: highest density of cells, high probability to have access to more cells, thus most effective; accuracy in the range of tens of meters; cons: also highest radio pollution environment (interferences, reflections), dynamic environment (highest rate of new buildings construction) thus challenging in terms of accuracy and reliability | pros: if conditions are met (i.e. "see" 3/4 cells at least) then horizontal accuracy obtained is still decent; cons: conditions can be met only occasionally; usually, one or two cells (handover region) can "see" the mobile terminal |
| Satellite<br><br>GNSS, A-GNSS | pros: very high levels of accuracy can be obtained, usually better than cell(s) based; no correlation with cell density; cons: physical obstacles (e.g. urban canyons, indoor) impeding direct sight with at least 3 satellites may result in the need for compensation although less likely where multi-GNSS is used (i.e. assistance from network; accuracy might be a bit diminished); propagation issues might be present | pros: very high levels of accuracy can be obtained, usually better than cell(s) based; no correlation with cell density; cons: physical obstacles (e.g. indoor, deep forest) impeding direct sight with at least 3 satellites may result in the need for compensation although less likely where multi-GNSS is used (i.e. assistance from network; accuracy might be a bit diminished) - less cases than in previous geotype |
| Other methods<br>(e.g. Wi-Fi fingerprinting) | pros: very high levels of accuracy can be obtained, accuracy in the range of tens of meters, independent of the geotype; location determination is independent of mobile operators technology; useable also for indoor location; location may be determined by the underlying operating system and/or specific applications; cons: works only in the coverage area of Wi-Fi spots – may generate reliability questions; it is usually used as a complement of other methods or as part of a hybrid solution (e.g. GNSS, A-GNSS) | pros, cons: identical to dense urban geotype; however the number of cases when such positioning methods can function is significantly reduced (e.g. Wi-Fi implementations usually follow the broadband network rollout pattern) |

**Table 3: Pros and cons for mobile positioning methods in different geotypes**

The horizontal accuracy of the mobile location estimate obtained after applying cell(s) based positioning methods varies with the cell size and cell density (especially for single cell methods).

While Multiple-cell methods usually provide better (horizontal) accuracy than Single-cell ones they need at least 3 or 4 (3G UTDOA) cells with LMU capabilities or stand-alone LMUs in order for the methods to actually provide results. Thus their “coverage” is limited to areas where the necessary density of elements is insured.

Due to the fact that Satellite methods are less network dependent, they can provide similar accuracy in all geotypes. In cases when assistance is needed for performing the satellite measurements it is sufficient for the mobile terminal to be in the coverage area of the mobile network.

Statistical reporting of the (horizontal) accuracy feature of emergency location estimates should be kept at least for situations where it proves to be inadequate for further analysis.

### 7.6.2 Availability

Most European countries have implemented national emergency roaming solutions, thus the user being able to call 112 even outside its home network coverage area, provided that there is another national mobile network operator covering the area in which the user is.

Usually, there is a maximum mobile coverage exceeding 90%, expressed as proportion from the national territory. However, differences between the coverage of the most extended network and the second one might be quite significant, especially when comparing 3G access network, mostly used nowadays to cover the data connections.

Comparing, in terms of territorial coverage, the two categories of cell-based positioning methods, one cell and multiple cell, seems relevant when deciding which method to implement for an e.g. national rollout. In doing this one may find that while the one cell based methods can be implemented in the entire network of one operator, the latter is useful only in cases when a mobile terminal can be seen by at least three cells. Based on data estimated by some PT ES members the usable area for multiple cell methods can be significantly lower and could be somewhere between 10% and 30% of the total coverage of a mobile network. In terms of number of cells, these areas may account for about 50% of the total number of cells in a network, both for 2G and 3G networks.

Satellite based solutions usually have a high availability level, compared to the national territory, with notable exceptions for emergency calls placed from indoors. Another reason for unavailability of such methods can be linked to the lack of satellite support for some mobile terminals.

Due to their short coverage, Wi-Fi access points do not have a significant availability area when compared to the national territory. Wi-Fi access point rollouts mostly follow the rollout of fixed broadband access networks.

Implementing hybrid solutions usually increase the overall availability which represents a combination of the availability of the different methods being hybridised.

#### *7.6.2.1 Indoor*

- One-cell: these methods should work as long as you have signal on your mobile terminal;
- Multiple-cell: similar situation as in one-cell methods; indoor may also be a challenge in terms of superposed cell coverage area, i.e. problems with picking up signals from multiple cells;
- Satellite: satellite systems usually work indoor only in limited number of cases (e.g. close to window); A-GNSS includes also augmentation techniques via hybrid solutions, improving to some extent the availability of the satellite solution for indoor cases;
- Other Methods (e.g. Wi-Fi fingerprinting): if signals from Wi-Fi or other short range wireless access points are available for a minimum period of time (in order to ensure a previous “fingerprinting”), the related location information is available.

In terms of horizontal indoor positioning, the cell-based methods work reasonably well in comparison with the results obtained outdoor (some errors due to signal attenuation and reflections may occur though).

The signal emitted by positioning satellites is quite weak, unable in most cases to penetrate building walls. Thus, in an indoor situation satellite-based positioning methods will either work, giving somewhat similar results as outdoor in terms of horizontal accuracy, or not work at all. A particular indoor case, called light indoor, happens when the mobile terminal “sees” less satellites and/or with less dispersed positions. In this case the positioning may still happen, especially when assisted methods are used, however some features of the location (e.g. accuracy, response time) may be affected.

Wi-Fi, femtocell or other short range wireless access point fingerprinting can also be used to obtain location information in indoor.

In terms of vertical indoor positioning, current cell based and satellite based methods do not give satisfactory results in terms of accuracy, the requirements being tighter in this case (e.g. a 10 meter horizontal accuracy translates into 4-5 floors vertical accuracy). Other methods like Wi-Fi, femtocell or other short range wireless access point fingerprinting or pressure sensors could be used to obtain this information.

The real impact of the indoor positioning problems and the measures to cope with this situation, in case of indoor mobile emergency calls, should be closely assessed.

### 7.6.3 Response time needed to provide caller location

The response time, defined by the duration from the moment when an emergency call is initiated to the moment when a location estimate is received by the emergency services organisation, is composed of the time needed to calculate the location estimate and the time needed for the information to reach the emergency system. While the second component should have a constant value, the first one may vary, depending on the location method used for the actual positioning. Also, the method used in transmitting the location estimate to the emergency organisation, either push based or pull based, may incur extra time when measuring the response time.
A comparison of the response time of different methods results in the following considerations:

- *One-cell*: shortest response time for plain Cell ID; a bit longer for Cell ID with enhancements (added time to make the measurements and additional positioning calculations for one cell);
- *Multiple-cell*: response time is likely to be longer than the one for Cell ID with enhancements (time to make measurements and calculations for several cells, at least 3!);
- *Satellite*: response time is likely to be longer than the one for multiple cell, depending on the level of assistance implemented into the network and the specific circumstances of the particular measurement;
- *Other Methods (including Wi-Fi)*: response time is likely to be longer than the one for Cell ID but shorter than the one for multiple-cell.

The response time is method type dependent, being usually considered geotype and technology - 2G, 3G, 4G, independent. Also response time increases with the level of accuracy provided (higher accuracy methods require more time to calculate the location estimate). Thus, taking into account the needs of emergency services organisations (short response time and best accuracy); it is optimal to envisage a location mechanism providing a two-stage answer:

- One fast/immediate answer with lower accuracy (but high reliability),
- A second answer with higher accuracy.

In some cases, the level of radio pollution in the environment, at the measuring moment, may trigger the need for more measurements and/or corrections in order to insure the correctness of the measurement, resulting in longer time to response.

### 7.6.4 Implementation Costs related to generation of caller location information

Information regarding the actual costs incurred by mobile network operators for implementing the positioning methods should take into account the current status of development for each particular network. Such analysis should be done at national level.
For comparison purposes Table 4 below illustrates some high level cost elements (i.e. equipment and software update) which are envisaged for implementing the various types of positioning method.

**Table 4: Implementation costs for different positioning methods in different technologies**

| Method | 2G | 3G | 4G |
|---|---|---|---|
| Cell ID | current status in EU<br>(see Section 7.5) | current status in EU<br>(see Section 7.5) | |
| Cell ID with enhancements | Cell ID+TA: the TA is a parameter which is part of the common implementation of 2G networks (minimal modifications for the network); the TA value is known for the serving BTS; *costs may be incurred for making the mobile location calculations based on the TA and superpose the result over the cell coverage; a location server equipment may be also needed; no costs related to mobile terminals* | Cell ID+RTT; Cell ID+Pathloss/RFPM; Cell ID+AoA: can work in either the RNC centric mode or in an SAS centric mode (*in latter case a location server equipment is needed*); the SRNC/SAS determines the identification of the cell providing coverage for the target mobile terminal and may request additional terminal and/or UTRAN measurements for Enhanced Cell ID methods - from the target mobile terminal using RRC measurement procedure (e.g., path loss, CPICH RSCP, CPICH Ec/No) or from the Node B(s) (e.g., RTT, Rx Timing Deviation, Angle of Arrival); if the location request from the CN is a request for periodic reporting, the general procedure may be repeated and UTRAN sends an LCS response one reporting interval after the previous LCS response message until the desired amount of reports is attained, or until the procedure is cancelled by UTRAN or CN; *costs may (also) be incurred for making the mobile location calculations based on the measurement result received for the implemented parameters and superposing this result over the cell coverage; no costs related to mobile terminals* | Enhanced Cell ID (the same possibilities as in 3G): similar to 3G; *costs may be incurred regarding the location server equipment and for additional capabilities for making the mobile location calculations based on the measurement result received for the implemented parameters and superposing this result over the cell coverage; no costs related to mobile terminals* |
| UTDOA | consists on network measurements of the Time Of Arrival (TOA) parameter of a known signal, sent from the mobile and received at **three** or more LMUs (*likely cost of LMUs; usually they are installed at the cell site, but if necessary they can be displaced more densely with additional costs for collocation space and - possibly - means to communicate with the network*); *a location server is usually needed; no costs mentioned related to mobile terminals; no costs related to software update at network side* | consists on network measurements of the Time Of Arrival (TOA) parameter of a known signal, sent from the mobile and received at **four** or more LMUs; *cost elements are similar to 2G case, i.e. LMUs, location server, no software update costs, no mobile terminal related costs* | mobile terminal must detect signal of at least **three** eNBs *cost elements are similar to 3G case* |
| OTDOA | E-OTD: measurements in the mobile terminal of the Enhanced Observed Time Difference of arrival of bursts of nearby pairs of BTSs (at least three distinct pairs of geographically dispersed BTSs); | measurements made by the mobile terminal and LMU of the UTRAN frame timing (e.g. SFN-SFN observed time difference); depending on the configuration of the network, the position of the mobile terminal is calculated in the SRNC or in the SAS; | mobile terminal must detect signal of at least **three** eNBs *costs: terminal support needed; no LMU costs* |

| Method | 2G | 3G | 4G |
|---|---|---|---|
| | when the transmission frames of BTSs are not synchronised, the network needs to measure the Real or Absolute Time Differences (RTDs or ATDs) between them; *costs: no LMU costs, costs on network side for assisting the measurements made by the terminal; if calculations are made in the network, then costs related to location server appear; no terminal costs* | *costs: LMU costs, costs on network side for assisting the measurements made by the terminal; if calculations are made in the network, then costs related to location server appear; no terminal costs* | |
| GNSS | *costs:, costs on network side for accessing the GNSS data generated by the terminal; terminals have to be GNSS enabled* | | |
| A-GNSS | *costs:, costs on network side as for GNSS plus additional costs for assisting the measurements made by the terminal; if calculations are made in the network, then costs related to location server appear; terminals have to be GNSS enabled* | | |

* Information contained in this table reflects only the situation illustrated by the correspondent 3GPP/ETSI standards

A more in-depth analysis, at national level, of the specific costs can be divided into:

1. Costs on terminal side (e.g. special hardware or software requirements for terminals in order to cope with the measurements specific to a certain method),
2. Costs on network side (hardware - e.g. new equipment, software - e.g. new features of the existing equipment - and implementation costs - time and financial resources to implement the required hardware and software updates).

### 7.6.5 Long term estimate

The technologies outlined so far are sometimes specifically related to mobile network generations. e.g. Time Advance for 2G networks only. As implementation costs are involved, the remaining lifetime of the network technology is an important consideration.

<u>2G networks:</u> circuit switched type of network; still in service, but the start of the implementation of 4G networks may signal a close end of life cycle for these technologies; in EU (usually) all 2G license owners have also 3G and/or 4G licenses; this technology proved to be robust and it may survive longer than expected for critical application;

<u>3G networks:</u> hybrid circuit switched and packet switched type of network; newer technology, offers more capabilities also for location; 4G announces to be a serious competitor for this technology on data transfer services, including voice;

<u>4G networks:</u> full packet switched EPS type of network; at this moment, seems to be the most future proof mobile network technology (LTE);

<u>Satellite positioning systems:</u> is here to stay on the long run; improvements in terms of accuracy and response time have been constantly added to the market; satellite investments seem to be on an ascending slope.

The link between technology and specific radio spectrum (e.g. GSM only in 900MHz/1800MHz spectrum bands) is expected to disappear completely in the following years. This will favour 4G LTE implementations, currently in deployment phase, allowing system implementation in (almost) all currently available mobile spectrum bands (e.g. 800MHz, 900MHz, 1800MHz, 2600MHz) thus insuring more flexibility in meeting coverage and bandwidth conditions.

Some mobile network equipment vendors are already signalling their intentions to discontinue their support for 2G network equipment in the near future.

In terms of coverage, currently the 2G and 3G networks coverage is usually above 90% with a small but significant advance in 2G coverage. These appear to be stable figures; any increase in terms of coverage for 2G and 3G networks should be marginal, and should be the case of a limited number of networks. This difference is likely to be preserved in time as 4G rollout investments are being considered.

It is reasonable to assume that a decision regarding a possible discontinuity of one of the two older network types, 2G and 3G, will be made in the medium term (next 5 years), by some network operators.
In the future we can expect that more users will have mobile terminals with GNSS capability. Some “sourced” figures here on smartphone implementation in Europe.

In terms of positioning methods solutions related to sensor measurements or Wi-Fi/other short range radio access technologies pattern matching could be envisaged for successfully coping with location in indoor environments, including with vertical accuracy issue.

Due to their robustness in terms of high level of accuracy, reliability, availability (including indoor), response time and (probably) costs, implementing hybrid solutions might prove to be the medium to long term way forward (e.g. next 5 to 10 years).

### 7.6.6 Other relevant aspects

The organisations responsible at national level with implementation of art.26 (5) of the Universal Service Directive should define the criteria for accuracy and reliability of the mobile location estimate in collaboration with PSAP and emergency organizations (see Chapter 3).

The mobile positioning procedure consists of two important parts:

- The performing of the necessary measurements, in order to gauge the “distance” from the mobile terminal to other elements with already known position and
- The performing of necessary calculations, taking into account the measurements results and other additional information necessary to improve accuracy of the calculation, in order to obtain the mobile location estimate.

These measurements and calculations are performed by the mobile terminal and/or the network. Depending on the side that is performing the measurements and calculations, the positioning methods can be divided into:

- Mobile assisted positioning – mobile terminal provides measurement results to the network for computation of a location estimate by the network; the network may provide assistance data to the terminal to enable position measurements and/or improve measurement performance,
- Mobile based positioning – mobile terminal performs both measurements and calculations of a location estimate; useful assistance data for either measurements or calculations is provided to the terminal by the network,
- Network assisted positioning – network provides assisting data to the mobile terminal for computation of a location estimate by the terminal; and
- Network based positioning – network performs both position measurements and calculations of a location estimate; assistance data for either measurements or calculations might be provided to the network by the mobile terminal.

Most positioning methods make use of resources, mobile terminal and network, in order to obtain the position estimate. There are also a limited number of methods performed exclusively by the mobile terminal (non-assisted GNSS) or by the mobile network (plain Cell ID).

### 7.6.7 Summary on Evaluation of different positioning technologies

It is acknowledged that an overall, national assessment of the various features of the positioning methods might lead to very wide estimations in order to cover all possibilities that may exist in reality, thus, the need for a higher granularity when assessing these features.

Scenarios were constructed based on the reasonableness of existence, in real life, of combinations of the three elements identified as important for assessing the features of the various positioning methods analysed in this document:

1. the cell density, in strong correlation with the size of cells in a scenario;
2. the density of dwellings in a scenario;
3. the sky visibility in a scenario.

The features identified as dependant on scenario configuration are the availability of a certain method, i.e. the possibility to use that method, and the accuracy of the location estimate.

The assessment of the accuracy of a method assumes that the method is available and usable (i.e. the necessary network and terminal investments have been carried out).

The accuracy refers to the result given by applying once a particular method. In practice, algorithms able to combine elements from several methods will result in improved accuracy for the respective solution (i.e. the application of several distinct methods - e.g. Cell-ID with TA and Cell-ID with Path loss - or same methods for several times - e.g. Cell-ID with signal strength or RFPM applied for 3-4 different cells which "see" the same mobile terminal - giving an overall Medium-High or even High value for solution accuracy).

The reliability of a positioning method is seen as dependant on reflections and attenuations of the signals used for positioning (for mobile and satellite methods) or on third parties deployments of certain equipment (Wi-Fi fingerprinting method).

The assessment of the response time of each positioning method is based on the various additional identified stages (as compared to previous the method illustrated in Table 4) of the positioning process, which may add to the total time needed to generate the position estimate: database query, data interpretation, measurements and error corrections.

The cost assessment refers to perceived cost elements related exclusively with obtaining the position estimate. Depending on the method analysed, these costs may include software updates and/or upgrades, implementation of new devices or new capabilities of existing devices, synchronisation mechanisms, deployment of special antennas. The assessment assumes costs related to implementation of a specific method in the entire network.

Costs related to transmission of the location information and costs incurred by the emergency services organisations were not analysed.

The handset assessment takes into consideration the need for additional features for the mobile terminal in order to make available a specific positioning method, other than those usually necessary for non-location related services.

For multiple cell positioning methods (UTDOA, OTDOA), due to their need to have at least three supporting cells or LMUs (assumed to be collocated with cells), for low cell density with large size cells scenarios, although in some cases these could work, in most cases (in terms of territorial coverage) they will not have enough elements to provide a location estimate. Thus, in such cases it was assumed that they will generally be unavailable.

Possibilities to extend the availability of A-GNSS positioning method in indoor environment, via deeper assistance from the mobile network, are known to be investigated.

Wi-Fi positioning method takes a similar approach as the Cell-ID method in the sense that it is based on a database query. Instead of cell towers, the geographical information of Wi-Fi Access Points is kept in a database which can be looked up for positioning.

Wi-Fi deployments usually follow fixed broadband roll-out and are user driven; it seems reasonable to assume scarce or even no penetration of Wi-Fi access points in low density dwellings of rural area scenarios. Due to their very limited range, wide unavailable areas can be found even in the medium and high density dwellings scenarios. Wi-Fi method is best suited for indoor application but not available everywhere.

In the context of emergency calls Wi-Fi fingerprinting positioning method can be used on top of other methods, for improved accuracy, if available.

Hybrid solutions are always available due to combination of Wi-Fi fingerprinting with satellite and mobile network elements/methods. Depending on the elements used for location, the reliability can rise from medium to highest. A special handset with Wi-Fi and/or GPS capabilities is needed.

Table 5 below summarises the information provided so far and is intended to allow an overall comparison of the various positioning methods.

## Table 5: Evaluation of Different Positioning Technologies

**Availability Column Legend:**

- Always available
- Sometimes available
- Unavailable

**Accuracy Column Legend:**

- Very High
- High
- Medium-High
- Medium
- Low-Medium
- Low

| | | Rural[5] | | | | | | | | | | | | Urban[5] | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Scenario A | | Scenario B | | Scenario C | | Scenario D | | Scenario E | | Scenario F | | Scenario G | | Scenario H | | Scenario I | | | | | |
| | | 1 - low cell density*, large size cells<br>2 - low density dwellings<br>3 - clear sky visibility | | 1 - low cell density*, large size cells<br>2 - low density dwellings<br>3 - partial sky visibility | | 1 - low cell density*, large size cells<br>2 - low density dwellings<br>3 - no sky visibility | | 1 - low cell density*, large size cells<br>2 – medium density dwellings<br>3 - no sky visibility | | 1 - low cell density*, large size cells<br>2 – medium density dwellings<br>3 - partial sky visibility | | 1 - low cell density*, large size cells<br>2 - medium density dwellings<br>3 - clear sky visibility | | 1 - high cell density, small size cells<br>2 - medium density dwellings<br>3 - clear sky visibility | | 1 - high cell density, small size cells<br>2 - high density dwellings<br>3 - partial sky visibility | | 1 - high cell density, small size cells<br>2 - high density dwellings<br>3 – no sky visibility | | | | | |
| | Methods | Availability | Accuracy/Performance | Availability | Accuracy/Performance | Availability | Accuracy/Performance | Availability | Accuracy/Performance | Availability | Accuracy/Performance | Availability | Accuracy/Performance | Availability | Accuracy/Performance | Availability | Accuracy/Performance | Availability | Accuracy/Performance | Overall Reliability | Response time | Costs[2] | Handset support |
| Single Cell | Cell ID (2G, 3G, 4G) | | | | | | | | | | | | | | | | | | | Highest | Shortest | Lowest | No |
| | Cell ID with Timing Advance – TA (2G) | | | | | | | | | | | | | | | | | | | High[3] | Shorter (data needs to be accessed and interpreted) | Low | No |
| | Cell ID with RTT/TADV (3G, 4G) | | | | | | | | | | | | | | | | | | | High[3] | | | No |
| | Cell ID with Path loss and Related Measurements (3G, 4G) | | | | | | | | | | | | | | | | | | | Medium[3,4] | | | No |
| | RF Pattern Matching (RFPM) (3G, 4G)[11] | | | | | | | | | | | | | | | | | | | Medium[3,4] | Short (additionally, algorithms need to calculate location estimate) | Medium | No |
| | Cell ID with Angle of Arrival (3G, 4G) | | 9 | | 9 | | 9 | | 9 | | 9 | | 9 | | 9 | | 9 | | 9 | High[3] | | Very High | No |
| Multiple Cell | Uplink Time Difference of Arrival (U-TDOA) (2G, 3G, 4G) | * | - | * | - | * | - | * | - | * | - | * | - | | | | | | | Medium[3,4] | Medium (additionally, measurements have to be made) | Very High | No |
| | Observed Time Difference of Arrival (OTDOA) (2G, 3G, 4G) | * | - | * | - | * | - | * | - | * | - | * | - | | | | | | | Medium[3,4] | | Medium | Yes |
| Satellite | GNSS (2G, 3G, 4G) | | | | | | - | | - | | | | | | | | | | - | Medium[3,4] | Long (additionally, measurements will take longer) | Low | Yes |
| | A-GNSS (2G, 3G, 4G) | | | | | | - | | - | | | | | | | | | | - | Medium[4]/High[4] | Medium (assistance data improves response time) | Medium | Yes |
| Other methods | Wi-Fi fingerprinting[7] | 1 | - | 1 | - | 1 | - | | | | | | | | | | | | | Medium[8] | Shorter | Low[6] | Yes |
| | Hybrid solution (A-GNSS, Wi-FI fingerprinting and cell-ID with TA/RTT/TADV or Pathloss) | | 3,4 | | 3, 4, 10 / 3,4 | | 3,4 | | 3 ,4, 10 / 3,4 | | 3, 4, 10 / 3,4 | | 3,4 | | 3,4 | | 3,4 | | 3,4 | Highest[3,4] (depending on the elements used for location) | Low accuracy: Shortest<br>Very High accuracy: Medium | High[6] | Yes |

[1] assumed that no Wi-Fi is detected by the mobile terminal (from user perspective, no Wi-Fi should be assumed)
[2] costs related exclusively with calculating the position estimate (PSAP costs not included)
[3] reflexions may occur, diminishing this value
[4] attenuations may occur, diminishing this value
[5] the accuracy colours represent ranges of values; for same colour, ranges may differ between urban and rural scenarios
[6] a database with mapping of Wi-Fi access points is additionally needed
[7] other radio access technologies could also be used for fingerprinting in a similar way e.g bluetooth
[8] lower reliability than Cell-ID considered due to third party responsibility for the functioning of the method (database, access point)
[9] the AoA positioning method gives improved accuracy than other single cell method since it is defined in ETSI/3GPP standards as being preceded by Cell-ID with TA/RTT/TADV
[10] depending on the availability of the higher accuracy method in the scenario, the accuracy colour may differ
[11] In this table only the single cell version of RFPM is considered
*Indicates a dependency between scenario characteristics and availability

## 7.7 PRIVACY CONSIDERATIONS

As noted in Section 5.4, information regarding individuals, including how this data is stored and the purposes to which it is used, is particularly relevant in the context of location information.

By implementing solutions to provide more accurate location information for emergency calls, MNOs and other third parties may consequently capture and eventually store accurate location details of callers. As set out in Directive 2002/58/EC: (36) “Member States may restrict the users' and subscribers' rights to privacy … with regard to calling line identification and location data where this is necessary to allow emergency services to carry out their tasks as effectively as possible.” The provision of caller location information associated with an emergency call to the emergency services clearly falls within this remit. However, in other circumstances such location data would need to be subject to the full requirements set out in relevant privacy and data protection legislation.

While we do not believe that the current framework regarding user privacy need specific alteration, relevant data protection and privacy authorities may need to take note of the specific methodologies of caller location information capture and storage adopted by MNOs to ensure compliance with the framework.

## 7.8 GUIDELINES FOR CRITERIA FOR MOBILE VOICE SERVICE

Due to its specificity and large scale use, it is the mobile voice service that raises most of the questions related to establishing criteria for accuracy and reliability for caller location information in the context of 112 emergency calls.

### 7.8.1 US mobile national criteria

In United States, an on-going project related to establishing national criteria for accuracy and reliability is going on since 1996. The Federal Communication Committee (FCC) established and refined, in time, national targets for accuracy and reliability in the form of a X (meters) accuracy with Y (percentage) reliability[19] with a number of implementation conditions and exceptions. For better understanding, the criteria expressed by the pair accuracy (measured in meters) and reliability (given in percentage), for example accuracy of 100m and reliability of 68%, means that in 68% of the time the positioning error must be equal or below 100m. The process focused on the statistical evaluation of the results obtained applying the technical methods and solutions developed in order to position a mobile terminal, leading to the evolution, in time, of the currently known positioning methods which were previously described in this chapter.

A number of test beds were set up, simulating as best as possible real life situations, in order to test the achievements of the various location solutions. Operators and manufacturers were invited to test their positioning solutions, in terms of performance and yield, in order to both develop solutions to cope with various situations highlighted by the test beds and also verify the reachability of the accuracy and reliability targets.

As technology progressed, providing for better accuracy and more reliability of various solutions, and based on the results obtained in test bed trials, during the last 18 years these criteria were revised several times, with the aim of driving technology further into providing better levels of accuracy and reliability.

Current targets were revised in 2012. They now require:

- 100m accuracy with 67% reliability and 300m accuracy with 90% reliability, for network based solutions and
- 50m accuracy with 67% reliability and 150m accuracy with 90% reliability, for mobile terminal based solutions

[19] The use of the term “reliability” by the FCC may not align with the definition of reliability in section 4.1 of this report.

For the timeframe until 2019, based upon requests from emergency services organisations, additional conditions and limitations apply (e.g. percentage of counties, PSAP service areas, population covered, exclusion of 15% for heavily forested areas).

Also, recently (spring 2014) FCC announced a consideration for future modification of the targets in 2019, aiming at setting a single set of targets (50m accuracy with 67% reliability and 150m accuracy with 90% reliability) for all types of solutions.

There is a response time set for providing location information – 30 seconds – with certain conditions attached (e.g. exclude from statistics calls lasting 10 seconds or less).

### 7.8.2 Proposals for establishing national criteria

The aim of the EU regulatory framework, while going in the same direction, refers to criteria directly linked to the day-to-day activities of PSAPs and emergency services organisations, after implementing specific methods and solutions for improving the accuracy and the reliability of the location information, rather than to the development and the improvement of technical methods and solutions for calculating that information in field trials – the US approach. In other words, while in US the aim is on testing and improving the technical methods and solutions for providing the location information, in EU the aim is directly focused on the improvement of the day-to-day activities of PSAPs and emergency services organisations.

Therefore, national criteria related to accuracy and reliability for emergency calls over a mobile voice service should refer to meters and percentages, as perceived on emergency services organisations side.

However, due to the lack of statistics related to accuracy and reliability of caller location information for 112 emergency calls (see Chapter 8) it is not possible, at this moment, to consider concrete figures. To do that, statistics need to be established and kept by the emergency services organisations.

Based on emergency services organisations needs and taking into account statistics implemented over a reasonable period of time (e.g. 1-2 years), target values related to accuracy and reliability of the location information provided and a deadline term (with possible intermediary steps) to comply with the target value should be set. Based on the mentioned statistics, different target values for the different implementation scenarios (as described in Table 5) may be envisaged. However, as a first step, aiming for improvements in the current positioning methods, which will lead to better accuracy and reliability, can also be considered as criteria.

Additionally, maximum response time (time to receive de location) value (in seconds) and availability of the information (percentage from total number of calls) could be set.

A mechanism for monitoring the evolution of the above parameters, ensuring the convergence, in time, towards the established target values will have to also be implemented.

Ideally, identical values for the above parameters should be set in all Member States in order to provide the same level of quality of the service throughout EU.

## 7.9 CONCLUSIONS ON CALLER LOCATION INFORMATION FOR MOBILE SERVICE

- There is no “one size fits all” method to provide highly accurate and reliable caller location information in all existing situations.
- It is very important to obtain reliable information in order to provide as much as possible an accurate location estimation. Bear in mind that there is generally a trade-off between accuracy and reliability.
- While the focus of this report is on accuracy and reliability there are other factors that need to be considered including the availability of a method, such as the timeliness of the information and the implementation cost when assessing the methods to be implemented.
- A combination of different methods offers the highest potential to give a timely, accurate and reliable position.

- Technology is available which, in accuracy terms, provides better results than the currently used positioning method, Cell-ID. Equipment vendors offer solutions for the three different network generations (2G, 3G, and 4G).
- From a cost perspective, any method requiring each base station to be upgraded should be carefully evaluated in relation to the potential benefits that can be realised.
- As a supporting method, Cell-ID can and should be used to validate location information provided using alternative technical (better) methods.
- A-GNSS-based positioning stands out of the list of available positioning methods in terms of accuracy, reliability and cost and should be implemented as a positioning method for emergency calls. Furthermore, multi A-GNSS improves performance in this respect.
- A-GNSS positioning method should be implemented in addition to current method, not replacing it.
- For greater reliability, accuracy and faster response times, it is important that an improved mobile network-based positioning method and A-GNSS assist and complement each other.
- When A-GNSS method is not available, the improved network-based positioning method is a reasonable fall-back solution.
- It is expected that even after the implementation of A-GNSS and network-based measures there may still be a percentage of emergency calls where adequate caller location information is not provided. Evidence and statistics will need to be gathered in order to understand this gap.
- Setting criteria for accuracy (meters) and reliability (percentages) of mobile positioning can be considered only after the implementation of the new positioning methods/solutions. Criteria should rely on statistics gathered by emergency services organisations, for a significant period of time, for the situations when provided location information proves to be insufficient for an efficient intervention in an emergency incident.
- A European harmonised approach (specifically for the different implementation options in the A-GNSS standards) for the implementation of the mentioned measures would be beneficial in order to achieve consistent minimum results and an efficient and widespread improvement of caller location implementations for emergency calls throughout Europe. Considering that A-GNSS is a promising technology and a European harmonised approach is desirable, all the necessary steps in the technical and regulatory area require further study.

# 8 LOCATION INFORMATION FOR NOMADIC SERVICES

## 8.1 INTRODUCTION

Fulfilling the requirements of the Universal Service Directive, i.e. to provide accurate and reliable caller location information for emergency services and establish implementing criteria, can present a significant challenge to service providers if the caller is using VoIP technology.

An Interconnected VoIP service allows a subscriber to make and receive calls to and from traditional phone numbers using an Internet connection, possibly a high-speed (broadband) Internet connection, such as DSL – Digital Subscriber Line, cable modem or wireless broadband. An Interconnected VoIP service can be used in place of traditional phone service. Typically, interconnected VoIP technology works by either placing an adapter between a traditional phone and Internet access point or by using a special VoIP phone that connects directly to your computer or Internet access point. While it is possible to choose an interconnected VoIP service provided at a single location some interconnected VoIP services can be used wherever you travel provided that an Internet connection is available (this second case is often called “nomadic VoIP”).

Nomadic VoIP can make it difficult to locate the caller accurately as there is no fixed relationship between the calling line identity (CLI) of the caller and his physical location, unlike the case of traditional landline services (e.g. POTS or ISDN).

In Europe, very few countries have taken steps to address this issue by developing adequate technical specifications. In UK, the Network Interoperability Consultative Committee (NICC) developed a UK national standard architecture to identify the physical location of VoIP callers in real time, and to provide that information to the emergency services organisations. The first stage of this work culminated with the release of the ND 1683 NICC Document in March 2010. This NICC solution architecture will be discussed in Section 8.8.1 of the present document.

The European Commission mandated ETSI to develop standards which shall overcome the issue addressed in Section 8.2 below (Mandate M/493 “Standardisation Mandate to the European Standards Organisations (ESO) in support of the location enhanced emergency call service“). In a first step ETSI develops a functional architecture which covers all parties (network and service providers) involved in an emergency call, and outlines all the necessary information which needs to be exchanged. In a second step of the work according to the M/493 protocols for the interfaces and entities of the defined architecture will be developed. Section 8.7.1.4 will provide more details of the work done by ETSI on M/493.

## 8.2 CHALLENGES OF ESTABLISHING THE LOCATION OF A NOMADIC CALLER

The VoIP service subscriber does not have to use a VoIP service provided by its internet service provider (ISP) or its access network provider (ANP). Indeed, it is likely that the ISP and/or ANP provider will not know that the customer is using a service from a voice service provider (VSP). Also, it is likely that the VSP will not know which ISP and/or ANP its customer is using. As the ANP (which may or may not be the ISP as well) is the only provider that can know the location of the subscriber, it can be seen that both the VSP and ANP need to be involved in the process of identifying the location of a particular call to the emergency services. In case of a separate ISP between the ANP and VSP this ISP would need to be involved as well. In addition, the fact that VoIP services can be nomadic means that the ISP and/or ANP could change on a call-by-call basis as the subscriber uses the service from different locations, for example other people’s access connections, Wi-Fi hotspots, or even the network of their employer or other organisations (i.e. private networks).

With VoIP, the service delivery model has changed from the conventional landline model where a service provider is responsible for complete service/application, active transport layer and physical network. In the VoIP model, the service may be provided by three different organisations:

- Voice Service Provider – for the voice service
- Internet Service Provider – for providing access to the Internet
- Access Network Provider – for the physical interconnection to a telecommunication network.

It should be noted that according to the definition in ETSI EMTEL SR 002 777 V1.1.1 an ANP provides only physical access to the network, whereas in the Draft ETSI ES 203 178 V0.0.24 the following definition for an access network provider applies:

"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 organisation or it may be provided by a number of different organisations, BUT the interfaces between these organisations are not relevant to the scope of the present document as it is matter of contractual relations between the parties."

This means that in Draft ETSI ES 203 178 V0.0.24 the ANP includes the ISP service for internet access.

It is still possible that the VSP, ISP and ANP could be the same organisation, but even in this case it might happen that internal systems will not be integrated sufficiently to align the VoIP call location information with the physical (administrative) address.

## 8.3 CURRENT SITUATION IN EU

In the COCOM 13-04REV1 working document "*Implementation of the European emergency number 112 – Results of the sixth data-gathering round*" in the fixed caller location section there are two sub-sections that treat the issue of VoIP caller location:

### 8.3.1 VoIP caller location

The Member States were invited to indicate whether caller location is provided for subscribers of **VoIP** services providing for originating national calls to numbers in the national numbering plan. An additional point was being added to this question regarding the availability of the actual address in case of nomadic VoIP systems.

Of the **27** Member States and **Croatia, Norway and Iceland** most confirmed that caller location is possible in case of such subscribers, with the exception of **Latvia, Poland,** as well as **Hungary** (no information). **Denmark** and indicated that some VoIP operators provide the actual location. **Belgium**, **Greece** and **Luxembourg** provide this facility partially.

Furthermore a number of countries, which in principle responded affirmatively, indicated that the caller location available in case of using nomadic VoIP systems is the registered subscription address: **Austria, Cyprus, Czech Republic, Denmark** (Some VoIP operators provide the actual location)**, Greece, Germany, Ireland, Italy, Luxembourg, Spain, Cyprus, Malta, the Netherlands, Romania, Slovenia** and **Norway**.

### 8.3.2 Information of VoIP subscribers about limitation on providing caller location

Finally, in view of the fact that the availability of caller location is subject to technical feasibility and it may not be possible for all VoIP systems, a new question has been introduced in the third questionnaire and retained in the following ones, asking Member States to indicate whether there is an obligation on the part of VoIP operators to inform their customers about the possible limitation on providing caller location to emergency services. **19** States have confirmed the existence of such an obligation (**Belgium, Bulgaria, Czech Republic, Estonia, Denmark, Finland, Germany, Greece, Ireland, Italy, Latvia, Spain, Portugal, Romania, Slovenia, Slovakia, Sweden, the United Kingdom** and **Norway**) whereas **Austria** indicated that the information of this category of subscribers is a recommendation for the VoIP operators concerned and not a legal requirement. **The Netherlands** reported that, if 112 routing is supported by VoIP operator, the location information must be delivered.

## 8.4 SITUATION IN OTHER JURISDICTIONS

The EU is not alone in setting out expectations with respect to VoIP calling. In this section examples are provided to highlight how other jurisdictions have addressed this and suggest similar approaches and expectations being adopted.

In Canada, the national regulator (CRTC) has recently (June 2014) published an emergency calling action plan, following consultation, which addresses the issue of providing location information for VoIP services[20].

This action plan noted responses highlighting the difficulties in providing location information with VoIP calls and determined that "the implementation of NG9-1-1 (next-generation 9-1-1) has the greatest potential to provide a long-term solution for determining the location of nomadic VoIP subscribers."

The regulator therefore requested that "the ESWG (Emergency Services Working Group) continue to monitor national and international technological developments in NG9-1-1 that could lead to a viable solution that would automatically provide a nomadic VoIP 9-1-1 caller's location to PSAPs".

Until such time that a viable solution is able to make enhanced 9-1-1 available to customers, the regulator will "ensure that these companies provide Basic 9-1-1 and inform Canadians about any limitations associated with their provision of 9-1-1 service."

In Australia, the obligations on VoIP services providers regarding emergency call services are specified in the 'Determination'[21] made by the national regulator (ACMA) and can be summarised as follows[22]:

"*Carriage service providers (CSPs) must carry emergency calls free of charge and deliver them to interconnection points for handling by emergency call persons (ECPs).provide free-of-charge access to the emergency call service numbers (Triple Zero (000), 112 and 106).*"

Obligations for services that allow 2-way communication also include the following:

- "populate the Integrated Public Number Database (IPND) with each public number of a customer and associated information, including an indication of possible location uncertainty by way of the alternate address flag;
  and
- provide location information by Standardised Mobile Service Area coding to the ECPs."

With regards to the provision of relevant consumer information, the ACMA recommends customers are given appropriate information regarding making emergency calls such as:

> "*This VoIP Outbound service does not provide access to the emergency call service number Triple Zero. Emergency calls can be made using fixed/PSTN or mobile phone services.*
>
> *Please note that your VoIP Out service cannot be used to make an emergency call (Triple Zero). Please ensure you have access to a landline (i.e. fixed) or mobile phone service to dial emergency services.*"

In USA, the FCC established some general requirements related to the provision of caller location information in the context of emergency calls:

- All interconnected VoIP providers must automatically provide 911 services to all their customers as a standard, mandatory feature without customers having to specifically request this service. VoIP providers may not allow their customers to "opt-out" of 911 services.

[20] http://www.crtc.gc.ca/eng/archive/2014/2014-342.htm
[21] "Telecommunications (Emergency Call Service) Determination 2009" http://www.comlaw.gov.au/Details/F2013C00626
[22] http://www.acma.gov.au/Citizen/Consumer-info/All-about-numbers/VOIP-numbers/voip-and-emergency-call-services-i-acma

- Before an interconnected VoIP provider can activate a new consumer's service, the provider must obtain from the customer the physical location at which the service will first be used, so that emergency services personnel will be able to locate any customer dialling 911. Interconnected VoIP providers must also provide one or more easy ways for their customers to update the physical location they have registered with the provider, if changes.
- Interconnected VoIP providers must transmit all 911 calls, as well as a call-back number and the caller's registered physical location, to appropriate emergency services call centre or local emergency authority.
- Interconnected VoIP providers must take appropriate action to ensure that their customers have a clear understanding of the limitations, if any, of their 911 service. All providers must specifically advise new and existing customers, prominently and in plain language, of the circumstances under which 911 services may not be available through the interconnected VoIP service or may in some way be limited in comparison to traditional (fixed) service.
- Interconnected VoIP providers must obtain affirmative acknowledgement from their existing customers that they are aware of and understand the limitations of their 911 service.
- In some areas, emergency service providers are not capable of receiving or processing the location information or call-back number that is automatically transmitted with 911 calls. In those areas, interconnected VoIP providers must ensure that 911 calls are routed to the appropriate PSAP.

## 8.5 DESCRIPTION OF AVAILABLE TECHNOLOGIES AND STANDARDS

According to Article 26 of the Universal Services Directive, all service providers providing end-users with an electronic communications service designed for originating calls through a number or numbers in a national telephone numbering plan must provide reliable and accurate access to emergency services, taking into account national specifications and criteria.

On the other hand, although this does not exempt network-independent service providers from fulfilling Article 26 requirements, Recital 40 of the Directive 2009/136/EC amending, among others, Universal Service Directive, acknowledges that for these service providers, "caller location information may not always be technically feasible".

However, also according to the Recital 40, "once internationally recognised standards ensuring accurate and reliable routing and connection to the emergency services are in place, network-independent undertakings should also fulfil the obligations related to caller location information at a level comparable to that required from other undertakings".

Thus, the level of requirements of Interconnected VoIP service providers becomes dependent on the existence of internationally recognised standards for accurate and reliable routing and connection to the emergency services.

### 8.5.1 Standardisation Organisations

International standardisation organisations have developed or are developing standards to obtain the location of the nomadic caller: IETF, ETSI.

#### *8.5.1.1 Internet Engineering Task Force IETF*

**IETF** is a large open international community of network designers, operators, vendors and researchers concerned with the evolution of the Internet architecture and smooth operation of the Internet. It is open to any interested individual. The actual technical work of the IETF is done in its working groups which are organised by topic in several areas (e.g. routing, transport, security, etc.) and much of the work is handled via mailing lists. IETF has developed standards and a technological architecture for calls to emergency services. A list of relevant standards which should be regularly checked for updates are:

- Location Retrieval: various protocols standardised for different environments:
  - HTTP-Enabled Location Delivery: RFC 5989
  - DHCP Civic Location: RFC 4676
  - DHCP Geodetic Location: RFC 3825

- Emergency Call Routing
  - Requirements: RFC 5012
  - Security Threats Analysis: RFC 5069
  - Lost: RFC 5222
  - Architecture: RFC 5582
  - Discovery of Lost Servers: RFC 5223
  - Support for Holes in Service Boundaries: RFC 5964.

IETF GeoRef WG defines mechanism to allow IP device to become location aware at time of network connection (http://www.ietf.org/internet-drafts/ draft-ietf-geopriv-dhcplci-option-03.txt).

IETF GeoPriv WG defines a protocol or requirements for transport of location information with appropriate privacy protection (http://www.ietf.org/internet-drafts/draft-ietf-geopriv-policy-01.txt).

IETF Sipping WG defines Scenarios e.g. hybrid VoIP–PSTN, Overall architecture for emergency calling, Describes "sos" SIP URI, New DNS resource records for location mapping (http://www.ietf.org/html-charters/sipping-charter.html).

IETF ECRIT WG describes where and how Internet technologies available to manage location and to perform call routing could be used. The group is working on specifications determining how location data and call routing information can be used to enable communication between the caller and the PSAP.

ECRIT will also address privacy and security concerns within its documents, following mainly the privacy and data protection levels considered appropriate for USA. More information is available at

http://datatracker.ietf.org/wg/ecrit/charter/

#### *8.5.1.2 European Telecommunications Standards Institute (ETSI)*

ETSI plays a major role in developing a wide range of standards and other technical documentation as Europe's contribution to worldwide standardisation in telecommunications, broadcasting and information technology.

#### *8.5.1.3 EMTEL*

ETSI's Special Committee EMTEL acts as a key coordinator in getting requirements on Emergency Communications. EMTEL may create and approve Technical Specifications and Technical Reports.

Documents published by Special Committee EMTEL:

- **TR 102 180**: Basis of requirements for communication of individuals with authorities/organisations in case of distress (Emergency call handling);
- **TR 102 299**: Collection of European Regulatory Texts and orientations;
- **TS 102 410**: Basis of requirements for communications between individuals and between individuals and authorities whilst emergencies are in progress;
- **TR 102 445**: Overview of Emergency Communications Network Resilience and Preparedness;
- **TR 102 476**: Emergency calls and VoIP: possible short and long term solutions and standardisation activities;
- **SR 002 777 (2010-07)**: Test / verification procedure for emergency calls.

#### *8.5.1.4 TISPAN/E2NA*

In the ETSI Technical Committee TISPAN WG2 started under European Commission's Mandate M/493, the work item "*Functional architecture to support European requirements on emergency caller location determination and transport*". ETSI E2NA continues the work after a reorganisation of some TCs in ETSI.

**Scope of the work item under Mandate M/493:**

The functional architecture needs to be developed in particular for the case where VoIP service provider and one or several network operators are independent enterprises needing to co-operate to determine the location of the (nomadic) caller.

The architecture shall identify all necessary interfaces, which are needed to fulfil the requirements outlined in EC Mandate M/493 and provide a basis for possible protocols to be used on those interfaces. The document is intended to be an ETSI standard (ES).

As indicated in the mandate M/493, "a practical solution for today's pre-NGN IP-based networks is required, ensuring to the utmost extent possible forward compatibility with the future all-NGN technical environment.

This work shall not be focused on NGN but shall address current implementations for all types of voice calls (fixed, mobile, static and nomadic VoIP) in EU countries. The standards should allow for the determination of the location information in the form of a geographical coordinate or a civic address as precisely as possible.

The M/493 experts group within E2NA is focusing on finalising the stage 2 work, which is the functional architecture, and has started the Stage 3 Work by selecting first protocols for interfaces in the architecture.

Once the mandate is successfully fulfilled and the European standards are adopted this could help network-independent service providers to provide location information for emergency calls in a reliable way.

### 8.5.2 Other Organisations

Organisations like NENA and EENA, although not registered as standardisation bodies, provide specifications, recommendations and architectures for calls to emergency services:

#### *8.5.2.1 National Emergency Number Association (NENA)*

NENA is a US based organisation which has been active in the field of definition and technical specifications for the reception in the PSAPs of 911 calls over IP[23].

**Table 6: List of NENA Specifications**

| | |
|---|---|
| NENA 08-002 v1 | Functional & Interface Standards for NG 911 (i3) |
| NENA 08-003 | NENA i3 Solution |
| NENA 08-501 v1 | Network Interface to IP Capable PSAP |
| NENA 08-501 v1 | E911 Requirements |
| NENA 08-503 v1 | VoIP Characteristics |
| NENA 08-504 v1 | VoIP Standards Development Organisations (SDO) |
| NENA 08-505 v1 | Location determination : IP – Based Emergency Services |
| NENA 08-751 v1 | i3 Requirements (Long Term Definition) |
| NENA 08-752 v1 | Location Information to Support IP Based Emergency Services |
| NENA 08-xxx draft | Emergency Services IP Network Design for NG 911 |

#### *8.5.2.2 European Emergency Number Association (EENA)*

EENA, the European Emergency Number Association, is a Brussels-based NGO set up in 1999 dedicated to promoting high-quality emergency services reached by the number 112 throughout the EU.

[23] www.nena.org (section - documentation)

EENA serves as a discussion platform for emergency services, public authorities, decision makers, researchers, associations and solution providers with a view to improving the emergency response in accordance with citizens' requirements.

## 8.6 EXISTING STANDARDS IMPLEMENTATIONS

In Europe, it appears likely that different countries will deploy IP-based emergency services over different time horizons. The outcome of the work of ETSI M/493 will have an impact on how emergency caller location determination and transport of this information to the PSAP in VoIP based network will be organised.

### 8.6.1 VoIP location implementation to date in UK

The requirements set out by Ofcom in the UK are broadly similar to those set out by the FCC (see 8.4 above), in that VoIP providers offering PATS are required to provide users with access to the emergency services and that for VoIP services at fixed locations, the subscriber's registered address, where available, should be made available to the emergency services. This covers both nomadic and fixed VoIP implementation. The PSAP operator is made aware that the call is being made via a VoIP service and hence additional questioning is required to confirm, or in the case of nomadic VoIP ascertain, the caller's location.

Although some VoIP service providers allow subscribers to update their location via web-based forms, such a mechanism has limitations in that it relies on the subscriber updating their location when they relocate, and that any updates can take time to be incorporated into the database used by the emergency services. However, solutions have been proposed, and in some cases standardised, that allow the automatic determination of the caller's location. For example, in the United Kingdom, this has been via the NICC-Network Interoperability Consultative Committee group work and in United States via the work of NENA. In both cases, full implementation of these architectures has yet to be taken, but independent examinations[24] in this area suggest that the work undertaken by NICC and NENA are the most developed initiatives in this area.

## 8.7 GUIDELINES FOR CRITERIA FOR NOMADIC VOICE SERVICE

In the nomadic voice service the support of an appropriate standard for the calculation of the caller location is missing (work is in progress in ETSI M/493). However, establishing national criteria for accuracy and reliability of the 112 emergency calls is foreseen to refer to the administrative address of the installation of the network termination point (e.g. broadband access point, Wi-Fi access point), based on information provided from network side.

Therefore, national criteria related to accuracy and reliability for emergency calls over a nomadic voice service will have to refer to the exact administrative address from where the call is placed.

Based on emergency services organisations needs and taking into account statistics implemented over a reasonable period of time (e.g. 1-2 years), target values related to reliability of the location information provided and a deadline term to comply with the target value will have to be set.

After the implementation of the relevant standards, a high reliability target can be considered as reasonable as the method of obtaining the location information is based on an access network database query thus high reliability targets should be easily achievable.

The location information provided should be considered as accurate if the administrative address received will actually be the address from where the 112 emergency call was placed.

Additionally, maximum response time (time to receive de location) value (in seconds) and availability of the information (as percentage from total number of calls) could be set.

A mechanism for monitoring the evolution of the above parameters, ensuring the convergence, in time, towards the established target values will have to also be implemented.

[24] Analysis Mason " Assessment of VoIP location capabilities to support emergency services " 28.06.2011

Ideally, identical values for the above parameters will have to be set in all Member States in order to provide the same level of quality of the service throughout EU.

### 8.8 CONCLUSIONS ON CALLER LOCATION INFORMATION FOR NOMADIC SERVICE

It should be possible to significantly improve on the provision of caller location information for nomadic VoIP services once the M493 standardisation work has been successfully completed within ETSI. M493 is designed to help increase the reliability of caller location information from nomadic VoIP services. Once ratified, regulators should take this into account when establishing criteria for caller location information for this type of service in the future.

However, it is important to note that while the existence of relevant standards is an important (and in some cases a necessary) condition for subsequent implementation, other factors may also be relevant. For example, where there is no legislation, each party in the end to end chain will need to justify the adoption of these standards with respect to their costs. This may be difficult to those that bear costs of implementation but receive little, if any, resulting benefit, such as infrastructure providers. While mandating the implementation of standards could overcome this issue it may not address all parties, as some may be outside the jurisdiction (for example, due to their geographical location or due to the extent of the legal remit of the NRA). This may mean that even with the ratification of appropriate standards, location of emergency callers using VoIP technology may not be as reliable and effective as for traditional fixed-line services today.

It should be possible to establish a procedure to pinpoint calls from business networks where nomadic services are provided, for example by requiring the owner of a corporate network with multiple locations connected internally to properly assist the public service provider to uniquely localise, provide timely location update and route the emergency calls to the appropriate PSAPs.

## 9 CONCLUSIONS

Previous chapters have set out specific conclusions regarding individual technologies. In this chapter the general policy conclusions and the key technical conclusions of the report are presented.

- Improving accuracy and reliability of the caller location information provided by electronic communications networks is feasible. Any regulatory step in this regard should be based on close collaboration, on an ongoing basis, between PSAPs, emergency services organisations, network and service providers and the competent national authorities.
- A harmonised European approach for the implementation of the caller location solutions (specifically for the different implementation options in the A-GNSS standards) would be beneficial for a number of reasons including achieving consistent minimum results and an efficient and widespread improvement of caller location implementations for emergency calls throughout Europe.
- Any investment made to improve the accuracy and reliability of caller location information provided by the network and the handset may also need to be met by a corresponding investment in the PSAP's capabilities (including training of staff in order to enable the effective receipt, interpretation, use and evaluation of caller location information). It is recommended that PSAP and emergency services organisations have a holistic approach to caller location handling when planning to invest in training and solutions to handle eCall or more accurate caller location information from other means.
- For mobile networks, A-GNSS-based positioning stands out of the list of available positioning methods in terms of accuracy, reliability and cost and should be implemented as a positioning method for emergency calls, as the first step of an overall programme for improvement, to complement the existing network-based methods rather than replacing them. Because of the somewhat limited availability of A-GNSS, network-based location methods will remain a critical component and ongoing improvements in the performance of the network-based caller location methods are likely to be necessary.
- Statistical feedback from emergency services organisations and PSAPs is vital in order to determine the benefits that such solutions are providing and to derive targets for any national criteria. Therefore relevant data-gathering systems should be implemented as part of an overall programme for improvement.
- With respect to nomadic (VoIP) services it should be possible to significantly improve on the provision of caller location information once the ETSI M/493 standardisation work has been successfully completed.
- A procedure should be established in order to be able to pinpoint the location of calls made to emergency services within corporate networks. This could be achieved by requiring the owner of a corporate network with multiple locations connected internally to properly assist the public service provider to uniquely localise, provide timely location update and route the emergency calls to the appropriate PSAPs.
- Criteria for fixed/nomadic and mobile should be different due to differences in the types of methods used for positioning.
- As a target, harmonised criteria should be set in all CEPT member countries, in order to provide the same level of quality of service to all citizens throughout Europe.

## ANNEX 1: LIST OF REFERENCES

[1] Directive 2009/136/EC of the European Parliament and of the Council of 25 November 2009 amending Directive 2002/22/EC on universal service and user's rights relating to electronic communications networks and services

[2] ECC Report 143: Practical Improvements in Handling 112 Emergency Calls: Caller Location Information, Lisbon, April 2010

[3] (3GPP) ETSI TS 143 059 v11.0.0 (2012-10) Digital cellular telecommunications system (Phase 2+); Functional stage 2 description of Location Services (LCS) in GERAN (3GPP TS 43.059 version 11.0.0 Release 11)

[4] (3GPP) ETSI TS 125 305 V11.0.0 (2012-09) Universal Mobile Telecommunications System (UMTS); Stage 2 functional specification of User Equipment (UE) positioning in UTRAN (3GPP TS 25.305 version 11.0.0 Release 11)

[5] (3GPP) ETSI TS 136 305 v11.3.0 (2013-04) LTE; Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Stage 2 functional specification of User Equipment (UE) positioning in E-UTRAN (3GPP TS 36.305 version 11.3.0 Release 11)

[6] (3GPP) ETSI TS 123 271 V11.2.0 (2013-04) Digital cellular telecommunications system (Phase 2+); Universal 8Mobile Telecommunications System (UMTS); LTE; Functional stage 2 description of Location Services (LCS) (3GPP TS 23.271 version 11.2.0 Release 11)

[7] (3GPP) ETSI TS 122 071 V11.0.0 (2012-10) Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); LTE; Location Services (LCS); Service description; Stage 1 (3GPP TS 22.071 version 11.0.0 Release 11)

[8] 3GPP TR 25.923 V1.0.0 (1999-04) 3rd Generation Partnership Project (3GPP); Technical Specification Group (TSG) RAN; Working Group 2 (WG2); Report on Location Services (LCS)

[9] ETSI TR 125 907 V9.0.1 (2010-02) Universal Mobile Telecommunications System (UMTS); Evaluation of the inclusion of path loss based location technology in the UTRAN (3GPP TR 25.907 version 9.0.1 Release 9)

[10] Standardisation mandate to the European standardisation organisations (ESO) in support of the Location Enhanced Emergency Call Service, European Commission, Directorate General for Information Society and Media, M/493 EN, Brussels, 6th May 2011

[11] Coordination Group on Access to Location Information for Emergency Services (CGALIES) "Report on implementation issues related to access to location information by emergency services (E112) in European Union", Final Report 18.02.2002

[12] Analysis Mason, Report for OFCOM "Assessment of VoIP location capabilities to support emergency services", 28 June 2011

[13] Mott MacDonald "Assessment of Mobile Location Technology" Final Report for OFCOM, 23 April 2010

[14] Mott MacDonald "Assessment of Mobile Location Technology - Update" Final Report for OFCOM, July 2012

[15] COCOM 13-04REV1 Final "Implementation of the European emergency number 112-Results of the sixth data-gathering round", 14 March 2013

[16] FCC-Federal Communications Commission: FCC 10-176 Wireless E911 Location Accuracy Requirements SECOND REPORT and ORDER, September 23, 2010; DA11-920 Small Entity Compliance Guide, Wireless E911, Location Accuracy Requirements, May 19, 2011

[17] FCC - Federal Communications Commission: FCC 14-13 Third further notice of proposed rulemaking, Proposed indoor location accuracy requirements; Improving the delivery of phase II location information

[18] Geospatial Positioning Accuracy Standards Part 3: National Standard for Spatial Data Accuracy

[19] Journal of Global Positioning Systems (2008) Vol. 7, No.1: 18-26: On outdoor positioning with Wi-Fi

[20] GPS Essentials of Satellite Navigation, Compendium, 2009

# ANNEX 2: ARTICLE 26 FROM UNIVERSAL SERVICE DIRECTIVE 2002/22/EC MODIFIED: EMERGENCY SERVICES AND SINGLE EUROPEAN EMERGENCY CALL NUMBER

Universal Service Directive and User's Rights relating to electronic communications networks and services (Directive 2002/22/EC)

Article 26 Emergency services and single European emergency call number

1. Member States shall ensure that all end-users of the service referred to in paragraph 2, including users of public pay telephones, are able to call the emergency services free of charge and without having to use any means of payment, by using the single European emergency call number "112" and any national emergency call number specified by Member States.
2. Member States, in consultation with national regulatory authorities, emergency services and providers, 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.
3. Member States shall ensure that calls to the single European emergency call number "112" are appropriately answered and handled in the manner best suited to the national organisation of emergency systems. Such calls shall be answered and handled at least as expeditiously and effectively as calls to the national emergency number or numbers, where these continue to be in use.
4. Member States shall ensure that access for disabled end-users to emergency services is equivalent to that enjoyed by other end-users. Measures taken to ensure that disabled end-users are able to access emergency services whilst traveling in other Member States shall be based to the greatest extent possible on European standards or specifications published in accordance with the provisions of Article 17 of Directive2002/21/EC (Framework Directive), and they shall not prevent Member States from adopting additional requirements in order to pursue the objectives set out in this Article.
5. Member States shall ensure that undertakings concerned make caller location information available free of charge to the authority handling emergency calls as soon as the call reaches that authority. This shall apply to all calls to the single European emergency call number "112". Member States may extend this obligation to cover calls to national emergency numbers. Competent regulatory authorities shall lay down criteria for the accuracy and reliability of the caller location information provided.
6. Member States shall ensure that citizens are adequately informed about the existence and use of the single European emergency call number "112", in particular through initiatives specifically targeting persons travelling between Member States.
7. In order to ensure effective access to "112" services in the Member States, the Commission, having consulted BEREC, may adopt technical implementing measures. However, these technical implementing measures shall be adopted without prejudice to, and shall have no impact on, the organisation of emergency services, which remains of the exclusive competence of Member States.

Those measures, designed to amend non-essential elements of this Directive by supplementing it, shall be adopted in accordance with the regulatory procedure with scrutiny referred to in Article 37(2).

## ANNEX 3: FCC 10-176 WIRELESS E911 LOCATION ACCURACY REQUIREMENTS SECOND REPORT AND ORDER (RELEASED SEPTEMBER 23, 2010)

Final Rules

Part 20 – Commercial Mobile Radio Services

Section 20.18(h) is amended as follows:

(h) Phase II accuracy. Licensees subject to this section shall comply with the following standards for Phase II location accuracy and reliability, to be tested and measured either at the county or the PSAP service area geographic level, based on outdoor measurements only:

**(1) Network-Based Technologies:**

(A) 100 meters for 67 percent of calls, consistent with the following benchmarks:

(I) One year from effective date of the Order, carriers shall comply with this standard in 60 percent of counties or PSAP service areas. These counties or PSAP service areas must cover at least 70 percent of population covered by the carrier across its entire network. Compliance will be measured on a per-county or per-PSAP basis using, at the carrier's election, either network-based accuracy data, or blended reporting as provided in paragraph (D) of this section.

(II) Three years from effective date of the Order, carriers shall comply with this standard in 70 percent of counties or PSAP service areas. These counties or PSAP service areas must cover at least 80 percent of the population covered by the carrier across its entire network. Compliance will be measured on a per-county or per-PSAP basis using, at the carrier's election either network – based accuracy data, or blended reporting as provided in paragraph (D) of this section.

(III) Five years from effective date of the Order, carriers shall comply with the standard in 100% of counties or PSAP service areas covered by carrier. Compliance will be measured on a per-county or per-PSAP basis, using, at the carrier's election, either network-based accuracy data, blended reporting as provided in paragraph (D) of this section, or handset-based accuracy data as provided in paragraph (E) of this section.

(B) 300 meters for 90 percent of calls, consistent with the following benchmarks:

(I) Three years for 90 percent of calls from effective date of the Order, carriers shall comply with this standard in 60 percent of counties or PSAP service areas. These counties or PSAP service areas must cover at least 70 percent of population covered by the carrier across its entire network. Compliance will be measured on a per-county or per-PSAP basis using, at the carrier's election, either network-based accuracy data, or blended reporting as provided in paragraph (D) of this section.

(II) Five years from effective date of the Order, carriers shall comply in 70 percent of counties or PSAP service areas. These counties or PSAP service areas must cover at least 80 percent of the population covered by carrier across its entire network. Compliance will be measured on a per-county or per-PSAP basis, using, at the carrier's election, either network-based accuracy data, or a blended reporting as provided in paragraph (D) of this section.

(III) Eight years from effective date of the Order, carriers shall comply in 85 percent of counties or PSAP service areas. Compliance will be measured on a per-county or per-PSAP basis using, at the carrier election, either network-based accuracy data, blended reporting as provided in paragraph (D) of this section or handset-based accuracy data as provided in paragraph (E) of this section.

(C) County-level or PSAP-level location accuracy standards for network-based technologies will be applicable to those counties or PSAP service areas, on an individual basis, in which a network-based carrier has deployed PHASE II in at least one cell site located within a county's or PSAP service area's boundary. Compliance with the requirements of paragraph (A) and paragraph (B) of this section shall be measured and reported independently.

(D) Accuracy data from both network-based solutions and handset–based solutions may be blended to measure compliance with the accuracy requirements of paragraph (A) and paragraph (B) of this section. Such blending shall be based on weighting accuracy data in the ratio of assisted GPS (A-GPS) handsets to non-A-GPS handsets in the carrier's subscriber base. The weighting ratio shall be applied to the accuracy data from each solution and measured against the network –based accuracy requirements of paragraph (1) of this section.

(E) A carrier may rely solely on handset-based accuracy data in any county or PSAP service area if at least 85 percent of subscribers, network-wide, use A-GPS handsets, or if it offers A-GPS handsets to subscribers in that county or PSAP service area at no cost to the subscriber.

(F) A carrier may exclude from compliance particular counties, where triangulation is not technically possible, such as locations where triangulation is not technically possible, such as locations where at least three cell sites are not sufficiently visible to a handset. Carriers must file a list of specific counties or portions of counties where they are utilising this exclusion within 90 days following approval from Office of Management and Budget for related information collection. This list must be submitted electronically into PS Docket No. 07-114 and copies must be sent to NENA. Further, carriers must submit in the same manner any changes to their exclusion lists within thirty days of discovering such changes. This exclusion will sunset on 8 years after effective date.

**(2) Handset-Based Technologies:**

(A) Two years from effective date of the Order, 50 meters for 67 percent of calls, and 150 meters for 80 percent of calls, on a per-county or per-PSAP basis. However, a carrier may exclude up to 15 percent of counties or PSAP service areas from the 150 meters requirement based upon heavy forestation that limits handset-based technology accuracy in those counties or PSAP service areas.

(B) Eight years from effective date of the Order, 50 meters for 67 percent of calls and 150 meters for 90 percent of calls, on a per-county or per-PSAP basis. However, a carrier may exclude up to 15 percent of counties or PSAP service areas from 150 m requirement based upon heavy forestation that limits handset-based technology accuracy in those counties or PSAP service areas.

(C) Carriers must file a list of the specific counties or PSAP service areas where they are utilising the exclusion for heavy forestation within 90 days following approval from the Office of Management and Budget for the related information collection. This list must be submitted electronically into PS Docket No. 07-114 and copies must be sent to NENA. Further, carriers must submit in the same manner any changes to their exclusion lists within thirty days of discovering such changes.

**(3) Confidence and Uncertainty Data:**

Two years after effective date of the Order, all carriers subject to this section shall be required to provide confidence and uncertainty data on a per-call basis upon request of a PSAP. Once a carrier has established baseline confidence and uncertainty levels in a county or PSAP service area, ongoing accuracy shall be monitored based on a trending of uncertainty data and additional testing shall not be required.

All entities responsible for transporting confidence and uncertainty between wireless carriers and PSAPs including LECs owners of E911 networks, and emergency service providers (collectively, System Service Providers (SSP)) must implement any modifications that will enable the transmission of confidence and uncertainty data provided by wireless carriers to the requesting PSAP. If an SSP does not pass confidence and uncertainty data to the PSAPs, the SSP has the burden of proving that it is technically infeasible for it to provide such data.

# ANNEX 4: DIFFERENT STAKEHOLDERS' VIEWS ON POSITIONING RELATED FEATURES

## A4.1 PSAP VIEWS

- NETHERLANDS POLICE

**Table 7: Location accuracy mobile 112 calls / National Police / Central Unit**

| Activity | Organisation | Functional operational needs | Needed Accuracy |
|---|---|---|---|
| Workflow management | 1st level PSAP | Volume management Routing call | 1000 - 3000 m |
| Intake | 1st level PSAP | Vertification emergency, identification needed emergence service | 500 - 1000 m |
| Intake Calltaker<br>Emergency Service<br>2nd level PSAP | Police | Volume management<br>Verification emergency<br>Assigning emergency unit<br>Locating caller/object<br>(victim /witness) | 1000 - 3000 m<br>300 - 500 m<br>500 - 1000 m<br>25 - 50 m |
| Intake Calltaker<br>Emergency Service | Firefighters | Verification emergency<br>Assigning emergency unit/organisation<br>Locating caller/object | 1000 - 3000 m<br>500 - 1000 m<br>25 - 50 m |
| Intake Calltaker<br>Emergency Service | Ambulance | Verification emergency<br>Assigning emergency unit/organisation<br>Select location route | 1000 - 3000 m<br>500 - 1000 m<br>25 - 50 m |
| Issued to emergency unit | P/F/A | Select location route<br>Find victim | 25 - 50 m |

- CO-ORDINATION GROUP ON ACCESS TO LOCATION INFORMATION FOR EMERGENCY SERVICES (C.G.A.L.I.E.S)

**Table 8: Location requirements of emergency services regarding the provision by operators of mobile caller's position (Source: Final Report on implementation issues related to access to location information by emergency services (E112) in the European Union.**

| | Indoor | Urban | Suburban | Rural | Highway Crossroads |
|---|---|---|---|---|---|
| Caller can provide general information | 10 - 50 m | 10 - 50 m | 30 - 100 m | 50 - 100 m | 20 - 100 m |
| Caller cannot provide any information | 10 - 50 m | 10 - 50 m | 10 - 100 m | 10 - 100 m | 10 - 100 m |

## A4.2 VENDOR AND OPERATOR VIEWS

In order to gather information from other relevant perspectives, particularly from equipment manufacturers, and also have more information about future developments and deployment regarding the provision of a more precise location of the caller to the 112 emergency number and other features like installation and maintenance cost estimates of different solutions, a series of consultations took place.

Here are some of the different stakeholders' views on positioning related features such as accuracy, reliability/yield, availability, cost, TTFF, based on specific method implementations proposed and the respective developed solutions. Based on the perspective used by each stakeholder there may be differences in the views even when assessing a positioning method or solution acting on the same standardised principles.

- ERICSSON

**Table 9: Method characteristics**

| Positioning Method | CAPEX | OPEX | Accuracy | Comment |
|---|---|---|---|---|
| CID (Cell Id) | Low | Low | Low | |
| CID+TA/RTT | Low+ | Low | Low+ | |
| AECID | Medium | Medium | Medium | |
| AECID+ | Medium+ | High | High | |
| A-GNSS | Medium | Low+ | High+ | Need terminal support.<br>Not indoor.<br>Hybrid with OTDOA |
| OTDOA | Medium+ | Medium | High | Terminal support.<br>Only LTE |

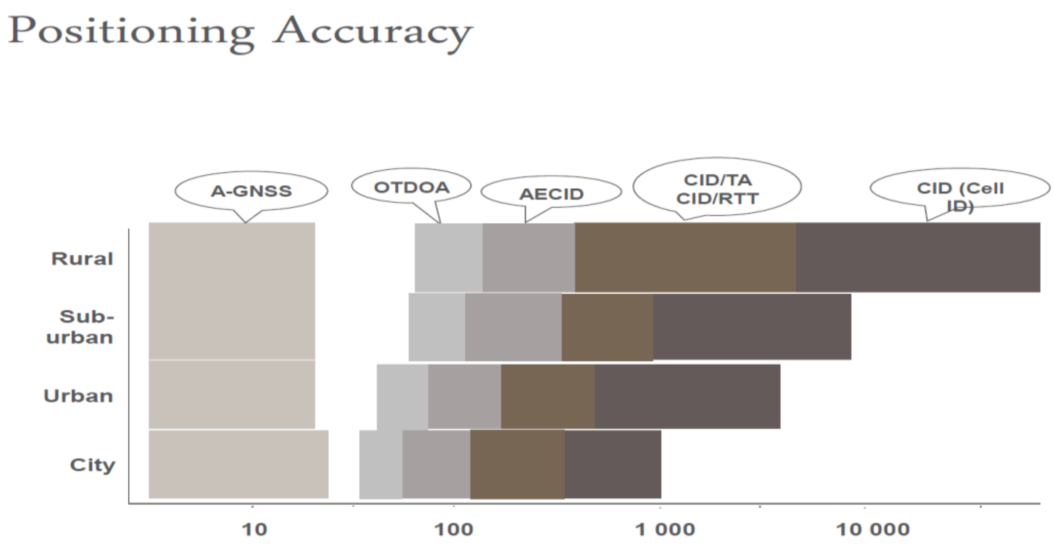



**Figure 7:**

- GSA

**Added value of A-GNSS and EGNOS: Test results from R&D project Inclusion**

Multi-constellation mass market GNSS (e.g. GPS + Galileo) provides average 5-10 meter location accuracy in the cities and less than 5 meters in rural areas (outdoor; even without assistance data).

| | | | HTC Standalone | HTC Assisted |
|---|---|---|---|---|
| Tracking | Outdoor | Accuracy | 5 m | 1.4 m |
| | | TTFF | 57 s | 12 s |
| | | Availability | 100 % | 100 % |
| Acquisition (Cold Start) | Light Indoor | Accuracy | 186.8 m | 54.6 m |
| | | TTFF | 60 s | 12 s |
| | | Availability | 90.5 % | 100 % |
| | Urban Canyon | Accuracy | - | 34.3 m |
| | | TTFF | - | 16 s |
| | | Availability | 0 | 100 % |

EGNOS Added Value

A-GNSS Added Value

**Figure 8: Added value of A-GNSS and EGNOS**

- QUALCOMM

## GNSS Yield, TTFF and Sensitivity

Depends on quality of assistance data.

- Example for different Reference Time accuracies.
- With precise time, solution yield is extended across the usable range of signal levels.
- Precise time, has improved performance at lower signal levels.
- Increased Reference Location Uncertainties (Punc) would shift the curves to the left.

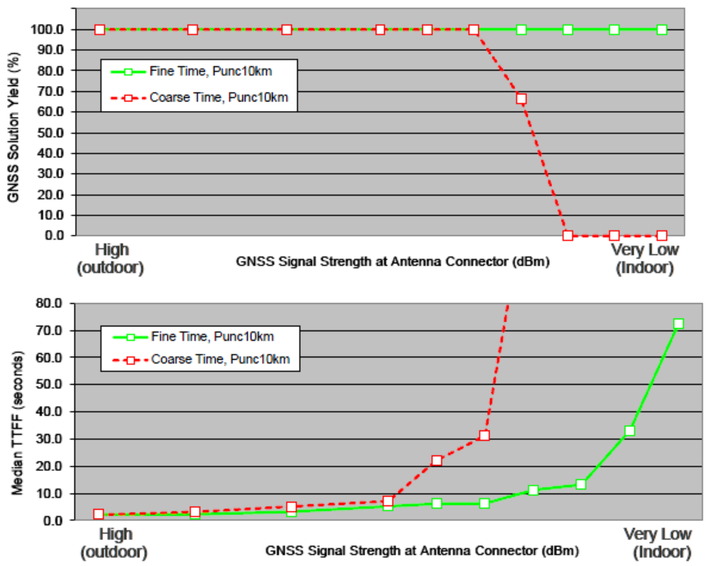



**Figure 9: GNSS Yield, TTFF and sensitivity**

- ALCATEL –LUCENT

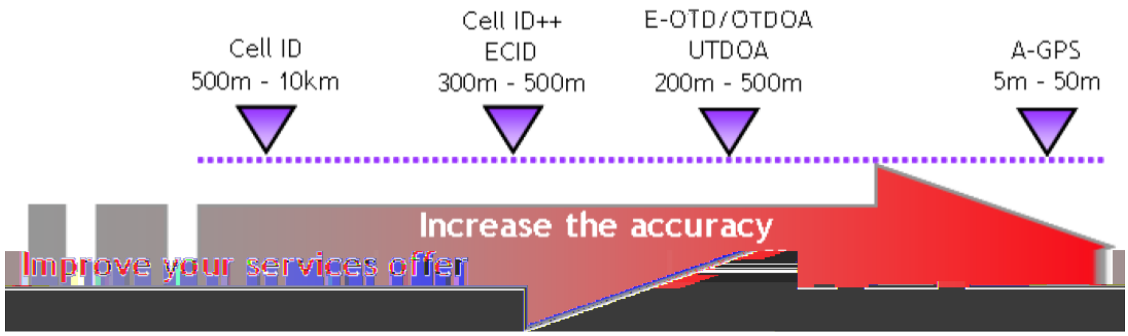
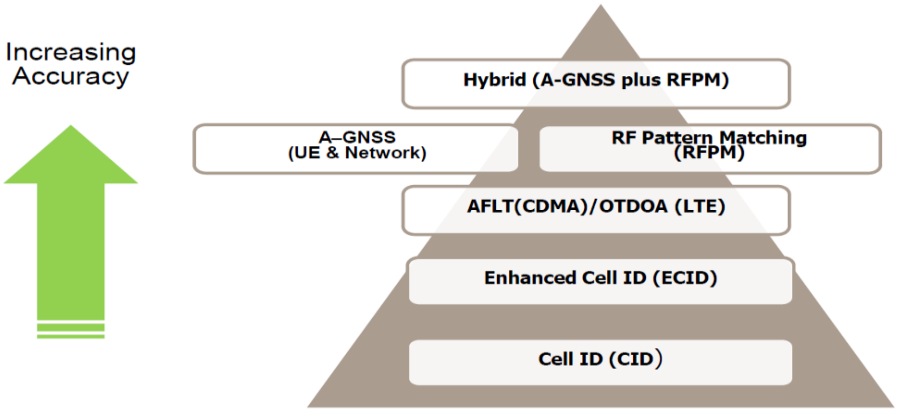



Figure 10: ALPS (ALU Location Server) Performance




| Cell Density (Meters) | Category | Positioning Technology | ALPS Typical Performance (Meters) | |
|---|---|---|---|---|
| | | | 67th Percentile | 90th Percentile |
| 0 - 500 | Dense Urban | RFPM, Hybrid (A-GNSS, OTDOA/RFPM, ECID) | < 45 | < 100 |
| 500 - 1000 | Urban | RFPM, Hybrid (A-GNSS, OTDOA/RFPM, ECID) | < 45 | < 100 |
| 1000 - 2000 | Sub-urban | A-GNSS, Hybrid (A-GNSS, OTDOA/RFPM, ECID) | < 40 | < 100 |
| 2000 - 5000 | Rural | A-GNSS (ECID Fallback) | < 30 | < 90 |
| > 5000 | Rural | A-GNSS (ECID Fallback) | < 30 | < 90 |

**ES Positioning Methods for 3GPP Networks**

| Method | Accuracy/ Performance | Yield | Handset Impact | Cost |
|---|---|---|---|---|
| AGNSS / AGPS | <50 Meters Average | MEDIUM | YES | MEDIUM |
| RFPM | 50-150 Meters Average | MEDIUM | NO | MEDIUM |
| OTDOA | <100m Average | MEDIUM | YES | MEDIUM |
| ECID | 300m – 500+ Average | HIGH | YES | LOW |
| CID | 300-500M+ Average | VERY HIGH | NO | LOW |

AGNSS Assisted Global Navigation Satellite System
AGPS Assisted Global Positioning System
RFPM Radio Frequency Pattern Matching
OTDOA Observed Time Difference of Arrival
ECID Enhanced Cell Identifier
CID Cell Identifier

Figure 11: ES Positioning methods for 3GPP networks

- SWISSCOM

Swisscom has invested considerable resources in developing their own solution for the provision of more accurate and reliable caller location information in Switzerland in order to meet the requirements of the PSAP and national legislation. Swisscom's first solution (Prob3D) was based on the field strengths of antennae; where at each grid 100*100 meter antennas, with higher field strength, get a higher probability and those with the same field strength the same. The field strengths are reused from standard 3D models for cell planning in mobile networks. The resulting probability map for each antenna is converted to one or more polygons, which are then converted to 1-10 ellipsis, which are all transferred to the PSAP.

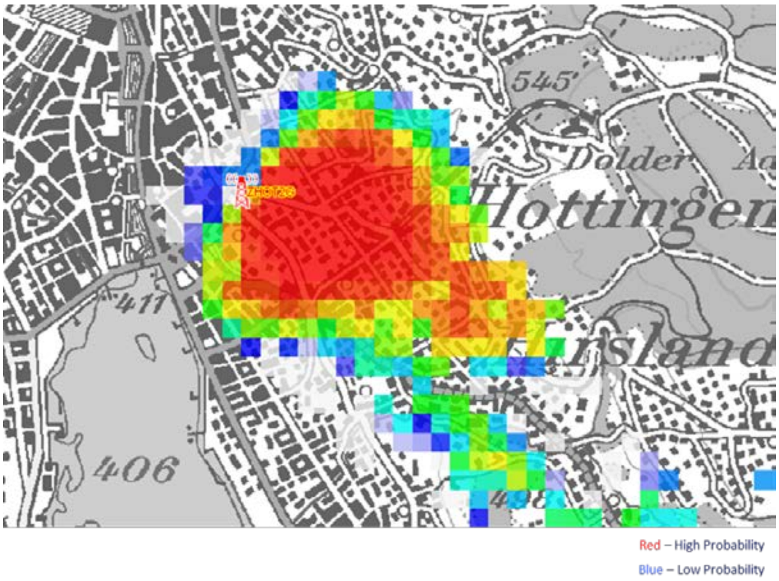



**Figure 12: First results Prob 3D with the probability map for one antenna (Source: Swisscom)**

Swisscom checked the results against real world call set-ups as observed on the network, which proves the quality of the prediction

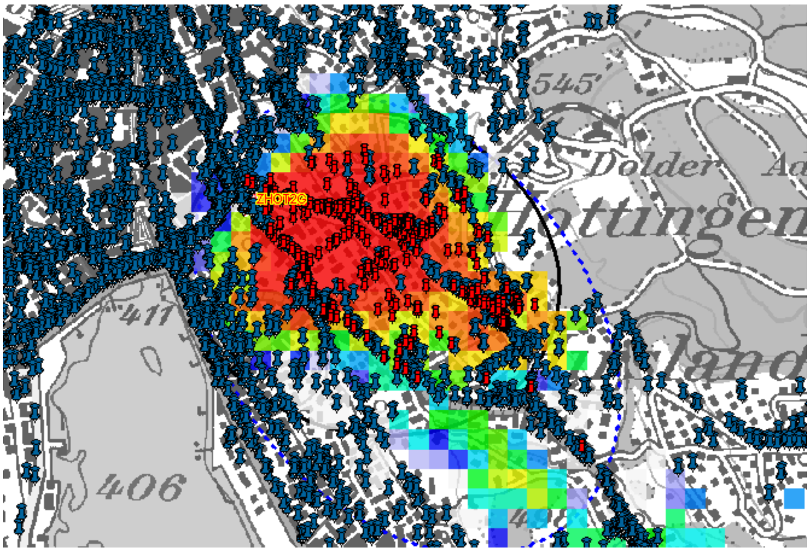



**Figure 13: Probability map with observed real world call set-ups included (Source: Swisscom)**

Prob3D provided much greater accuracy than Cell-ID alone, providing much more accurate and reliable caller location information. In order to further improve the results received, two additional mobile network parameters were included in the calculations, namely Timing Advance (TA) for GSM and Round Trip Time (RTT) for UMTS. This enhanced solution is known as Prob3D+. Swisscom provided real world examples, where these enhancements greatly increase the accuracy in a number of different environments. One such example is illustrated in Figure 9 below, showing the location area for a UMTS test call in Prob3D.

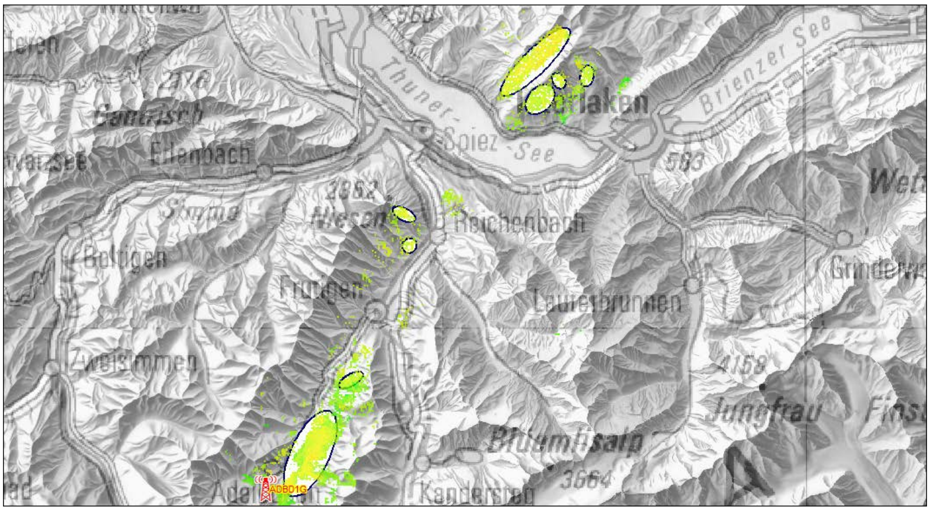



**Figure 14: UMTS call in Prob3D. Location according 3D antenna coverage (Source: Swisscom)**

With the additional calculation of Round Time Trip included, the location area greatly reduces as illustrated in Figure 4 below.


**Figure 15: UMTS call in Prob3D+, 5 km from the antenna, obtained from RTT (Source: Swisscom)**

Swisscom drew the following conclusions based on their experience of implementing Prob3D and migrating to Prob3D+:

- Prob3D was already much better than flatland Cell ID calculation only, as the effects of antenna density, hills and valleys are taken into account too
- Prob3D+ is a another huge improvement, as with the distance obtained from TA and RTT the resulting areas could be reduced even more, while keeping the hit rate above 95%

## ANNEX 5: SUMMARY OF RESPONSES TO PT ES QUESTIONNAIRE

This Annex is contained in a separate accompanying document entitled – “ECC Report 225 – Annex 5”

# ECC Report 225 - Annex 5

Accuracy & Reliability of Caller Location Information for Emergency Services Calls
– Summary of Responses to Questionnaire

Questionnaire prepared by ECC/WG NaN/
Project Team Emergency Services (PT ES)

**Approved 21 October 2014**

# LIST OF ABBREVIATIONS

| Abbreviation | Explanation |
| --- | --- |
| **CEPT** | European Conference of Postal and Telecommunications Administrations |
| **ECC** | Electronic Communications Committee |
| **PT ES** | Project Team Emergency Services |
| **PSAP** | Public Safety Answering Point |
| **ERO** | Emergency Response Organisation |
| **ECAS** | Emergency Call Answering Service |
| **PPDR** | Public Protection and Disaster Relief |

## 1. INTRODUCTION

On 10 October 2013, the ECC/WG NaN's Project Team on Emergency Services (PT ES) issued a questionnaire entitled "Accuracy & Reliability of Caller Location Information for Emergency Services Calls".

The purpose of the questionnaire was to gain feedback and insights from key stakeholders to assist PT ES to develop an ECC Report the purpose of which is to provide guidance to CEPT member countries to implement EU legislative requirements set out in Article 26(5) of the Universal Service Directive (2002/22/EC).

The closing date for responses was 15 November 2013 which was then extended to 6 December 2013.

Questions 1-17 were addressed to emergency organisations/PSAP operators while questions 18 - 27 were addressed to electronic communications network operators with questions 24-27 specifically addressed to mobile network operators.

This document analyses and summarises the responses received to the questionnaire.

## 2. BREAKDOWN OF RESPONSES

The following table provides a breakdown of responses received from organisations representing 26 countries:

| Country | Responding Organisation | Category of Respondent |
|---|---|---|
| Austria | Federal Ministry for Transport, Innovation and Technology (BMVIT) | Ministry |
| Bosnia & Herzegovina | Communications Regulatory Agency BH | National Regulatory Authority |
| Croatia | Croatian Post and Electronic Communications Agency (HAKOM) | National Regulatory Authority |
| Cyprus | Office of the Commissioner of Electronic Communications and Postal Regulation (OCECPR) | National Regulatory Authority |
| | Cyprus Police | Police |
| Denmark | Danish National Police | Police/ Public Safety Answering Pont (PSAP) |
| | Copenhagen Fire Brigade | Fire |
| | TDC | Fixed and Mobile Operator |
| | Telia | Fixed and Mobile Operator |
| | Telenor | Fixed and Mobile Operator |
| | Hi3G (Three) | Mobile Operator |
| Estonia | Emergency Response Centre | PSAP |
| | Technical Surveillance Authority | National Regulatory Authority |
| Finland | TeliaSonera | Fixed and Mobile Operator |
| | Mobile Positioning/DNA | Fixed and Mobile Operator |
| | Emergency Response Centre Administration (ERCA) | PSAP |
| | Elisa Oyj | Fixed and Mobile Operator |
| Germany | Deutsche Telekom | Fixed and Mobile Operator |
| | Bundesnetagentur on behalf of “Expertengruppe Notruf(EGN)” | PSAP |
| | E-Plus Mobilfunk GmbH & Co. KG | Mobile Operator |
| | Vodafone | Fixed and Mobile Operator |
| Greece | Ministry of Infrastructure Transports & Networks (MITN) | Ministry |
| Hungary | Hungarian National Police | Police |
| Ireland | Emergency Call Answering Service (ECAS) | PSAP |
| | Irish Fire Services | Fire |
| | Health Service Executive | Ambulance |
| | Meteor | Mobile Operator |
| | H3GI / Three | Mobile Operator |
| Italy | Telecom Italia | Fixed and Mobile Operator |
| Latvia | State Fire and Rescue Service | Fire |
| | Latvijas Mobilais Telefons | Mobile Operator |
| | Telekom Baltija | Fixed Operator |
| | Bite | Fixed and Mobile Operator |
| Lithuania | Ministry of Transport and Communications | Ministry |
| | The Communications Regulatory Authority of the Republic of Lithuania (RRT) - Co-ordinated response representing the following | |

| Country | Responding Organisation | Category of Respondent |
|---|---|---|
| | stakeholders: | |
| | Omnitel | Mobile Operator |
| | Bite Lietuva | Mobile Operator |
| | Tele2, UAB | Fixed and Mobile Operator |
| | TEO LT, AB | Fixe Operator |
| | Emergency Response Centre (ERC) | PSAP |
| Luxembourg | Luxembourg Regulatory Institute (ILR) | National Regulatory Authority |
| Mauritius | Vijay Boojhawon | Independent Consumer Electronics Professional |
| Montenegro | Agency for Electronic Communications and Postal Services (EKIP) | National Regulatory Authority |
| Norway | Norwegian Post and Telecommunications Authority (NPT) | National Regulatory Authority |
| Poland | Ministry of Administration and Digitisation | Ministry |
| Portugal | Portugal Telecom | Fixed Operator |
| | Vodafone | Fixed and Mobile Operator |
| | Cabavisao Television | Fixed and Mobile Operator |
| Romania | National Authority for Management and Regulation in Communications (ANCOM) ) - Co-ordinated response representing the following stakeholders: | National Regulatory Authority |
| | 112 PSAP operator | PSAP |
| | Romanian National Police | Police |
| | Romanian National Fire Brigade | Fire |
| | Romanian National Ambulance Service | Ambulance |
| | Serviciul Mobil de Urgenţă, Reanimare şi Descarcerare (SMURD) | Emergency Rescue Service |
| | Vodafone Romania | Mobile Operator |
| | Orange Romania | Mobile Operator |
| | Cosmote Romania | Mobile Operator |
| | RCS&RDS | Mobile Operator |
| | Romtelecom | Fixed Operator |
| | GTS Romania | Fixed Operator |
| | NetConnect Internet | Fixed Operator |
| | UPC Romania | Fixed Operator |
| Slovak Republic | Ministry of the Interior of the Slovak Republic | Ministry / PSAP |
| | Orange Slovensko | Fixed and Mobile Operator |
| | Slovak Telekom | Fixed and Mobile Operator |
| | Telefónica Slovakia | Mobile Operator |
| | UPC Broadband Slovakia | Fixed Operator |
| | GTS Slovakia | Fixed Operator |
| Slovenia | Amis | Fixed and Mobile Operator |
| | Debitel Telekomunikacije | Fixed and Mobile Operator |
| | Detel Global | Fixed Operator |
| | Mega-M | Fixed Operator |
| | Novatel | Fixed / VoIP operator |
| | SI.mobil | Mobile Operator |
| | Softnet | Fixed / VoIP operator |
| | T-2 | Fixed / VoIP operator |
| | Teleing | Fixed and Mobile Operator |
| | Telekom Slovenije | Fixed and Mobile Operator |
| | Tusmobil - Mobile | Mobile Operator |
| | Tusmobil - Fixed | Fixed Operator |

| Country | Responding Organisation | Category of Respondent |
|---|---|---|
| Spain | 112 Canarias - Dirección General de Seguridad y Emergencias (Canaries) | PSAP |
| | CAT112 (Cataluña) | PSAP |
| | Axencia Galega de Emerxencias (Galicia) | PSAP |
| | Euskaltel S. A. | Fixed and Mobile Operator |
| | 112 Castilla y León (JCyL) | PSAP |
| | 112 Castilla-La Mancha (JCLM) | PSAP |
| | 112 Murcia (Murcia) | PSAP |
| | France Telecom España (Orange) | Fixed and Mobile Operator |
| | Vodafone Spain | Fixed and Mobile Operator |
| | Telecable de Asturias S.A. | Fixed and Mobile Operator |
| | Yoigo | Mobile Operator |
| Sweden | SOS Alarm Sverige AB | PSAP |
| Switzerland | Orange Switzerland | Mobile Operator |
| | Backbone Solution AG | Fixed / VoIP operator |
| | Sunrise Communications AG | Fixed and Mobile Operator |
| | Swisscom | Fixed /Mobile / VoIP Operator |
| United Kingdom | Ofcom | National Regulatory Authority |

97 responses from 27 CEPT countries representing ministries, NRAs, PSAPs, fixed, mobile and VoIP operators and 1 response from an independent consultant based in Mauritius.

# 3. RESPONSES TO QUESTIONS

## 3.1 QUESTION 1

PT ES has made a preliminary determination that there are three stages within the service chain where caller location information is needed. They are:

1. To establish the correct PSAP? – Using available caller location information the call is routed from the electronic communications network to the corresponding PSAP (i.e. the PSAP responsible for the area in which the incident occurred);
2. To assign the correct dispatch station/emergency team? – based on the responsibility area of each dispatch station/emergency team per discipline (e.g. police, fire brigade, ambulance) the call is further routed from the PSAP to the correct dispatch station/emergency team (usually the closest available to the incident's area);
3. To determine the location of the incident and consequently the best route to reach the emergency incident? – based on more accurate caller location information and information obtained directly from the caller (interview) the best incident location is calculated resulting also in the best route being used to reach the emergency.

Respondents were asked if they agreed with the above stages and to provide an explanation if they had a different view.

## 3.2 SUMMARY OF RESPONSES TO QUESTION 1

The vast majority of respondents agreed with the 3 stages set out in Question 1. There were some who answered no and provided further information explaining why.

**Denmark** (**Danish National Police)** agreed with stages 1 and 2 noting that the PSAP provides the responding emergency service with the incident's area. The responding emergency service then determines the best route to the incident.

**Denmark (Copenhagen Fire Brigade)** agreed but noted that stage 2 will also normally be based on further information from the caller in addition to location since in many cases they also perform the actual dispatch.

**Germany (EGN)** answered yes but noted that in Germany assigning the correct dispatch station / emergency team (stage 2) is a matter for the PSAP taking the call (Stage 1) and managing the emergency service actions. The call is typically not further routed to a dispatch station / emergency team. Stage 3 is covered by the PSAP as well.

**Greece (MITN)** also agreed but stressed that there is only one PSAP operating for 112 calls. It is located in Athens. The other 4 national emergency numbers for police, fire brigade, emergency medical service and coast guard are using their own regional PSAPs.

**Ireland (ECAS)** disagreed as the National PSAP and Emergency Response Organisation (ERO) model in Ireland is slightly different. For the purposes of responding to this questionnaire ECAS has attempted to reference the model used where possible. The PSAP in Ireland is an independent stage 1 filtering PSAP and individual EROs do not entirely fit with stage 2 as defined in Question 1. In the Irish model there is a single independent stage 1 PSAP which utilises caller location information to identify the correct Emergency Service and indeed division within the individual services is identified based on operational areas of responsibility. Any available caller location information associated with an emergency call is passed directly to the responsible ERO.

**Lithuania** answered "No" for stages 1 and 2 and "Yes" for stage 3. The reason for this is that in Lithuania, emergency call routing is a different mechanism defined by competent authorities (such as Ministry of the Interior and Ministry of Health) and submitted to public network operators so that they know the PSAPs and the areas they serve and route emergency calls accordingly. We believe that in the scope of Universal

Service Directive location data is supplementary to a voice call and the main purpose of it is to locate an incident rather than to find an appropriate PSAP.

**Montenegro** agreed noting that within the Operational Communication Centre's (OKC 112) systems there is a possibility to integrate with a centralised system for managing traffic signals. However as there is no such centralised system in Montenegro it is not possible for OKC 112, in the case of an accident, to define the nearest route to the scene of an accident.

**Poland** agreed and elaborated by stating that the PSAP is responsible for answering emergency calls and then passing the information, including caller location information, on incidents to a correct dispatch station. The PSAP is not responsible for dispatching and is not involved in determining the best route to reach the emergency location. Currently, the call is answered by the PSAP responsible for the area in which the incident occurred or one substitute PSAP. In the future (2014), in order to reduce the time needed for answering, the calls will be answered by any of 17 PSAPs in Poland who will have the ability to establish caller location and assign to the correct dispatch station.

**Romania** disagreed with the sequencing of the stages. The answers it received from the 4 emergency organisations and the national PSAP operator determines that the correct chain of events in Romania is not 1,2,3 but actually 1, 3, 2 (i.e. determine the PSAP, determine the location of the incident and then dispatch the emergency team). See further details in the answer to Question 2.

**Spain (Galica)** agreed but clarified certain issues regarding each of the stages based on its own experiences:

a) Regarding stage 1, a small percentage of calls (1%) that are made from territories bordering Galicia (Portugal, Castilla y León and Asturias) that are routed to our 112 PSAP in Galicia, should be routed to their respective 112 emergency centers.
b) Regarding stage 2, currently it does not integrate all the 112 services (fire brigade, ambulances, police, etc.), and most of the time it has to carry out additional steps with the emergency call, in order to transfer data to the resources mobilised for the emergency.
c) Regarding stage 3, in some cases the location area from which the emergency call is provided by the mobile operators, covers an extensive area, especially with calls originating in rural areas. In this case, the information it can offer in order to locate the emergency is limited.

**Spain (Vodafone)** noted that every emergency number (short code) that requires location information has a translation to a longer number (normally a geographic number of the national numbering plan). The translation tables from the short code to the long numbers determine another variable, the location. Using specific rules dependent on the type of service (fixed, mobile or nomadic) the location information and based on this, the translation is made from short code to long number and the call is then routed. Vodafone has detected an increasingly complex system to deliver a call to an emergency centre. 112 in Spain is the competence of each Autonomous Community and sometimes there is more than one number to deliver the call to the emergency centre. Considering all the emergency services and all the circumstances there is a really complex system where there are 364 different end-points to deliver calls to depending on the location of the user. This leads to ambiguous situations, for instance, when the service has different numbers for different areas that can be covered by the same cell.

**Sweden (SOS Alarm)** agreed with stages 2 and 3. For stage 1 it currently only uses "municipality ID" to guide the call to the correct PSAP. However, it intends to review using caller location here as well.

### 3.3 QUESTION 2

This question requested the views of respondents on whether or not they saw any additional uses of caller location information other than those mentioned in Question 1. (e.g. other critical stages where location information is needed, other relevant details related with these stages, from a location information perspective). Respondents were asked to provide as much information as possible.

### 3.4 SUMMARY OF RESPONSES TO QUESTION 2

14 respondents answered "No" to this question with **Ireland (Fire Service)** stating that the list was comprehensive and **Poland** noting that the 3 stages outlined in the questionnaire provided a sufficient mechanism to assign the correct emergency team.

14 respondents answered "Yes" and 13 of those provided additional information.

**Austria** considers that additional uses could include identifying nearby parallel incidents, identifying multiple messages on the same incident and identifying similar/other incidents at that location that occurred in the past.

**Croatia**, **Montenegro**, **Slovak Republic** and **Spain (JCLM)** consider that the information could be used effectively to identify fake, hoax or false calls to the emergency services by comparing the content of the call with the caller location.

**Denmark (Danish National Police)** noted that in Denmark the fire service can define special objects at a particular location (e.g. stores of ADR[1] goods). Thus the emergency service can take precautions in an early stage of the incident.

**Denmark (Copenhagen Fire Brigade)** stated that major incidents often produce multiple calls. If caller location is of a reasonable quality (GPS level accuracy) it can also be used to determine the order in which to answer calls. Calls originating in the close vicinity of an already-reported incident are more likely to be an additional call about the already-known incident, so it makes more sense to answer other calls first.

**Finland (ERCA)** considers that caller location information could be used to locate persons that are lost or in distress and **Norway** has a similar view stating that whenever the caller is unable to, or due to the nature of the specific situation does not want to, explain where he/she is.

**Hungary (Hungarian National Police)** considers that caller location information can sometimes be very useful for the public emergency warning systems for example in the case of nuclear power plant accident or a mass collision on the highway. By analysing caller location information from multiple calls, the PPDR organisations are able to evaluate the geographic scope of situation.

**Ireland** (**ECAS)** considers that it would be useful in some cases to be able to report current or recent track (actual course over ground as distinct from heading) for the caller if available to the EROs. This would be of great benefit, for example with incidents such as accidents on motorways, by allowing the EROs to identify the correct carriageway and save valuable time in reaching people. This is incorporated in the eCall standards but would also be of use for conventional calls from mobile phones. Caller Location may also be of use at some time in the future to identify clusters of incidents or emergencies and also allow emergency services to quickly determine if additional calls received are in relation to incidents they may already be responding to (e.g. multi-vehicle accidents, or incidents observed by multiple passers-by). Highly accurate (<5m) caller location information could also be of use to the emergency services to direct the actions of callers in need of assistance if used with accurate mapping and GIS information.

**Switzerland (Swisscom)** considers that caller location information could be used in the process of legal interception where, for example, a child has been kidnapped.

**Sweden (SOS Alarm)** always needs to get a position where the caller is located (if he is at the site of the event). It provides an opportunity for fast and efficient handling of the case by being able to send alerts resources to the right place. Other uses include informing the caller about where the nearest defibrillator (AED) is available. This is used today in the Stockholm area and will be extended over additional areas in Sweden. One should not forget the inverse relationship to caller location, i.e. be able to position the mobile phones that are within a certain geographical area in order to warn them if some accident/emergency events occurs, such as gas emissions. Here is a precise positioning as possible important. In Sweden is such a model under development. The technology is in place, but it requires a change in the law in order to get a

[1] ADR (formally, the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR)) is a 1957 United Nations treaty that governs transnational transport of hazardous materials. "ADR" is derived from the French name for the treaty: **A**ccord européen relatif au transport international des marchandises **D**angereuses par **R**oute).

generally position within a geographical area in these specific cases. Desirable is a unified (European) vision and standard for this.

**Romania** did not answer “yes” or “no” but provided the following information relating to the steps it follows in handling an emergency call:

1. Call is routed to the right 112 PSAP based on A-number geographic prefix (also for mobile);
2. Cell id/sector id information is passed to the 112 PASP together with the call, in the SS7/ISUP/IAM;
3. The 112 PSAP establish the cell coverage based on a database of cell features sent/updated offline by the mobile operator;
4. The 112 PSAP call taker answers the call (interview begins) – T0 moment; questions related to location and type of emergency are being asked (procedure) – assess location and agencies involved; interview has a max target time of 40 seconds (T0 + 40);
5. Upon assessment, call is passed to relevant agencies’ PSAPs (police, fire brigade…), at county level, including location on GIS maps – call conference;
6. Each agency conducts its specialised interview, if needed, to establish the type and level of intervention needed; also further questions regarding location, if needed, may be asked – total max target time 2 minutes (T0 + 120);
7. The agencies’ intervention teams are being dispatched; depending on the type of intervention and location of the incident the max target times are between 8 and 20 minutes for cars or 1 hour of flight for helicopters; location info is passed via specific resources available (usually TETRA terminals); limited availability of GIS map representation of the incident location; intervention teams are dispatched even if there is no accurate incident location info available;

**Questions 3 to 7** aim to gather different views regarding important aspects of the accuracy and reliability features of the 112 caller location information which will help shape the definition of the terms “accuracy” and “reliability” of caller location information to be used in the ECC Report.

### 3.5 QUESTION 3

In Question 3, emergency organisations/PSAP operators were asked if they define any requirements or criteria regarding the "accuracy" of the 112 caller location information. If yes, more information on those definitions was requested.

### 3.6 SUMMARY OF RESPONSES TO QUESTION 3

26 respondents answered “No”. Of those some additional remarks were included.

**Croatia** stated that it would be helpful for PSAPs, emergency services and safety of citizens (interest of states) to have any acceptably accurate positioning system.

**Finland (ERCA)** made a remark that accuracy is equal to meters from real location.

**Hungary (National Police)** commented that it used to have a regulatory backbone solution but it currently does not have this.

**Ireland (ECAS)** stated that it requests caller location information but it does not define the required accuracy. This is not currently within the remit of ECAS as the Stage 1 PSAP for Ireland. Fixed line and mobile operators are directed to provide the “best available information” in line with current EU Directives however no other criteria have been defined. The individual agreements that ECAS has in place with the various mobile and fixed line operators cover the requirement to provide caller location information but do not define the required accuracy or reliability.
http://www.btirelandwholesale.com/pdf/-RIOLIROMainBodyExecutionVersionGenericV3_2.pdf

**Lithuania** stated that according to a national legislation, the ERC shall propose location information accuracy and reliability criteria to the National Communication Regulator which in turn shall define these criteria.

**Norway** stated that its national requirements are outlined in the Norwegian Electronic Communications Act and the Norwegian Regulations on Electronic Communications Networks and Services (Ecom Regulations). NPT provides the requirements based on the regulations. The emergency organisations/PSAPs give inputs to NPT regarding "accuracy" and other aspects with regard to emergency communications.

**Poland** stated that there is only a general regulation based on article 78.3 of 'The act of 16 July 2004 Telecommunications Law" indicating that ˜information on the location of a network termination point shall mean: 1) for a public fixed telecommunications network "detailed address of a network termination point installation; 2) for a public mobile telecommunications network "geographic location of publicly available telecommunications services user terminal".

**Romania** stated that no special requirements are currently used. The mandatory requirements apply (cell id/sector id for mobile service, postal address for fixed service, and declared address with special flag in address database for nomadic service).

**Sweden (SOS Alarm)** does not define additional requirements, but on the other hand, its customers require a precise alert address/location and they do not care how they get it.

<u>5 respondents answered "Yes"</u> and provided the following information.

**Ireland (Fire Service)** answered "Yes" and supposed that pinpointing the caller's actual location, and if possible predicting motion, would be advantageous.

**Montenegro** provided the following details: Due to Article 12. Regulation of the quality of service parameters, limits and methods of measurement parameters for the use of the single European number 112 for emergency calls (Sl.CG, no. 64/2009 of 22.9.2009.):

a) All data provided about location must be accompanied by the identification of the network from which the call begins;

b) Fixed public telephone network operators are obliged to make available the installation address lines from which 112 calls were made, with the requirement that the location area of the caller from a landline does not exceed 100 m2;

c) Public mobile operators are obliged to provide the information about the caller's location, according to the requirement that the area of a circle that determines the caller's location, to be within the circle of radius 100m in 67% of calls or within a circle of radius 300m with 95% of calls across the network based technology;

d) Operators process location data on a non-discriminatory manner. It is specifically prohibited to discriminate between the quality of data about its subscribers and other users of public telephone networks;

e) Software applications that are used to process information about location on the operator side, must support the technology for the processing of caller location, based on calculations time difference dispatch receiving signals from base stations, which allows obtaining information about the location with the required degree of accuracy specified in paragraph 3 of this Article;

f) Operators are required to contact the ministry in charge of electronic communications, for approval - a positive opinion on the equipment, software and hardware that processes information about the caller's location, in order to provide the criteria and parameters to be single platform.

In the **Slovak Republic**, according to the Decree of Ministry of Interior of the Slovak Republic no. 91/2013, providers of fixed telephone networks must provide the address of where the end user terminal is installed. Providers of mobile communications networks must provide sector ID.

In **Spain (Galicia)** the current caller location system for mobile terminals (75% of total calls) could be improved if instead of working with a probability area, it could deal with a GPS position from where the call is made.

**Switzerland (Swisscom)** specified the following criteria:

a) Criterion for “fixed” or “mobile”: Method of location estimation - Criterion “size”: Diameter of the circle, which has an area which is the same as the sum of all location areas delivered for one call (we have in Switzerland per call 1..10 ellipsis);
b) Criterion “hit rate”: percentage how many from 100 calls are in reality inside the location area. This criterion is at least as important as the size. A small size with a bad hit rate is very different in comparison to a small size with a very high hit rate.
c) Criterion “average size city/rural/mountain”: Average size (see definition above) of calls in city/rural/mountain. IMPORTANT: Don’t make a statistic of all cells in the respective areas, as one cell can cover a much larger area, than many small cells somewhere well hidden in a city. We therefore define the average size depending on a test track with a car in the respective area, where we make all 20 seconds a call. The cells hit by these calls are used to calculate the average size of the cell. This reflects better the real world situation, where emergency calls can start anywhere.

While not answering “Yes” or “No”, **Denmark (Copenhagen Fire Brigade)** stated that the requirements depend on the stages outlined in Question 1:

Stage 1: To establish the correct PSAP – Base station coverage area (“Cell ID”) will suffice (but will also generate errors)

Stage 1a: Selection of call answering order - Position within 100 meters. Must be accompanied with quality data e.g. with 90% probability within a reported radius. The more accurate the better until a radius of 5 meters after which further accuracy does not matter greatly.

Stage 2: To assign the correct dispatch station/emergency team - In addition to position within 100 meters with quality data, further incident information (subtype of incident) is needed for dispatch. The more accurate the better until a radius of 5 meters after which further accuracy does not matter greatly.

Stage 3: To determine the location of the incident and consequently the best route to reach the emergency incident - Position with 50 meters (the more accurate the better). Must be accompanied with quality data e.g. with 90% probability within a reported radius. The more accurate the better until a radius of 5 meters after which further accuracy does not matter greatly.

**Ireland (HSE Ambulance)**, while also not answering ”Yes” or “No”,  stated that if X and Y coordinates are available this also assists with location identity.

**Greece**, while not answering “Yes” or “No” listed the current requirements in force regarding the accuracy of the “112” caller location information. They are:

a) for fixed telephone connection: the physical address of the fixed telephone connection,
b) for mobile telephone numbers: the best possible accuracy that can be achieved through existing technological capabilities.

There is also a legal obligation for mobile network operators that have location based systems in their networks that allow for better accuracy than the coordinates of the Base Station to provide this type of information.

## 3.7 QUESTION 4

In Question 4, emergency organisations/PSAPs were asked if they saw the requirements for “accuracy” linked to:

a) information transmitted by the electronic communications network?

b) information transmitted by the end-user terminal equipment?

c) information provided directly by the caller, during the emergency call?

d) other type of information (please specify)?

e) Or, do you believe that there should be differences in requirements between different types of voice services (fixed, mobile, nomadic)? Please elaborate on this.

### 3.8 SUMMARY OF RESPONSES TO QUESTION 4

The following table summarises the responses received including additional comments:

| Country | Organisation | a | b | c | d | e | Remarks |
|---|---|---|---|---|---|---|---|
| Austria | BMVIT | Y | Y | Y | Y | Y | Accuracy needs to be the best possible for each individual case |
| Croatia | HAKOM | Y | Y | Y | | | |
| Cyprus | All | Y | Y | Y | | | |
| Denmark | Police | Y | Y | | | | Especially with mobile and nomadic service which is often used |
| | CPH Fire Brigade | Y | Y | | | | - **For Fixed:** Reliable directory service with official address verification ("geocodable")<br>- **For Mobile:** a + b (eCall like behavior)<br>- **For Nomadic:** a + b (for mobile nomadic an eCall like behavior, for fixed nomadic a real A-number, not just the A-number of the entry point into the fixed network) |
| Estonia | All | Y | Y | Y | | | |
| Finland | ERCA | Y | Y | | | | |
| Greece | | Y | ? | Y | | | The information concerning the name of the caller, may be very helpful as the Emergency Services can take any possible information about the exact location of the caller (being on a mountain, or in a boat on the sea), contacting to his/her home family.<br>In relation to point e) we believe that there's a greater need for setting accuracy requirements in mobile telecommunications and nomadic voice services, as this would facilitate the process of locating the caller. |
| Hungary | Police | Y | Y | | | | In these cases the harmonised legislation seems to be relatively simple |
| Ireland | ECAS | | | | | Y | The PSAP Operator and Emergency Service Call Taker should be provided with the best possible information in terms of reliability and accuracy however it should be noted that at various stages of the call and call handling process, the available information can change or be updated e.g. a mobile call may be initially presented with cell mast location only, a few seconds later this could potentially be updated with a caller provided location or indeed a user terminal supplied location (e.g. apps or eCall) or indeed a mobile network derived location via MLS query. The Call handling process should utilise the most up to date and accurate information however this currency, accuracy, and reliability of the different sources or feeds of caller location will need to inform and direct the call handling process and be clearly displayed to the PSAP and ES operators.<br>Requirements and Criteria for the accuracy of Caller Location information should apply to any and all information which can be provided in advance of the call (e.g. database submissions for fixed line installation and Cellular network Cell ID information) and also to any information provided or derived at the time of or during the call including Information provided by the Cellular network (e.g. Cell ID presented with the call and also network derived or handset supplied location to be made available in real-time during the call via mechanisms such as MLP – mobile location protocol or other methods)<br>Differences in requirements and criteria for the provision of caller |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | location information between different types of Voice services are and will continue to be necessary arising from the fact that the type and use of the service as well as the potentially available information will always differ. E.g. for a Traditional home or small business POTS (or derivative) installation, 100% accuracy and reliability in terms of the Installation address should be expected however in the fixed line case of Corporate installations with centralised telephony systems caller location will not always be at the line installation location. This fact however (i.e. that this installation may serve multiple callers not located at the installation address) should be clearly presented to and understood by both the PSAP operator and The Emergency Service call taker by the Telecoms installation provider so that is can be appropriately used in the call handling and assistance processes.<br><br>As the type and source of Caller location varies depending on the type of the call and also potentially varies during the course of the emergency call it is expected that the accuracy and reliability criteria will also need to reflect this and a model may need to be developed that incorporates the various types of information as well as the use of any subsequently provided or updated information. |
| | Fire Service | Y | | | | | |
| | HSE (Ambulance) | Y | Y | Y | | | |
| Latvia | All | Y | | | | | |
| Lithuania | All | Y | | | | Y | There are different ways of a transmission of location data from fixed line and mobile data, so are different accuracy criteria for both. |
| Luxembourg | ILR | Y | Y | | | | |
| Mauritius | Vijay Boojhawon | Y | | | | | |
| Montenegro | EKIP | | | | | | There should be no difference between these voice services. The current state should be identical to all three services. With the existence of address model, digital maps with address, location of the caller from a landline is directly related to that address, and it can't be more accurate. For mobile services everything is defined in the response for previous question, and it depends of that does the informations go through electronic communications network or via the end-user terminal equipment. |
| Norway | NPT | Y | Y | | Y | Y | Information is collected from "The National Reference Database" (NRDB). All available caller information is accessed via the NRDB. PSAPs only deal with the interface to the NRDB. |
| Poland | Ministry of Administration and Digitisation | | | | | | The general criteria listed in the article 78.3 of ˜The act of 16 July 2004 Telecommunications Law" are currently sufficient for the PSAP to establish caller location and assign the correct emergency team to the emergency incident. |
| Romania | All | | | Y | | Y | Interview and interviewing techniques are also very important and cannot be substituted by automated location; location questions during interview are compulsory in order to locate the incident (not necessarily the same thing with the location of the caller), to detail the location via e.g. points of interest in the area, to confirm the correctness of the position obtained |
| Slovak Republic | PSAP | Y | | Y | | | Also see answer to question 3 |
| Spain | Canaries | | Y | Y | | | |
| | Cataluña | | | | | | For a PSAP, ideally the level of accuracy should be independent of the technology. In fact, it can be considered a margin of error "reasonable" to give mobile calls. |
| | Galicia | | | | | Y | Requirements should by different depending on the type of voice calls (fixed, mobile or nomadic). If we work on a fixed voice call, the precision is good because we are working with a GPS point, but with a mobile phone call the accuracy in finding the location is very important because it depends if the call comes from an urban or a rural area. |
| | JCLM | Y | Y | | Y | Y | D: CMT database<br><br>E: Yes, we believe that different types of voice services require different criteria (for example: size of the probability area in mobile |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | calls, or the age of the information in fixed phones) |
| | JCyL | | | Y | | | We see the accuracy of the 112 caller location information definition linked to the information provided by the caller, during the emergency call. To check and to confirm any other information related to location data and generated by the networks, by asking directly the caller during the interview, constitutes a basic operative procedure for us. |
| | Murcia | Y | Y | Y | | | |
| Sweden | SOS Alarm | Y | Y | Y | | Y | Yes. Basically, we wish an accuracy of 2 meters. However, we recognise the difficulties for telecom operators to always be able to deliver such accuracy. If we know that we always get an accurate end-user position, we can initially be satisfied with an approximate net position from the network referred to in paragraph (a) and (b) below.<br>- A: Direct in the conversation an approximate position is delivered with an accuracy of about 1000 m, which gives us a municipality.<br>- B: Within 30 seconds end-user terminal delivers a GPS position with accuracy of 2 meters.<br>- C: We cannot make any claims on the caller<br>- D:-<br>- E: We want to have the same kind of requirements on all types of communication. Our ambition is to build a more precise position over time, i.e. an approximate position from the beginning and as soon as possible a more precise position. Even nomadic IP must be able to be positioned. |
| Switzerland | Swisscom | | | | | | There should be different requirements for devices which are used on a fixed address and such for devices moving in different access networks. In the second case the requirements should be linked to all technical elements in the call chain, which can influence the accuracy: - a) information transmitted by the end-user terminal equipment: transport without errors, deliver the source of the information too - b) information transmitted by the end-user terminal equipment: Accept them as additional info for PSAP, but if they do, to follow a set of recommendations, where all PSAP have to agree on. Recommendations can be for example to deliver at least beside the localisation the age of information. Problem here: No possibility to enforce any requirements - d) requirements for all access network providers in a country, see the upcoming standards for VoIP calls in the group m493 at ETSI (Swisscom does participate there too). Requirements should be the method used for localisation, and for each method additional technical minimum requirements on the quality of the implementation, as there are many ways to implement them. We have seen many very bad implementations, with a lot of errors. If access networks are not challenged with real-world tests, these errors are never corrected. - Requirements for the VPN case as defined from a contribution of Swisscom in m493 at ETSI |

## 3.9 QUESTION 5

In Question 5, emergency organisations / PSAPs were asked if they define any requirements regarding the “reliability” of 112 caller location information and to provide that information is relevant.

## 3.10 SUMMARY OF RESPONSES TO QUESTION 5

24 respondents answered “No” that they did not define any requirements for “reliability” of caller location information.

Of these, **Croatia (HAKOM)** added that the PSAP is the end-user of caller location information provided by electronic communications operators but that it had no impact on strategic decisions and policies in relation to this matter. Nevertheless, it considers that there should be criteria set regarding “reliability”

Similarly, the **Hungary (National Police)** stated that the emergency organisations do not have competence to regulate the parameters of reliability but they do have needs. Usually these requirements are fitted with the capability of the network providers' infrastructure.

In **Ireland** the **ECAS** stated "No" under current legislation and agreements whereas the **Fire Service** stated "No" based on proven technologies.

**Lithuania** also stated "No" but according to national legislation ERC shall propose location information accuracy and reliability criteria to the National Communication Regulator which in turn shall define these criteria.

**Norway** stated "No" and referred to its remarks on Question 3 which state that its national requirements are outlined in the Norwegian Electronic Communications Act and the Norwegian Regulations on Electronic Communications Networks and Services (Ecom Regulations). NPT provides the requirements based on the regulations. The emergency organisations/PSAPs give inputs to NPT regarding "accuracy" and other aspects with regard to emergency communications.

In **Poland** the answer is also "No" but like Lithuania provisions exist in legislation. According article 78.6a of ˜The act of 16 July 2004 Telecommunications Law" the President of the Office of Electronic Communications may specify, by means of a decision for a particular operator, detailed requirements concerning the accuracy and reliability of a network termination point location for public mobile telecommunications networks, taking account of technical capabilities and prospects for network development of a particular operator as well as the need to precisely locate the network termination point in order to provide effective help by statutory emergency services. The decision shall also specify the schedule to adapt the network to the requirements specified in the decision with respect to accuracy and reliability of the network termination point location.

7 respondents answered "Yes" with the following additional information provided.

The **Czech Republic's** requirement is that the caller must be within the provided area in at least 70% of cases.

**Denmark (National Police)** stated that if the location information is not reliable (based on some definition) you must be able to take other considerations into account.

**Finland (ERCA)** stated "Yes" and considers that reliability = real-time. If the information is older than 5 days it will not be used.

**Montenegro** stated "Yes" and cited Article 12.  – Regulation of the quality of service parameters, limits and methods of measurement parameters for the use of the single European number 112 for emergency calls.

The **Slovak Republic** stated "Yes" and cited the Decree of the Ministry of the Interior of the Slovak Republic no. 91/2013, which states that providers must provide identification or callers location within 15 seconds in at least 99,5% of cases.

**Switzerland (Swisscom)** also answered "Yes" stating a requirement for a 95% hit rate with an availability requirement of 99.7%.

**Denmark (Copenhagen Fire Brigade)** did not answer "Yes" or "No" but referred to its answer to Question 3 i.e. position should be accompanied with quality data e.g. with 90% probability within a reported radius

**Ireland (HSE Ambulance)** also did not answer "Yes" or "No" but stated that X & Y coordinates, however if the person is making the call for someone else, (patient) then their location details  necessary also.

### 3.11 QUESTION 6

In Question 6 respondents were asked if they saw such requirements/criteria for "reliability" linked to the following 5 options (and if option e was selected to elaborate with more information):

a) the degree of trust of the source generating the location information (e.g. a location information generated by the end-user terminal equipment might be less reliable than an information generated by an electronic communications network)
b) the means (technologies and/or transmission lines) used to generate and transmit the location information from the electronic communications network side to the PSAP/emergency side (e.g. using network components with high reliability or redundancy)
c) issues related to the interpretation of the information received (e.g. use of different geo-referencing systems on the transmitting side and on the receiving side might cause different information being generated)?
d) existence of means to verify, in a timely manner, that the location information received is compliant with the applicable rules (e.g. the information provided which should meet an accuracy level of x does actually meet this requirement)?
e) other issues (please specify)?

### 3.12 SUMMARY OF RESPONSES TO QUESTION 6

| Country | Organisation | a | b | c | d | e | Remarks |
|---|---|---|---|---|---|---|---|
| Austria | BMVIT | Y | | | Y | | |
| Croatia | HAKOM | Y | | Y | | | The harmonised solution across Europe should ensure criteria in all EU states. |
| Cyprus | Police | Y | Y | Y | | | |
| | OCECPR | Y | Y | Y | | | |
| Czech Republic | CTO | | Y | | Y | | |
| Denmark | Danish National Police | | | | | | Yes |
| | CPH Fire Brigade | Y | Y | | | | |
| Estonia | All | Y | Y | Y | | | |
| Finland | ERCA | Y | Y | | Y | | |
| Greece | | n/a | Y | n/a | Y | | In relation to point e) other issues the information concerning the name of the caller, may be very helpful as the Emergency Services can obtain helpful information about the exact location of the caller (being on a mountain, or in a boat on the sea), contacting to his/her home family, which can be verified with the electronic communication network information. |
| Hungary | National Police | Y | Y | Y | | | |
| Ireland | ECAS | Y | Y | Y | Y | Y | Remark on a): The source of caller location information should be considered in terms of the reliability of that information to be used in Call handling and Emergency Caller location. This is particularly relevant to user supplied information e.g. the Handset supplied information or indeed subscriber provided address details used for VoIP Service accounts which are typically not verified by the provider. Higher reliability requirements should be expected and associated with Service provider supplied information.<br><br>Remark on b): It should be clarified however that the protocols and standards for the transmission of location information (once determined) should control or eliminate the possibility for transmission error i.e. if a location is to be transmitted it should be verifiable at the receiving side as being 100% correct or it should simply be ignored if it cannot be verified as being transmitted correctly. The reliability of the transmission of caller location (i.e. once the information is received can it be considered accurate and reliable) is considered to be a different question to availability as a function of the ability to send or receive the information dependent on reliable transmission and redundancy.<br><br>Remark on c): Again however it should be clarified that the protocols, standards and mechanisms for the transfer of caller locations information should eliminate the potential for this type of interpretation error. Standard coordinate reference systems are widely used and it is expected that agreement on the CRS to be used in specific cases would eliminate these errors. |

| | | | | | | | |
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| | | | | | | | Remark on d): The definition of a Timely manner however is expected to involve some discussion. If this is taken to mean validation and verification of information available at the time of the call then the expectation is that this could only be achieved through the comparison of multiple sources of information (e.g. Cell Location and Handset supplied GPS co-ordinates). If multiple sources of caller location information are available then it may be reasonable to expect that the decisions and location components of the PSAPs systems would indicate reliability based on a relative comparison of multiple sources of information. In practice however this could be quite difficult to achieve and report on requiring significant changes to the existing systems.<br><br>After the fact reporting (either automated or manual) or indeed data sampling (through drive testing or other means) can also provide some indication that the data provided is compliant with the relevant criteria however these methods will also add to the cost of PSAP operations.<br><br>Remark one): Any agreed or mandated criteria for reliability should clearly define “reliability” and should specifically incorporate and reference “availability” of information as a component of reliability as covered above. |
| | HSE | | | | | | CLI and location information should be transmitted by the communication device in every instance and verbal and other communication methods should complement this. |
| Latvia | All | Y | Y | | | | |
| Lithuania | All | Y | Y | Y | Y | | |
| Luxembourg | ILR | Y | Y | Y | | | |
| Mauritius | Vijay Boojhawon | Y | | | | | |
| Montenegro | EKIP | Y | Y | Y | Y | | |
| Norway | NPT | Y | Y | Y | Y | | |
| Poland | Ministry of Administration and Digitisation | | | | | | The regulations of ˜The act of 16 July 2004 Telecommunications Law” are currently sufficient for the PSAP to establish caller location and assign the correct emergency team to the emergency incident. If necessary, according the article 78.6a of ˜The act of 16 July 2004 Telecommunications Law”, the President of the Office of Electronic Communications may specify, by means of a decision for a particular operator, detailed requirements concerning the accuracy and reliability of a network termination point location for public mobile telecommunications networks. |
| Romania | All | | Y | Y | Y | Y | The reliability issue, as a general concept, should be kept in mind and dealt with during the design of the specific technical implementing solution phase (i.e. the solution for passing the location information from telecom side to emergency side and inside emergency). |
| Spain | Canaries | Y | | | | | |
| | Cataluña | | | | | | No |
| | Galicia | Y | Y | | Y | | |
| | JcyL | | | | | | We see the reliability of the 112 caller location information definition linked to the information provided by the caller, during the emergency call. To check and to confirm any other information related to location data and generated by the networks, by asking directly the caller during the interview, constitutes a basic operative procedure for us. |
| | JCLM | | | Y | | | |
| | Murcia | Y | Y | Y | Y | | |
| Sweden | SOS Alarm | Y | Y | Y | ? | ? | It would be very interesting, if we can get an indication of the reliability together with the incoming emergency call, for example, information on the technology that generated the position, if it is the same geodatasystem as the PSAP uses, when the position was last updated etc. |
| Switzerland | Swisscom | | | | | | It is very important that a minimum hit rate is defined, required and tested in a regular way by independent companies. Based on experience in Switzerland a minimum hit rate of 95% should be defined and tested. Any hit rates below this criterion create unnecessary insecurity on level PSAP. |

### 3.13 QUESTION 7

In Question 7, respondents were asked if they believed that there should be differences in the definitions between different types of voice services (e.g. fixed, mobile, nomadic) and to elaborate on their response.

### 3.14 SUMMARY OF RESPONSES TO QUESTION 7

16 respondents answered “Yes”.

**Croatia (HAKOM), Germany (EGN) and the Hungary (National Police)** added that different technologies with different capabilities and using different methods for positioning require different definitions.

**Ireland (ECAS)** agreed noting that different means of determining caller location already dictate to a great extent the differences in definitions for accuracy and reliability between different types of voice services. For Fixed line services it should be considered that there is a relatively slow installation/deployment/change rate and that in general fixed line by definition identifies a place where that installation is located. It is therefore not unreasonable to expect 100% availability and reliability, as well as accuracy of <10m of provided location for fixed line installations. For Mobile Services this again is highly dependent on the technologies both on the handset and within the network itself and the criteria for availability, accuracy and reliability are likely to be complex. For Nomadic services such as VoIP this is a much bigger consideration e.g. it could be expected that there should be 100% reliability in stating that the line in question is in fact a potentially Nomadic service but beyond that further criteria are required in terms of accuracy and reliability.

**Ireland (Fire Service)** considers that Nomadic is the issue nowadays.

**Finland (ERCA)** stated that in fixed lines the installation address should be provided whereas in mobile a measured point should be provided.

**Norway** stated that there should be 3 levels of requirements based on the nature of the types of voice service: 1. Fixed, 2. Nomadic and 3. Mobile.

The requirements are already set out in legislation in **Poland**. It stated that in the range of accuracy the differences are already indicated in the article 78.3 of “The act of 16 July 2004 Telecommunications Law“ different definition of “information on the location of a network termination point” for a public fixed telecommunications network and for a public mobile telecommunications network. Also if necessary, according the article 78.6a of ˜The act of 16 July 2004 Telecommunications Law”, the President of the Office of Electronic Communications may specify, by means of a decision for a particular operator, detailed requirements concerning the accuracy and reliability of a network termination point location for public mobile telecommunications networks.

**Romania** also has established requirements. Current status for automated location:

a) Mobile calls: cell id/sector id information sent with the call to 112 PSAP where a database with cell/sector technical characteristics is maintained, helping draw an estimate of the cell/sector service area;
b) Fixed calls: the A number identity received at 112 PSAP is matched with the subscriber database maintained from operators’ reporting, resulting in an administrative address;
c) Nomadic calls: similar situation as for fixed calls; operators are also obliged to inform (flag) 112 PSAP when updating the subscriber database about the nomadic use of specific identification entries;

There are (quite) significant differences in requirements between agencies. For some agencies, the current degree of accuracy of the location of the incident poses fewer problems than for other agencies.

**Denmark (CPH Fire Brigade)** considers that 1) Fixed - should have a geocodable directory address, 2) Mobile - should include quality data and 3) mobile nomadic - should include quality data. Fixed nomadic – a real A-number should have a geocodable directory address. Spain (Canaries)

The **Slovak Republic (PSAP)** considers that:

a) For the fixed network, the address where end user terminal is installed is usually sufficient.

b) For the mobile networks, the desired accuracy of caller location should be within 50 meters. This is however not achievable with sector ID location method used in Slovakia.

c) Nomadic calls to European emergency number 112 are not possible in Slovakia.

**Spain (Canaries)** considers that the need for different requirements is motivated by the need for greater precision in the case of mobile services due to their nature, where there is a frequent change of location data.

**Spain (Galicia)** stated that the location on mobile and nomadic voice services should include a system in order to report information about the cause associated with failure in receiving this information on the location as this happens in approximately 15% of mobile calls.

**Czech Republic (CTO)** considers that an exact address is required for fixed calls while

**Spain (JCLM)** considers that different types of voice services require different criteria (for example: size of the probability area in mobile calls, or the age of the information in fixed phones)

**Switzerland (Swisscom)** stated that the accuracy of a device used only at a fixed address and a nomadic device cannot be the same. In the first case the situation is easy. It can be required to get the address. In the second case the accuracy is highly dependent on the location determination method. VoIP services can use different networks for the transport and so different location determination methods can be involved. However, Swisscom highly recommend defining one reliability requirement for ALL kind of services and for all kind of methods of location determination! For example a hit rate of 95%. All methods can increase the size of the location determination, until the hit rate is 95%. This way the localisation areas can also be better compared, as it is always a play between the hit rate and the size of the localisation area.

<u>13 respondents answered “No”.</u>

**Denmark (Danish National Police)** believes however that it is a more relevant issue in mobile and nomadic services while **Latvia, Montenegro** and **Ireland (HSE Ambulance)** believe that there should be no differences as accurate location information is required for each incident. This should be recognised on a global basis.

**Spain (Cataluña)** stated that, as a PSAP, we need the maximum possible accuracy and reliability in all types of voice services. In mobile communications, Cataluña can consider less precision.

**Sweden (SOS Alarm)** see the same need for accuracy and reliability regardless the type of voice service.

**Greece** answered “No” however, sometimes in rural areas, the cell coverage maybe too large, which affects the time we need to find the exact point of the caller.

**Questions 8 to 13 address accuracy and reliability related problems encountered and solutions implemented to cope with them, per type of service and geotype. These questions aim to gather any relevant experience of emergency organisations receiving 112 caller location information with insufficient accuracy and/or an insufficient degree of reliability.**

### 3.15 QUESTION 8

In Question 8, respondents were asked if they have encountered any problems regarding the “accuracy” of the 112 caller location information received from electronic communications networks and, if yes, to describe them.

### 3.16 SUMMARY OF RESPONSES TO QUESTION 8

<u>7 respondents answered “No”.</u> 2 respondents added additional comments.

**Hungary (National Police)** noted that they had very little information about this topic so it is possible that there may have been problems but available information suggests that this data collection has not happened in Hungary at PPDR organisations yet.

**Poland** stated that no such problems were reported to them.

21 respondents answered "Yes" and the following additional comments were provided.

**Croatia (HAKOM)** stated that 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. This method can be used regardless of the type of phone but the provided accuracy and reliability are not according to emergency services' needs.

**Lithuania** had similar concerns stating that the main problem is inaccuracy of location data received from mobile networks. To date there is a requirement for mobile network operators to provide location information with Cell-ID accuracy which is basically based on a coverage of each base transceiver station. The error radius ranges from 50 meters to 20 and more kilometers. Longer error radius causes longer time for localisation of the caller therefore response time becomes longer as well. This in turn may put life and health of those calling for help at risk.

**Latvia** and **Luxembourg** commented that only CELL ID information is available.

**Montenegro** stated that mobile operators are able to provide the location of the caller based on the base station (cell, sector) whose accuracy is measured in $km^2$. But by the Regulation of the quality of service parameters, limits and methods of measurement parameters for the use of the single European number 112 for emergency calls, they have to change that.

**Norway** also referred to the higher requirements in European legislation and the new Electronic Communications Act and stated that the accuracy for mobile (and nomadic VoIP) is not good enough today.

**Romania** made a number of points:

a) The coverage of a responsibility zone for an intervention team varies taken into account the specific purpose of the respective agency and the geotype (e.g. smaller for ambulance, larger for fire brigade);
b) Sometimes a cell/sector coverage area intersects several responsibility zones from one agency;
c) Sometimes isolated problems with updating the technical information database;
d) Insufficient accuracy of the location information.

**Denmark (DANISH National Police)** stated that with nomadic service the PSAP often gets misleading information. In mobile services the accuracy with Cell ID varies from 1000 to 4000 meters

**Denmark (CPH Fire Brigade)** pointed out that Cell ID borders do not follow PSAP borders which may cause calls to be transferred to the wrong PSAP.

**Estonia** mentioned experiences where occasional inaccuracy of location data in terms of distances is sent and that the accuracy varies depending on the technological capacity of the network operators.

**Finland (ERCA)** also noted that the accuracy of location information varies widely and it can lead to a situation where the dispatcher does not trust the accuracy of the location information in general and he will rather use false address information than more accurate location information.

**Germany (EGN)** noted the experience of receiving calls from mobile phones where the caller is unaware of his/her location or unable to provide the information verbally.

The **Slovak Republic** considers that in the case of mobile networks, sector ID criteria used in Slovakia are sufficient for the need of basic verification of information provided by the caller, but unless more details are provided by the caller the exact location of incident could not be determined.

**Spain**'s 6 112 PSAPS all answered yes and made the following points:

a) The level of accuracy of location information sent by the Mobile Operators in areas with low levels of density base stations (EEBB) **(Canaries)**.

b) For calls from mobile, the location that receives the PSAP is the POSIC (cell / sector, location). This area is too large to accurately locate the caller **(Cataluña)**.

c) In **Galicia**, they have detected some cases in which the information for the location from a call made from a mobile terminal doesn´t correspond with the location of the caller. In some cases, where the call is made from rural areas, the location area is so large that the information provided on location is very short and limited. The lack of accuracy on this type of information is under the responsibility of the telecommunication operators or phone companies that offer the services.

d) **JCLM** has observed that the information provided by the CMT isn't accurate.

e) In **Murcia** they found that the 112 caller location information in rural zone is less accuracy than in urban zone.

**Sweden (SOS Alarm)** constantly encounter problems regardless of type of electronic communication. The worst calls are via VoIP where it currently is required to distinguish the calls which do not have a geographic location attached and label them as IP calls. Therefore the SOS Alarm call taker will be extra careful in the interview. The number of such calls is constantly increasing. We don't have any statistics on the success rate over mobile positioning, but there are many cases where, for example, mobile operators moved base station towers to another geographical area and forgott to reprogram them which has given a total of faulty mobile positioning. We feel that the prospect of a 112 caller location constant becomes worse and worse.

**Switzerland (Swisscom)** noted many problems.

- The PSAPs get different localisations from different sources, where some are reliable and some not. They cannot distinguish from which source they got the information and so they have lost confidence in the sources which were very reliable!
- PSAP in cities would like to see from mobile networks a street name and a house number. When they get areas, which cover several streets and house numbers they are frustrated and do not use any of this information anymore.
- Swisscom has learned the hard way that location areas can be interpreted in many different ways. If for example an ellipse is delivered, it can be interpreted as the most probable point is in the center, or that the most probable point is equally spread over the whole area of the ellipse. It is necessary to provide training for those who use this information, and to teach them also different strategies using this information in a good way. The problem with this is that there are always many different people on the phone receiving emergency calls, and so not all receive the same training, if there is a training at all.
- PSAPs in cities work with maps on street level. When the localisation is covering areas with several streets they see on their screen just all in red, which frustrates them. Therefore they have lost confidence in this kind of information and do not use this information any more, even when it can be very valuable in special situations.

### 3.17 QUESTION 9

In Question 9 respondents were asked if they identified any possible solutions to the problems identified in response to Question 8.

### 3.18 SUMMARY OF RESPONSES TO QUESTION 9

<u>14 respondents answered "No"</u> with the following additional information provided.

**Montenegro** referred to regulations mentioned already which obliges operators to give precise locations. Although this regulation was adopted in year 2009, the operators still do not fulfill their obligations.

**Poland** referred to its answer to Question 8 where it stated that the Ministry had not received reports of such problems and **Spain (Galicia)** considers that the solution to these problems depend on the telecommunications operators or phone companies.

**Sweden (SOS Alarm)** believes that the only solution is regulatory requirements.

16 Respondents answered "Yes" providing the following additional information.

**Croatia** stated that today the PSAP in Croatia has no way to force or persuade mobile network operators to increase the accuracy of positioning using more accurate method (e.g. E-CITA)

The **Czech Republic** stated that secondary location information could be obtained by pull method from the operators.

**Finland (ERCA)** considers that more information about location information accuracy and reliability could be delivered to the dispatcher when he locates the caller while **Romania** stated that these things are usually sorted out during the interview between the dispatcher and the caller.

**Germany (EGN)** considers that smartphone Apps utilising GPS could provide more accurate and reliable information.

**Ireland (ECAS)** regularly notifies fixed line operators of individual issues with installation records and are currently working to improve the overall quality of the fixed line address information. A more long term and consistent solution to the accuracy and indeed reliability of provided fixed line information will only be possible by the fixed line operators undertaking a complete review and enhancement of the information that they hold and make that information available to the PSAP. This is likely to require agreed standards and criteria to be enforced.

**Ireland (HSE Ambulance)** stated that systems should be made 99.999% reliable.

**Lithuania** called for better accuracy within mobile networks with an acceptable error radius of 100 meters.

The **Slovak Republic** stated that in the case mobile services the use of GNSS location data provided by the end user terminal and improvement of location information provided by electronic communication networks would be beneficial. It adheres to the findings identified in the EENA operations document – "Caller Location in Support of Emergency Services"(http://www.eena.org/ressource/static/files/2011_05_27_2.2.2.cl_v1.3.pdf)

**Spain (Canaries)** stated that the use and standardisation of smart phone APP´s able to send accurate location information obtained from GPS module of these devices (in GPS coverage area) to the Emergency Centers should be encouraged. 1-1-2 CANARIAS has implemented an international APP called FRESS 1-1-2 that provides not only accurate location, but also the possibility of sending pictures and text chat.

**Spain (Cataluña)** stated that, currently, operators can provide caller position with greater accuracy by using triangulation positioning, and other technologies.

**Spain (JCLM)** stated that it is necessary to establish standards in the information related to the user personal files, provided by communications networks.

**Switzerland (Swisscom)** considers that there is a need to define a minimum reliability for all localisations, i.e. a hit rate of 95%. For every localisation method a short documentation describing how it does work and how the results should be interpreted. Training needs to be provided so that PSAP operators know the strategy on how to handle and interpret the localisation information with all other information received from the caller. There is also a need to define how the center of the ellipse has to be interpreted – i.e. most probable point or nothing special, the most probable point can be anywhere inside. The method used to create the localisation also needs to be marked so that it is known which operator/method created it.

### 3.19 QUESTION 10

In Question 10 respondents were asked to group the solutions provided in Question 9 into the following categories:

| Type of service | Geotype (only for mobile) | Positioning method* | Description of the problem | How it affects the accuracy | (Possible) Solution | Comments |
|---|---|---|---|---|---|---|
| | | | | | | |

*e.g. cell/sector location, TA (Timing Advance), RTT (Round Trip Time), UTDOA (Uplink Time Difference of Arrival), EOTDA (Enhanced Observed Time Difference of Arrival), GNSS (Global Navigation Satellite System), AGNSS (Assisted GNSS), or combinations of the above.

### 3.20 SUMMARY OF RESPONSES TO QUESTION 10

The responses are best illustrated in table format:

| Respondent | Type of service | Geo-type (mobile only) | Positioning method* | Description of the problem | How it affects the accuracy | (Possible) Solution | Comments |
|---|---|---|---|---|---|---|---|
| **Czech Republic** | mobile | any | Operator defined area | Location area too big | Not accurate enough | Using ANY possible method | Need to be required by law |
| **Denmark** | Mobile | all | Cell ID | Cell ID borders does not follow PSAP borders which may cause call to be transferred to the wrong PSAP | | promote mandatory eCall like behavior for all mobile devices calling 112 | |
| **Finland (ERCA)** | mobile | all | Depends of mobile operator cell/sector location, TA (Timing Advance), RTT (Round Trip Time), UTDOA (Uplink Time Difference of Arrival), EOTDA (Enhanced Observed Time Difference of Arrival), | | | | |
| **Germany** EGN | mobile | dense urban, urban and rural | GPS | | Increases accuracy significantly compared to Cell ID | Smartphone App | |
| **Greece** | mobile | rural | Cell location | Large cell coverage | delay in time for the exact location estimation | Other type of positioning method is necessary | Based on operator's technological solutions |
| **Ireland** ECAS | Fixed | | Installation address and optionally co-ordinates supplied in advance | Incorrect Address provided (rare occurrence but has happened) | Not accurate. | Identify CLI in question and flag it with relevant operator | This is an after-the-fact solution to a problem which could be avoided with better quality information. |
| | Fixed | | Installation address and optionally co-ordinates supplied in advance | Unusable address provided | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Fixed | | Installation address and optionally co-ordinates supplied in advance | No Installation details | STD Code matching/lookup will be used to determine caller location for automatic call routing purposes. Will be confirmed by ECAS operator. | Identify CLI in question and flag it with relevant operator | This is an after-the-fact solution to a problem which could be avoided with better quality information. |
| | Mobile | Urban, Rural | Cell/Sector ID | Large Cell Sizes. Cell/Sector ID cannot be considered an accurate method of determining caller location although generally sufficient for the identification of the correct Operational Area. | Definition of a caller location as possibly being within a large cell is not accurate for caller location. | | Use Cell/Sector ID for initial call routing decision only. Caller location should be determined using network based and/or handset based techniques. |
| **Lithuania** | There exist methods/technologies that can be used to increase caller localisation accuracy. As the emergency response organisation we aren't competent to tell which of technologies is the best to be used. We say – acceptable error radius – 100 meters. | | | | | | |
| **Luxembourg** | Mobile | All | Cell ID | Accuracy to low | Not enough precision | To get coverage maps from all the cells of all mobile operators Introduction of location based services (triangulation) by mobile operators | |
| **Norway** | Fixed | | Based on the callers registered address | The registrations may not be accurate, or there may be some missing information | It may take longer time to determine where the caller is. Depending on the caller's ability to explain. | Better system for checking the correctness of all registered addresses. | |
| | Nomadic | | As for fixed , but the call Is flagged to tell the PSAP operator that the caller may be somewhere else, and one will have to ask whether the given address is correct or not. | There is no good solution if a nomadic VoIP user is located elsewhere than the registered address | The registered addresses may differ from the actual location of the caller. | Implement a solution based on ETSI M493 project or IETFs ECRIT project. | |
| | Mobile | | Today:<br>Only cell ID.<br>In one year:<br>Cell ID, Sector, TA (timing advance) and base/cell station coverage estimation | The address of the owner of the subscription is also visible, like it is for fixed. | Cell ID alone may give a 360 degree circle with radius up to 32 kilometres. Not very accurate. | New regulation to force implementation of sector and TA view, together with base/cell station coverage estimation. | |
| **Romania** | Things are usually sorted out during the interview. | | | | | | |
| **Slovak Republic (PSAP)** | See answer No 9. | | | | | | |
| **Spain** | Mobile | Dense | GNSS | accuracy | Improves | APP Fress | Complements |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **(Canaries)** | | Urban | | | accuracy if GNSS coverage | | 112 call location sent from the Provider |
| | Mobile | Urban | GNSS | accuracy | Same improvement | APP Fress | Complements 112 call location sent from the Provider |
| | Mobile | Rural | GNSS | accuracy | Same improvement | APP Fress | Complements 112 call location sent from the provider that usually has low reliability due to the low density of EEBB. |
| **Spain (Cataluña)** | Mobile | All | POSIC (cell/sector location) | Area where the mobile could be, is too large | Low Precision | Alternative technologies (triangulation) | |
| **Spain (JCLM)** | Fixed | | CMT Database | No standards | DDBB don't match | to establish standards | |
| **Spain (JCyL)** | Mobile | Rural | POSIC | Probable Location zone is too big | | | |
| **Spain (Murcia)** | Mobile | Dense urban | Cell/sector location | None | | | |
| | Mobile | Urban | Cell/sector location | None | | | |
| | Mobile | Rural | Cell/sector location | Geolocation include an area of 2km square | | | To improve geolocation protocols of network operators. |
| | Fixed | | Matching with database of networks operators | None | | | |
| **Switzerland (Swisscom)** | Any | Any | Any | Different reliabilities from different sources | One bad accuracy from one operator can destroy the confidence in good accuracy from other operators | National authority creates a requirement for a minimum reliability | |
| | | Any | Any | When receiving bad accuracy: Being able to detect the source | One bad accuracy from one operator can destroy the confidence in good accuracy from other operators | Mark the source of localisation in all protocols | |
| | Any | Any | Any | Ambiguity of location information | Wrong interpretation of the data | Define in standards how to interpret the center of circles and ellipsis. Training on level PSAP | |

## 3.21 QUESTION 11

In Question 11 respondents were asked if they had encountered any problems regarding the “reliability” of the 112 caller location information received from electronic communications networks and if so to describe them.

### 3.22 SUMMARY OF RESPONSES TO QUESTION 11

13 respondents answered "No" and provided the following additional information.

In **Germany (EGN),** utilisation of caller location information is only starting so there is no experience of any problems yet.

In **Hungary (National Police)**, there is very little available information on this topic but the Police are sure that there could be but as far as they know data collection has not happened in Hungary at PPDR organisations yet.

**Montenegro** stated that it does not have the possibility to get location of caller, because mobile and fixed-line operators don't pass that information.

**Sweden (SOS Alarm)** stated that the service works stable but with poor accuracy

16 respondents answered "Yes" and provided the following information.

The **Czech Republic** stated one problem was that the caller was too far from the presented location area.

**Spain (Cataluña)** presented the same problem where sometimes the location is incorrect and they receive the location from a BTS that is not coursing the call.

**Denmark (CPH Fire Brigade)** stated poor quality data from mobile operators due to lack of maintenance of cell id coverage.

**Estonia** stated that potential inaccuracies may cause perceived unreliability.

**Finland (ERCA)** stated that location information received has been too old or out of date.

**Ireland (ECAS)** noted that reliability of caller location information is less visible to a stage-1 filtering PSAP service as operated by ECAS. Caller location is always (currently) verbally confirmed by the ECAS operator prior to handover where possible. It should also be noted that for mobile calls (as it only receives Cell ID) the reliability of this is difficult, if not impossible, to measure. Consistent availability of caller location is a big consideration however and we regularly have situations where we have no caller location information for a fixed line or mobile call.

**Latvia** has encountered the problem of an end-user location where the user device is in a VoIP network.

**Lithuania** noted the problem of a 2 months' time gap between updates of databases of fixed line operator customers.

In **Norway**, the reliability is pretty good, but there are occasions when the call is routed to the wrong PSAP. The caller may be located in the region of PSAP 1 while the base station to which he/she is connected is located in the region of PSAP 2. In such cases the call will be transferred to the right PSAP.

**Romania** stated that the reliability issue, as a general concept, should be kept in mind and dealt with during the design of the specific technical implementing solution phase (i.e. the solution for passing the location information from telecom side to emergency side and inside emergency).

**Slovak Republic** stated that very rarely, caller location could not be determined by the electronic communication network (but it is well within 0, 5% limit), or the caller is located outside the sector provided by the network.

**Spain (Canaries)** experienced cases where no data is received because of technical location failure from the Provider or by failure to transport the location information to the PSAP from the Telecommunications Provider. See the operational data to analyse more cases that have occurred, but there is no statistical evidence. **Spain (Galicia)** reported similar problems where around 15% of the calls made from mobile terminals have no associated information on the location. The source of the problem is related to the communication operator that receives the call.

**Switzerland (Swisscom)** provided details of two problems:

a) Fraud: Seldom, and when it happens, it is always the same source, where it can be tracked down who it is.

b) Technical problems: Delays, data errors, errors in the protocols, different interpretation of protocols, number of digits used of the coordinates

**Ireland (HSE – Ambulance)** did not answer “Yes” or “No” but stated that it is difficult to determine, from Ambulance Control perspective, control cannot question or interrogate electronically transmitted information.

### 3.23 QUESTION 12

In Question 12 respondents were asked if they identified any solutions to the problems raised in response to Question 11.

### 3.24 SUMMARY OF RESPONSES TO QUESTION 12

15 respondents answered “No”.

**Montenegro** added that Mobile operators have to fulfill their obligations by Article 12. Regulation of the quality of service parameters, limits and methods of measurement parameters for the use of the single European number 112 for emergency calls.

The question was not applicable to 4 respondents. **Ireland (ECAS)** added that for availability concerns they are continuing to work with the fixed line and mobile operators to improve the availability of the information provided in advance of the call.

5 respondents answered “Yes”. Lithuania added that updates should be done more often or automatic data provision solutions should be implemented.

### 3.25 QUESTION 13

In Question 13 respondents were asked to describe the solutions identified in response to Question 12 and to group those in accordance with the following table:

| Type of service | Geotype (only for mobile) | Positioning method* | Description of the problem | How it affects the reliability | (Possible) Solution | Comments |
|---|---|---|---|---|---|---|
| | | | | | | |

*e.g. cell/sector location, TA (Timing Advance), RTT (Round Trip Time), UTDOA (Uplink Time Difference of Arrival), EOTDA (Enhanced Observed Time Difference of Arrival), GNSS (Global Navigation Satellite System), AGNSS (Assisted GNSS), or combinations of the above.

### 3.26 SUMMARY OF RESPONSES TO QUESTION 13

| Respondent | Type of service | Geotype (only for mobile) | Positioning method* | Description of the problem | How it affects the reliability | (Possible) Solution | Comments |
|---|---|---|---|---|---|---|---|
| **Czech Republic** | mobile | any | cell/sector | GSM can serve up to 35 km | | Using ANY possible method | |
| **Denmark** | Mobile | all | Cell ID | poor data | Erroneous or | Fix current | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | quality from mobile operators due to lack of maintenance of cell id coverage | missing position | systems and underlying data | |
| **Finland (ERCA)** | Mobile | all | | If the location information is not real-time it could be false. | False information causes false location. | More information about how old the location information is | |
| **Germany EGN** | N.A. | | | | | | |
| **Ireland ECAS** | Fixed | | Installation address and optionally co-ordinates supplied in advance | No Installation details | Fixed line Caller information is not reliably available. (falls Backbone Solution to STD code matching) | Identify CLI in question and flag it with relevant operator | This is an after-the-fact solution to a problem which could be avoided with better quality information. |
| | Mobile | Urban/rural. | Cell/Sector Location | Cell/Sector information not available | Automated Call routing cannot be performed and manual search with Caller provided location required | Flag Cell/Sector to relevant mobile operator to resolve. | We have worked extensively with mobile operators and have recently reduced the number of “misses” for this type of lookup. |
| **Lithuania** | There exist methods/technologies that can be used to increase caller localisation reliability. As the emergency response organisation we aren’t competent to tell which of technologies is the best to be used. | | | | | | |
| **Spain (Cataluña)** | Mobile | All | Cell/sector location | Incorrect location | Incorrect location | Configuring mobile operators in their Backbone Solution bone | |
| | Fixed | | Pull | The data provided are incorrect | Incorrect location | Updated data from operators | |
| **Spain (JCyL)** | Fixed | | | Sometimes Errors in data and no data | | | |
| | Mobile | All | POSIC | Sometimes Errors in data and no data | | | |
| | VoIP | | | No location | | | |
| **Spain (Murcia)** | Mobile | Dense urban | Cell/ sector location | None | | | |
| | Mobile | Urban | Cell/ sector location | None | | | |
| | Mobile | Rural | Cell/ sector location | None | | | |
| | Fixed | | Matching with database of networks operators | - Database of network operators has errors in location data<br>- No all networks operators are all include in CMT | | - To improve location data in CMT’s BBDD.<br>- To include local networks operators in CMT’s BBDD. | |
| **Switzerland (Swisscom)** | Any | Any | Any | - Fraud: Seldom, and when it happens, it is always the same source, where it can be tracked down who it is. | - | - Track down fraud cases | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Any | Any | Any | - Technical problems: Delays, data errors, errors in the protocols, different interpretation of protocols, number of digits used of the coordinates | - | - Better testing<br>- Fixing errors | |
| | Any | Any | Any | | | - Track down fraud cases | |

**Question 14 addresses accuracy and reliability functional requirements needed, per type of service and geotype. As direct "beneficiaries" of 112 caller location information it is necessary to gather emergency organisations' views on the functional requirements for accuracy and reliability of caller location information.**

## 3.27 QUESTION 14

In Question 14 respondents were asked, after taking account of the need for optimal functioning of the emergency system and the most efficient way to implement any new measures, for their opinions regarding the requirements needed by the emergency services regarding the accuracy and reliability of 112 caller location information at each main stage of the service chain as described in Question 1. Respondents were asked to frame their answers using the following model:

| Type of service | Geotype (only for mobile) | Main Stage | Accuracy Requirement | Reliability Requirement | (Possible) Positioning Method* | Comments |
|---|---|---|---|---|---|---|
| | | | | | | |

*e.g. cell/sector location, TA (Timing Advance), RTT (Round Trip Time), UTDOA (Uplink Time Difference of Arrival), EOTDA (Enhanced Observed Time Difference of Arrival), GNSS (Global Navigation Satellite System), AGNSS (Assisted GNSS), or combinations of the above.

## 3.28 SUMMARY OF RESPONSES TO QUESTION 14

| Respondent | Type of service | Geotype (only for mobile) | Main Stage | Accuracy Requirement | Reliability Requirement | (Possible) Positioning Method* | Comments |
|---|---|---|---|---|---|---|---|
| **Austria** | All Services | | | As good as possible, definitively way below 100 meter | As good as possible | The best possible and available solution | |
| **Czech Republic** | all | All | PSAP | region | 100% | any | |
| | all | All | emergency team | city district | 100% | any | |
| | all | All | navigation | coordinates | 100% | any | |
| **Denmark (Fire brigade)** | See answer to question 3 | | | | | | |
| **Finland (ERCA)** | All | all | 1 | cell location | real-time | | |
| | All | all | 2 | best possible | real-time | | |
| | All | all | 3 | best possible | real-time | | |
| **Germany (EGN)** | Fixed | | 1 | Civic address | 99% | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Fixed | | 2 and 3 | Civic address | 99% | | |
| | mobile | dense urban | 1 | 1000 m | 67% | | 3000 m in 90% of cases |
| | mobile | Urban | 1 | 1000 m | 67% | | 3000 m in 90% of cases |
| | mobile | Rural | 1 | 1000 m | 67% | | 3000 m in 90% of cases |
| | mobile | dense urban | 2 and 3 | 25 m | 67% | | 100 m in 90% of cases |
| | mobile | Urban | 2 and 3 | 35 m | 67% | | 150 m in 90% of cases |
| | mobile | Rural | 2 and 3 | 50 m | 67% | | 200 m in 90% of cases |
| | Additional comment: Regarding the accuracy and reliability requirements the outcome of the final report from CEGALIES should be considered as well. *Coordination Group on Access to Location Information by Emergency Services (CEGALIES): "Report on implementation issues related to access to location information by emergency services (E112) in the European Union", Jan. 28th, 2002* | | | | | | |
| **Ireland ECAS** | Fixed | | Identify correct ERO and operational area | Identify coordinates and address of the property where the fixed line call originated. +/- 10m for coordinates. | Information should be available for >99% of calls and expected reliability of the information should be close to 100% | Pre-populated database or real-time external lookup of fixed line installation details keyed on Originating CLI. | For fixed line installations, the address data is often provided in advance for all installations. It is not unreasonable to expect a high level of accuracy and reliability for this information derived and provided by the Telecoms operator based on actual, desktop, or automated GIS survey and property information. |
| | Fixed | | Determine the Exact Location of the Incident | Identify coordinates and address of the property where the fixed line call originated. +/- 5m for coordinates. (5m requirement based on densely populated urban areas) | Information should be available for >99% of calls and expected reliability of the information should be close to 100% | Pre-populated database or real-time external lookup of fixed line installation details keyed on Originating CLI. | |
| | Mobile | All | Identify correct ERO and operational area | +/- 500m is desirable but not possible with cell/sector ID based approaches. For cell/sector ID information to be used only to identify the correct ERO +/- 3km would be desirable. | Stated accuracy achieved in > 95% of calls. This allows some margin for error due to mobile network topology etc. but should be consistently high (and available) in urban areas. | Cell/Sector ID, Network based methods, Handset based methods or hybrids. | Caller location for identification of the correct ERO should be available immediately. Network based and Device based positioning methods may introduce a delay in determining position and consequently initial call routing decisions will need to be based on cell/sector ID. This decision can be updated in-call |

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| | | | | | | | when more accurate information may be supplied from network based or device based methods. |
| | Mobile | All | Determine the Exact Location of the Incident | +/- 10m desirable to assist in locating person in need of assistance. | Enhanced level of accuracy should be available for >70% of calls and if available the reliability of this information should be >95% | (A)GNSS | See note below[i] |
| | Note: While (A)GNSS is likely to be the only reliable means of attaining the level of accuracy that the emergency services may require to locate people in all cases, there are a variety of technical and integration challenges associated with the use of device supplied (A)GNSS information including such factors as indoor coverage, device support, device reliability (e.g. user-preferences) etc. To address these challenges and provide a more universal caller location solution for mobile caller, network based technologies should also be utilised (in parallel) as and where supported by the underlying mobile networks. This is likely to result in a blended approach to Caller location based on the concept of immediate supply of Cell/Sector ID for call routing purposes and subsequently refined and updated in call with network based caller location and then (A)GNSS based device supplied information. The source of the information and in particular the relevant expected levels of accuracy and reliability should be clearly defined for and indicated to the PSAPs and ERO as the users of this information. | | | | | | |
| **Latvia** | Fixed | - | All stages | | | Telecommunication operator data base | |
| | Mobile | Rural | 1. stage | | | Cell/sector location | |
| | Mobile | Rural | 2. stage | | | Cell/sector location | |
| | Mobile | Rural | 3. stage | | | Cell/sector location + GNSS | |
| | mobile | Urban | 1. stage | | | Cell/sector location | |
| | mobile | Urban | 2. stage | | | Cell/sector location + GNSS | |
| | mobile | Urban | 3. stage | | | Cell/sector location + GNSS | |
| **Lithuania** | There exist methods/technologies that can be used to increase caller localisation accuracy and reliability. As the emergency response organisation we aren't competent to tell which of technologies is the best to be used. Our wish – precise address with every 112 call from fixed line networks and 100 meters errors radius accuracy with every 112 call from mobile networks. | | | | | | |
| **Luxembourg** | All | All | 1,2,3 | No requirements | No requirements | Cell/sector location | For fixed service: detailed address of caller |
| **Montenegro** | | | | Yes | Yes | This depends from technical capabilities of mobile phones operators | They have to meet the expectation from Regulation, and it's their decision which type of service satisfies required precision |
| **Norway** | Mobile | | | | Very good | Cell ID, Sector view, Timing Advance and cell coverage measures/estimates.<br>+<br>GPS positioning provided by the handset. | |
| | Fixed | | | Correct registered address. | 100% | | |
| | Nomadic | | «Flag» indicating | Correct registered | | The use of | |

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| | | | that the device may be located elsewhere than the given registered address(es). | address, and at least one alternative address. | | location servers. | |
| **Poland** | fixed and mobile | as listed in in the article 78.3 of ‘The act of 16 July 2004 Telecommunications Law'<br><br>(for a public mobile telecommunications network – geographic location of publicly<br>Available telecommunications services user's terminal). | at all stages<br><br>(as described in Question 1) | no additional requirements;<br><br>but if necessary, the President of the Office of Electronic Communications may specify, by means of a decision for a particular operator, detailed requirements concerning the accuracy and reliability of a network termination point location for public mobile telecommunications networks | no additional requirements;<br><br>but if necessary, the President of the Office of Electronic Communications may specify, by means of a decision for a particular operator, detailed requirements concerning the accuracy and reliability of a network termination point location for public mobile telecommunications networks | no additional data | no additional comment |
| **Romania** | For fixed service the current solution works right, particular problems are mainly related to location inside large private networks. The nomadic service does not currently pose a lot of problems due to the limited no. of such calls to 112.<br>Regarding the mobile service an upgrade of the current solution or other solutions resulting in a "designated area" might not help improve significantly the results; the accuracy seen as a significant improvement relates generally with the possibility to send a response team (i.e. to allow dispatching a team to an assigned location).<br>From an operational perspective some ideas which might help better identify the problems encountered by the emergency organisations are presented below:<br>- False/hoax calls pose sometimes significantly more problems in terms of costs of dispatching intervention teams than those caused by inaccurate location information – estimation, no data available. They happen mostly in urban areas rather than in rural ones, usually from mobile pre-paid subscriptions – estimation;<br>- (Possible) Worst case scenario from positioning perspective: person unable to provide any info regarding the incident site, rural area with low to zero population density, large location area (cell, currently) intersecting several different responsibility zones;<br>- A very important role also plays the level of detail of the GIS map available for emergency services, all the way to the intervention team, and the number of additional details regarding the points of interest shown on the map (useful during interview to "understand" the exact location of the incident). Ideally, all parties involved (112 PSAP, agency PSAP, intervention team) should access/share the same location data; access to online street-view cameras would also be useful;<br>- The call-back possibility can be used, sometimes, to update de location, directly (new positioning request in the telecom network or new call) and via interview (asking for more details). | | | | | | |
| **Slovak Republic (PSAP)** | We adhere to the requirements identified in the EENA operations document „Caller Location in Support of Emergency Services“ (http://www.eena.org/ressource/static/files/2011_05_27_2.2.2.cl_v1.3.pdf) | | | | | | |
| **Spain (Canaries)** | Currently there is no periodic statistic about call location. | | | | | | |
| **Spain (Cataluña)** | Fixed | | establish the correct PSAP | 1 km. | 98 % | | |
| | Mobile | All | establish the correct | 1 km. | 98 % | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | PSAP | | | | |
| | Fixed | | assign the correct dispatch | 50 m. | 98 % | | |
| | Mobile | All | assign the correct dispatch | 50 m. | 98 % | | |
| | Fixed | | determine the location of the incident | 50 m. | 99 % | | |
| | Mobile | All | determine the location of the incident | 50 m. | 99 % | | |
| | Fixed | | establish the correct PSAP | 1 km. | 98 % | | |
| **Spain (JCLM)** | Fixed | | Determine the location of the incident | Establish standards in the information related to the user personal files, provided by communications networks. | | CMT Database | |
| | mobile | | Establish the correct PSAP | Reduce the number of calls received on each other PSAP region from bordering areas | | cell/sector location | |
| **Spain (JCyL)** | Fixed | | All | Actualised Data | Actualised Data | | |
| | Mobile | All | All | The best according the available technologies of telecommunication operator | The best according the available technologies of telecommunication operator | | |
| | VoIP | | All | The best according the available technologies of telecommunication operator | The best according the available technologies of telecommunication operator | | |
| **Spain (Murcia)** | Mobile | All of them | 1 y 2 | | | Cell/Sector ID | |
| | Mobile | All of them | 3 | | | GNSS | |
| | Fixed | - | 1, 2 y 3 | | | Matching with database of networks operators | |
| **Switzerland (Swisscom)** | Any | dense urban, urban, rural | 1 | municipality | 99,7% | Any suitable | |
| | Any | dense urban, urban, rural | 2 | 1 km | 99,7% | Any suitable | |
| | Any | dense urban, urban, rural | 3 | 100 Meter | 95% | Any suitable | |

**Questions 15 to 17 relate to statistics of 112 calls with accuracy & reliability problems and measurement methods, per type of service and geotype. This inquiry aims to gather relevant opinions based on existing call statistics or future projections regarding inaccurate information or where reliability may be questionable. The purpose of this is to quantify the impact of accuracy and reliability requirements on the performance of the emergency services particularly where any modifications have been made and how those modifications helped to improve the performance of emergency responders.**

## 3.29 QUESTION 15

In Question 15 respondents were asked if they measure in any way the impact of accuracy and/or reliability of the 112 caller location information related problems or quantify the impact they have on the performance of emergency service responders.

## 3.30 SUMMARY OF RESPONSES TO QUESTION 15

25 respondents answered "No".

**Ireland (ECAS**) stated that as a stage-1 filtering PSAP ECAS does not have visibility of the full impact of caller location information on performance of the Emergency Services in responding to persons in need of assistance at this time.

**Romania** stated that no statistics exist for measuring the adequacy of the current accuracy of the caller location coming from the telecom side. The general expert opinion signals no issues with the location sent via fixed service. Nomadic service is not currently seen as an issue also. Current statistics available refer to number of different types of calls, response times and QoS factors mentioned in COCOM questionnaire.

**Spain (Galicia)** added that they don´t have tools in order to measure the performance of the system.

Only **Ireland (HSE Ambulance)** answered "Yes".

## 3.31 QUESTION 16

In Question 16 those respondents that answered "Yes" to the previous Question 15 were asked to describe their measurement and quantification processes and methods and also including the type of service and geotype (for mobile) it applies to.

## 3.32 SUMMARY OF RESPONSES TO QUESTION 16

**Ireland (HSE Ambulance)** stated that they measure timings within the anatomy of a call. All timings are examined to ascertain if a more effective way of providing patient care can be devised.

## 3.33 QUESTION 17

In Question 17 those respondents that answered "No" to Question 15 were asked if they thought it would be useful to have a process in order to track the impact, in time, of (insufficient) accuracy and reliability of the 112 caller location information?

## 3.34 SUMMARY OF RESPONSES TO QUESTION 17

20 respondents answered "Yes" that it would be useful to have tools to track and record this information.

**Denmark (CPH Fire Brigade)** stated that it is a chicken vs. egg situation. Unless position quality is improved IT does not make sense to monitor the impact.

**Ireland (ECAS)** and **Montenegro** considers that this would be a useful metric to discuss and improve the overall services offered.

**Germany (EGN**) answered “Yes” provided that the information could be collected automatically.

**Romania** stated that Implementation of statistics is important in order to monitor the specific cases where location fails or more accuracy is needed. This might affect the current flow of actions, requirements of emergency teams to complete some more data is necessary. A periodic exercise is favoured over a permanent one.

The **Slovak Republic** thinks it would be useful in order to justify expenditures on implementation of progressive technologies to enhance accuracy and reliability of caller location.

**Switzerland (Swisscom)** would be especially interested for the cases where it had a huge impact, so they could perhaps optimise their location estimation. Like Slovakia, Swisscom also considers that it would make it easier to justify investments.

**Spain (Canaries)** believes that it would allow to have a target to measure the number of calls positioned, their degree of reliability and have a comparison between incidents of the same type managed with or without call location,

**Spain (Galicia)** considers that it would be useful to have some kind of mechanism for being able to measure the impact, the accuracy and the reliability of the information on the location from the call made to our 112 PSAP.

**Sweden (SOS Alarm)** stated that it would be very useful to be able to measure, but it needs to collect data from the entire chain, ie from the first approximate position until the helpful resource is in place on the actual position (which requires that the resource actually reports when he arrives on location and not before).

### 3.35 QUESTION 17A

A sub-question of Question 17 asked if it would be difficult to implement such a mechanism to track the impact, in time, of (insufficient) accuracy and reliability of the 112 caller location information.

### 3.36 SUMMARY OF RESPONSES TO QUESTION 17A

11 respondents answered “Yes” it would be difficult.

**Hungary (National Police)** stated that it would not be easy. The mechanism can be based on the existing mission control/management systems. The quantification process can rely on the evaluation of information stored in it. Otherwise the mission control/management systems have different architecture, databases, data format etc. Due to these facts the implementation would be a challenge.

**Norway** stated that it would be difficult and maybe the focus should be on improving the actual accuracy performance.

**Spain (JCLM)** stated that its technology platform currently does not allow it.

5 respondents answered “No” that it would not be difficult to implement such a mechanism.

**Finland (ERCA)** stated that a comparison of utilised information data and emergency response delays would be easy and **Ireland (HSE – Ambulance)** stated that parameters could be set on a measuring tool.

8 respondents did not answer “Yes” or “No” but provided the following information.

**Germany (EGN)** stated that the possibility had not been evaluated yet and **Ireland (ECAS)** stated that it was unknown but that some of the Emergency services in Ireland may be able to develop such metrics. For Example the Ambulance Service will have data on the time taken to dispatch assistance on a call by call basis however this data would need to be analysed in the context

**Greece** answered that it is “Not necessary”.

**Montenegro** stated that it could confirm the information about location received from its operational units and that it could confirm if the informations received is true or not.

**Poland** stated that the Ministry of Administration and Digitisation is responsible for the general modernisation of the emergency call system in Poland. This includes changes of law regulations (project of the new act on emergency call system, accepted by the Council of Ministers, accepted by the Parliament, not yet signed by the President of the Republic of Poland) as well as the infrastructure (new ˜public safety answering points” with a dedicated telecommunication network). According to the project, new PSAP will be able inter alia to gather data and statistics about handling emergency calls. Ministry of Administration and Digitisation currently does not have sufficient information about the impact of accuracy or reliability of the 112 caller location information on the performance of emergency service responders. According the project of the act on emergency call system, new PSAP will provide necessary information and statistics that would allow such analysis. According to the project of the act on emergency call system, new PSAP will gather information and statistics that would provide such a mechanism.

**Romania** stated that implementation of statistics is important in order to monitor the specific cases where location fails or more accuracy is needed. This might affect the current flow of actions, requirements of emergency teams to complete some more data is necessary. A periodic exercise is favoured over a permanent one.

The **Slovak Republic** stated that the implementation might be complicated unless a single European method is developed. Different services use different technologies and have different information sharing policies as well as operating procedures. If possible, tracking the accuracy and reliability of callers shouldn´t burden PSAP operators or first responders with new tasks.

**Spain (Canaries)** considers that, technically, statistics could be implemented on the number of calls that should position themselves and has not been received from the operator, or GPS data in the case of IP services. Economic investment is required to develop specific modules to obtain automated information.

**Spain (Galicia)** considers that it might be difficult to have this type of mechanism because the communication operator would have to give additional information on how they deal with this information of the location of the call made to the 112 PSAP. We don´t think they will be in favour of these types of actions.

**Sweden (SOS Alarm)** stated that the data needed are probably there already, but it can be costly to adjust the technical preconditions for compiling data and to ensure that the final position (when the unit arrives) is correctly reported.

### 3.37 QUESTION 17B

Another sub-question of Question 17 asked respondents their views on what would be the most important information to gather regularly and to elaborate on that if possible.

### 3.38 SUMMARY OF RESPONSES TO QUESTION 17B

**Austria** stated that accuracy and the quality of accuracy would be the most important info. Ideally the transmission of the accuracy of a caller’s location should automatically be combined with an accompanied info about the quality of the accuracy data (e.g. visual with a traffic light system green-yellow-red)

**Croatia** stated that the most important problem encountered is the time needed to provide the location. Emergency situations require an immediate response. Delays to obtain the location data are unacceptable. The location data shall be available as soon as the call reaches the authority handling emergency calls. The data on the deviation of received and precise location. The time needed to identify precise location in the case of receiving incorrect location.

**Cyprus (Police and OCECPR)** stated that “accurate position of the CLI was important.

**Denmark (Police)** stated that service time at the PSAP and no. of incidents with errors in location provided to the responding services was important.

**Denmark (CPH Fire Brigade)** stated that reported position (including quality) linked with actual position of incident was important.

**Estonia** considers that the most important information is the time spent on ascertaining the exact location of the caller, on issuing the dispatch order and on actual arrival of the operational resources on the site.

**Finland (ERCA)** listed 3 important elements:

a) The location data that ERC-data system has used when alarming units.
b) Other location information available to dispatcher during the call e.g. cell location
c) Location information from the units at the scene.

**Germany (EGN)** stated that location information provided vs. actual location of the emergency incidence was important.

**Greece** stated the needed time for the exact location estimation at all cases.

**Hungary** stated that it would be very useful to have some kind of mechanism, because it can help the efficiency improvement of emergency situation handling. In its opinion it is very important to gather regularly all of the data connected with the time frame out of emergency situation handling, which comes from the inaccuracies. But it is almost sure the most important information is the loss of time.

**Ireland (Fire Service)** considers that GPS co-ordinates are the solution but there are lots of delays in receiving these.

**Ireland (HSE Ambulance)** stated that CLI and location information are vitally important to responding Emergency Services. The accuracy of this information should be regularly benchmarked to ensure it is of the highest quality.

**Latvia** stated that caller location measurement accuracy and time needed to receive accurate location of caller was important.

**Luxembourg** considers that accurate position of caller location in reference to the cell ID location is important.

**Norway** stated that statistics on the accuracy/validity of all registered addresses was important.

**Romania** stated that implementing such statistics is a cross-agency task, involving modifications in the electronic system and at intervention procedure level (system will need to monitor some other parameters and intervention teams will be asked to complete some data in the case file after the closing of the case).

Possible examples of relevant information for accuracy & reliability issues:

a) The average coverage of a responsibility zone for an intervention team, per geotype, with (yearly) repartition of no. of calls.
b) The average cell coverage area for 2G/3G/4G national mobile networks, per geotype, with (yearly) repartition of no. of cells and calls.

The **Slovak Republic** considers that the accuracy of callers location (size of the area in m2), verification whether caller was indeed located inside the area identified and time needed to achieve incident location by the first responders. Verification should be automated as much as possible.

**Spain (Canaries)** listed 3 groups of important information:

a) Located call percentage
b) Comparison of time resolution between incidents correctly located or not
c) Number of failures in position and origin (source of information, transportation information or receiving information)

**Spain (Cataluña)** stated that

a) When there hasn't been location information.
b) When the information received is incorrect.
c) Time spent by the operator in locating the emergency when it isn't available by automatic means or when is wrong.

**Spain (Galicia)** considers that the most important information would be to have identified all the reasons of why this kind of information from mobile phones isn´t available in those calls that offer no location details. This happens in approximately 15% of mobile calls.

**Spain (JCLM)** stated that the following information is important:

a) Percentage of calls with automatic location information
b) Percentage of calls with accurate location information.

**Sweden (SOS Alarm)** stated that the most important thing is to regulate the telecom operators' obligations and to ensure that the positioning is handled assimilated regardless the way of electronic communication. Additionally it is important to pursue, primarily a world standard, and secondly a European standard if the former is impossible. The methodology should be a rough position at an early stage so exactly and reliably as possible and then a precise point as soon as possible.

**Switzerland (Swisscom)** stated that information, especially in typical cases where the localisations are not correct and all cases where wrong localisation had a huge impact. Important: Provide each case with date/time and MSISDN.

**Questions 18 to 27 are addressed to electronic communications network operators. These questions aim to gather data from relevant operators for each type of service (fixed, mobile, nomadic) and geotype for mobile (dense urban, urban, rural) in order to have an overview of positioning methods used and reliability related features implemented throughout Europe and, if possible, to learn from national experiences.**

### 3.39 QUESTION 18

Respondents were asked to provide information regarding the 112 caller location information which is sent from their respective networks to the emergency organisations and to frame their answers using the table below:

| Type of service | Geotype (only for mobile) | Positioning method * | Accuracy of location information | Map or data/index ** | Means of transmission *** | Technology/ protocol | Comments |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

* e.g. cell/sector location, TA (Timing Advance), RTT (Round Trip Time), UTDOA (Uplink Time Difference of Arrival), EOTDA (Enhanced Observed Time Difference of Arrival), GNSS (Global Navigation Satellite System), AGNSS (Assisted GNSS), or combinations of the above.
**whether the information passed is the location map or the data/index needed to compute the map
***e.g. radio, copper links, optic fibre

## 3.40 SUMMARY OF RESPONSES TO QUESTION 18

| Respondent | Type of service | Geotype (only for mobile) | Positioning method * | Accuracy of location information | Map or data/index ** | Means of transmission *** | Technology/ protocol | Comments |
|---|---|---|---|---|---|---|---|---|
| **Austria** | A) Fixed Line | n.a. | Customer database; Network-Termination-Point | Street/ street number/ postal code | Data/index; Postal address | Fax/Telephone | Fax/Telephone | No location information available in case of private networks.<br><br>SOAP/https in discussion/preparation |
| | B) Nomadic services | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | No location information available in case of nomadic use. |
| | C) mobile | dense urban, urban, rural | Network-Cell-Area | Depends on cell-area width (>700m) | Index: Antenna-Position in WGS84 (decimal) | Internet (optional: Telephone) | SOAP/https (optional: Fax) | SOAP/https only with few PSAP in use |
| **Croatia** | mobile | Urban<br>Rural | Cell ID<br>Cell ID | 300m<br>1000-5000 m | Data<br>Data | Eth/fiber<br>Eth/fiber | MLP 3.2.0<br>MLP 3.2.0 | |
| | fixed | Urban<br>Rural | | Urban: for 90% locations is under 100 m, for 10 % locations is under 500 m<br>Rural: for 90% locations is under 500 m, for 10 % locations is under 5000 m | map geo-coordinates and street address | n/a | Web Service /SOAP | Service is ready from operator's side but it is currently not active because of limitations on PSAP.<br>Besides the described solution, there is another possibility for delivering of caller location information for which we are waiting the changes of regulations, in accordance with the opinion of the Personal Data Protection Agency from July 13, 2010 (Class: 004-02/10-01/105) |
| **Cyprus (CYTA & MTN)** | Mobile telephony<br>MNO 1 | | Cell location | • Installation address of the base station<br>• Cell ID<br>• Latitude & Longitude of the Base Station<br>• Name of the subscriber if it is registered to our database | Overlay on Google maps | Radio | 2G, 3G | |
| | Mobile Telephony MNO 2 | Dense urban, urban, rural | Cell and sector location | Cell and sector location provided have an accuracy of 100% | Information provided:<br>a) site coordinates<br>b) site address<br>c) sector orientation/azimuth<br>d) technology (2G/3G) | Depends on the PSAP connectivity to internet. Usually DSL/Copper link. | Web Interface | Average time for providing the data is 45sec and maximum time is 90sec. Both from the time the call to 112 has been initiated. |
| | VoIP Telepho | | Location information | | | copper link | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | ny (nomadic) | | refers to the registered subscriber address | | | | | |
| | Fixed Telephony | | subscriber address | | | copper link | | |
| **CYPRUS (OCECPR)** | Mobile telephony MNO 1 | | Cell location | Installation address of the base station Cell ID Latitude & Longitude of the Base Station Name of the subscriber if it is registered to our database | Overlay on Google maps | Radio | 2G, 3G | |
| | Mobile Telephony MNO 2 | Dense urban, urban, rural | Cell and sector location | Cell and sector location provided have an accuracy of 100% | Cell and sector location provided have an accuracy of 100% | Cell and sector location provided have an accuracy of 100% | Web Interface | Average time for providing the data is 45sec and maximum time is 90sec. Both from the time the call to 112 has been initiated. |
| **Czech Rep. (Telefonica)** | Fix | | Address of the network termination point | Very good | | Radio, copper links, optic fiber | | |
| | Mobile | All | Cell/sector location | Good | | Radio | GERAN, UTRAN | |
| **Czech Rep. (Vodafone)** | Emergency call, location number specification (coordinates of BTS, azimuth, signal ratio, type of cell Indoor, outdoor, femto…) | Whole network: Location is presented - Triangle, circle, coordinates of point (indoor cell) | Cell ID, where call is originated, information is part of telephony setup (User to user signalling) | Cell covered area | Yes, coverage map sources are provided to emergency center database | Telephony signalling | ISUP – location number, translated to ISDN DSS1 User to user signaling for delivery to emergency center | |
| **(Czech Rep.) T-Mobile** | Mobile | ?? | Location of the “best server” of the cell where the caller is located is transmitted. | Depends on the cell size. | n/a – the location is transmitted. | All. | At the end the call is handed over to PSAP in ISUP | The solution works in this way:<br>- Caller initiates call to the 112.<br>- In the SUP:IAM:CalledNumberParameter we transmit <routing code which points to the nearest emergency center><112><GPS location of the best server of the cell where the caller is located encoded to 8 digits> |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Fixed | n/a | n/a | n/a | n/a | File exchange | | For fixed lines the operator handovers periodically the address (street, building, city etc.) of each fixed line in special file called “info35” to the PSAP. |
| **Denmark (TDC)** | GSM | | TA | | UTM | Radio | | |
| | UMTS | | RTT | | UTM | Radio | | |
| **Denmark (Telia)** | Mobile | All | Cell ID | Depends on cell size. Please also see answer to Q24 on 112 app (GPS). | Data/index | Radio | LIF's Mobile Location Protocol (MLP) | N/A |
| | Fixed | | USD Directory subscriber information | 100% | N/A | Fixed technology | N/A | N/A |
| **Denmark (Telenor)** | Fixed | | Public address book of phone number | House/ apartment/ office address | index | n/a | n/a | Address of calling party looked up at emergency centre |
| | Mobile | Dense urban | Cell/sector | 200-500 m | map | Copper links | XML data | Common solution between DK operators developed. Coordinates with approximate location transferred in XML format using MPLS network. Coordinates of the cell are pre-computed representing the center of the cell. Data is sent in parallel with the call instantly and does not affect the call setup. The position given will be the same for all calls originating from that cell – and as such does not give a precise position of the calling party – only approximate – however enough for the police to avoid misunderstandings regarding alike place-names |
| | Mobile | Urban | Cell/sector | 1km-5km | map | Copper links | XML data | As above |
| | Mobile | rural | Cell/sector | 10 km | map | Copper links | XML data | As above |
| **Denmark (Hi3G)** | Mobile | DU/U/R | RTT | RTT 80-5000m | Data/index | radio | MLP | Accuracy depending on Sector size |
| | Mobile | DU/U/R | GPS | 25-50 | Data/index | radio | MLP | Danish Emergency authorities have chosen not to use this positioning method as it takes to long time (GPS fix) |
| **Estonia** | Mobile | | Various technologies: CGI, CGI-TA, E-CGI, sector+distance | Dense urban up to 200m Urban – up to 500m, Rural – up to few kms | WGS84 coordinates and probability area | IP connection | HTTP/POST XML | |
| | Fixed | | Customer address database | Postal address | Can be translated to coordinates | IP | HTTP/POST XML | |
| **Finland** | Mobile | All | CELL ID, | | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **(TeliaSonera)** | | | TA+RTT | | | | | | |
| **Finland (Mobile Positioning/ DNA)** | Mobile 2G | | CGI/TA | | | | | | |
| | Mobile 3G | | RTT | | | | | | |
| **Finland (Elisa)** | Mobile | All | 2G: CI+TA+Rx and combinations, CI as the base method 3G: CI | Generally around 0 - 300 meters in dense urban, 0 - 2000 meters in urban and 0 - 6000 meters in rural. However, it's not possible to state maximum inaccuracy due to multiple sources of inaccuracy ranging from errors in radio network data to air interface unpredictability. | Data/index (WGS84 coordinates of the subscriber). | Copper | MLP 1.0 with some modifications. | | The positioning platform is highly available. |
| **Germany (Deutsche Telekom)** | | | | | | | | | Cell based localisation: According to German regulation (Section 7 paragraph 7 sentence 3 NotrufV + paragraph N3-A.6.1.4 TR Notruf) |
| **Germany (EPlus)** | GSM/UMTS Voice | no Differentiation | Cell (Center of Gravity) | depending on Cell Size | Coordinates of the Centre of Gravity of the Cell | Radio | U2U Signaling | | Transmission of the Coordinates together with the Voice Call |
| **Germany (Vodafone)** | Fixed Network<br>Mobile Network | <br>All | Address data<br>Cell data | Exact<br>Cell size | Data<br>Data | Fixed network<br>Radio Network | TDM / ISUP<br>TDM / ISUP | | |
| **Greece** | fixed | | Physical Address of telephone line connection | Exact position | | Copper links | | | |
| | mobile | | Cell Area, Cell Set, Cell ID, Base station Address, Azimuth, and maximum coverage distance | Cell coverage | | | | | |
| | Nomadic | | Register subscriber's address | | | | | | |
| **Ireland** | Fixed | N/A | Installation | Subject to | N/A | Multiple | See: http://ww | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **(Meteor)** | | | address | accurate address entry & precision of address (absent post codes) | | Interconnect routes for resilience. Address details for fixed installations provided by FTP. Address lookup is based on CLI of incoming call. | w.btwholesale.ie/whole_ecas.shtml | |
| | Mobile | All | Cell ID | Approximation within the radius of the cell site and varies with cell size | Latitude & Longitude of cell site. | Multiple Interconnect routes for resilience. Cell site details provided by FTP. Address lookup is based on Global Cell Identity provided in call signaling. | See: http://www.btwholesale.ie/whole_ecas.shtml | |
| | Nomadic | N/A | Installation Address | Subject to Accurate Address entry & precision of address (absent post codes) | | Multiple Interconnect routes for resilience. Address details for fixed installations provided by FTP. Address lookup is based on CLI of incoming call. | See: http://www.btwholesale.ie/whole_ecas.shtml | |
| **Three** | Mobile | Static mapping of Cell ID to address | Static mapping | The location provided gives an area equal to the coverage foot print of the cell. | Cell ID value is passed only. | In band on the same links that carry the customer's voice call via E1 copper. | The caller ID presented to the 112 operator has additional digits appended to include the Cell ID of the serving cell at time of call connect. | |
| **Italy (Telecom Italia)** | Fixed telephony | N.A: | Subscriber fixed line physical access location (i.e. subscriber name and subscriber site street address). | The provided subscriber fixed line street address is the subscriber site address where the public network termination | N.A. | Fixed caller location is retrieved directly by the PSAP querying the operator location platform with the subscriber | Secure (IPsec) IP VPN for connectivity and MLP protocol for location messages exchange. | Network provided caller location information and its accuracy has been defined by the competent Administration via a government decree in 2008 and 2009.<br><br>**Common fixed and mobile telephony remarks:**<br>Location information in |

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| | | | | point was installed, as declared in the contract with operator for publicly available telephony provision. | | Calling Line Identity (i.e. E.164 number) of the established emergency service call. In fact operators and PSAPs are interconnected through a secure IP-based national centralised VPN that is operated by the Administration (so called CED Interforze operated by the Ministry of the Interior Affair). | | not used or necessary for call routing purposes, since each PSAP territorial serving area is defined in advance with the Administration basing on the set of telephone districts which a specific Operative Centre is in charge of for emergency provision. When the emergency call is established with the pertinent PSAP, the PSAP itself, on the basis of the information included in call signalling, activates a query to operators' database platform to derive location information; such as query is delivered to operators' system using a national centralised system, which is operated by the responsible Administration (so called CED Interforze belonging to the Ministry of the Internal Affair) and it is directly interconnected with all the operator location platforms.<br>Regarding latency for location provision the Administration fixed an initial average indicative value of about 4s and also the international sufficient latency limit of 15 s. |
| | Mobile telephony | dense urban, urban, rural. | Radio coverage cell to which is attached/registered the calling end user mobile terminal equipment. | Network provided Cell ID (more specifically. CellID+TA for GSM, CellID+RTT for UMTS and CellID for LTE) of the radio coverage cell in which end user terminal is attached/registered. | Geographic coordinates adhere to the OMAP LIF TS 101 V 3.0.0. Appendix C: Geographic Information. | PSAPs and operators are interconnected with a dedicate IP-based VPN and the location retrieval is operated by a national centralized system, that is directly operated by Administration (so called CED Interforze / Ministery of the Interior | IPsec VPN connectivity and OMA LIF Mobile Location Protocol (Emergency Location Immediate service) standard. | Caller location information and its accuracy has been defined by the competent Administration via a government decrees in 2008 and 2009.<br><br>In addition the previous indicated remarks also apply. |

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| | | | | | | Affair). | | |
| **Latvia** | Mobile | All listed | Cell ID | Estimated cell size | Cell center coordinates and estimated cell circle radius | Dedicated copper links | HTTPS/OMA MLP protocol | *Mobile operator Latvijas Mobilais Telefons* |
| | Mobile | data | Cell location | Up to 40km | Index | radio | CDMA 2000-1x | *Mobile operator Triatel* |
| | Mobile | Dense urban | Cell/Sector | 200-2500m | Data | Radio | HTTPS | *Mobile operator Bite*<br>Time – 10s;<br>Dis: accuracy |
| | Mobile | Urban | Cell/Sector | 1000-5000m | Data | Radio | HTTPS | *Mobile operator Bite*<br>Time – 10s;<br>Dis: accuracy |
| | Mobile | Rural | Cell/Sector | 5000-10000m | Data | Radio | HTTPS | *Mobile operator Bite*<br>Time – 10s;<br>Dis: accuracy |
| **Lithuania (Omnitel)** | Mobile | Dense urban, urban, rural | Cell ID/sector location | On the level of Cell ID and sector | Data (x, y coordinates; radius and azimuth) | Copper fixed line (redundant solution) | XML over HTTP | Compliant to PSAP requirements |
| **Lithuania (Bite Lietuva)** | Mobile | Dense urban | Cell/Sector | 200-2500m | Data | Radio | Https | No comments |
| | Mobile | Urban | Cell/Sector | 1000-5000m | Data | Radio | Https | No comments |
| | Mobile | Rural | Cell/Sector | 5000-10000m | Data | Radio | Https | No comments |
| **Lithuania (Tele2)** | Mobile | Dense urban | Cell/sector location | Till 500 m | Data/index | Copper links & optic fiber | MLP through secure IP/VPN channel | |
| | Mobile | Urban | Cell/sector location | 500 m – 1 km | Data/index | Copper links & optic fiber | MLP through secure IP/VPN channel | |
| | Mobile | Rural | Cell/sector location | Till 15 km | Data/index | Copper links & optic fiber | MLP through secure IP/VPN channel | |
| **Lithuania (TEO LT; AB)** | Fixed | - | User installation address | - | - | - | - | CD is regularly provided with user address DB bind to telephone number |
| **Luxembourg** | Mobile Voice and SMA | | Technology (2G/3G)/Cell /sector | Reliable | To our knowledge, map is not computed at 112 services | Mobile Voice and SMS | Cobber links | ISUP |
| | Fixed | N/A | N/A | N/A | N/A | Fixed | Copper / optical fiber | TDM / VOIP |
| **Montenegro** | | | | | | | | Operators do not provide information about 112 caller location due to technical reasons. Currently, there is no communication between operators and 112 Center, but its implementation is expected in near future. |
| **Norway** | Mobile | | Cell ID (one out of three mobile network operators also offer sector and TA) | Moderate | Data/index | Copper links and fiber | | |
| | Fixed | | Registered addresses | Good | Data/index | Copper links and fiber | | |

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| **Poland** | fixed (PSTN /ISDN access, IP PABX service) | | Postal address declared at the moment of signing the agreement for telephony service (service address location/ network termination point address). Information sent to the Location and Information Platform with a Centralised Data Base (PLI CBD) prior to emergency call (at the moment of creation new client) contains: subscribe name, postal code, city/town, street name, building number | | | | | |
| **Portugal (Portugal Telecom)** | Fixed | | Location address | Address + ZIP Code | data/index | Optical fiber, copper | Proprietary | The information is stored in an external database. The address is obtained from the A-number using a specific application. |
| | Mobile | all | CI based | 100 m - greater than 20 Km | data | Mainly optical fiber | Proprietary | Positioning is provided in the call setup redirecting number. Low accuracy due to the positioning method. |
| **Portugal (Vodafone)** | | | | | | | | Based on the site location number where the call is setup, information regarding latitude/longitude and an estimated ratio of the location where the calling party is potentially located is sent with the call to 112 centre. This information is passed in ISUP IAM message to PSTN |

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| | | | | | | | | that delivers it to PSAP. This is procedure for all 2G/3G/4G mobile calls with and without SIM/USIM cards in UE and is also valid for customers which are not subscribers of our network (such as roamers In and other PLMN subscribers). For fixed access, the location information is based on the post code and address of the calling party's number |
| **Portugal (Cabavisao Television)** | Fixed | | Customer Address sent offline every Monday | The information is validated by customer and from the Service providers during the service installation and maintenance operations | Not Applicable | Not applicable | FTP | |
| **Romania** | The answers given below to questions 18 to 27 cover the responses received from all 4 mobile operators and 4 fixed operators.<br>a. Mobile calls: cell id/sector id information sent with the call to 112 PSAP where a database with cell/sector technical characteristics is maintained, helping draw an estimate of the cell/sector service area;<br>b. Fixed calls: the A number identity received at 112 PSAP is matched with the subscriber database maintained from operators' reporting, resulting in an administrative address;<br>c. Nomadic calls: similar situation as for fixed calls; operators are also obliged to inform (flag) 112 PSAP when updating the subscriber database about the nomadic use of specific identification entries. | | | | | | | |
| **Slovak Republic (Orange)** | Mobile telephony service | All | cell/sector location | cell coverage | Data – x,y, angle, radius | IP interconnection | MLP (XML over HTTP) | |
| | Mobile telephony | | Location number in SS7 format | Cell location/ address | WGS position of BTS | Signaling link | SS7 | |
| | Landline telephony | | Installation address | Postal address | data | Offline batch | - | Switch to online exchange is planned (currently stopped) |
| | Mobile telephony service | All | cell/sector location | cell coverage | Data – x,y, angle, radius | IP interconnection | MLP (XML over HTTP) | |
| **Slovak Republic (Slovak Telekom)** | MOBILE | | CELL-ID | 300m-25km | DATA | RADIO | MLP 3.0 | Time:1s-15s |
| | FIXED | | | | DATA | | SOAP/WSDL | Information on where the service is to be provided (network termination point placement) as specified in subscriber contract. |
| **Slovak Republic (Telefonica)** | 112 | all | sector location | size of sector computed based on cell power | location map vectors | radio | LBS/MLP | time for location depends on paging time |
| **Slovak Republic (GTA Slovakia)** | fixed | | place of installation defined in contract | street / house no | | | | |
| **Slovenia (Amis)** | fixed | | Pull | 100% | Data (address of caller) | | | Communication between emergency organisation and provider (us) is established via phone |

| | | | | | | | | |
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| | | | | | | | | call. |
| **Slovenia (Debitel)** | mobile | all | Cell | 90% | map, vector diagram | internet/ VPN | webservices | real-time |
| **Slovenia (Detel)** | Fixed Nomadic | | | | data | | | |
| **Slovenia (Mega M)** | Fixed | | N/A | N/A | N/A | N/A | N/A | Call is only routed to correct regional center according to postcode of subscriber. No location data sent. |
| **Slovenia (Novatel)** | Fixed | | Address of users | 100% | no | | Pull data protocol | We send caller location on emergency organisation request |
| | Nomad | | Address of users | | no | | Pull data protocol | We send caller location on emergency organisation request |
| **Slovenia (Si.Mobil)** | VoIP | | | | Address of subscriber line | Copper, fiber | SIP, h.248 | Location is fixed and send upfront to 112 centers |
| | Mobile | Cell ID | Cell/sector location | Cell Coverage | - MSISDN<br>-Cid<br>-cell coverage<br>-time stamp | radio | AIF<br>IuCS<br>ISUP | Push method |
| **Slovenia (Softnet)** | VOIP | / | Fixed location | 100% | / | Copper / Optic fibre | Fixed VOIP technology | / |
| **Slovenia (T-2)** | Fix | / | / | +/- 10m | Data + index | Fibre optic | TCP/IP xML | |
| | Mobile | / | Cell/ sector location | / | Map | Fibre optic | TCP/IP xML | |
| **Slovenia (Teleing)** | Fix | / | / | +/- 10m | Data + index | Fibre optic | TCP/IP xML | |
| | Mobile | / | Cell/ sector location | / | Map | Fibre optic | TCP/IP xML | |
| **Slovenia (Telekom)** | mobile | all | cell | 90% | map, vector diagram | internet/ VPN | webservices | real-time |
| | fixed | | coordinates | 100 m² | data | VPN | web service | real-time |
| **Slovenia (Tusmobil)** | Emergency service | / | User provided address | 99% | / | Copper / optic | Fixed land line PSTN,ISDN / VoIP | |
| | Emergency service | Shape files | Shape files WGS84 | 99% | Map | Radio | GSM/UMTS | |
| **Spain (112 Euskaltel)** | Fixed | | CLI | | | | | We provide CLI. External DB with CLI-Location info available. |
| | Mobile | | | | | | | As MVNO, this service is provided by MNO |
| **Spain (Orange)** | 112 | Longitude/ Latitude | Cell/sector location | | data | | http/ipSEC | |
| | 062 | Longitude/ Latitude | Cell/sector location | | data | | http/ipSEC | |
| | 091 | Longitude/ Latitude | Cell/sector location | | data | | http/ipSEC | |
| **Spain (Vodafone)** | Fix Telephony | any | Subscriber's address | Very high | | | | (1) |
| | Mobile Telephony | any | User Cell ID | high | | | | (2) |
| | Nomadic services | any | Subscriber's contract address | Dependent on user circumstances | | | | (3) |
| | (1) Subscriber's address is obtained through the phone number identified in the call. Operating companies are obliged to send CMT[2] the subscriber's address corresponding the telephone number which corresponds with the Network Terminating Point.<br>(2) Using protocol POSIC112 v2 VODAFONE gives to the emergency centres the following parameters or values in each of the calls originated in its mobile network to locate the user (following are shown examples of each values):<br>a. Calling number: 34426124222<br>b. Emergency number: 112<br>c. Service: E112<br>d. Timestamp: 20130206115321 | | | | | | | |

[2] Comisión del Mercado de las Telecoimunicaciones

| | | | | | | | | |
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| | e. Zone or cell where the user is located, it can be a sector or circle depending on the Cell Global Identity (CGI),in UTM coordinates:<br>Zona1:--> NumZona:31; LetraZona:T; (x:-2122578944,y:1167476480);<br>RadioInterior:0; RadioIncertidumbre:201;<br>AngIni:0; AngFin:360;<br>Probabilidad:100.<br>Additionally, to some emergency centres VODAFONE gives the following values:<br>- Autonomous community: 2 (Andalucía)<br>- Province: 22 (Huelva)<br>- Town (postal code of the cell): 22482<br>- Second incertitude zone, so:<br>i. If zone 1 is an arc, zone 2 must be a circle.<br>ii. If zone 1 is a circle, zone 2 must be another circle with a 25% greater radius.<br>Subscriber's contract address is obtained through the phone number identified in the call. Operating companies provide the data. | | | | | | | |
| **Spain (Telecable )** | From our fixed lines, we have two different scenarios in calls to 112 services:<br>- From our cable customers, based on the location of the customer, we call to the specific 112 emergency site. The location information in the provisioning process, based on where the line is installed.<br>- From our SIP customers, since we don´t know the location of the customer, we have to use a code related to the postal code indicating the 112 emergency site we have to call to.<br>In both cases, from our switches we call the 112 emergency sites through ISUP trunks. In those calls we sent the following information: originating number, date and time. Besides, we're full MVNO, so we don´t have our own radio network, we use the radio network of<br>our host operator. So, in calls to emergency organisations, they sent us the calls indicating the short<br>emergency code and the translated geographic number. They set that information based on the location of the mobile line, but we don´t know where it exactly is.<br>After receiving the call from our host operator, we sent it to the emergency organisations through ISUP trunks too, with the same information as in fixed lines case. | | | | | | | |
| **Spain (Yoigo)** | mobile | all geotypes | cell id/Local Area Code | | Date needed to compute the map | Radio | | |
| **Switzerland (Backbone Solution)** | nomadic | | client profile address information | dependant on clients profile actuality | zip-code and city name | | | location is depending on the clients efforts to keep his profile and location of his VoIP device actual. The client gets informed about this when his registering for our VoIP service |
| **Switzerland (Sunrise Communications)** | Mobile 2G | dense urban,<br>urban,<br>rural | TA (Timing Advance) | | data/index | | | only two rows, not able to add row and input for 4G |
| | Mobile 3G<br>****<br>Mobile 4G | dense urban,<br>urban,<br>rural<br>*****<br>dense urban,<br>urban,<br>rural | cell/sector location<br>**** | | data/index | | | ****<br>only two rows, not able to add row and input for 4G<br>****<br>No call feature on 4G => fallback to 2G or 3G |
| **Switzerland (Orange)** | As MVNO of Orange, we refer to Orange's answer to that question | | | | | | | |
| **Switzerland (Swisscom)** | Mobile | Dense, urban, rural, mountains | Prob3D+ (Probability calculation, propagation of antennas in 3D, calibrated TA and RTT, | Depending on GSM and UMTS, Topology, distributions of Antennas | 1..10 ellipsis | Mixed | MLP over IP | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | History) | | | | | |
| | Fixed and VoIP | Dense, urban, rural, mountains | Address of fixnet or access | Building | Address data | Mixed | MLP over IP | |

**Questions 19 and 20 are intended to gather any relevant experience from electronic communications network operators regarding the sending of 112 caller location information to the emergency organisations and any issue regarding the accuracy or the reliability of the information that might have been experienced.**

### 3.41 QUESTION 19

Respondents were asked if, during liaisons with emergency organisations, they noticed themselves or the emergency services signalled to them any problem related to the "accuracy" of the 112 caller location information sent and if so, to describe them.

### 3.42 SUMMARY OF RESPONSES TO QUESTION 19

41 Respondents answered “No” and provided the following additional information.

**Denmark (Telenor)** stated that during implementation of current system (2005) the requirements were to establish a good enough location to avoid confusion when emergency personnel were interviewing the calling party regarding whereabouts. It was agreed that an electronically given position should – if possible - be supplemented with interview of the caller. This to avoid limitations from stand-alone electronic location information if the caller is a person just passing by (location less relevant), going opposite direction on highway, calling on behalf of someone else etc.

**Lithuania (Tele2)** stated that there were some technical issues regarding reliability, but accuracy wasn’t affected if subscriber location report was sent and received.

**Spain (Vodafone)** stated that in the Public Consultation made by SETSI, it was said that emergency centres have detected that 10.28% of calls coming from fix networks hadn’t location information. The origin of this inaccuracy should be investigation though VODAFONE can’t bring additional information since we don’t have detected this type of problems in the calls coming from our fix network. Vodafone don’t have incidences in the incidences managing system that is centralised and managed by CMT.

**Spain (Yoigo)** stated that only issues were referred to non-updated info, but corrections were applied immediately.

17 Respondents answered “Yes” and provided the following additional information.

**Croatia** stated that in mobile networks more accurate positioning method would be preferred.

**Czech Republic (Vodafone)** stated that accuracy is dependent on area covered by cell, proper system provisioning and map sharing, during cutovers to new technology or network reconfiguration. Benefit – cell accuracy is delivered inside of telephony signaling – location number, no additional channel to EMC.

**Finland (Mobile Positioning DNA)** stated that of course they would like to have better accuracy. Finland is quite big country but only 5.3 million people. Outside of our capital city there are very wide places which are covered with large mobile cells. That does our positioning quite inaccurate.

**Finland (ELISA)** stated that in couple of cases over the past 10 years the location estimate returned has been incorrect due to synchronisation issues in radio network (RNW) data. The RNW data is imported daily to the positioning platform and used as basis for calculating the location estimate with the data got from the target UE (i.e. CI or possibly other additional information).

**Ireland (Three)** stated that at times the database provided to ECAS did not include a number of temporary sites which were installed for several special events, this has since been addressed.

**Norway** stated that for fixed, the emergency organisations have signalled that the reliability/quality of registered addresses must be better. For nomadic, there should be some possibilities for locating when the unit is not on its registered address. For mobile, there are requests for sector view, TA and estimated/measured cell coverage. For mobile there should also be a GPS solution as add-on to the information gathered by the networks themselves.

**Portugal (Vodafone)** stated that it has received some questions regarding how it could improve accuracy on the information provided for mobile access, namely the possibility of using solutions based on the use of GPS (which is directly related to the type on handset used by the customer) and the possibility to indicate in which direction is the calling party heading to while in mobility.

**Romania** referred to some isolated problems:

a) Isolated problems with updating the technical information database; and
b) Given the specificity of electromagnetic wave propagation and the fact that can't define the range of the cell according to counties' borders, neighbouring rural areas can cause problems on the accuracy of location information, which is manifested by routing the call to the PSAP in neighbouring county.

**Slovak Republic (Slovak Telecom)** stated that some cell radius parameters are too big for efficient localisations.

**Slovenia (Slovenia Telekom, Debitel and Novatel)** referred to the problem of how to locate callers using nomadic services.

**Spain (Orange)** stated that sometimes due to errors loading the location data of the cells in the platform

**Switzerland (Sunrise Communications)** stated that for mobile, the emergency organisations are not satisfied with the accuracy of the location information as they compare the results with what they see in TV series. We too had problems with the routing to the regional centers of the emergency organisations because of errors during network migration/upgrade activities.

**Switzerland (Swisscom)** referred to the problem of certain areas being far too large where several ellipses are difficult to handle. Also missing data.

<u>2 respondents did not answer "Yes" or "No"</u> but provided the following information.

**Italy (Telecom Italia)** stated that first of all the location procedure and its accuracy were defined in advance by the responsible Administration, choosing the network provided solution for its availability and reliability. So no specific issue about accuracy emerged, since each involved actor knew the chosen and expected accuracy level.

For fixed telephony the subscriber site street address is the only reliable possibility, considering that the operator only knows the public network access to which the end user is attached; no issue emerged for accuracy of the fixed subscribers location.

Also for mobile telephony the location information reliability is the main point, so a network provided location information provision was selected by the responsible Administration; the Cell ID is the reliable location information that each mobile operator can assure in any national area. Of course when the radio coverage cell is larger, the location information is less precise. No specific accuracy issue emerged till now..

**Spain (Telecable)** stated that in fixed lines, as soon as it is advised any change on translated numbers, it updates them in its switches in order to route them correctly. In mobile lines, regularly it checked calls to emergency services in order to validate the information received from its host operator.

### 3.43 QUESTION 20

In Question 20, respondents were asked if they found any possible solutions to coping with the problems identified in their responses to Question 19 and if yes, to describe them by framing their answers using the following table.

| Type of service | Geotype (only for mobile) | Positioning method* | Description of the problem | How it affects the accuracy | (Possible) Solution | Comments |
|---|---|---|---|---|---|---|
| | | | | | | |

* e.g. cell/sector location, TA (Timing Advance), RTT (Round Trip Time), UTDOA (Uplink Time Difference of Arrival), EOTDA (Enhanced Observed Time Difference of Arrival), GNSS (Global Navigation Satellite System), AGNSS (Assisted GNSS), or combinations of the above.

### 3.44 SUMMARY OF RESPONSES TO QUESTION 20

13 respondents answered "No" or "Not Applicable" to this question. Additional information from those respondents who answered "Yes" is contained in the table below.

| Respondent | Type of service | Geotype (only for mobile) | Positioning method* | Description of the problem | How it affects the accuracy | (Possible) Solution | Comments |
|---|---|---|---|---|---|---|---|
| **Czech Republic (Vodafone)** | Mobile | Location number | cell/sector location | Signal is received sometimes too far from BTS (mountains) | | | |
| | Fixed | Address of end point | coordinates, address | Provide correct address of caller due to different billing address, address of POI connection, customer own distributed network, easy remote VoIP technology access to customer located PBX, Improve customer onboarding process | | | |
| **Denmark (Hi3G)** | Mobile | Dense urban/urban/rural | RTT | Cell db on location server is updated 1-2 a week. If call is made just after a new site has been set up or moved it could result in missing location | No location | More frequent updates | Prediction calculation has taken many hours before. With smarter calculations the calculation now is much quicker and by that it is possible to update cell db more often |

| | | | | | | | |
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| | Mobile | Dense urban/urban/rural | GPS | Long time to fix position | Operator do not get position until 20-25 sec after call is made | Removal of GPS positioning. Operator make a second positioning after have retrieved RTT | |
| **Finland (Mobile Positioning/DNA)** | mobile 2G | rural | CGI/TA | very large cells | | Some GPS based system | |
| | mobile 3G | rural | RTT | very large cells | | Some GPS based system | |
| **Finland (Elisa)** | Mobile | | All | | | Improving the RNW data quality by importing it from multiple sources. | Positioning relies very heavily on the reliability of the RNW data. The RNW data sources are not originally intended to be used for this purpose. |
| **Greece** | Mobile | rural | Cell id | Large coverage | Difficult to find the exact location | Other type of positioning method is necessary | |
| | Fixed | It is stated that it is not always possible to give the exact location in the following cases: Home zone type (telephone connection that looks like mobile but is fixed), For VoIP calls there is a notification/flag for the user in case it is nomadic, the telephone connection is in operation less than 1 day, DDI connections | | | | | |
| **Ireland (Meteor)** | Fixed | N/A | Registered postal address. | Rural addresses in particular can be reliant on local knowledge (e.g. Family Name, Townland, and County). Also Subject to human error in data entry. | Emergency services may not have sufficiently granular local knowledge. Depending on address entry, the address provided may be of little or no use. | New precision post code system set to be implemented in Ireland by 2015 is expected to significantly improve accuracy. | |
| | Mobile | All | Cell ID | Not precise and varies by cell site. | Used currently limited to matching call origin appropriate regional emergency service but rural sites can overlap two or more regional emergency service areas. | Ultimate solution will flow from the wider debate in which device and network solutions are being considered. Also a need for emergency services to be able to handle more precise location information. | |
| Lithuania (TEO LT, AB) | Fixed | - | User installation address | Some addresses could be incorrectly assigned, or user made changes to | This will allow to identify accuracy inconsistencies | Provide several address: Billing, installation, coordinates of operators user distribution box (last | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | installation, moved VoIP phone to other location. | | in chain before user installation), location of IP Address installation if calling using VoIP | |
| **Norway** | Mobile | | Cell ID (one out of three mobile network operators also offer sector and TA) | Cell ID with possible coverage radius of 32 km is not very accurate | In rural areas the accuracy is very poor. Better in urban areas where the cell coverage radius is much smaller. | | |
| | Fixed | | Registered addresses | The addresses may be of poor quality, wrong or not present at all. | | Better cross-check of all registered addresses. | |
| | Nomadic | | Registered addresses and «flag» indicating possible nomadic use. | The addresses may be of poor quality, wrong or not present at all. | | Better cross-check of all registered addresses. + Some solution for acquiring correct location when unit is not located on registered address. | |
| **Portugal (Vodafone)** | Taking into account the requirements demanded regarding the information sent to PSAP (reliability of the location of the calling party, same information regardless of the handset of the calling party, capability of allowing access to callers from other networks and callers without SIM cards and based on push solutions), none of the solutions address are capable to deliver a more accurate information.<br>Potential solutions to the issues referred above are highly dependent on the calling party's handset, functionalities and capabilities of the device (namely on what regards GPS solutions) and personal configurations set by the user. Also, the implementation of tools to cope with the issues referred above are not only dependent on developments from the operators side; PSAP capabilities need to be able to support them, which requires further developments from the PSAP side are needed. Finally and taking into account that access should be assured to any calling party (even calls made without SIM cards), it won't be possible to send an Any_time_interrogation / Provide_Subcriber_Info MAP operation to reconfirm location.<br>GPS solution depends on mobiles capabilities | | | | | | |
| **Romania** | 1. Increase the frequency of updating the database (for 1st issue).<br>2. For this problem a solution has not been identified so far (for the 2nd issue). | | | | | | |
| **Slovak Rep. )Slovak Telecom)** | MOBILE | RURAL | CELL-ID | Big areas | VERY | Use better localisation methods | |
| | MOBILE | DENSE | TA, ECGI | TA accuracy is worse than CELL-ID. TA step is 550m | HIGH | Use other localisation methods in URBAN area | Because of signal reflection caused by buildings and because of TA step definition, which is 550m |
| | MOBILE | EVERYWHERE | AGNSS | Problem with mobile phone capability to use this localisation method by default | HIGH | Mobile phone manufactures needs to provide A-GPS over control plane capabilities by default into all mobile phones | |
| **Slovenia (Debitel)** | mobile | Nomadic | | how to find the location of terminal | | | |
| **Slovenia (Novatel)** | Nomadic | | Address of users | The Nomadic users on VoIP. We cannot | fully | Emergency organisation have one reserved 112 | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | provide there location | | number for nomadic users | |
| **Spain (Orange)** | All | All | Cell / Sector Location | Incorrect data | Bad location of the call | Periodic Audit of the data | |
| **Spain (Vodafone)** | VODAFONE thinks that the existing systems are accurate from the perspective of what the network can deliver. Trying to incorporate new functionality lying on the operator side may not be rational or proportionate. | | | | | | |
| **Spain (Telecable )** | Based on our solutions, we have to focus on provisioning correctly our fixed lines (where we specify the location) and hacked regularly the information sent from our host operator, in our mobile lines. | | | | | | |
| **Spain (Yoigo)** | mobile | all geotypes | cell id/Local Area Code | cells not updated | Position provided was not correct | Info of the cell updated | |
| **Switzerland (Swisscom)** | Mobile | Urban, rural | All location calculation methods from network vendors | Bad concepts and very bad quality of localisation from worldwide acting network vendors. No flexibility from network vendors to eliminate the errors and to optimise all | Unusable location estimation | Using from network vendors only the original values for cell ID, TA, RTT and implementing a different location calculation with Prob3D+ | Solved in Prob3D+ |
| | Mobile | Urban, rural | Cell location | More than one antennas per cell ID | Wrong localisation | Redesign architecture for multiple antennas per cell ID | Solved in Prob3D+ |
| | Mobile | Urban, rural | Cell location | Unrealistic antenna model | Wrong localisation | Using type of antenna and for each type a 360 degree beam map | Solved in Prob3D+ |
| | Mobile | Urban, rural | Cell location | Ignoring cell selection process handset/network | Too large areas | Modeling cell selection process handset/network GSM/UMTS, using for GSM a penalty of -10 on the field strength measurement in comparison to UMTS | Solved in Prob3D+ |
| | Mobile | Urban, rural | all | Conceptual mixing real field strength and predicted field strengths | Huge wrong areas when assuming the phone picks the strongest antenna | Using normal distributions for real field strengths, with the predicted field strength in the center and estimating the standard deviation from real world samples. | Solved in Prob3D+ |
| | Mobile | Urban, rural | Cell location | Flatland calculations in areas with hills and mountains | Localisation in wrong valleys, far too large areas | Using 3D propagation model of radio beams | Solved in Prob3D+ |
| | Mobile | Urban, rural | Cell location | Too large cells | Localisation in all distances from an antenna | Using TA and RTT | Solved in Prob3D+ |
| | Mobile | Urban, rural | Cell location + TA/RTT | Many reflections in cities | Caller far closer to antenna than calculated from TA or RTT | Estimating distance distribution for each TA with 100, 000 test calls in cities. Estimate distributions for | Solved in Prob3D+ |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | RTT in a similar way with many sample calls UMTS. | |
| | Mobile | Rural, mountains | Prob3D+ | Reduce factor of reflections in rural and mountain areas | Too large location areas | Using different distance distributions for city/urban/mountains areas | We are in discussion to implant this soon. |
| | Mobile | Urban, rural | all | Wrong localisation in tunnel and in-house | Bad localisation in-house and tunnel | Using maps for all tunnel and in-house | Solved in Prob3D+ |
| | Mobile | Urban, rural | Anything with TA or RTT and repeater in tunnel | Repeater in tunnel | Bad localisation in-house and tunnel | Calculate propagation using nearest repeater in tunnel | Solved in Prob3D+ |
| | Mobile | Urban, rural | Anything method based on TA or RTT and repeater in tunnel | Delays in cable | Wrong shift of position in tunnel and airports | Estimating propagation delays for all repeaters based on type of connection (cable, fiber or air) and the length of the cable | Solved in Prob3D+ |
| | Mobile | Urban, rural | all | Often a caller does call multiple times. Not using all data available. | Too large areas | Using all data from the last 15 min and combine it | Solved in Prob3D+ |

## 3.45 QUESTION 21

In Question 21, Respondents were asked if they had encountered any problems regarding the "reliability" of the 112 caller location information sent and, if yes, to describe those problems.

## 3.46 SUMMARY OF RESPONSES TO QUESTION 21

48 Respondents answered “No” and provided the following additional information:

**Denmark (Telenor)** stated that Cell-ID is always available and can be used for immediate approximate positioning.

**Spain (Orange)** stated that it uses the IPSec protocol with 112 Centers.

12 Respondents answered “Yes” and provided the following additional information:

**Czech Republic (Vodafone)** referred to its response to Question 23.

**Ireland (Three)** stated that the information sent historically was out of sync with the network at times due to the pace of change. This has since been addressed.

**Lithuania (Omnitel)** stated that so far it” providing location data automatically only with CLI to central PSAP call center from Vilnius area. For other calls manual procedure for obtaining location information is available. Automated location data provision for all calls is due by the end of 2013.

**Lithuania (Tele2**) stated that there were some technical issues regarding reliability, when subscriber location report was wrongly sent/not sent from mobile operator side or wrongly interpreted/was not taken from PSAP side.

**Luxembourg** provided details of an incident in March 2013. "XXXX has been notified by Administration des Services de Secours that a substantial amount of calls originated from XXXX network to 112 were not related with emergency calls. Furthermore, these calls were all presenting CLI 352091000022 and not Customer CLI. Explanation: The CLI 352091000022 is assigned by default to all emergency calls to 112 from mobile devices with no SIM card. It is obvious that with such a configuration, XXXX has no possibility to sort out the real emergency character of the calls to 112. There is actually no means of filtering such calls. Furthermore, the Administration des Services de Secours has evaluated that 10% of such calls are indeed falling into Emergency characters which require 112 assistance.

**Montenegro (Telenor)** stated that reliability (accuracy) in GSM-based locating depends on the density and layout of base stations, density of call structure and terrain.

**Montenegro (MTel)** stated that a problem may arise if a cell covers a border area between two towns. There is no such problem in the fixed telephony unless the user indicates the wrong town in his/her address.

**Norway** stated that problems can occur due to missing or wrong, or low quality of, registered addresses. For mobile the reliability is pretty good, but the accuracy varies a lot.

**Slovenia (Slovenia Telekom and Debitel)** stated that there were problems with failure of equipment.

**Switzerland (Swisscom)** stated that there was a problem with very bad quality LBS systems from network vendors and very low motivation from network vendors to improve their LBS solutions. LBS is now usually integrated in network equipment, which is paid in a block. This way network vendors have low interest to improving and optimising their systems, as they get the cash almost independent from any quality requirements. We had no quality checks on data problems with failure of equipment.

<u>2 respondents did not answer "Yes" or "No"</u> but provided the following information.

**Spain (Vodafone)** stated that from its perspective the same considerations done in accuracy are predicable for the reliability of the location information provided. It thinks that there is path for improvement in the system and an important part of the work is in the emergency centres side. As mentioned above, Vodafone has detected an increasing complex system to deliver a call to an emergency centre. 112 in Spain is competence of each Autonomous Community sometimes there is more than one number to deliver the call to the emergency centre. Considering all the emergency services and all the circumstances there is a really complex system where there are 364 different ending points to deliver a call depending on the location of the user. This will lead to ambiguous situations, for instance, when the service has different numbers for different areas that can be covered by the same cell.

In Vodafone's opinion, public administrations should make the effort to keep the balance between efficiency and complexity. It is also important, in its opinion, to keep a reference database public and accessible for those who need access to that information, at least for operators in order to have a reference for auditing purposes.

No system is 100% reliable so, when, for instance when the cell ID is not present there is a real problem for the operator to deliver the call, especially taking into account the additional regulation in Spain to deliver the location information. There always should be an overflow called number to ensure that an emergency call is delivered to an ending point even if some information is missing.

Above all of these considerations there is also place to make slight improvements in existing systems that are reality specific to each implementation, for instance Vodafone already make suggestions to CMT to improve the existing system to provide subscribers' addresses.

**Spain (Telecable)** stated that where SIP lines are used it is quite difficult to be sure where the line is, due to the technology implementation.

### 3.47 QUESTION 22

In Question 22, Respondents were asked if they found any possible solutions to coping with these problems identified in response to Question 21.

### 3.48 SUMMARY OF RESPONSES TO QUESTION 22

28 respondents answered “No” or “Not applicable”. Of those that answered “No” the following additional information was provided.

**Montenegro** stated that solutions to the problems identified in response to Question 22 were technologically infeasible.

**Slovak Republic (UPC)** stated that customers are obligated to use the Voice service only on dedicated geographical address according to the general terms and conditions (GTC), but we are not able to guarantee that customer will comply with the GTC.

8 Respondents answered “Yes” but only two provided further details of those solutions identified.

**Denmark (Hi3G)** referred to its answers to Question 20 which were – solution for fixed: more frequent database updates – solution for mobile: Removal of GPS positioning and operators to make a second positioning after having retrieved Round Time Trip (RTT).

**Ireland (Three)** stated, in reference to the problem it identified in response to Question 21, that a new more robust automated process is now used for the sharing of this information with ECAS. As the solution is a procedural fix rather than a technical one the answers to 23 are not applicable.

### 3.49 QUESTION 23

In Question 23 respondents who answered “Yes2 to Question 22 were asked to describe the solutions also specifying the type of service (fixed, mobile, nomadic) and – in case of mobile service – per geotype (dense urban, urban, rural), using this table:

| Type of service | Geotype (only for mobile) | Positioning method * | Description of the problem | How it affects the reliability | (Possible) Solution | Comments |
|---|---|---|---|---|---|---|
| | | | | | | |

* e.g. cell/sector location, TA (Timing Advance), RTT (Round Trip Time), UTDOA (Uplink Time Difference of Arrival), EOTDA (Enhanced Observed Time Difference of Arrival), GNSS (Global Navigation Satellite System), AGNSS (Assisted GNSS), or combinations of the above.

### 3.50 SUMMARY OF RESPONSES TO QUESTION 23

| Respondent | Type of service | Geotype (only for mobile) | Positioning method * | Description of the problem | How it affects the reliability | (Possible) Solution | Comments |
|---|---|---|---|---|---|---|---|
| **Czech Republic (Vodafone)** | fixed,<br><br>mobile, | Address, coordinates<br><br>Cell/Sector | | Management of subscriber database, Different billing address than calling, hidden private WAN networks<br><br>Worst location in areas with small density of cells, | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | nomadic | Address provided by subscriber | | e.g. Mountains<br><br>Same principles like for fixed, Subscriber database with address, no nomadic localisation functionality | | | |
| **Denmark (Hi3G)** | Mobile | Dense urban/urban/ rural | RTT | Cell db on location server is updated 1-2 a week. If call is made just after a new site has been set up or moved it could result in missing location | No location | More frequent updates | Prediction calculation has taken many hours before. With smarter calculations the calculation now is much quicker and by that it is possible to update cell db more often |
| | Mobile | Dense urban/urban/ rural | GPS | Long time to fix position | Operator do not get position until 20-25 sec after call is made | Removal of GPS positioning. Operator make a second positioning after have retrieved RTT | |
| **Ireland (Meteor)** | Mobile | All | Cell ID | Minor administrative issues affecting updates to the list of cell IDs. | Potential for a slight increase in latency in providing location information for new sites. FallBackbone Solution to LAC remained for more general regional location information. | Solution in place through a revision to the process for providing these updates. | Past issue which has been resolved. |
| **Italy (Telecom Italia)** | Fixed telephony | N.A: | Subscriber fixed line physical access location (i.e. subscriber name and subscriber site street address). | The provided subscriber fixed line street address is the subscriber site address where the public network termination point was installed, as declared in the contract with operator for publicly available telephony provision. | Fixed caller location is retrieved directly by the PSAP querying the operator location platform with the subscriber Calling Line Identity (i.e. E.164 number) of the established emergency service call. In fact operators and PSAPs are interconnected through a-secure IP-based national centralised VPN that is operated by the | Secure (IPsec) IP VPN for connectivity and MLP protocol for location messages exchange. | Network provided caller location information and its accuracy has been defined by the competent Administration via a government decree in 2008 and 2009.<br><br>**Common fixed and mobile telephony remarks:** Location information in not used or necessary for call routing purposes, since each |

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| | | | | | Administration (so called CED Interforze operated by the Ministry of the Interior Affair). | | PSAP territorial serving area is defined in advance with the Administration basing on the set of telephone districts which a specific Operative Centre is in charge of for emergency provision. When the emergency call is established with the pertinent PSAP, the PSAP itself, on the basis of the information included in call signalling, activates a query to operators' database platform to derive location information; such as query is delivered to operators' system using a national centralised system, which is operated by the responsible Administration (so called CED Interforze belonging to the Ministry of the Internal Affair) and it is directly interconnected with all the operator location platforms. Regarding latency for location provision the Administration fixed an initial average indicative value of about 4s and also the international sufficient |

| | | | | | | | |
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| | | | | | | | latency limit of 15 s. |
| **Lithuania (OMNITEL)** | Mobile | Dense urban, urban, rural | Cell/sector location | Mapping of call and location data sent over separate channels | If unique identifier is missing for a transaction, mapping is not possible | In case of no CLI IMEI will be provided in the A number field for both call and location data transaction. Yet, IMEI is not the best unique subscriber identifier (as it is not truly unique in the network). | |
| **Lithuania (TELE2)** | Mobile | All types | Cell/sector location | Cell/sector coordinates were wrongly interpreted | Wrong caller location was set | System configuration changes on PSAP side. | |
| | Mobile | All types | Cell/sector location | Wrong A number was sent | PSAP couldn't identify caller location | Software changes on mobile operator side | |
| | Mobile | All types | Cell/sector location | Cell/sector coordinates were wrongly interpreted | Wrong caller location was set | System configuration changes on PSAP side. | |
| **Norway** | For the registered addresses issue, the Norwegian regulator performs random checking of the mobile service providers. The regulator also gets statistics from the NRDB (mentioned above). In addition the regulator has a web based solution for registering incidents with regard to wrong routing and other issues concerning emergency calls. | | | | | | |
| Portugal (Vodafone) | Taking into account the requirements demanded regarding the information sent to PSAP (reliability of the location of the calling party, same information regardless of the handset of the calling party, capability of allowing access to callers from other networks and callers without SIM cards and based on push solutions), none of the solutions address are capable to deliver a more accurate information.<br>Potential solutions to the issues referred above are highly dependent on the calling party's handset, functionalities and capabilities of the device (namely on what regards GPS solutions) and personal configurations set by the user. Also, the implementation of tools to cope with the issues referred above are not only dependent on developments from the operators side; PSAP capabilities need to be able to support them, which requires further developments from the PSAP side are needed. Finally and taking into account that access should be assured to any calling party (even calls made without SIM cards), it won't be possible to send an Any_time_interrogation / Provide_Subcriber_Info MAP operation to reconfirm location.<br>GPS solution depends on mobiles capabilities | | | | | | |
| **Slovenia (Debitel)** | all | all | | | | Redundancy of the equipment implemented, organised vendor's support. | |
| **Slovenia (Slovenia Telekom)** | all | all | | | | Redundancy of the equipment implemented, organised vendor's support. | |
| **Spain (Telecable )** | With SIP customers, we found the solution of using a code related to the postal code to cope with that problem | | | | | | |
| **Switzerland (Swisscom)** | Mobile | all | all | Network vendors not being able to correctly implement location calculations and being inflexible to correct errors or improve calculations. | Unusable results, extreme quality variations | Reducing role of network vendors to deliver only the basic data: time stamp, cell ID, TA and RTT and implement a far better location calculation based on this basic input data and other data (for example 3D models) and complete | |

| | | | | | | | |
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| | | | | | | independent of them. This way being able to react fast, optimise all what is necessary and not having to discuss every single detail of the implementation with all the many people worldwide involved in big network vendors | |
| | Mobile | all | all | no location for PSAP | long phases with no data | Auto check and alarm on warning and errors in log files | |
| | | | | different interpretation of data | misinterpretation | Briefing PSAP of possible uncertainties and how to cope with the caller | |

### 3.51 QUESTION 24

Question 24 is aimed at retrieving information from respondents on any plans they might have for future commercial implementation of more accurate mobile positioning methods, per geotype. The inquiry intends to give an overview of the actions that might be already scheduled by some mobile operators, on a voluntary basis, in the following 3 years, which will also improve the accuracy and the reliability of the 112 caller location information. Respondents who answered "Yes" were asked to describe these measures and how they affect the accuracy and/or the reliability of the information sent to emergency organisations. Also specifying the geotype (dense urban, urban, rural).

### 3.52 SUMMARY OF RESPONSES TO QUESTION 24

<u>39 Respondents answered "No".</u> Of those, the following additional information was provided.

**Denmark (Telia)** stated that positioning is based upon agreement with the authorities. No work in this area is foreseen. Authorities have launched a 112-app that initiates a 112-call to the emergency services and transfers positioning data based on GPS.

**Denmark (Telenor)** stated that no launches of any commercial services are planned. However "legal intercept", legal tracing on 2G/3G has been implemented – where positioning is initiated from the core towards the radio network. The radio network (in build SMLC) responds with estimated location (calculated from Cell ID, TA/RTT, site coordinates, mast height, antenna direction, neighbor information or retrieving GPS position from terminal etc.) Same method can be implemented for emergency calls – thus providing a more accurate position – but not substituting the need for interviewing the calling party.

**Germany (Deutsche Telecom)** stated that it does not intend to provide commercial services with additional accurate mobile positioning methods. There is no demand in the market for new solutions, in the past few years there was only low demand for location based services. Furthermore improved accurate positioning methods for providing commercial services would cause severe privacy issues.

**Germany (Vodafone)** stated that due to the development and increasing penetration of handset based location technologies using GNSS derived location information any implementation of network based location technology would not be commercially sustainable.

**Italy (Telecom Italia)** stated that no commercial plan exists to improve location accuracy, also taking into account that the direct use of 112 emergency service location is not possible basing on the existing EU regulation.

**Lithuania (Omnitel)** stated that its business product roadmap does not contain any requirements related to more accurate positioning services.

**Lithuania (Tele2)** stated that, at the moment, there is no plan to use commercial services. However operator and emergency center are working on improving reliability of connectivity as parallel location report sending to multiple locations.

**Luxembourg** stated that from its point of view, the 112 caller location information is well optimised and, thus, does not require significant improvement regarding accuracy and/or reliability. There is no plan to launch commercial services actually using LBS due to the small size of the country.

**Portugal (Vodafone)** stated that it is not planning any implementation of other positioning system beyond the ones already implemented supported on TA and RTT. This is supported by the principal of universal access (i.e., allowing any caller to access the emergency services). More accurate systems require specific devices and equipment and, therefore won't be available and supported to all calling parties.

**Romania** stated that taking into account the investments for the network development and coverage extension, including LTE, for the next three years no upgrade in the field of mobile positioning is stipulated in the mobile operators' investment plans.

**Slovenia (T-2 and Teleing)** stated that the accuracy they have is based at the level of calls. In the future, they do not plan to use the GPS or other methods.

**Spain (Vodafone)** stated that it already delivers accurate and reliable information for locating the user calling to emergency centre. Vodafone is not considering new changes on its system, if new changes era imposed by new dispositions, Vodafone will develop the changes which should be proportionate, rational and implemented at a European level.

**Spain (Yogi)** stated that it is improving the information update process to improve the accuracy of the information provided.

**Switzerland (Swisscom)** stated that all new devices have their own location calculation based on AGPS, WLAN etc. which can be used for commercial Apps. Today 1/3 of all apps are location based. They do not need location calculation from networks.

<u>7 respondents answered "Yes"</u> and the following additional information was provided:

**Czech Republic (Vodafone)** stated that E-call functionality will be activated, dependent on government legislation, option: LTE network, VoLTE deployment requirements.

**Czech Republic (T-Mobile)** stated that, If agreed with PSAP, they would like to change the current method in mobile networks from the solution described in the answer to Question 18 to a new method where T-Mobile would handover the cell id where the caller is located in the ISUP in respective field and abandon the encoding of location information to the called number. This would significantly simplify the solution both on the side of T-Mobile CZ and PSAP.

**Norway** stated that new regulations are already in effect. The accuracy shall be equivalent to, or better than, what one can obtain from Cell ID + Sector view + TA. It is also strongly recommended that the network operators offer information on actual cell coverage.

**Portugal (Portugal Telecom)** is analysing ways to improve the cell ID database regarding cell radius values.

**Slovenia (Debitel and Telekom Slovenia)** stated two upcoming improvements - a) GPS data sent from application on android/iOS. b) eCall

3 Respondents did not answer "Yes" or "No" but provided the following information:

**Estonia** stated that commercial services are available and they provide reasonable accuracy for most commercial applications. Currently there is remarkable network equipment generation upgrade (LTE 4G) in process which may provide better accuracy.

**Denmark (Hi3G)** stated that it already has the possibility to deliver last known position by cell/sector. That is not used by 112 at the moment.

**Spain (Vodafone)** stated that, as already indicated it already delivers accurate and reliable information for locating the user calling to emergency centre. Vodafone is not considering new changes on its system, if new changes are imposed by new dispositions, Vodafone will develop the changes which should be proportionate, rational and implemented at a European level.

## 3.53 QUESTION 25

Question 25 attempts to evaluate the accuracy of different possible mobile positioning methods, per geotype. Respondents are asked to provide this information in order to have industry's opinion on the accuracy of different mobile positioning methods. Respondents were asked to frame their answers based on the following table.

| Geotype | Positioning method* | Accuracy of location information | Comments |
|---|---|---|---|
| | | | |

* e.g. cell/sector location, TA (Timing Advance), RTT (Round Trip Time), UTDOA (Uplink Time Difference of Arrival), EOTDA (Enhanced Observed Time Difference of Arrival), GNSS (Global Navigation Satellite System), AGNSS (Assisted GNSS), or combinations of the above.

## 3.54 SUMMARY OF RESPONSES TO QUESTION 25

| Respondent | Geotype | Positioning method* | Accuracy of location information | Comments |
|---|---|---|---|---|
| **Austria** | n.a. | n.a. | n.a. | n.a. |
| **Croatia** | Urban | E-CITA | 140m | On 67% of request |
| | Rural | E-CITA | 550m | On 67% of request |
| **Cyprus (CYTA & MTN) MNO1** | | Cell location | Refer to Answer 18 | |
| **Cyprus (CYTA & MTN) MNO2** | All | A-GPS LBS (Location Based Server) | Approx. 1m | |
| **Cyprus (OCECPR)** | | Cell location (MNO 1) | Refer to Answer 18 (MNO 1) | |
| | All (MNO 2) | A-GPS LBS (Location Based Server) (MNO 2) | Approx. 1m | All (MNO 2) |
| | | | | |
| **Czech Republic (Telefonica)** | | | | N.A |
| **Czech Republic (T-Mobile)** | | | | N.A |
| **Czech Republic (Vodafone)** | dense urban,<br>urban,<br>rural | cell/sector location | Good<br>Good<br>Not accurate | Available for all subscribers |
| | dense urban,<br>urban,<br>rural | GPS | Available only in outdoor, best accuracy | Only for smart phones<br>Delay in GPS collection data, GPRS subscription |
| **Denmark (Telenor)** | Dense urban | Cell/TA/RTT/(A)GPS | Varying | GPS signals are weak in dense urban so cell id with TA/RTT can provide a more reliable location – though less accuracy. Large amount of customer base still have |

| | | | | |
|---|---|---|---|---|
| | | | | no phone with GPS |
| | Urban | GPS/AGPS/Cell+TA/RTT | | As above but better GPS signal.<br>Large amount of customer base still has no phone with GPS |
| | Rural | GPS/AGPS/cell+TA/RTT | | Not much experience with this – however GPS signals are more easily retrieved in rural areas. Depends on available GPS in phone |
| **Denmark (Hi3G** | Dense Urban | RTT | Very good | |
| | Urban | RTT | Good | |
| | Rural | RTT | Fair to good | Dependent on how far MS is from base station |
| | Dense Urban/Urban/rural | GPS | Very good | If user is outdoor |
| **Estonia** | | • CGI, CGI-TA, E-CGI – urban 300-500m rural up to few km.<br>• A-GPS – outside buildings ca 10 m RTT – up to 200 m | | |
| **Finland (TeliaSonera)** | All | A-GPS | Refer network vendors | |
| **Finland (Elisa)** | dense urban | Enhanced Cell ID methods, OTDOA and (A-) GNSS. | OTDOA and (A-)GNSS: 0 - 100 meters<br>ECID: 0 - 300 meters<br>(maximum inaccuracy cannot be stated) | In dense urban where the cell density is high it's probable that ECID, OTDOA and (A.)GNSS methods are nearly on a same level regarding accuracy. Of course, plain GNSS is not probably available indoors and availability near tall buildings, at least here in Finland and with GPS, can be poor. |
| | urban | ECID, OTDOA and (A-)GNSS | ECID: 0 - 2000 meters<br>OTDOA: 0 - 200 meters<br>(A-)GNSS: 0 - 70 meters<br>(maximum inaccuracy cannot be stated) | ECID and OTDOA accuracies depend in addition to the geotype also on the cell density which is, of course, related to frequency used as well. |
| | rural | ECID, (OTDOA) and (A-)GNSS | ECID: 0 - 6000 meters<br>(OTDOA: 0 - 2000 meters)<br>(A-)GNSS: 0 - 50 meters<br>(maximum inaccuracy cannot be stated) | ECID and OTDOA accuracies depend in addition to the geotype also on the cell density which is, of course, related to frequency used as well. OTDOA might not be applicable, depending on the frequency used, because UE needs to measure at least 2 neighbouring eNBs. |
| **Finland (Mobile Positioning/DNA)** | mobile 2G/3G | CGI/TA / RTT | | Better accuracy = more money. Technically it is possible to get better accuracy but it costs lot of money and there is no income from this side. |
| **Germany (Deutsche Telekom)** | We couldn't gain any experience of mobile positioning methods besides cell based localisation. | | | |
| **Germany (EPlus)** | We do not intend to implement any service to improve the accuracy of location information | | | |
| **Germany (Vodafone)** | Due to the market development into the direction of handset based location technologies using GNSS derived location information Vodafone has not further analyzed network based location technologies. We, therefore, do not have any experience with these technologies. | | | |

| | | | | |
|---|---|---|---|---|
| **Ireland (Meteor)** | N/A | N/A | N/A | N/A |
| **Ireland (Three)** | We have no experience with the other suggested methods. | | | |
| **Italy (Telecom Italia)** | See answer to question 27 | | | |
| **Latvia (Triatel)** | | GPS (GNSS) | 5-10 m | |
| **Lithuania (Omnitel)** | Dense urban | TA, RTT, triangulation by signal strength of neighbor cells | ~100-300 m | |
| | Urban | TA, RTT, triangulation by signal strength of neighbor cells | ~200-500 m | |
| | Rural | TA, RTT, triangulation by signal strength of neighbor cells | ~500-3000 m | |
| **Lithuania (Bite Lietuva)** | N.A. | | | |
| **Lithuania (Tele2)** | All types | Cell/sector location | The more base stations operator has, the more accurate location can be set. | |
| **Montenegro** | GSM-based technology enables only relatively good accuracy (from several hundred meters up to several kilometers). When assessing the quality of GSM-based positioning, it should take account of the fact that the range of a base station is normally 35km, and the extended range is 120km. For a high accuracy (of one meter), GPS technology is necessary. It requires the use of user devices with GSM functions (hw + sw), and GPS satellite network. A mobile operator can only indirectly affect the type of user devices in the market through its supply. | | | |
| **Portugal (Portugal Telecom)** | Dense urban, urban | CI+TA | Better accuracy in dense urban areas than rural areas. | Cheapest solution and quickest in locating the UE.<br>A disadvantage is the very low accuracy (depending on cell size).<br>We have never tested this type of solutions, so our answer is based in theoretical information and some information collected from suppliers. |
| | Dense urban, urban, rural | U-TDOA | Good accuracy in most areas. | An advantage is that it works on any UE.<br>A disadvantage is the cost of implementation. Requires LMUs.<br>We have never tested this type of solutions, so our answer is based in theoretical information and some information collected from suppliers. |
| | Rural | AoA | Better accuracy in rural areas than in urban areas due to better results with line of sight. | An advantage is that it works on any UE. Cheap solution and quick in locating the UE.<br>A disadvantage is the very low accuracy. Special antennas are needed.<br>We have never tested this type of solutions, so our answer is based in theoretical information and some information collected from suppliers. |
| | Urban, rural | A-GPS | Good accuracy in open areas like rural and some urban areas. | An advantage is the high accuracy in open areas. SUPL implementation of A-GPS is a more cost effective solution.<br>A disadvantage is the support of the feature |

| | | | | |
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| | | | | in the UE (UE complexity). Another disadvantage is that it does not work in indoor locations. A third disadvantage is that the GPS receiver drains the UE battery power.<br>We have never tested this type of solutions, so our answer is based in theoretical information and some information collected from suppliers. |
| | Urban, rural | E-OTDA | Good accuracy in most areas. | A disadvantage is the support of the feature in the UE. Another disadvantage is the cost of implementation. GSM method of location.<br>Requires LMUs (OTDOA in UMTS and LTE).<br>We have never tested this type of solutions, so our answer is based in theoretical information and some information collected from suppliers. |
| **Portugal (Vodafone)** | Please see answer to question 24 | | | |
| **Romania** | Answer from Orange Romania:<br>Dense urban A-GNSS 5m Dedicated application<br>Urban A-GNSS 5m Dedicated application<br>Rural A-GNSS 5m Dedicated application<br><br>The current method offers the best accuracy from a cost-benefit point of view.<br>A-GNSS could represent a further development taking advantage of the above mentioned accuracy of location information. The disadvantage is the fact that the caller to benefit from this method of location should initiate the call on a smartphone terminal equipped with GPS cell. This aspect may be neglected, taking into consideration the evolution of the mobile handset market.<br>In our view the other mentioned technologies would require major unreasonable investment, with no real and tangible benefits for the operator. | | | |
| **Slovak Republic (Orange)** | All | Cell/sector location | Cell | |
| **Slovak Republic (Slovak Telekom)** | DENSE URBAN | CELL | 100m – 500m | DENSE URBAN |
| | DENSE URBAN | TA | 550m – 1,1km | DENSE URBAN |
| | DENSE URBAN | ECGI | 250m – 600m | DENSE URBAN |
| | DENSE URBAN | RTT | 150m – 300m | DENSE URBAN |
| | URBAN | CELL | 300m – 1km | URBAN |
| | URBAN | TA | 550m – 1,1km | URBAN |
| | URBAN | ECGI | 250m – 1km | URBAN |
| | URBAN | RTT | 250m – 500m | URBAN |
| | RURAL | CELL | 1km – 25km | RURAL |
| | RURAL | TA | 550m – 5km | RURAL |
| | RURAL | ECGI | 1km – 5 km | RURAL |
| | RURAL | RTT | 500m – 3 km | RURAL |
| | EVERYWHERE | AGNSS | 5m – 30m | EVERYWHERE |
| **Slovak Republic (Telefonica)** | dense urban | sector location | may be sufficient (indoor cell) | depends on particular case |
| | rural, urban | sector location | mostly not sufficient | depends on particular case |
| | - | others | | we have no experience with other positioning methods |
| **Slovenia (Debitel)** | | GPS | GPS | |
| **Slovenia (Mega M)** | N/A | N/A | N/A | N/A |
| **Slovenia (Novatel)** | We do not provide mobile network | | | |
| **Slovenia (Softnet)** | | | | VoIP on fixed location |
| **Slovenia (Slovenia** | | GPS | GPS | |

| | | | | |
|---|---|---|---|---|
| **Telekom)** | | | | |
| **Vodafone** | VODAFONE considers that the existing location information is accurate and reliable. It is used not only in the 112 emergency service but in different emergency services. Different positioning methods that will increase the costs of location information might not be neither proportionate nor rational, since they will affect more than one service increasing costs for all the calls to the emergency systems to get a slight benefit in some of them. | | | |
| **Yoigo** | Dense Urban | Cell id/Location Area Code | quite precise | info provided is good and enough for the purposes of the PSAP agency |
| | Urban | Cell id/Location Area Code | quite precise | info provided is good and enough for the purposes of the PSAP agency |
| | Rural | Cell id/Location Area Code | not very precise | in some cases info provided is enough, but in others the info is too wide |
| **Swisscom** | Dense | Prob3D+ GSM | 50 (in-house) 500 Meter | - |
| | Dense | Prob3D+ UMTS | 50 (in-house) 300 Meter | - |
| | Urban | Prob3D+ GSM | Usually 1..5 ellipsis 500 3000 Meter | Variations depending on topology and density of antennas |
| | Urban | Prob3D+ UMTS | Usually 1..5 ellipsis 100 800 Meter | Variations depending on topology and density of antennas |
| | Rural/mountains | Prob3D+ GSM | Usually 1..5 ellipsis 500 1500 Meter | Variations depending on topology and density of antennas |
| | Rural/mountains | Prob3D+ UMTS | Usually 1..5 ellipsis 100 800 Meter | Variations depending on topology and density of antennas |
| **Orange** | Refer to Orange reply | | | |

## 3.55 QUESTION 26

Question 26 asks respondents, based on the current status of their respective networks to provide any evaluation of time and costs of implementing more accurate positioning methods, for each geotype (dense urban, urban, and rural), using the following table:

| Geotype | Positioning method * | Time needed | Costs involved | Comments |
|---|---|---|---|---|
| | | | | |

* e.g. cell/sector location, TA (Timing Advance), RTT (Round Trip Time), UTDOA (Uplink Time Difference of Arrival), EOTDA (Enhanced Observed Time Difference of Arrival), GNSS (Global Navigation Satellite System), AGNSS (Assisted GNSS), or combinations of the above.

## 3.56 SUMMARY OF RESPONSES TO QUESTION 26

| Respondent | Geotype | Positioning method * | Time needed | Costs involved | Comments |
|---|---|---|---|---|---|
| **Austria** | n.a. | | | | |
| **Croatia** | ALL (one network based GMLC/SMLC (Gateway Mobile Location Centre / Serving Mobile Location Center) | E-CITA | 6 months | around 1 mil â‚¬ | |
| **Cyprus (CYTA & MTN) MNO1** | Refer to answer in 24 | | | | |
| **Cyprus (CYTA & MTN) MNO2** | All | A-GPS LBS (Location Based Server) | 6 months | €500,000 | |
| **Cyprus (OCECPR)** | Refer to question 24 (MNO 1) | | | | |
| | All (MNO 2) | A-GPS LBS (Location Based | 6 months (MNO 2) | â‚¬500,000 (MNO 2) | |

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| | | Server) (MNO 2) | | | |
| **Czech Republic (Telefonica)** | n.a. | | | | |
| **Czech Republic (Vodafone)** | All network | GPS smartphones | 6 month | Dependent on type of solution | New interface towards EMC |
| **Czech Republic (T-Mobile)** | Due to old infrastructure on the side of emergency centers all plans to increase the accuracy were so far abandoned. | | | | |
| **Denmark** | | | | | |
| **Denmark (Telenor)** | Dense urban/urban/rural | Combination of cell+TA/RTT and (A)GPS | 1 year | 750.000 to 1.500.000 Euro | As not all mobiles have GPS and GPS signal is not reliable in indoor environment – fall Backbone Solution methods are needed. Positioning in-call of UEs using SMLC functionality (from more accurate GPS over calculated position (cell, TA/RTT, direction, neighbour cell to only cell id) |
| **Denmark (Hi3G)** | We already deliver up to AGNSS which is the most accurate positioning method at the moment | | | | |
| **Estonia** | No such analysis available | | | | |
| Finland (TeliaSonera) | All | Positioning of simless handsets | +1 year | | |
| Finland (Elisa) | All | CI+RTT | 6 - 12 months | 500000 eur and upwards capex and x eur opex | It's impossible to estimate costs and time precisely due to many reasons, e.g. end of life for certain network elements, customisation work needed from network vendor etc. |
| | All | A-GNSS | 12 months - 18 months | 800000 - 1300000 eur capex and 200000 eur per year opex | It's impossible to estimate costs and time precisely due to many reasons, e.g. end of life for certain network elements, customisation work needed from network vendor, required capacity etc. |
| | All | LTE CID | 12 months - 18 months | 800000 - 1300000 eur and x eur opex | It's impossible to estimate costs and time precisely due to many reasons, e.g. end of life for certain network elements, customisation work needed from network vendor, required capacity etc. |
| | All | LTE ECID | 12 months - 18 months | 900000 - 1400000 eur and x eur opex | It's impossible to estimate costs and time precisely due to many reasons, e.g. end of life for certain |

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| | | | | | network elements, customisation work needed from network vendor, required capacity etc. |
| | All | LTE OTDOA | 12 months - 18 months | 1000000 - 1500000 eur and x eur opex | It's impossible to estimate costs and time precisely due to many reasons, e.g. end of life for certain network elements, customisation work needed from network vendor, required capacity etc. |
| **Germany (Deutsche Telekom)** | As yet has not been considered | | | | |
| **Germany (EPlus)** | Not relevant | | | | |
| **Germany (Vodafone)** | As we do not have any experience with network based location technologies we are not able to make any comments on timescales and costs of these technologies. | | | | |
| **Ireland (Meteor)** | Any | Any | 2 years+ | Several Million Euro | Meteor would have to invest some time and resource to generate an informed estimate of the scope of work involved and the associated cost. No such work has been undertaken to date. There is limited internal knowledge to build from as Meteor does not currently offer any commercial location based services. |
| **Ireland (Three)** | We would need to undertake a detailed study to answer this question which would take longer than the time provided to respond to this questionnaire. | | | | |
| **Italy (Telecom Italia)** | See answer to question 27 | | | | |
| **Latvia** | | UTDOA/EOTDA | 3Y | Up to 3 000 000 EUR | Mobile operator Triatel |
| | All type | TA or Enhanced Cell ID | 1 year | 700 000 EUR | Mobile operator Bite |
| **Lithuania** | | | | | |
| **Lithuania (Omnitel)** | Dense urban<br>Urban<br>Rural | TA, RTT, triangulation by signal strength of neighbor cells | ~12 months of implementation work | ~3M - 10M LTL CAPEX | This is based on a rough estimate of previous proposals. Such implementation was never thoroughly evaluated. |
| **Lithuania (Bite Lietuva)** | All type | TA or Enhanced Cell ID | 1 year | 700 KEUR | |
| **Lithuania (Tele2)** | | 2G/CI-TA-Rx, 3G/CI-RTT | | Approx. 3.2 million LTL | |
| **Montenegro (Telenor)** | For time and costs estimation, RFI process is necessary. Currently, there is no sufficient data for valid estimation. The information about accurate location depends on the capabilities of mobile telephones. | | | | |
| **Montenegro (Mtel)** | As we had no intention to implement the services for caller location, we have no precise data available. According to previous proposals of solutions presented to us, the price of hardware and software for MPS with implementation services amounted to about €500,000. We are not able to provide more precise information./Mtel/ | | | | |
| **Norway** | Implementation of sector view and TA for the two remaining mobile network operators are estimated to no more than NOK 10 million per network. The possible implementation of measured/estimated cell coverage presentation/view has no cost estimates yet. On the PSAPs side, some systems must be updated and extended. No cost estimates yet made. For the possible use of handsets GPS location information, no cost estimates are present. For the position of nomadic users, no cost estimates are present. | | | | |

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| **Portugal (Portugal Telecom)** | Dense urban | U-TDOA, A-GPS | â‰¥ 6 months | N.A. | Considering UE impact of supporting A-GPS UE we need an alternative location method. Cost of radio features depend of positioning method and needs to be supported by radio vendors. |
| | Urban | U-TDOA, A-GPS | â‰¥ 6 months | N.A. | Considering UE impact of supporting A-GPS UE we need an alternative location method. Cost of radio features depend of positioning method and needs to be supported by radio vendors. |
| | Rural | CI+TA, AoA, A-GPS | â‰¥ 6 months | N.A. | Considering the cost of the radio component, U-TDOA will not be implemented initially. Cost of radio features depend of positioning method and needs to be supported by radio vendors. |
| **Romania** | No costs evaluation.<br>Orange Romania: For A-GNSS method, a preliminary feasibility study is needed. After completing the analysis and the preparation of the business plan, an implementation period of approx. 10 months could be envisaged. | | | | |
| **Slovak Republic (Orange)** | All | TA | 1 year | 500 000 € | SMPC |
| **Slovak Republic (Slovak Telecom)** | ALL | AGNSS, RTT,ECGI | 6 months | Unknown approx. 200k € | |
| **Telefonica** | - | more accurate than sector location | | high | |
| **Slovenia (Mega M)** | N/A | N/A | N/A | N/A | N/A |
| **Slovenia (Novatel)** | We do not provide mobile network | | | | |
| **Slovenia (Softnet)** | VoIP on fixed location | | | | |
| **Spain (Vodafone)** | Implementing new positioning systems will mean additional costs. It's difficult to know the amount of them not knowing the kind of technical adaptations required and same is predicable for time. Since VODAFONE thinks the existing system is right to deliver accurate and reliable information and isn't proposing a new one, it is harder to have an idea of the cost of a different system. Anyway, since the location information in Spain is delivered to more than one emergency service, to make a cost/benefit analysis, it is necessary to have this in mind for our country. | | | | |
| **Spain (Yoigo)** | Urban Dense | Cell id/Location Area Code | | | no need to improve or the cost require will not compensate the investment |
| | Urban | Cell id/Location Area Code | | | no need to improve or the cost require will not compensate the investment |
| | Rural | Cell id/Location Area Code | | | cost to improve the accuracy is difficult to |

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| | | | | | estimate but anycase it will be huge and difficult to manage for a single operator, especially if it´s a small/medium one |
| **Switzerland (Orange)** | Refer to Orange MVNO | | | | |
| **Switzerland (Swisscom)** | dense urban, urban, rural | Application on device using AGPS, WLAN etc. | 2 - 3 Years | 3 - 4 Million CHF | - |
| | dense urban, urban, rural | Optimise ProbCalc3D+ with network based forced short handovers, wherever multiple antennas (on different places) are available, to get other TA/RTT | 2 - 3 Years | approx. 20 Million Euro | We have seen that RTT has a very stable distance accuracy of +- 70 Meter. This allows very accurate triangulation, if antennas are switched during an emergency call. This can be developed together with network vendors. |

### 3.57 QUESTION 27

The 27th and final Question gave Respondent's an opportunity to provide additional information (e.g. considerations on the estimates made for time and costs). Not covered in previous questions.

### 3.58 SUMMARY OF RESPONSES TO QUESTION 27

**Croatia** considers that it would make sense that one positioning (network based; e.g. E-CITA method) platform could serve on the most economical way all end users (e.g. police, 112,) and this should be centralised under one of the Government agencies used for all emergency services. Operators are willing to work on positioning enablers (features and interfaces in the network), but there should be consensus on national/EU level on positioning methods and overall technical solution that should be implemented.

**Cyprus (CYTA, MTN and OCECPR**) sees no clear commercial business case for such an investment.

**Czech Republic (Vodafone)** mentioned Integration of LBS system, which will collect GPS coordinates from callers ~ 0,5 – 1M Euro, new interface to EMCN/A (T-Mobile)

**Denmark (Telenor)** stated that its radio network is not capable of triangulating mobiles and the cost of implementing this equipment would be in the order of 7-10mill Eur. SMLC solution with position retrieved from GPS capable mobiles (in GPS coverage), alternatively calculated from all known information about current cell, TA/RTT, neighboring cells etc. Adaptations needed to forward positioning information in already implemented data-network.

**Denmark (Hi3G)** stated that it already delivers up to AGNSS which is the most accurate positioning method at the moment.

**Finland (Teliasonera)** stated that it has an action plan for features of positioning for roaming customers and simless handsets.

**Finland (Elisa)** stated that all cost and time estimates are non-binding. Plain GNSS is most probably not feasible solution due to limited availability (not available e.g. indoors), possibly long TTFF etc.

**Germany (Deutsche Telekom)** suggests to discuss the alternative approach that to improve the accuracy of the localisation data of emergency calls in addition to the network based localisation information (in this case radio cells), additional device based localisation information (in this case GNSS/GPS) should be used. Subsequently, in the standards regarding 'emergency call' the transmission of additional device based localisation information should be included. Whether the approach using E-Calls (the transmission of additional information through voice channel) or alternative approaches are expedient, would have to be examined. This solution would be limited solely to emergency calls, and therefore fundamentally unproblematic with regard to data privacy

**Germany (Vodafone)** stated that any regulatory measure on emergency call localisation should consider the developments with commercial location based services. These now almost exclusively use GNSS derived location information from the handset. Even governmental emergency related initiatives as e-call rely on these technologies due to their superior accuracy. Hence, future provision of location data with emergency calls should as well predominantly rely on handset based technologies. Network based information could be suitable to complement the handset derived information.

**Ireland (Meteor)** would be concerned that any network based solutions could become redundant by the time they could be delivered as handsets with Geo Positioning capabilities become ever more pervasive.

Italy (Telecom Italia) stated that it is not possible to estimate the cost of so general alternatives, since the impact is usually very high on the mobile networks for time and cost. So in general more precise location solutions through BTS radio channel measures are to be considered very expensive and in principle not economically sustainable for operators. Instead “best effort” solutions based on the autonomous GPS inside the mobile terminal equipment or on the more reliable “Assisted GPS” solution could be the most appropriate choice to deepen. So in the medium-long term the improving of mobile location accuracy should not be based on UTDOA (Uplink Time Difference of Arrival) or EOTDA (Enhanced Observed Time Difference of Arrival) methods, since they are not a definitive solution for improving accuracy and they have a very high cost for operators. More viable direction for analysis by CEPT/ECC, in our view, are GNSS (Global Navigation Satellite System) based solutions. It is has also to be considered that, if future evolution for improving location accuracy will be based on internal GNSS/GPS of the mobile terminal equipment (i.e. the location software GNSS/GPS application for smartphone), the location data is likely to be “best effort” (no reliability). Probably the so called “Assisted GNSS” (AGNSS) with an appropriate standard for mobile terminal equipment could be a more viable and balanced solution, in fact GNSS/GPS data can be integrated with the telephone network in order to provide potentially more precise and also reliable location information. This is an issue for the future.

**Latvia (Triatel)** stated Installation and implementation additional cells (sites), CORE Hardware and Software

**Lithuania (Tele2)** qualified that the price stated in response to Question 26 is only for indication purposes as we haven't started any official request for bill of quantity.

**Portugal (Portugal Telecom)** stated that usually there is no position technology applicable in every situation and area. Some positioning methods do not work indoors or have problems in urban areas while others work well in urban areas but have poor results in rural areas. It is also expected that the next generation of mobile will not only support GPS but also Galileo to achieve better accuracy and availability.

**Slovak Republic (Orange)** suggested that EC makes efforts to push the terminal vendors willing to sell terminals in EU countries to fully support 3GPP and OMA standards to support enhanced network initiated positioning methods, e.g. A-GPS (SUPL or Control Plane), OTDOA and other positioning methods as it is the case in North America region.

**Slovak Republic (Slovak Telecom)** stated that licensing rules of buying positioning methods and positioning performance capacity should be different according to vendors of location based services.

**Slovak Republic (Telefonica)** added that all costs related to emergency services in Slovakia are borne by operators. Therefore, there are no incentives for operators to invest in more accurate localisation methods, particularly if commercialisation potential is low.

**Spain (Telecable)** stated that since it is a full MVNO these questions apply to its host operator and it is not aware of any plans to implement more accurate mobile positioning methods.

**Switzerland (Swisscom)** stated that unfortunately, there are not many vendors in the market and since the topics are mainly driven by the needs of operators and not of PSAP, there was never a big clean up based on end-to-end tests and quality optimisations. The vendors do also not work together and share knowledge, they keep all closed. So it is not only a question of costs but also a question about how all the processes are handled in the future.

## 4. SUMMARY OF GENERAL RESPONSES RECEIVED

Several stakeholders submitted general observations and comments rather than a question-by-question response to the questionnaire. This section summarises those responses.

### 4.1 BOSNIA AND HERZEGOVINA:

Dear Colleague,

In accordance with: Calls to Emergency Services: Accuracy & Reliability of Caller Location Information, we inform you the following:

In Bosnia and Herzegovina call centers 112 for emergency services have not been implemented. All emergency calls are directed directly from caller to separate emergency services (122-police, 123-firebrigade and 124-health) without any data about locations of the caller. Emergency services 122, 123 and 124 have not been implemented as central emergency centres and generally it is implemented in a way that we have distributed emergency centres per municipalities. Routing in mobile networks is done based on the cellular location (base stations).

Caller location information are obtained directly from the caller (interview).

The implementation of call centers 112 for emergency services is the responsibility of the Government of Bosnia and Herzegovina (Civil Protection Sector).

Electronic communications network operators are able to comply with the time schedule and to upgrade their systems in accordance with technical requirements of the Government of Bosnia and Herzegovina, in the implementation of the call centers112 for emergency services.

Best regards

Rešid Šeremet,

Chief of Numbers Licensing Department

Communications Regulatory Agency B&H

### 4.2 UNITED KINGDOM

Dear Mr Dragomir,

**RE: ECC Questionnaire: Calls to Emergency Services: Accuracy & Reliability of Caller Location Information**

Thank you for your request for information regarding the accuracy and reliability for caller location information for emergency calls in the UK. Having read through your questionnaire, I'm afraid that at this time it would not be possible to provide answers to all of the questions raised. This is because Ofcom is currently in the process of a public consultation into this issue[3], in which we are seeking responses to similar questions, and therefore providing answers to some questions could pre-empt consultation responses.

Our Consultation will continue until 23rd December. We will review the responses received in the New Year and consequently be in a position to address some of the forward-looking aspects of your questionnaire

[3] Consultation and responses (when published) can be found here: http://stakeholders.ofcom.org.uk/consultations/emergency-mobiles-cfi/

thereafter. As discussed on the phone, I intend to attend the next meeting of this working group in February 2014.

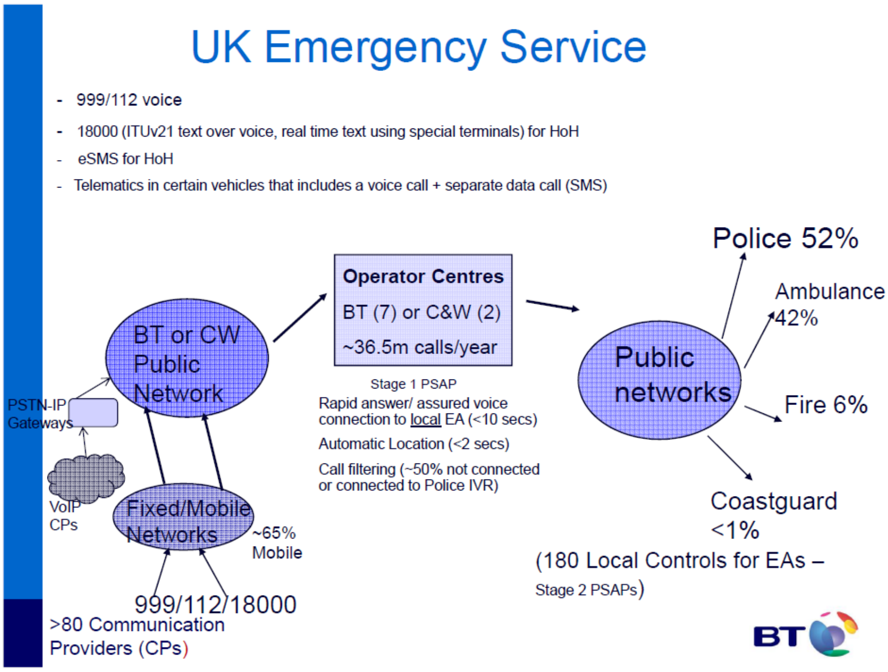
At this time we are able to provide answers to those questions that pertain to the current regulatory framework and emergency call handling practices. I must point that those answers provided are made on behalf of Ofcom and do not necessarily represent the views of, for example, the Emergency Authorities, PSAP operators or Communications Providers.

Yours sincerely

Tim Gilfedder

*cc. Huw Saunders, Director, Network infrastructure, Ofcom*

**UK Emergency Call Architecture (questionnaire Q1):**
The UK emergency call architecture consists of a single Stage 1 PSAP (consisting of a number of operator centres), which identify the correct Emergency Authority (EA) to whom to forward the call.




Source: BT, http://www.niccstandards.org.uk/meetings/2012johnmedland.pdf?type=pdf
Ofcom's Statement of Policy regarding the performance of Stage 1 PSAPs (Call Handling Agents (CHAs)) can be found here:
http://stakeholders.ofcom.org.uk/binaries/consultations/emergency-call-handling/statement/statement.pdf

**Current regulatory policy (questionnaire Q3 & Q7):**
Ofcom's General Conditions of Entitlement apply in this regard. In particular General Condition 4 states:
"*4.1 The Communications Provider shall ensure that any End-User can access Emergency Organisations by using the emergency call numbers "112" and "999" at no charge and, in the case of a Pay Telephone, without having to use coins or cards.*
*4.2 The Communications Provider shall, to the extent technically feasible, make accurate and reliable Caller Location Information available for all calls to the emergency call numbers "112" and "999", at no charge to the Emergency Organisations handling those calls, at the time the call is answered by those organisations.*
*4.3 Where a Communications Provider provides an Electronic Communications Service:*
*(a) at a fixed location, the Caller Location Information must, at least, accurately reflect the fixed location of the End-User's terminal equipment including the full postal address; and*

*(b) using a Mobile Network, the Caller Location Information must include, at least, the Cell Identification of the cell from which the call is being made, or in exceptional circumstances the Zone Code.*
*4.4 For the purposes of this Condition,*
*(a) "Caller Location Information" means any data or information processed in an Electronic Communications Network indicating the geographic position of the terminal equipment of a person initiating a call;*
*(b) "Cell Identification" means the geographic coordinates of the cell which is hosting the call, and where available, an indication of the radius of coverage of the cell;*
*(c) "Click to Call Service" means a service which may be selected on a web-site or other application by an End-User and which connects the End-User only to a number or a limited set of numbers pre-selected by the Communications Provider or an End-User;*
*(d) "Communications Provider" means a person who provides End-Users with an Electronic Communications Service, or provides access to such a service by means of a Pay Telephone, for originating calls to a number or numbers in the National Telephone Numbering Plan but shall exclude any Click to Call Service;*
*(e) "Mobile Network" means either the GSM (Global System for Mobile communications as defined by the European Telecommunications Standards Institute) or UMTS (Universal Mobile Telecommunications System as defined by the European Telecommunications Standards Institute) networks or any other standard for mobile communications that is, or may be, adopted in the UK;*
*(f) "Pay Telephone" means a telephone for the use of which the means of payment may include coins and/or credit/debit cards and/or pre-payment cards, including cards for use with dialling codes. For the avoidance of any doubt, references to a Pay Telephone include references to a Public Pay Telephone10;*
*(g) "Zone Code" means a code which identifies the geographic region in which the call was originated.*"
With regards to Voice over IP (VoIP) calls, our Statement in 2008 (http://stakeholders.ofcom.org.uk/binaries/consultations/voip/statement/voipstatement.pdf):
States:
"*…for mostly fixed services we would expect a registered address and VoIP flag on the emergency call handling database. For mostly nomadic or mobile services we would expect a VoIP flag only*".
**Measurement of location information accuracy (questionnaire Q15)**
Ofcom has an 'own-initiative' programme examining compliance with GC4. The scope of this activity is generally considered every 6 months, and includes both fixed and mobile Communications Providers.
http://stakeholders.ofcom.org.uk/enforcement/competition-bulletins/open-cases/all-open-cases/cw_996/

### 4.3 VODAFONE SPAIN

VODAFONE SPAIN RESPONSE TO SETSI INVITATION TO PARTICITE IN THE CEPT COLLECTION OF DATA TO MAKE A REPORT ON ACCURACY AND RELIABILITY OF 112 LOCATION INFORMATION.

On 7th August 2013, State Secretary for Telecommunications and Information Society (Secretaría de Estado de Telecomunicaciones y para la Sociedad de la Información- SETSI) has contacted VODAFONE ESPAÑA, S.A.U. (VODAFONE) informing that European Conference of Postal and Telecommunications Administrations (CEPT) inside Network and Numbering working group (NaN) decided last April creating a working sub-group to study emergency services: PT ES (Project Team Emergency Services).

SETSI informed that main objective of the PT ES group is preparing a report with recommendations about accuracy and reliability of emergency calls location in different networks and telephony services (mobile, nomadic, VoIP). The report will be of technical nature and will have the objective of exploring different options from the technical point of view and cost/benefit analysis, including the point of view of all agents implied in this type of services either from the offer or the demand side: Operating companies, manufactures and emergency centres. SETSI also invited VODAFONE to participate responding to the proposed questions contained in this document. VODAFONE sent its response on 12 September 2013, aligned with the response to the public consultation made by SETSI at the beginning of 2013, accommodating the format of the content to the CEPT consultation and being specific.

On 15 October 2013, SETSI contacted VODAFONE again with an updated questionnaire coming from PT ES.

VODAFONE welcomes the opportunity for answering the new approach of questions and will do it in the same terms done in the previous document sent in September.

## PREVIOUS CONSIDERATIONS

Location services for emergency calls in VODAFONE networks (fix and mobile) are based on accuracy and reliability criteria and are free of charge following the in force dispositions. Any improvement of the existing processes must be proportional and rational.

Given that the scope of this collection of data is to prepare a report of technical nature, VODAFONE considers that the mention to Next Generation Networks (NGN) is a "must", specially taking into account that the VoIP technology is contained in the information sent by SETSI. Taking into account that services should be technology neutral, VoIP can sustain either telephony or nomadic services and in NGN networks, telephony services will be sustained over VoIP either on fix or mobile networks (VoLTE). This technical change, in VODAFONE opinion, doesn't mean the necessity of changes in the nature of the information sent by the location service for emergency calls.

An additional issue to consider at this stage is the location information to be delivered by no telephony VoIP calls (nomadic services). This type of information to be sent and whether the caller has or hasn't a CLI. In Spain, the National Numbering Plan has a specific attribution of a range for nomadic services. The disposition is the following:

*RESOLUCIÓN de 30 de junio de 2005, de la Secretaría de Estado de Telecomunicaciones y para la Sociedad de la Información por la que se atribuyen recursos públicos de numeración al servicio telefónico fijo disponible al público y a los servicios vocales nómadas, y se adjudican determinados indicativos provinciales.*

It stipulates that the operator using this numbers to provide the service should send the contract address as location information.

Another scenario appears when the VoIP call is made without a CLI, normally the service providers are OTTs like Skype, Line, etc. In this case different questions come on board: who is responsible to send location information? Which type of information can be delivered? Or how the sender should interface with PSAPs?

In VODAFONE's opinion, the general framework puts the obligation of delivering location information on the service provider, not in the network operator. The above mentioned Resolution on nomadic calls is a good example since the operator who provides the services is responsible for delivering the location information regardless the network operator used for the connection.

The obligation to provide location services for emergency calls at the European level is restricted to 112 calls. Nevertheless, Spanish regulation is much more extensive and includes the same obligation for 7 additional numbers, regulating the kind of information and the service implied in following dispositions.

*"RESOLUCIÓN de 21 de noviembre de 2008, de la Secretaría de Estado de Telecomunicaciones y para la Sociedad de la Información, por la que se identifican los servicios de atención de llamadas de emergencia a efectos de la obtención de los datos de los abonados al servicio telefónico disponible al público"* which establishes the obligation for operating companies to send to emergency services entities (including 061, 062, 082, 085, 088, 091, 1006 and any service attending situations of the same nature) the same information provides to 112; y

"Orden ITC/750/2010, de 17 de marzo, por la que se establecen las condiciones para la puesta a disposición de los datos de localización del usuario llamante del servicio telefónico móvil a los servicios de atención de llamadas de emergencia prestados a través de los números 062 y 091" which establishes the obligation for Operating Mobile Companies to provide for 062 and 091 location information using the technical solution implemented for 112 as reference.

The existence of these regulations allows envisaging that the type of information and the procedures are accurate and reliable so is used beyond the strict European dispositions.

At the same time, their existence should be taken into account when analysing technical changes which might impose disproportionate burdens for the Operating Companies if the technical changes aren't encompassed with the necessary remedies of normative and/or economic nature.

Being the information accurate and reliable, the technological change in the telephony due to the implantation of NGNs where voice will be transmitted using packets instead of circuit switching technologies, doesn’t need to involve new information to be delivered. Nevertheless, it might mean some technical changes in the networks to ensure that emergency services can get the same information regardless the users are NGN or Circuit Switching.

As VODAFONE mention in its response to the SETSI public consultation on the same matter, any change in the provision of the location services should be considered under the following circumstances: i) the change must be done by all the countries in the European Union zone and ii) operating companies will have public financing to make the changes. The second circumstance is out of scope for the present collection of data which, at list from the technical point of view, is taking into account the first one.