

**Caller Location in
Telecommunication Networks in
view of enhancing
112 Emergency Services**

**Recommendations towards a
European policy and
implementation plan**

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Executive Summary

Introduction

This document has been prepared by Helios Technology Limited ('Helios') on behalf of the Directorate-General Information Society, European Commission under contract reference 2001/48559. It presents proposals for "Recommendations towards a European policy and implementation plan for location enhanced 112" for discussion by CGALIES (Co-ordinating Group for Access to Location Information by Emergency Services).

The availability of caller location information could significantly enhance the provision of emergency services and deliver large benefits to society. Many operators and emergency authorities (EAs) throughout Europe have already deployed systems that enhance the call with location information (based upon for example, a known installation address).

Caller location systems in mobile communication networks are expected to become widespread in the coming years. The huge prospect for commercial services is expected to drive the location based services (LBS) market forward. It is expected that this market will develop rapidly due to favourable return on the related investment and competitive incentives. As location technology becomes widely available, the scope for further enhancement of emergency calls increases dramatically.

This issue is relevant to all of Europe and therefore a greater degree of cooperation and common development of solutions seems sensible. Effective introduction of a location enhanced emergency service requires co-ordination between stakeholders and users from different communities and cultures. Therefore, in May 2000, the Commission established CGALIES to actively involve the relevant players and to develop a consensus on relevant implementation issues.

Context of this study

With the adoption of the new regulatory package, the Council and the European Parliament have made the forwarding of caller location by operators obligatory. Article 26 from the Directive on universal service and users' rights relating to electronic communications networks and services (2002/22/EC of 7 March 2002) states that:

"Member States shall ensure that undertakings which operate public telephone networks make caller location information available to authorities handling emergencies, to the extent technically feasible, for all calls to the single European emergency call number 112".

This provision establishes a legal requirement on operators, both fixed and mobile, for delivering location enhanced 112 (or 'E-112') to EAs across Europe and provides the context for this study. It will enter into force by 24 July 2003.

In close conjunction with this new provision is the need to protect users' privacy rights. This is dealt with in the new Directive concerning the processing of personal data and the protection of privacy in the electronic communications sector (at the time of writing, in second reading in the Council and the European Parliament). However, Article 10 from the Directive specifies that in the case of emergency calls, rights for life and for health protection take precedence over rights for privacy and therefore, data processing may be used in some cases without the user's consent. The exception for emergency authorities allows for 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. Any technical solutions for location enhancement must therefore meet the requirements for privacy protection.

To complement the new legislation, the Commission Services considered that it was important to outline a roadmap for implementation of E-112 services. Taking into account other work and discussions and further study by the contractor, this report makes proposals for recommendations for discussion by CGALIES.

Current status

CGALIES issued a questionnaire to mobile operators regarding the plans and cost of deploying location technology in mobile cellular networks. The primary conclusion that may be drawn from the responses and further discussions with operators during the course of this study is that all operators have firm plans for the introduction of LBS. Some variance is likely in terms of services, timescales and technology. Basic levels of location service that are based on cell identity and signal strength will be ubiquitous by 2003 and higher performance location services (eg A-GPS, E-OTD) may be expected to penetrate the market by 2006.

Many Member States have already enhanced emergency call services by providing fixed caller location information to EAs based upon installation address. The availability of location information from cellular networks now makes feasible the provision of location information for all emergency calls. But EAs and other relevant public bodies must ensure that they do not fail to exploit the capabilities of this new technology for public benefit.

There is considerable variance between Member States in terms of structural arrangements and technical solutions surrounding the provision of emergency call services. There is therefore, in the context of E-112, an opportunity for increased cooperation in the pursuit of common solutions, where practical and feasible, whilst at the same time respecting matters of national policy interest and culture.

An uncoordinated approach by local or national authorities is likely to lead to increased costs and complexity for all stakeholders across Europe. The solutions currently being developed by the mobile industry through bodies such as Location Interoperability Forum (LIF) and proposed for standardisation to the third Generation Partnership Project (3GPP) may provide a potential basis for common solutions for E-112.

Benefits to society and emergency authorities

The primary benefit to society is saving lives and an increased sense of security. This is delivered by improved call routing and obtaining faster (and improved) information for dispatching relevant resources. An increased sense of security is particularly relevant for European citizens travelling abroad who may not necessarily be familiar with the local language or local emergency service arrangements.

The primary benefit to the EA operations is to provide a timelier, and more effective response to the citizen who is in an emergency situation. It is expected that improved location information will also:

- /// Enable a more efficient use of valuable public resources;
- /// Help to deter the increasing number of spurious and malicious calls;
- /// Reduce stress amongst emergency personnel.

Capability of location technologies

In order to deliver the planned benefits, a set of provisional user requirements has been developed through CGALIES, a summary of which can be found in this document.

With regard to fixed calls, the existing location solutions deployed by several Public Safety Answering Points (PSAPs) are broadly capable of meeting user expectations. The main issue is the inaccuracy of databases, partly caused by a failure to ensure timely updates. With respect to the location of mobile calls, no single location technology installed or currently under development is believed to meet all of the user requirements.

Currently available solutions based upon Cell ID (including Timing Advance (TA)) and Enhanced Cell Global Identity (E-CGI) can utilise legacy handsets and should satisfy many user requirements¹. Technologies already available but not yet widely deployed (eg A-GPS and E-OTD) are expected to deliver more accurate location data and should satisfy a large proportion of the requirements. However, the commercial justification for the corresponding investment in infrastructure and handsets has yet to be demonstrated in an untested market.

Existing solutions based upon Cell ID and E-CGI can cater for legacy handsets and could therefore provide a baseline capability for full user roaming across Europe. Roaming at higher levels of service, for instance those based on technologies such as A-GPS and E-OTD, will rely upon the development of common handset solutions. Whilst this is unlikely to occur in the short term, it is likely that consolidation within the mobile industry will eventually lead to a limited number of interoperable handset solutions.

In summary, a determination of the location of 112 emergency calls is technically feasible now. However, the interface between the operators and the EAs/PSAPs will need to be specified as a matter of urgency. In addition, EAs/PSAPs will need to invest in upgrading their systems to be able to receive, process and use the location information that operators may provide. The newly adopted legislation that requires that "...caller location information is made available to authorities handling emergencies, to the extent technically feasible...", should therefore be interpreted accordingly.

Establishing a European policy

It is considered that a coordinated implementation policy will help to accelerate the implementation and maximise the benefit of E-112 to EAs and society. Such a policy will need to define the approach to be adopted towards the implementation of E-112 and further enhancements as to the quality and the accuracy of location data.

The specific objectives of establishing a European implementation policy are to:

- a) Increase awareness of the potential benefits of E-112;
- b) Exploit currently available location information and emerging location technologies as soon as their performance is demonstrated and become available;
- c) Ensure that the potential benefits to society and EAs are realised to the fullest extent and at the earliest possible point in time;
- d) Reduce the overall cost of implementation to all parties where feasible, through increased cooperation and the development of common solutions.

¹ See for instance CGALIES Working Package 1 report, Annex I to CGALIES report on implementation issues related to access to location information by emergency services (E-112) in the European Union

The implementation policy must effectively strike a balance between benefits, cost and acceptable return on investment. Furthermore, as the realisation of benefits relies upon the smooth convergence of implementation plans and timescales by fixed and mobile operators, PSAPs and EAs, all organisations along the chain will need to commit and invest towards realising E-112.

The available measures

The types of measures that could form the basis of a European implementation policy are:

- a) Additional European regulation, for instance by specifying concrete performance parameters for E-112;
- b) Development of common technical solutions, such as a common interface between operators and PSAPs/EAs;
- c) Development of a common European implementation plan, guided by continued liaison and cooperation across Europe.

The primary purpose of implementing additional regulatory measures would be to accelerate the performance in terms of accuracy and service availability (eg in-door, urban, etc) of E-112 beyond that which could otherwise be justified on commercial grounds; taking into account what can be delivered today by cellular networks. This approach is analogous to the approach adopted in the US where the Federal Communications Commission (FCC) has mandated performance parameters² that requires operators to make significant additional infrastructure (and handset) investment.

It is the common belief of Europe's mobile operators that such regulation will not help to drive the current European market for mobile location based services (LBS). Some operators also believe that it may instead damage the wider commercial marketplace as a result of distracting attention and investment towards E-112.

There is an immediate opportunity to pursue the common development of data transfer interfaces between operators and PSAPs/EAs, and operational systems and applications deployed by EAs.

EAs and PSAPs must be prepared to make the necessary investments in operational systems and applications in order to receive and interpret location information in an automated way. With the increased cooperation between Member States and commonality regarding the issues encountered, the development of common ideas and solutions should help to mitigate the risk of technically divergent solutions and thereby reduce overall implementation costs. It will also contribute towards creating an increased awareness of location enhancement, particularly amongst PSAPs and EAs.

It is considered that some degree of continued cooperation and communication between stakeholders through bodies such as CGALIES would help to:

- ✍ Establish best practice and highlight common technical solutions;
- ✍ Establish a quicker and improved understanding of operational benefits and critical implementation issues/risks by stakeholders;
- ✍ Achieve a further reduction in costs and implementation effort.

² see for instance Annex II of CGALIES report on implementation issues related to access to location information by emergency services (E-112) in the European Union

The preferred option

Given the types of measures available with which to influence the implementation of E-112, it is considered that a European implementation policy may broadly follow one of three options. As the principle that location information must be passed on is now in European regulation, all three options are considered as 'Regulated' but with various degrees of involvement during implementation, namely:

☞ **Option A: 'Do Minimum'**

Regulated/Uncoordinated approach where national and regional organisations are left to prepare for implementation;

☞ **Option B: 'Best Effort'**

Regulated/Coordinated approach where operators pass the best location information available to them (including Cell ID and E-CGI) with further performance improvement depending on commercial development. PSAPs and EAs upgrade their information systems to be able to receive, process and use the location information provided;

☞ **Option C: 'Accelerated'**

Regulated/Coordinated with an additional regulatory measure to impose improved performance characteristics for E-112 on operators at an early date. PSAPs and EAs upgrade their information systems to be able to receive, process and use the location information provided.

It is considered that a 'Best Effort' approach (Option B) should form the basis of a European implementation policy towards the initial phase of implementation of E-112 ('E-112 Phase I'). This approach reduces the financial needs and risks when compared to the Accelerated approach. It will enable Europe to commence implementation of E-112 quickly and allow stakeholders to 'get a foot on the ladder' and reap the benefits of location information at an early stage.

Furthermore, when compared to the 'Do Minimum' approach, it will benefit Europe since:

- ☞* The development of common solutions and the increased cooperation across Europe will bring benefits to all stakeholders and reduce risks, in particular for PSAPs and EAs;
- ☞* It will help to synchronise the plans by operators and PSAPs and EAs.

As Europe's EAs gain experience with the use of location information provided to them, it is expected that their requirement will become more precise. At the same time, it is expected that the commercial Location Based Services (LBS) market will develop and new or upgraded location determination technologies will become more mature. Under such conditions, it is considered that a review should take place by Governments to review the Best Effort approach against expectations and determine whether a more accelerated approach via additional regulatory force is necessary. Of course, adopting this approach does not prevent any Member State from implementing its own additional measures.

Member States are advised that the ongoing provision of location information should, wherever possible, be provided free of charge by operators to PSAPs/EAs in order to encourage uptake of services. This does not include the initial cost of upgrading existing systems and applications in order to receive and interpret location information, which should be borne by each responsible organisation (including PSAPs and EAs). In addition, and in line with the provision that 112 must be provided free of charge to the user, it is important to specify that the cost of forwarding location information is not borne by the end user.

The necessary actions

On the basis of the findings of this study, we recommend the following actions to be undertaken:

- /// Coordinated action to **increase awareness** amongst EAs and PSAPs of the benefits of location enhancement. This could include a mixture of media including on-line services, documentation, presentations and managed events;
- /// Coordinated action to ensure that the **necessary budget allocations** are made at national level to prepare for the necessary investment in systems and software upgrades for EAs and PSAPs;
- /// Continue coordination at European level and establish national liaison groups to establish common practices and benchmarks and **reduce the overall risks and costs**;
- /// Pursue the development of **common technical solutions** (eg data transfer interface), to facilitate implementation and reduce overall risks;
- /// Establish procedures governing the transfer of location information to EAs, including on the conditions for overriding the users' choice, in order to **create the best possible protection of the users' privacy**.

In support of this, it is recommended that the Commission undertakes the following specific actions:

- /// In the context of CGALIES, help **establish an awareness programme** to promote the potential benefits of E-112;
- /// In the context of CGALIES, help to develop (on an on-going basis) **generic E-112 implementation guidance** based on best practice and other relevant experiences;
- /// In the context of ETSI, investigate the possibility of **establishing a common interface standard** for the transfer of location data between operators and PSAPs/EAs; based (where possible) on commercial standards already under development. In view of the legal obligation to pass location information by July 2003, the common interface standard should be available by the beginning of 2003;
- /// In the context of ETSI and in order to assist a future review, establish **common measurement methods** and criteria for assessing the quality of the location information provided by operators to EAs;
- /// **Seek to continue CGALIES** to support the continued liaison and exchange of expertise and knowledge between stakeholders. It is recommended that a continuation of CGALIES would be highly beneficial to the E-112 implementation process. This should be under revised terms of reference focused upon the need of users including PSAPs and EAs and for liaison between Member States.

As a result of the newly adopted legislation concerning the provision of location information, it is recommended that operators should provide:

- /// **Fixed caller location** based upon most recently updated telephone installation address in the current database system of the fixed operator;
- /// **Mobile caller location** based upon the best location information available to the mobile operator.

Other actions recommended for operators and governments are:

- /// Continue and where necessary strengthen co-operation to ensuring a **seamless migration to higher levels of location performance** resulting from more accurate mobile location technologies whilst also helping to provide a full roaming functionality across network and country borders;
- /// **Reduce the overall cost** of implementation to all parties where feasible, through increased cooperation and the development of common solutions. These should be based, where possible, upon widely available commercial standards;
- /// Consider the need, and where necessary pursue, further measures that would **limit operators' liability** and protect them against damage claims resulting from poor performance or wrong location information. In the US, Congress passed law to this end that was felt a necessary pre-requisite for operators to pursue with the progression of location enhancement of emergency calls.

In support, it is recommended that the Commission undertakes the following specific actions:

- /// In conjunction with the Member States and in the context of CGALIES, **monitor the progress of E-112 implementation.**
- /// In conjunction with the Member States, after two years year of operation (i.e. by 2005), **assess the need for additional measures** including possible regulatory measures, aimed at raising the 'baseline' performance across Europe and speeding implementation. It is considered that by 2005, further information will be known regarding user requirements, the progress of E-112 implementation and mobile operators' plans for infrastructure roll-out;
- /// **Contract relevant studies** (as required) to support this review.

It is recommended that CGALIES gives careful consideration to these recommendations and, based on this, agrees on a common implementation path.

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1 Introduction

1.1 General

1.1.1 This document has been prepared by Helios Technology Limited ('Helios') on behalf of the Directorate-General Information Society, European Commission under contract reference 2001/48559. It presents proposals for "Recommendations towards a European policy and implementation plan for location enhanced 112" for discussion by CGALIES (Co-ordinating Group for Access to Location Information by Emergency Services).

1.1.2 Current emergency call service provision across Europe consists of calls made to the single European number 112 and other emergency numbers in use within each Member State. This report is concerned primarily with the enhancement of mobile and fixed 112 calls with location information. The same principles may be applied by each Member State to other emergency numbers in use.

1.2 Background

1.2.1 The rapid proliferation of GSM (Global System for Mobile Communication) has been both an enormous benefit and a problem for Europe's emergency authorities. More specifically, it has aggravated problems for emergency services since now more than half of emergency calls originate from mobile phones, the location of which is often not readily available. The availability of caller location information could significantly enhance the provision of emergency services and reduce the stress of both the victim and emergency staff.

1.2.2 The same issues apply to emergency calls from fixed telephones where, for one of a number of reasons, the emergency call taker is unable to accurately determine the location of the caller and incident. In response to this issue, many operators and emergency authorities throughout Europe have already deployed systems that enhance the call with location information (based upon for example, a known installation address).

1.2.3 Caller location systems in mobile communication networks are expected to become widespread in the coming years. Some systems are developed for GSM and were standardised by ETSI (European Telecommunication Standards Institute). Other systems have been developed elsewhere such as GPS, or are currently under development.

1.2.4 The huge prospect for commercial service offerings is expected to drive the mobile location market forward. Various estimates of the annual business potential run into billions of Euros for Europe alone³. It may be expected that this market will develop rapidly due to favourable returns on the associated investment and competitive incentives. The commercial services will need to roam across geographical and network boundaries, thus posing new and unique problems. Industry has understood the difficulties and has therefore begun to co-operate to produce common standards and solutions.

1.2.5 As location technology becomes widely available, the scope for further enhancement of emergency calls increases dramatically. Whilst operators and emergency authorities have already done much, more could be done and more benefits could be delivered to society and emergency authorities.

³ Example: 'Mobile Location Services – Market Strategies', Ovum Ltd, 2000.

1.2.6 This issue is relevant to all of Europe and therefore a greater degree of cooperation and common development of solutions is sensible. Furthermore, effective introduction of a location enhanced emergency service requires co-ordination between stakeholders and users from different communities and cultures. Therefore, in May 2000, the Commission established CGALIES to actively involve the relevant players and to develop a consensus on relevant implementation issues.

1.2.7 Much work has already been undertaken by the members of CGALIES⁴. This work has examined technical solutions, networking requirements as well as the cost and business models. This information is of enormous value and acts as both a major input into this study and a source of more detailed technical information. This report has also considered the final results from the Commission sponsored LOCUS study which were recently published⁵.

1.3 European regulatory framework

1.3.1 **Caller location information:** With the adoption of the new regulatory package, the Council and the European Parliament have made the forwarding of caller location by operators obligatory (see Annex B).

1.3.2 Article 26 from the Directive on universal service and users' rights relating to electronic communications networks and services (2002/22/EC of 7 March 2002) states that:

"Member States shall ensure that undertakings which operate public telephone networks make caller location information available to authorities handling emergencies, to the extent technically feasible, for all calls to the single European emergency call number 112".

1.3.3 This provision establishes a legal requirement on operators, both fixed and mobile, for delivering E-112 to EAs across Europe and provides the immediate context for this study. It will enter into force by 24 July 2003.

1.3.4 Whilst recognising the importance to society of delivering E-112, it must also respect matters of consumer rights and privacy and liability (see Annex B).

1.3.5 **Consumer rights and privacy:** In the case of emergency calls, rights for life and for health protection take precedence over rights for privacy. Therefore, data processing may be used in some cases even without the user's consent. The exception for emergency authorities is provided in a special clause (Article 10 – Exceptions) in the new data protection Directive.

1.3.6 This Directive allows for 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. The Directive also states that 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 deny such consent. Any technical solutions for location enhancement must meet the requirements for privacy protection.

⁴ See www.telematica.de/cgalies

⁵ See www.telematica.de/locus - Deliverable D4

- 1.3.7 **Liability:** As far as the use of location information is concerned, a new situation arises. If an operator makes a commitment or is obliged by law to provide an estimation of a user's position with a specified performance, then it will be possible to consider this operator as responsible for achieving the expected performance.
- 1.3.8 There is a risk therefore that operators will face liability implications as a direct result of providing location information. However, all location technologies have a limited level of performance that may be outside the operators', PSAPs' or EAs' control. If concerns over liability emerge, then the introduction of E-112 will be significantly delayed and essential public benefits will not be delivered.
- 1.3.9 In the US, it has been necessary to establish new laws on liability and protection in order to provide the required reassurances to mobile operators. A similar framework may be necessary for Europe to provide a degree of protection to operators and therefore not hinder the progress of E-112.

1.4 Study objectives

- 1.4.1 To complement the new legislation, the Commission Services considered that it was important to outline a roadmap for implementation of E-112 services. Taking into account other work and discussions and further study by the contractor, this report makes proposals for recommendations for discussion by CGALIES.
- 1.4.2 The specific aims of this study are:
- /// To examine the current provision of emergency services amongst the Member States of the European Union;
 - /// To assess the results of the different questionnaires that were distributed amongst Member States, including the generic European requirements for, and costs of, emergency services;
 - /// To examine the current and future development of mobile location technologies and their application to E-112;
 - /// To assess the commercial, technical and regulatory options for implementing E-112 across Europe, taking into account diversity between Member States and operators;
 - /// To undertake a qualitative assessment of generic benefits and costs, and consider suitable measures for cost reduction;
 - /// To produce proposals for recommendations for discussion in CGALIES and to evaluate the comments and reactions from players to determine the best implementation strategy.

1.5 Structure of this document

- 1.5.1 Section 2 summarises the current status of emergency call provision across Europe and the key issues that need to be addressed by E-112. It also summarises how the emerging Location Based Service (LBS) market may be applied.
- 1.5.2 Section 3 specifies the objectives and potential benefits of E-112 and states the purpose of establishing a European policy.
- 1.5.3 Section 4 examines the options for a European policy in terms of benefit, cost and risk and proposes a preferred way forward.

- 1.5.4 Section 5 considers the actions necessary to implement the proposed European policy and resolve any residual issues.
- 1.5.5 Section 6 presents the study conclusions and recommendations to CGALIES.
- 1.5.6 Supporting information is provided as follows:
- /// Glossary of terms (Annex A);
 - /// Relevant legal issues (Annex B);
 - /// User requirements (Annex C).
 - /// Mobile location technologies (Annex D);

2 Current status

2.1 Definitions

2.1.1 The following terms and abbreviations are used in this section and the remainder of the document:

/// **Emergency Call Services (ECS)** is the generic term used to refer to the transfer of emergency voice calls through to an Emergency Authority. This refers to all existing and future types of service.

/// A **Public Safety Answering Point (PSAP)** is a physical location where emergency telephone calls are received. This may be a public authority or a telecommunications operator.

/// The **Emergency Authority (EA)** is the agency responsible for dealing with the call and managing the most appropriate response (eg dispatching vehicles).

2.2 Emergency call service provision

2.2.1 Structural arrangements

2.2.1.1 On the basis of the responses from eleven Member States to a questionnaire issued by the Commission Services, CGALIES found that, when extrapolated to the whole of the European Union, more than 185 million calls are received by PSAPs each year in the countries of the European Union. Only 80 million of these are 'real' emergencies, the others being calls that do not require the emergency services; people testing their new mobile phone, nuisance calls, children, and accidental dialling. Approximately 50% of the 'real' emergency calls originate from mobiles - in some countries the amount is closer to 70%.⁶

2.2.1.2 Although 112 is considered in all Member States as the European emergency call number, only two have established 112 as the only emergency call number - Denmark and the Netherlands. In all other Member States, 112 may coexist with one or more national emergency call numbers. The awareness of using 112 abroad is quite low. In a survey presented during the "112 Implementation for European Citizen" workshop held in Luxembourg in May 2000, it was stated that 19.2% of European citizens would dial 112 in an emergency abroad, however, 41.3% would not know what number to call⁷.

2.2.1.3 The current structural arrangements for managing emergency calls vary enormously between Member States. Figure 2-1 provides a generic structural framework.

2.2.1.4 In its simplest form, a fixed or mobile emergency call is usually directed either through an operator's network or directly to a PSAP, where it is answered in person. The PSAP potentially has both a call routing and filtering function (eg removing silent and nuisance calls). The call centre operator at the PSAP routes each call to the appropriate EA, who is responsible for dispatching a resource to deal with the emergency. This is commonly the police, ambulance services, fire brigade or coastguard.

⁶ CGALIES, *Strawman paper version 2.0, 13/08/2001*

⁷ CGALIES, *Strawman paper version 2.0, 13/08/2001*

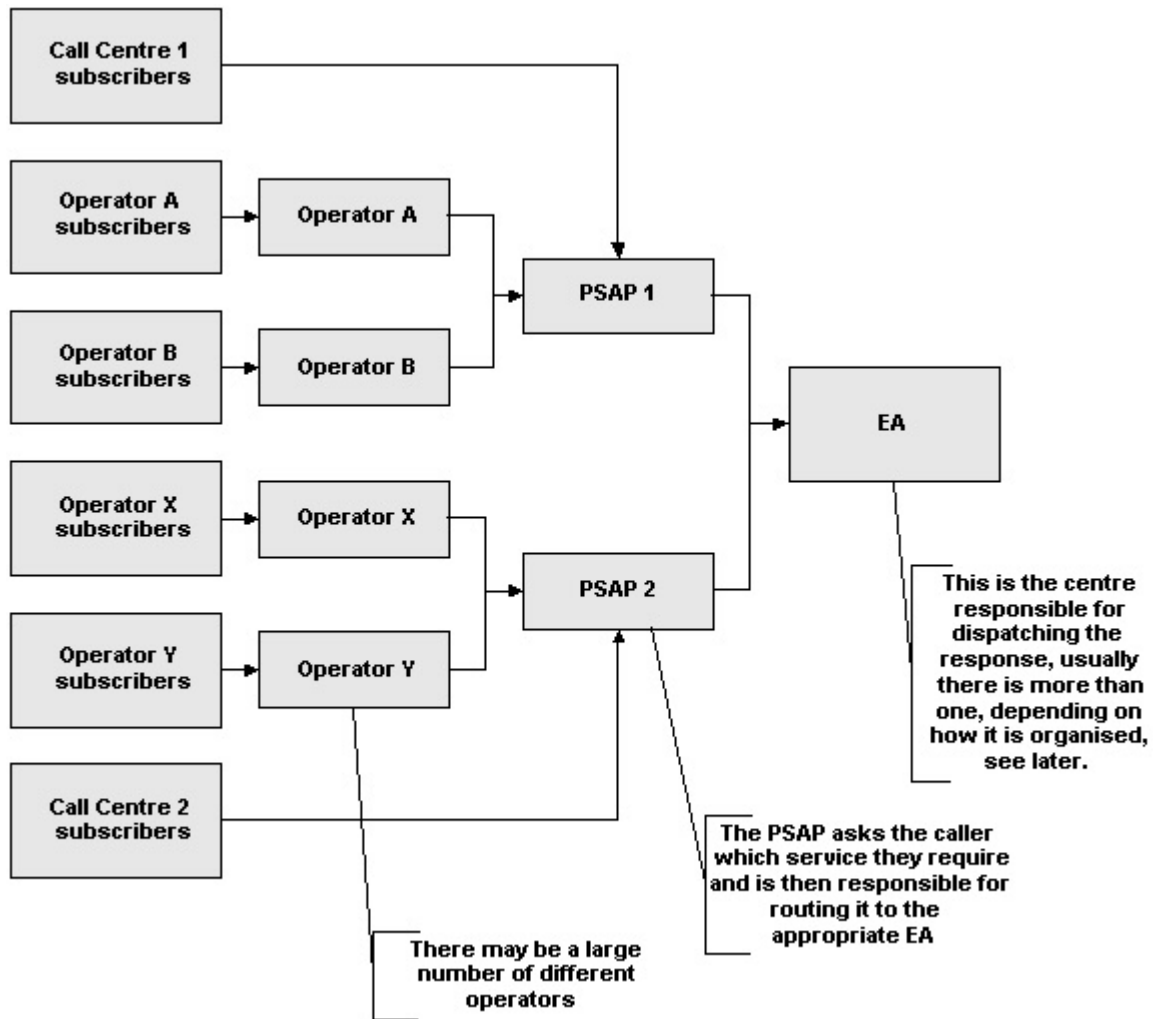


Figure 2-1: Generic structural arrangement⁸

2.2.1.5 Some practices across Europe vary from this general model:

- ☞ In some countries (eg Sweden) there is only one PSAP, which is responsible for the routing of all the calls.
- ☞ In Austria, the operators pass the call to the PSAP with the area code of the caller. With the fixed network number, the call can be passed directly to the appropriate EA, without going through the PSAP.
- ☞ In countries such as Finland and Portugal each operator is responsible for forwarding emergency calls directly to the appropriate emergency response centre - there is no intermediate PSAP to route the calls.

2.2.1.6 In each country, PSAPs may also be organised locally, regionally or nationally:

- ☞ A few countries have a local organisation, (eg France and Austria) resulting in approximately 100 PSAPs around the country.

⁸ LOCUS – Deliverable D1 (Overview of location services)

- ☞ Most countries have a regional organisation resulting in fewer PSAPs eg Finland (with 36 centres), Portugal (with approximately 30 centres), Spain (with 17 centres), Sweden (with 20 centres), UK (with 17 centres).
- ☞ The Netherlands has just one national PSAP for mobile calls that is run by a national EA, which is then responsible for routing the call to the appropriate local EA.

2.2.1.7 In some Member States, PSAPs are operated by public companies such as the police (eg Portugal), or fire fighters (eg France, Finland) - in other countries, the PSAP is operated by a private sector operator (eg UK, Sweden).

2.2.2 Fixed emergency calls

2.2.2.1 In the main, fixed calls are received at the PSAP where the caller's number is determined and the call is then transferred to the appropriate EA based on known location information. This is usually the area code of the caller or a known installation address if this is known to the PSAP.

2.2.2.2 The service for fixed calls has already been partially enhanced in many Member States with the provision of Caller Line Identity (CLI). This allows EAs to call back an emergency caller or 'Good Samaritan' in the event that further information is required to deal with the incident.

2.2.2.3 The way in which this has been implemented (eg verbally or electronically) and the degree to which it has been exploited by EAs varies between Member States. In some States, the real time transfer of CLI information is not possible, and information may only be provided if a court order applies⁹.

2.2.2.4 **Location enhancement:** In addition to routing, it is possible to make available to the EA, the billing/installation address of each fixed call. For example, in the UK, British Telecom provides the installation address of each fixed caller in real time to approximately 20% of all EAs in the UK. This is enabled by a reverse request or 'pull' by each EA of BT's database and enables the location details to be made available to the EA operator within two seconds of receiving the call. In other countries (eg Spain, Germany), the situation depends on the specific region - some EAs are able to request address details in the case of a fixed call whilst others do not.

2.2.2.5 European guidelines exist for CLI stating that that the emergency services should be able to use this service to identify callers.¹⁰ There are also some national guidelines and regulations in existence. For example, in Spain, a Royal Decree, (dated 16 June 1997), and an order (dated 14 October 1999) state that operators must facilitate the access by the 112 emergency call service providers to the databases, enabling them to match CLI with other subscriber information.¹¹

2.2.3 Mobile emergency calls

2.2.3.1 In general terms, most mobile emergency calls are located by the PSAP by means of a zone code. This 'coarse' indication is sufficient to allow the call to be transferred to the correct EA. The zone code is determined by the precise location

⁹ LOCUS – Deliverable D1 (Overview of location services)

¹⁰ 'European Guidelines for Caller Line Identification', European Telecommunications Platform CLI Working Group, 22 Jan 1999

¹¹ LOCUS – Deliverable D1 (Overview of location services)

of the cell (or 'Cell ID') from which the call originates. On current evidence, this information is not yet passed automatically to any EAs.

2.2.3.2 The level of information that is passed to the EA varies between Member States, organisations and type of call. For example, in some Member States, it is current practise to pass on verbally, a mobile caller's number. In other Member States, the CLI (Caller Line Identification) is passed on automatically.

2.2.3.3 **Location enhancement:** Since the adoption of the relevant European regulatory package (see Section 1.3), it appears that the level of activity has already increased. In particular, a number of mobile operators and PSAPs have begun developing common solutions within specific Member States. It should be remembered that those operators which act as PSAPs in many Member States will soon be governed by the newly adopted legislation.

2.2.3.4 It is therefore to be expected that, in the same way that CLI and fixed caller location has developed, specific local implementations of E-112 using mobile caller location will soon develop in an un-coordinated fashion. This will rely upon local commercial and technical agreements between operators at a Member State level and may occur independently of European or Member State policies.

2.2.4 Costs

2.2.4.1 In all countries across Europe calling 112 is free for the end user, be it a fixed or mobile call. The European Directive¹² on the application of open network provision (ONP) to voice telephony and on universal service for telecommunications in a competitive environment states:

"it is important that users are able to call emergency telephone numbers and, in particular, the single European emergency call number '112' free of charge from any telephone, including public pay-telephones, without the use of coins or cards;"

2.2.4.2 The cost of telecommunications services and equipment is largely shared between operators, PSAPs and EAs where each party bears those costs that fall most naturally to them. For example, EAs pay for any necessary call centre systems to support enhanced information plus the equipage of rescue-vehicles with any necessary fleet management and route guidance systems.

2.2.4.3 Although the provision of enhancements such as CLI are generally provided free of charge to the EAs, in some cases access to this information is associated with a fee¹¹. Public authorities may either pay a recurring fee (eg Sweden) or an initial payment to set up the database plus regular update fees (eg Spain).

2.3 Mobile industry

2.3.1 Evolution of location technologies

2.3.1.1 The primary change in the telecommunications industry that gives rise to the possibility of location enhancement for all emergency calls is the widespread location capability of mobile cellular handsets and other devices. This in turn, is led by an enormous desire to develop Location Based Services (LBS) that are expected to reap commercial return for mobile operators and other service providers.

¹² Directive 98/10/EC of the European Parliament and of the Council of 26 February 1998, (31998L0010) Official Journal L 101 , 01/04/1998 p. 0024 - 0047

- 2.3.1.2 The implementation of LBS and associated enabling technologies varies between operators in terms of services, technologies and timescales. A summary of the key technologies that have been considered by CGALIES is provided in Annex D.
- 2.3.1.3 CGALIES issued a questionnaire to mobile operators regarding the plans and cost of deploying location technology in mobile cellular networks. The conclusions, with regard to the wider commercial market, that may be drawn from the synthesis of nine replies received during 2001 are as follows:
- /// **Range of services:** Commercial location services are currently entering the marketplace, all based on Cell ID. A much greater range of commercial services may be expected to become available during the next few months.
 - /// **Technology enhancement:** Several operators indicated that they will enhance their location capability beyond 'straight forward' Cell ID (eg with Timing Advance (TA) or E-CGI) within the next 6 to 24 months. Others however, will not consider such implementations.
 - /// **High accuracy solutions:** All of the operators plan to upgrade their networks for the provision of high accuracy location services, but strong divergence was seen in their plans.
 - /// **Network migration:** General agreement exists that E-OTD will only be deployed in areas where commercial applications are of value (ie in urban areas). Operators were consistent in their assessment that only 50% of their GSM network might reasonably be covered by E-OTD.
 - /// **Terminal penetration:** Some believe that they could reach a level of 75% to 100% by the end of 2006. Others are more cautious estimating that the penetration rate of new terminals will follow a natural pattern of only 5 to 10% per year.
 - /// **Technology coverage:** By 2006, roughly 25% of the mobile subscribers will use accurate positioning (using A-GPS), and these services will be available in 100% of the area covered by the individual networks. Another 30% of the mobile subscribers will use E-OTD, available only in urban areas. The remaining 45% of the mobile subscribers will still depend on Cell ID, available in 100% of the covered area. Gradually, this group of subscribers will become smaller, but it will take many years before all subscribers have terminals supporting more accurate positioning services (eg A-GPS, E-OTD).
- 2.3.1.4 These facts all lead to the conclusion that commercial LBS are inevitable although some variance is likely in terms of services, timescales and technology. Furthermore, there is also evidence that, despite the general current downturn in market conditions, LBS remains a high priority for many operators. Indeed, it is seen by some as one of the ways in which to displace the falling profitability of voice calls and transfer users to compelling data services¹³.
- 2.3.1.5 The implementation of a particular location technology is a commercial decision for each network operator. Furthermore, the deployment of infrastructure upgrades depends on many factors including availability of the upgrade from vendors (hardware and software), new equipment from vendors, required geographical coverage and the quantity of base station sites to be upgraded.

¹³ *LOCUS Deliverable D1 (Overview of location services)*

2.3.2 Standards development

- 2.3.2.1 The relevant standards entities in Europe are ETSI and Third Generation Partnership Project (3GPP). ETSI is a non-profit making organisation whose mission is to produce the telecommunications standards that will be used throughout Europe and beyond. ETSI is one of the founding partners of the 3GPP, which co-operates in the production of Technical Specifications and Reports for a Third Generation Mobile System.
- 2.3.2.2 Due to the relatively complex situation of Location Services, the lack of applications and contents interoperability, the Location Interoperability Forum (LIF) was established. LIF is an industry initiative whose purpose is to define and promote through the global standard bodies and specification organisations, a common and ubiquitous location services solution.
- 2.3.2.3 The exchange of information between operators should take place across a standardised interface. In commercial terms, this interface is known as the 'Le interface' and sits between any application external to the network and the Gateway Mobile Location Centre (GMLC). Amongst other functions, the interface will govern the transfer of location information according to each type of application and user consent. The interface between a mobile operator and a PSAP (see Section 2.2) is directly analogous.
- 2.3.2.4 Certain operators and manufacturers have specified the LIF protocol for E-112. It is now understood that this interface has been formally adopted by 3GPP as the Le interface. Its true value to E-112 will be in the extent to which it and other similar interfaces become a de-facto benchmark for Europe.

2.4 Summary of key issues

- 2.4.1 Many Member States have already enhanced emergency call services by providing fixed caller location information to EAs. The availability of mobile location information from cellular networks now makes feasible, the provision of location information for *all* emergency calls throughout Europe. Furthermore, with the adoption of the new regulatory package on 14 February 2002, the Council and the European Parliament has made the forwarding of caller location by operators obligatory (see Section 1.3).
- 2.4.2 Section 2.2 highlights the variance between Member States in terms of structural arrangements and technical solutions. There is therefore, in the context of E-112, an opportunity for increased cooperation in the pursuit of common solutions, where practical and feasible, whilst respecting matters of national policy. This should ultimately lead to a reduction in implementation costs for Europe.
- 2.4.3 Section 2.3 has described the fast progress of commercial LBS and the inevitable introduction of location-enabled mobile devices. It therefore seems reasonable to expect in any circumstances, that local agreements will be established to support the location enhancement of 112.
- 2.4.4 This uncoordinated approach will lead to increased costs and complexity for EAs across Europe. The common solutions and standards already being developed by entities such as 3GPP and LIF therefore provide a potential basis for future solutions based upon a commercially open standard.

3 Benefits and requirements

3.1 Objective of E-112

3.1.1 E-112's primary objective is to enhance all 112 emergency calls made throughout Europe with location information. This information will be provided to the relevant Emergency Authority (EA), enabling a **timelier, more effective and improved quality of service**. This in turn delivers substantial benefits to society in terms of saving lives and a sense of security.

3.2 Planned benefits

3.2.1 Overview of operation

3.2.1.1 In general terms, there are four operational stages to the handling of an emergency call (as shown in Figure 3-1).

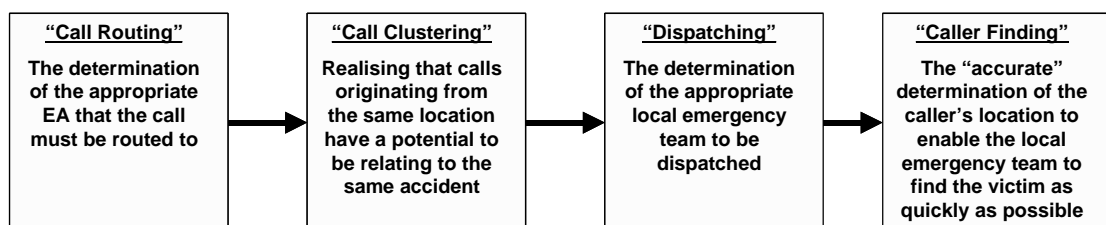


Figure 3-1: Stages to emergency call handling

3.2.1.2 The provision of location information will potentially assist, as follows:

- ✎ **Call routing:** Location information could be used to assist routing the calls to the appropriate EA faster and minimise misrouting of calls. Member States have stated that an acceptable level of misrouted calls is 5%¹⁴.
- ✎ **Call clustering:** The number of 'Good Samaritan' calls has the potential to increase with wide availability of mobile phones, and hence calls can become more clustered. The degree to which this is a problem varies greatly between EAs. The provision of location information will help to identify potential call clusters due to the same incident and this may, in turn, result in more optimised call handling policies.
- ✎ **Dispatching:** Location information can assist the dispatch process by ensuring that the most appropriate (eg nearest) service is sent to the incident.
- ✎ **Caller finding:** For 6% of mobile emergency calls the caller cannot give location, according to the questionnaires from Member States.¹⁵ The provision of location information can obviously assist in finding the caller in these situations and when insufficient location data is given verbally.

3.2.1.3 These operational stages form the basis from which benefits are delivered to society (Section 3.2.2) and EA operations (Section 3.2.3). In addition to these

¹⁴ CGALIES, Strawman paper version 2.0, 13/08/2001

¹⁵ CGALIES, Strawman paper version 2.0, 13/08/2001

major benefits, E-112 is also expected (as a consequence) to benefit industry. In particular, the development of a European policy on E-112 is expected to improve the efficiency of providing location-enhanced emergency calls, the demand for which is likely to increase over time.

3.2.2 Benefits to society

3.2.2.1 The primary benefit to society is straight forward; that of **saving lives** and an **increased sense of security**. This may be in terms of improved call routing, more efficient determination of call clustering, obtaining faster and perhaps improved information for dispatching relevant resources, and most importantly improved information to locate the caller. What is of paramount importance here is that the relevant resources are delivered to the person in need as soon as possible.

3.2.2.2 An increased sense of security is particularly relevant for European citizens travelling abroad who may not necessarily be familiar with a local language or local emergency service arrangements.

3.2.2.3 The secondary benefits may be varied and include:

/// **Increased confidence in emergency service provision:** A faster arrival at the scene of the incident will increase the confidence that the citizens have in the emergency services.

/// **Reduced stress:** The caller will feel less distressed and more secure if they are aware that the emergency services can locate them faster.

/// **Decreased reliance on verbal communication:** Since the EA will already know the location of the caller, the fact that they may be unable to communicate may not be as critical. This situation may arise for callers with disabilities such as being deaf or dumb, for callers under stress, or for callers who do not speak the appropriate language.

/// **Reduced traffic congestion:** A faster response time to an accident on a major road could result in less traffic congestion, and additionally it may be possible to redirect the traffic away from the accident. Here the direction may also need to be known in order to identify which side of the carriageway the incident has occurred.

3.2.3 Benefits to EA operations

3.2.3.1 The primary benefit to the EA operations is to provide a **timelier and more effective response** to the citizen who is in an emergency. Secondary benefits may include:

/// **More efficient use of resources:** With additional information on location, resources closest to the incident can be dispatched. This could in turn reduce the cost of operations if efficiency is improved. Therefore an upfront investment could serve to save costs in the longer term.

/// **Deterrent to spurious and malicious calls:** The perception that an emergency call will be located may, by itself, act as a deterrent to spurious or malicious calls.

/// **Reduced stress and trauma amongst personnel:** If officers are able to reach the incidents faster then this may lead to reduced stress and reduced work overload.

- /// **Increased arrests:** A faster response time to an emergency call to the police could result in an increased chance of arresting the offender.
- /// **Increased effectiveness of automatic emergency systems:** When vehicles automatically call the emergency service in response to airbag deployment, it would be useful if location information is supplied, especially if the passengers were unconscious.
- /// **Improved incident management:** If E-112 was also able to provide links through location information to other databases (eg firearms licences, previous incident records), then a more informed response could be made.

3.3 User requirements

3.3.1 Location information

3.3.1.1 In order to deliver the planned benefits, a set of user requirements has been developed through CGALIES, a summary of which can be found in Annex C of this document. The requirements with regard to location information specify provisional expectations of:

- /// Horizontal accuracy;
- /// Indication of quality of information (ie error range);
- /// Latency (ie time delay);
- /// Vertical accuracy (non-mandatory and of secondary importance).

3.3.1.2 With regard to fixed calls, the existing location solutions deployed by several PSAPs are broadly capable of meeting user expectations. This depends critically upon:

- /// A PSAP database containing the installation addresses of all CLI, that is updated at regular intervals;
- /// The facility to transfer address information to EAs either automatically with each voice call ('push'), or semi-automatically upon a request ('pull').

3.3.1.3 The user requirements summarises in Annex C state that databases of fixed caller installation addresses need to be available every day for 24 hours, and any changes should be updated within 24 hours and kept accurate and in line with local digital maps/databases. This would necessitate the close integration of customer service data and fixed caller location databases as opposed to 'static' databases such as CD-ROMs.

3.3.1.4 Providing an indication of quality of information and vertical accuracy of each fixed call is not possible to provide from a PSAP database and depends upon the characteristics and size of each address point.

3.3.1.5 With respect to the location enhancement of mobile calls, it is possible to draw a number of conclusions from the summary of current status (Section 2.3) and the supporting information in Annexes C and D, namely:

- /// No single location technology installed or currently under development is believed to meet all of the user requirements. A process of evolution from existing location methods to higher levels of accuracy must therefore be expected.

- ✎ Currently available solutions based upon Cell ID (and including Timing Advance (TA) and Enhanced Cell Global Identity (E-CGI)) should satisfy all call routing requirements and partially satisfy other requirements. This is particularly true for urban areas where the performance of these technologies is greatest.
 - ✎ Technologies already available but not yet widely deployed (eg A-GPS and E-OTD) should satisfy a significant proportion of the requirements and thereby deliver most of the required benefits.
 - ✎ Transmitting additional data alongside the actual location information may satisfy the quality of service requirements. This could be readily supported by existing GSM standards that allow the quality of service to be defined in accordance with the requirements of Annex C.
- 3.3.1.6 Section 3.2 has highlighted the importance of providing an improved sense of security amongst European citizens travelling abroad within Europe. This means that a mobile emergency caller should, in principle, receive the same level of service when roaming on a visited network as (s)he received on their home network.
- 3.3.1.7 Existing solutions based upon Cell ID and E-CGI can cater for legacy handsets and will therefore provide a baseline capability for full user roaming across Europe. Roaming at higher levels of service deploying technologies such as A-GPS and E-OTD will rely upon the development of common handset solutions. Whilst this is unlikely to occur in the short term, it is likely that consolidation within the mobile industry will eventually lead to a proliferation of common handset solutions.

3.3.2 Privacy protection

- 3.3.2.1 The user requirements (see Annex C) include the functional requirement for unique access to location information by EAs. This requirement is governed by legislation concerning consumer rights and privacy (see Section 1.3 and Annex B).
- 3.3.2.2 In order to ensure that requirements for privacy protection are met, it is important that clear procedures are established (by Member States, PSAPs and operators) governing the transfer of such information. This includes the conditions under which user consent may be overridden, including a clear definition of:
- ✎ Those organisations for which such exceptions may be permitted (including agencies not directly involved in the management of an incident or to whom information may be passed at a later date);
 - ✎ Those events that constitute an emergency thereby permitting access to location information.
- 3.3.2.3 Critical to the success of E-112 will be the degree to which any necessary standards for the transfer of location information are able to meet the requirements for privacy protection (see Section 5.4).

3.4 Objectives of European policy

- 3.4.1 In summary, location enhancement of 112 emergency calls is technically feasible now. The existing methods for providing fixed call location plus the range of current and emerging mobile location technologies provide the basis for technical solutions that appear to satisfy the majority of user expectations. The newly adopted legislation (see Section 1.3), which requires that "...caller location

information is made available to authorities handling emergencies, to the extent technically feasible...”, should therefore be interpreted accordingly.

- 3.4.2 Whilst such solutions are feasible, this information is failing to be exploited by Europe’s EAs. The increasing awareness of location enhancement and the availability of mobile location solutions now enable widespread implementation.
- 3.4.3 It is considered that a coordinated implementation policy will help to accelerate the implementation and maximise the benefit of E-112 to EAs and society. Such a policy will need to define the approach to be adopted towards the implementation of E-112 and further enhancements as to the quality of the accuracy of location data.
- 3.4.4 The specific objectives of establishing a European implementation policy are to:
- a) Increase awareness of the potential benefits of location enhanced 112 (E-112);
 - b) Exploit currently available location information and emerging location technologies as soon as their performance is demonstrated and become available;
 - c) Ensure that the potential benefits to society and EAs are realised to the fullest extent and at the earliest possible point in time;
 - d) Reduce the overall cost of implementation to all parties where feasible, through increased cooperation and the development of common solutions.
- 3.4.5 The implementation policy must effectively strike a balance between benefits, cost and timescales. Existing solutions will satisfy a proportion of the user requirements and can be provided at minimal cost to all parties. Future solutions should satisfy a greater proportion of the requirements but are not yet fully implemented and may therefore incur additional cost to operators, PSAPs and EAs. The precise balance will depend upon the timescales for implementation, which are discussed in more detail in Section 4.
- 3.4.6 The realisation of benefits also relies upon the smooth convergence of implementation plans and timescales by fixed and mobile operators, PSAPs and EAs. The planned benefits will not be fully realised until all organisations along the delivery chain are committed and invest in realising E-112.

4 Policy options

4.1 Available measures

4.1.1 General

4.1.1.1 A European policy will define the broad approach to be adopted towards the implementation of E-112 and will ultimately consist of a number of measures to be taken by different stakeholders.

4.1.1.2 In order for the policy to be feasible and able to be implemented (as stated in Section 3.4), it is important to recognise the complete set of potential measures that are available and may influence the policy objectives stated in Section 3.4. The types of measures that could form the basis of a European implementation policy are:

- a) Additional European regulation, for instance by specifying concrete performance parameters for E-112;
- b) Development of common technical solutions, such as a common interface between operators and PSAPs/EAs.
- c) Development of a common European implementation plan, guided by continued liaison and cooperation across Europe;

4.1.2 Additional European regulation

4.1.2.1 The newly adopted legislation with respect to location information *already* requires operators to make available location information (see Section 1.3). The primary purpose of implementing additional regulatory measures would be to accelerate the performance in terms of accuracy and service availability (eg in-door, urban, etc) of E-112 beyond that which could otherwise be justified on commercial grounds; taking into account what can be delivered today by cellular networks.

4.1.2.2 Adopting this measure requires the Commission (and its Member States) to recognise and understand the benefits to society of implementing E-112 and thereby promote an accelerated pace of progress. This approach is analogous to the approach adopted in the US where the Federal Communications Commission (FCC) has mandated performance parameters¹⁶ which, in order to meet the requirements, requires operators to make significant additional infrastructure (and handset) investment.

4.1.2.3 This additional regulation would have the greatest impact upon mobile operators and (indirectly) handset manufacturers. It is likely that no such additional regulation would be required for fixed operators (see Section 3.3).

4.1.2.4 Any additional regulatory forces placed upon mobile operators may need to specify (to some degree):

- ✎ The method of location and/or performance to be delivered;
- ✎ The method of data transfer and standard interfaces to be adopted;
- ✎ A path for future migration towards higher levels of location accuracy.

¹⁶ see for instance Annex II of CGALIES report on implementation issues related to access to location information by emergency services (E-112) in the European Union

- 4.1.2.5 With regard to the stated policy objectives (Section 3.4), the benefits of applying additional regulatory forces are that:
- a) Emerging location technologies may be exploited before they would otherwise be available on commercial grounds;
 - b) The potential benefits of E-112 may be realised to the fullest extent through the earlier availability of more accurate location information;
 - c) Further regulation would (indirectly) help to contribute towards an increased awareness of location enhancement.
- 4.1.2.6 This approach effectively removes many of the uncertainties associated with the future progress of the commercial marketplace. By overcoming such risks, one would ensure that common solutions were adopted throughout Europe and that higher levels of service were achieved through higher accuracy technologies. This may extend to the requirement for international roaming.
- 4.1.2.7 In order to overcome the identified risks, significant investment is required by operators. The actual level of investment required is also unclear. Opinions expressed by CGALIES to date have strongly resisted such a regulatory approach.
- 4.1.2.8 The lessons learnt in the US from adopting such an approach have also shown that applying such regulation risks an immediate reduction in the level of cooperation between mobile operators and governments (and their regulators). Furthermore, it remains unclear whether or not the regulatory approach adopted in the US has actually accelerated the timescales for implementation.
- 4.1.2.9 It is the common belief of Europe's mobile operators that additional regulation will not help to drive the current European market for mobile location based services (LBS). Some operators also believe that it may instead damage the wider commercial marketplace as a result of distracting attention and investment towards E-112.

4.1.3 Development of common European solutions

- 4.1.3.1 Section 2 concludes that, in the context of E-112, there is an immediate opportunity for increased cooperation in the pursuit of common solutions, where practical and feasible. The principal areas for common development are:
- ☞ Interfaces and methods for the transfer of location information (including the need to meet privacy protection requirements), and;
 - ☞ Operational systems and applications deployed by EAs.
- 4.1.3.2 EAs and PSAPs must be prepared to make the necessary investments in operational systems and applications in order to receive and interpret location information. With increased cooperation between States and the development of common ideas and solutions, such costs should be reduced. Any common solutions need not be mandatory and therefore each Member State or EA would still have the final say on its chosen solution.
- 4.1.3.3 With regard to the stated policy objectives (Section 3.4), the development of common solutions will:
- a) Contribute towards an increased awareness of location enhancement, particularly amongst EAs;

b) Mitigate the risk of technically divergent solutions and thereby reduce the overall cost of implementation.

4.1.3.4 The interfaces already developed by the mobile industry through LIF and 3GPP (see Section 2.3.2) could potentially provide the basis of a common European solution for the transfer of location information.

4.1.4 Continued liaison and cooperation

4.1.4.1 It is considered that some degree of continued cooperation and communication between stakeholders through bodies such as CGALIES would help to:

- /// Establish best practice and to highlight common technical solutions,
- /// Establish a quicker and improved understanding of operational benefits and critical implementation issues/risks by stakeholders;
- /// Achieve a further reduction in costs and implementation effort.

4.1.4.2 The specific types of measures that may be applied include:

- /// European-wide dissemination and awareness programmes;
- /// Financial contributions towards pre-operational system development and pilot projects;
- /// Additional studies (eg cost benefit analysis, post implementation analysis);
- /// Continued liaison and communication between stakeholders.

4.1.4.3 There is a risk that the need for cooperation at a European level may, in some way, delay the timescales for introduction. However, it is considered that the downstream value in terms of both cost and operational benefit makes such measures worthwhile.

4.2 Definition of options

4.2.1 General

4.2.1.1 Given the types of measures available with which to influence the implementation of E-112, it is considered that a European implementation policy may broadly follow one of three options. As the principle that location information must be passed on is now in European regulation, all three options are considered "Regulated" but with various degrees of involvement during implementation, namely:

/// **Option A: 'Do Minimum'**

Regulated/Uncoordinated approach where national and regional organisations are left to prepare for implementation;

/// **Option B: 'Best Effort'**

Regulated/Coordinated approach where operators pass the best location information available to them (including Cell ID and E-CGI) with further performance improvement depending on commercial development. PSAPs and EAs upgrade their information systems to be able to receive, process and use the location information provided;

~~///~~ **Option C: 'Accelerated'**

Regulated/Coordinated with an additional regulatory measure to impose improved performance characteristics for E-112 on operators at an early date. PSAPs and EAs upgrade their information systems to be able to receive, process and use the location information provided.

4.2.1.2 It is valid to consider a combination of one or more of these approaches over the course of the entire implementation period. For example, it may become more acceptable to adopt a more regulated approach in the long term as the commercial market and its enabling technologies become more mature and stabilised (see Section 3.3). As the situation stabilises, EA requirements will also become more precise and better understood.

4.2.1.3 The following sections assess each option, whilst making direct reference to the issues already raised in Section 4.1.

4.2.2 Option A (Do Minimum)

4.2.2.1 This option requires no further measures in addition to those regulatory measures already adopted. To this end, operators will be required by Member States to meet their legal obligations. However:

~~///~~ There would be little or no cooperation amongst EAs across Europe;

~~///~~ Technically divergent solutions are likely to emerge;

~~///~~ The progress of E-112 may continue to be hindered by a lack of awareness amongst EAs.

4.2.2.2 Unless common solutions are developed in the interests of all parties, there is a risk that the early solutions for location enhancement may become technically divergent in order to meet legal obligations by 2003. This unnecessary divergence will lead to increased implementation costs for Europe in the long term. Any increase in costs will hinder and delay the progress of E-112 amongst EAs, many of whom are not yet fully aware of the potential benefits that it may bring.

4.2.2.3 This 'Do Minimum' option carries a risk that the benefits of location enhancement will never be fully realised across Europe due to:

~~///~~ A continued lack of awareness amongst EAs;

~~///~~ Additional obstacles to implementation from increased costs;

~~///~~ The emergence of short-term solutions that may prevent migration towards future location technologies and increased benefit.

4.2.2.4 This option fails to meet any of the stated policy objectives (Section 3.4) and is therefore considered unacceptable as a way forward.

4.2.3 Option B (Best Effort)

4.2.3.1 This option does not call for any further regulatory forces at a European level, and instead maximises the benefits at each stage of implementation without imposing further deadlines and specific requirements upon operators. To this end, progress of E-112 (and specifically location enhanced mobile emergency calls) will be largely influenced by the progress of the wider commercial market.

- 4.2.3.2 This option includes the need for common solutions (Section 4.1.3) and increased cooperation (Section 4.1.4). Solutions to the fixed call location enhancement are assumed to be feasible and available today. However, it is considered that this option would still enable more common solutions to emerge than has been the case to date.
- 4.2.3.3 Whilst the network solutions are already feasible, Europe must ensure that EAs and other public bodies are fully aware of the benefits of location enhancement and are therefore fully prepared to implement the necessary solutions as soon as they are available (ie July 2003).
- 4.2.3.4 This option therefore meets the majority of stated policy objectives (Section 3.4) insofar that it:
- a) Exploits emerging location technologies as soon as they become available (as determined by the commercial market);
 - b) Reduces the overall cost of implementation to all parties where feasible, through increased cooperation and the development of common solutions;
 - c) Increases awareness of the potential benefits of location enhancement through increased cooperation and communication.
- 4.2.3.5 This option does not address the risks associated with the commercial market, namely that:
- ✍ Benefits to society and EAs will depend entirely upon the state of the commercial marketplace and the success or otherwise of the mobile operators;
 - ✍ The diversity seen amongst operators' future rollout plans may prevent a pan-European rollout of higher accuracy mobile location technologies. This would mean that users would 'fall-back' to Cell ID as the 'minimum common denominator' for international roaming.
- 4.2.3.6 These residual issues effectively mean that this option does not in itself ensure that the potential benefits of E-112 to society and EAs are realised to the fullest extent. However, the effect of these risks may be mitigated by suitable measures (see Section 5).
- 4.2.3.7 This option effectively shifts the emphasis to the market as a principal driver, and therefore it becomes increasingly important that user expectations are met and that future mobile location technology deliver the expected performance to users.
- 4.2.4 Option C (Accelerated)**
- 4.2.4.1 This option requires the full set of measures identified in Section 4.1 to be implemented, including additional regulatory forces by Member States. Whilst this accelerated approach meets the majority of the stated policy objectives, it also carries a number of significant risks.
- 4.2.4.2 This option would require operators to (potentially) implement higher accuracy solutions for the specific purposes of emergency calls. The cost of implementing higher accuracy solutions such as A-GPS and E-OTD is significant (Annex D.3) and yet to be fully justified by operators on commercial grounds.
- 4.2.4.3 The principal driver for adopting Option C would be to remove many of the uncertainties associated with the future progress of the commercial marketplace. In order to do so, there is significant investment required by mobile operators that must either be absorbed by the public sector, or otherwise risk:

- /// A reduced level of effective cooperation from operators;
 - /// No acceleration of timescales for implementation of higher accuracy solutions due to inevitable commercial pressures (as already seen in the US);
 - /// Damage to the wider commercial marketplace as a result of distracting attention and investment towards E-112.
- 4.2.4.4 Furthermore, if the additional cost of investment was redistributed in some way to a third party (ie government or consumers), then it would be difficult to ensure that the costs had been reallocated in a fair and open manner. The additional incremental costs may only be known by each operator and would depend upon a complex set of commercial decisions and subjective assumptions.
- 4.2.4.5 As time goes on, the availability of higher accuracy solutions will increase (see Section 2.3.1) as the industry is able to justify the necessary expenditure on commercial grounds. As a result, the financial impact of making available such information for the purposes of emergency calls also decreases with time.

4.3 Preferred option

- 4.3.1 It is considered that a 'Best Effort' approach (Option B) should form the basis of a European implementation policy towards the initial phase of implementation of E-112. This option maximises the benefits to society and EAs at all stages of implementation, whilst at the same time minimising the overall financial impact. Such an approach does not stipulate any further regulation at a European level in addition to that already adopted.
- 4.3.2 This approach is recommended since:
- /// The development of common solutions and increased cooperation across Europe will bring financial benefit to all stakeholders and, in particular EAs;
 - /// The current variation in operators' plans makes additional European-wide regulation difficult at this time;
 - /// A more accelerated implementation plan would bring with it excessive financial implications that could not necessarily be borne across all Member States;
 - /// There is no guarantee that a more aggressive regulated approach would result in the quicker realisation of benefits to society and EAs and may introduce additional commercial risk.
- 4.3.3 In the longer term, it is expected that the commercial LBS market will become more stable and its enabling technologies more mature. Furthermore, the requirements of EAs with respect to E-112 will also become better understood. Under such conditions, it is considered that a more accelerated approach via additional regulatory forces (Option C) may become more acceptable. A move towards Option C will enable the introduction of higher accuracy information and in particular, a higher 'minimum baseline' for Europe's roaming users.
- 4.3.4 In adopting Option B, one must take into account that it does not in itself ensure that the potential benefits of E-112 are realised to the fullest extent. Any proposed measures must therefore consider the dependency of this policy upon the progress of the commercial market and its inevitable uncertainty.
- 4.3.5 Adopting a 'Best Effort' approach does not prevent any Member State from implementing its own additional regulatory measures, having given consideration to the issues outlined above.

- 4.3.6 Member States are advised that the ongoing provision of location information should, wherever possible, be provided free of charge to PSAPs, EAs and other public authorities in order to encourage uptake of services (see Section 2.2.4). EAs and PSAPs will however need to invest in any necessary call centre systems to support enhanced information plus necessary communications services.

5 Implementation plan

5.1 Proposed measures

5.1.1 In order to ensure that the proposed approach satisfies the stated policy objectives whilst also addressing the residual risks stated in Section 4, the set of measures that form the implementation plan will need to:

- a) Increase awareness amongst EAs and other public bodies;
- b) Exploit emerging location technologies as soon as they become available;
- c) Develop an evolution path towards higher service levels;
- d) Reduce the overall cost of implementation to all parties where feasible, through increased cooperation and the development of common solutions.

5.2 Awareness programme

5.2.1 It will be necessary to maximise awareness of E-112 and its application to other national emergency numbers within each Member State. Each EA should be aware of the potential operational benefits and the likely cost implication in order to make an informed decision regarding its introduction.

5.2.2 The specific actions recommended are presented in Section 5.5.

5.3 Evolution of location technologies

5.3.1 Section 3 concludes that the technologies necessary to meet operators' regulatory legal obligations already exist and are available.

/// **Fixed calls:** Methods for locating fixed calls via CLI and installation addresses are already well defined and mature in many Member States.

/// **Mobile calls:** Cell ID and other methods based upon legacy handsets are already available and are expected to be ubiquitous throughout Europe's mobile networks by 2003.

5.3.2 As soon as the legislation comes into effect, each mobile operator should provide Cell ID - as defined in GSM standards (or equivalent) - as a minimum service level. Furthermore, if operators are able to provide higher levels of performance as a result of having implemented improved solutions in part or over their entire network, then this should also be provided *in addition to* Cell ID.

5.3.3 Cell ID will provide a 'minimum baseline' for Europe and a full roaming capability. In order to deliver a 'higher baseline' across all of Europe, it will be necessary to deliver an improved international roaming capability. This will ensure that the full set of potential benefits are provided, thus ensuring that a European citizen is afforded the same level of service as (s)he travels throughout Europe.

5.3.4 It is proposed that the Commission should monitor the progress of E-112 and the rollout of location technologies. The feasibility of implementing further measures in the future and adopting an Accelerated approach (as in Option C) may then be assessed.

5.3.5 The feasibility of implementing additional regulatory forces in the future will be determined by the following factors:

- /// The network penetration of location technologies such as E-OTD and A-GPS;
- /// The availability of handsets and devices to support one or more of these technologies;
- /// The commercial prospects for the mobile market and, in particular, LBS;
- /// The degree of diversity between operators' infrastructure plans.

5.3.6 The variation in operators' plans makes additional European-wide regulation difficult at this time. If higher levels of performance are justified on commercial grounds, then Member States should ensure that such benefit is shared by the public sector. It is therefore considered that Member States may also wish to assess operators' plans within each country and consider the potential benefits (and costs) of additional measures above those prescribed in Section 4.

5.4 Development of common solutions

5.4.1 General

5.4.1.1 The areas in which further cooperation are considered to be of highest value are:

- /// Overall architecture and functionality (Section 5.4.2);
- /// Interfaces and standards for data transfer (Section 5.4.3);
- /// Interpretation of location information (Section 5.4.4).

5.4.2 Architecture and functionality

5.4.2.1 CGALIES has already undertaken much work to assess the different solutions for meeting the technical and functional user requirements for E-112 (Annex C). Different options have been discussed based upon previous experience both within Europe and also, most notably, in the US as a result of E-911.

5.4.2.2 There is little benefit in prescribing in detail the optimum technical solution to be implemented across Europe. This decision will instead need to be taken by each Member State in order to:

- /// Ensure a sufficient level of interoperability between regional EAs;
- /// Take into account technical factors, legacy systems/arrangements, liability and matters of specific national interest (see Section 2.2).

5.4.2.3 CGALIES has already shown how increased cooperation can support national level decision-making, through the application of best practice and sharing experiences and ideas. It is therefore recommended that a common implementation framework should be developed on behalf of Member States to help support their decisions on future implementation.

5.4.3 Interfaces and standards

5.4.3.1 Two primary interfaces exist for the transfer of location data, namely:

☞ **Interface 1: Operator/PSAP.** Data interface between fixed/mobile operator and PSAP¹⁷;

☞ **Interface 2: PSAP/EA.** Data interface between PSAP and EA¹⁸.

5.4.3.2 **Interface 1 (Operator/PSAP):** There is already a strong drive within the industry to implement a common standard across Europe for this interface (see Section 4.1.3). In particular:

☞ Each PSAP (of which there may be many within one Member State) is required to interface to multiple fixed and mobile operators;

☞ Some major mobile operators have pan-European service ‘footprints’ and will therefore strongly favour a common implementation.

5.4.3.3 It is considered that a European de-facto standard is likely to evolve over time, and potentially satisfy the needs of E-112. Divergence towards a common standard that is based upon widely implemented *commercial* standards will help to minimise implementation costs of all parties.

5.4.3.4 Such commercial standards are only currently being developed for the purposes of the mobile industry and therefore one must also take account of the needs of fixed operators. The requirements for transferring fixed caller location are functionally similar to mobile calls and it is therefore considered feasible that a single interface could be provided for the transfer of both fixed and mobile calls to a PSAP.

5.4.3.5 As well as minimising cost, the advantage of establishing a common operator/PSAP interface is to ensure that the requirements of E-112 are met, paying particular attention to the need for:

☞ An indication of location data quality (see Annex C.2.2);

☞ A seamless migration towards future positioning technologies (see Annex C.4);

☞ Privacy protection (see Section 3.3.2);

☞ The specific functional needs associated with E-112 (eg both ‘push’ and ‘pull’ data transfers (see Annex C.3).

5.4.3.6 It is therefore recommended that a common interface standard be sought for the transfer of E-112 location information between operators and PSAPs. It is expected that the commercial standards already under development should be capable of meeting the functional and technical requirements of E-112 within the required timescales. Furthermore, it is expected that these standards will actually deliver common solutions and interoperability across Europe.

5.4.3.7 **Interface 2 (PSAP operator/EA):** In some Member States, operators and EAs are already working together in order to implement location enhancement and have already defined their own architecture and interface. The primary disadvantages

¹⁷ Each PSAP may be a public authority or telecommunications operator, depending on each Member State.

¹⁸ This interface may not specifically exist in those Member States in which the same public authority may be acting as both PSAP and EA.

with such an approach is that proprietary solutions emerge and remain confined to each Member State or local EAs.

5.4.3.8 The immediate consequences of not adhering to a European harmonised implementation framework for EAs are that:

✍ The costs of implementation at a Member State or local level may not necessarily be minimised;

✍ The market for EA systems adhering to the required standards remains within each Member State and is not pan-European.

5.4.3.9 On balance therefore, it is considered that a greater level of cooperation between EAs and PSAPs across Europe should reap a subsequent reduction in costs. Furthermore, it is expected that increased co-operation at a European level will, in itself, help to encourage co-operation between stakeholders *within* each Member State. Whilst the final say on technical solutions remains with Member States and EAs, these should take account of the functional and technical requirements specified by CGALIES (see Annex C).

5.4.3.10 It is perhaps worth noting that in North America, the standards body TIA, have standardised call-associated methods of signalling between the operator and EA. However, such standards are non-mandatory and therefore inevitably vary between system manufacturers and suppliers.

5.4.4 Interpretation of location information

5.4.4.1 The technical requirements presented in Annex B state that the accuracy of location information should not be constrained by the operational systems in use by the EA. These include mapping displays, GIS (geographical information systems) and incident management systems. At present, not all EAs make use of digital maps, and continue to rely upon text based systems and displays.

5.4.4.2 **Text display:** Showing the latitude and longitude to the operator of a text display is meaningless. Instead, one would need to convert the information into an understandable frame of reference such as a street name or an area that could be easily recognised by the operator.

5.4.4.3 **Digital map display:** The display of fixed call location is relatively straightforward since the location will be referred to a specific billing or installation address. Provided that the digital display is supported by an appropriate gazetteer, then such an address may be readily displayed.

5.4.4.4 The GSM standard 03.22 already defines several shapes that can be used to define the uncertainty region centred on a mobile location estimate. The boundary of the shape represents the degree of uncertainty (ie how likely the handset is thought to be within this area), typically, 67% and 95%. The location estimate could then be displayed to the relevant EA as a shaded area on a map such that the size and shape of the area indicates the accuracy of the position estimate.

5.4.4.5 The EA investments must be directed towards receiving and processing location information differing in accuracy and reliability depending on the transmitting network. It is therefore important that the information received is in the same format, regardless of which network is sending the information or which location technology has been utilised, thus passing responsibility to the EA to interpret the information in the most appropriate manner. This requires a common frame of reference for location information (see Annex C.4).

5.5 Necessary actions

5.5.1 Emergency Authorities (EAs)

5.5.1.1 On the basis of the finding in this study, we recommend the following actions to be undertaken:

- a) Coordinated action to **increase awareness** amongst EAs and PSAPs of the benefits of location enhancement. This could include a mixture of media including on-line services, documentation, presentations and managed events;
- b) Coordinated action to ensure that the **necessary budget allocations are made** at national level to prepare for the necessary investment in systems and software upgrades for EAs and PSAPs;
- c) Continue coordination at European level and establish national liaison groups to establish common practices and benchmarks and **reduce the overall risks and costs**,
- d) Pursue the development of **common technical solutions** (eg data transfer interface), to facilitate implementation and reduce overall risks;
- e) Establish procedures governing the transfer of location information to EAs, including on the conditions for overriding the users' choice, in order to **create the best possible protection of the users' privacy**.

5.5.1.2 In support of this, it is recommended that the Commission undertakes the following specific actions:

- a) In the context of CGALIES, help **establish an awareness programme** to promote the potential benefits of E-112.
- b) In the context of CGALIES, help to develop (on an on-going basis) **generic E-112 implementation guidance** based on best practice and other relevant experiences.
- c) In the context of ETSI, investigate the possibility of establishing **a common interface standard** for the transfer of location data between operators and PSAPs/EAs; based (where possible) on commercial standards already under development. In view of the legal obligation to pass location information by July 2003, the common interface standard should be available by the beginning of 2003.
- d) In the context of ETSI and in order to assist a future review, establish **common measurement methods** and criteria for assessing the quality of the location information provided by operators to EAs;
- e) **Seek to continue CGALIES** to support the continued liaison and exchange of expertise and knowledge between stakeholders. It is recommended that a continuation of CGALIES would be highly beneficial to the E-112 implementation process. This should be under revised terms of reference focused upon the need of users including PSAPs and EAs and for liaison between Member States.

5.5.1.3 The functions of the new user group (or sub-groups) should include:

- ✍ Liaison between Member States and EAs on progress, technical solutions, standards, costs and benefits;

- ✍ Reports from early implementations and (potentially) Commission funded pilot projects and trials;
- ✍ Input from invited system manufacturers and suppliers.

5.5.1.4 Assuming the functions outlined above, then it is clear that the membership of a future group will need to include a far greater representation from the civil protection and the EA community.

5.5.2 Telecommunications operators

5.5.2.1 As a result of the newly adopted legislation concerning the provision of location information (Section 1.3), operators should provide:

- ✍ **Fixed caller location** based upon most recently updated telephone installation address in the current database system of the fixed operator.
- ✍ **Mobile caller location** based upon the best location information available to the mobile operator.

5.5.2.2 Other actions recommended for operators, and governments are to:

- a) Continue and where necessary strengthen co-operation to ensuring a **seamless migration to higher levels of location performance** resulting from more accurate mobile location technologies whilst also helping to provide a full roaming functionality across network and country borders.
- b) **Reduce the overall cost** of implementation to all parties where feasible, through increased cooperation and the development of common solutions. These should be based, where possible, upon widely available commercial standards.
- c) Consider the need, and where necessary pursue, further measures that would **limit operators' liability** and protect them against damage claims resulting from poor performance or wrong location information. In the US, Congress passed law to this end that was felt a necessary pre-requisite for operators to pursue with the progression of location enhancement of emergency calls.

5.5.2.3 In support, it is recommended that the Commission undertakes the following specific actions:

- a) With the Member states and in the context of CGALIES, **monitor the progress of E-112 implementation.**
- b) With the Member States, after two years year of operation (by 2005), **assess the need for additional measures** including possible regulatory measures, aimed at raising the 'baseline' performance across Europe and speeding implementation. It is considered that by 2005, further information will be known regarding user requirements, the progress of E-112 implementation and mobile operators' plans for infrastructure roll-out.
- c) **Contract relevant studies** (as required) to support this review.

5.5.2.4 It is recommended that CGALIES gives careful consideration to these recommendations and, based on this, agrees on a common implementation path.

6 Conclusions and recommendations

6.1 Conclusions

6.1.1 Current status

- 6.1.1.1 Many Member States have already enhanced emergency call services by providing fixed caller location information to EAs. The availability of mobile location information from cellular networks now makes feasible the provision of location information for *all* emergency calls throughout Europe. Furthermore, with the adoption of the new regulatory package, the Council and the European Parliament have made the forwarding of caller location by operators obligatory.
- 6.1.1.2 This document has highlighted the variance between Member States in terms of structural arrangements and technical solutions. There is therefore, in the context of E-112, an opportunity for increased cooperation in the pursuit of common solutions, where practical and feasible, whilst respecting matters of specific national policy interest. This should ultimately lead to a reduction in implementation costs for Europe.
- 6.1.1.3 This document has also described the progress of mobile LBS and the inevitable introduction of location-enabled mobile devices. It therefore seems reasonable to expect in any circumstances, that local agreements will be established to support the location enhancement of emergency calls regardless of any European policy.
- 6.1.1.4 This uncoordinated approach by local or national authorities will lead to increased costs and complexity for all stakeholders across Europe. The common solutions and standards currently being developed by the mobile industry through bodies such as LIF and proposed for standardisation to 3GPP may provide a potential basis for common solutions.

6.1.2 Benefits of E-112

- 6.1.2.1 E-112's primary objective is to enhance all 112 emergency calls made throughout Europe with location information. This information will be provided to the relevant Emergency Authority (EA), enabling improved call routing and obtaining faster information for dispatching resources. This in turn delivers substantial benefits to society in terms of saving lives and an increased sense of security.
- 6.1.2.2 In summary, the determination of location of 112 emergency calls is technically feasible now. The existing methods for providing fixed call location plus the range of currently available mobile location technologies provide the basis for technical solutions that could satisfy the majority of user expectations. It would therefore be a failure if Europe's PSAPs and EAs were not able to exploit this capability.
- 6.1.2.3 With respect to the location enhancement of mobile calls, it is also concluded that:
- ✍ No single location technology installed or currently under development is believed to meet all of the user requirements. A process of evolution from existing methods to higher levels of service is therefore expected.
 - ✍ Currently available solutions based upon Cell ID (and including Timing Advance (TA) and E-CGI) can utilise legacy handsets and should satisfy many user requirements. This is particularly true for urban areas where the performance of these technologies is greatest.

- ✍ Technologies already available but not yet widely deployed (eg A-GPS and E-OTD) are expected to deliver more accurate location and should satisfy a large proportion of the requirements.
- ✍ Transmitting additional data alongside the actual location information may satisfy the quality of service requirements. This could be readily supported by existing GSM standards that allow the quality of service to be defined in accordance with the requirements of Annex C.

6.1.2.4 An increased sense of security is particularly relevant for European citizens travelling abroad who may not necessarily be familiar with a local language or local emergency service arrangements. Existing solutions based upon Cell ID have been specifically designed to cater for legacy handsets and should therefore provide full user roaming across Europe. At higher levels of service that require new handset capabilities, a pan-European roaming capability will be very difficult to achieve. This will depend upon both capability of a particular handset and the different capabilities of multiple networks across Europe.

6.1.3 Proposed European policy

6.1.3.1 The specific objectives of establishing a European implementation policy are to:

- a) Increase awareness of the potential benefits of location enhanced 112 (E-112);
- b) Exploit currently available location information and emerging location technologies as soon as their performance is demonstrated and become available;
- c) Ensure that the potential benefits to society and EAs are realised to the fullest extent and at the earliest possible point in time;
- d) Reduce the overall cost of implementation to all parties where feasible, through increased cooperation and the development of common solutions.

6.1.3.2 This study concludes that a Regulated/Coordinated approach should form the basis of a European implementation policy towards the initial phase of implementation of E-112 ('E-112 Phase I'). This approach requires the development of common European solutions where appropriate and greater cooperation and communication across Europe. This approach does not stipulate any further regulation in addition to that already adopted at a European level.

6.1.3.3 This so-called 'Best Effort' approach allows Europe to commence implementation of E-112 quickly and 'get a foot on the ladder'. It is designed to maximise the benefits to society and EAs at all stages of implementation, whilst at the same time minimising the overall financial impact.

6.1.3.4 The existing methods for providing fixed call location plus the range of currently available mobile location technologies already satisfy the majority of user requirements. Measures are therefore required to ensure maximum use of E-112 by PSAPs and EAs across Europe within the timescales enabled by the commercial market.

6.1.3.5 It is considered that adopting an 'Uncoordinated' approach fails to meet any of the stated policy objectives and is therefore considered unacceptable as a way forward. The key advantages of adopting a more coordinated approach are:

- ✍ Increased awareness amongst EAs of E-112 and its potential benefits;
- ✍ Minimum financial impact on all parties;

- /// Continue coordination at European level and establish national liaison groups to establish common practices and benchmarks and **reduce the overall risks and costs**,
- /// Pursue the development of **common technical solutions** (eg data transfer interface), to facilitate implementation and reduce overall risks;
- /// Establish procedures governing the transfer of location information to EAs, including the conditions for overriding the users' choice, in order to **create the best possible protection of the users' privacy**.

6.2.1.2 In support of this, it is recommended that the Commission undertakes the following specific actions:

- /// In the context of CGALIES, help **establish an awareness programme** to promote the potential benefits of E-112.
- /// In the context of CGALIES, help to develop (on an on-going basis) **generic E-112 implementation guidance** based on best practice and other relevant experiences.
- /// In the context of ETSI, investigate the possibility of **establishing a common interface standard** for the transfer of location data between operators and PSAPs/EAs; based (where possible) on commercial standards already under development. In view of the legal obligation to pass location information by July 2003, the common interface standard should be available by the beginning of 2003.
- /// In the context of ETSI and in order to assist a future review, establish **common measurement methods** and criteria for assessing the quality of the location information provided by operators to EAs;
- /// **Seek to continue CGALIES** to support the continued liaison and exchange of expertise and knowledge between stakeholders. It is recommended that a continuation of CGALIES would be highly beneficial to the E-112 implementation process. This should be under revised terms of reference focused upon the need of users including PSAPs and EAs and for liaison between Member States.

6.2.2 Operators

6.2.2.1 As a result of the newly adopted legislation concerning the provision of location information, it is recommended that operators should provide:

- /// **Fixed caller location** based upon most recently updated telephone installation address in the current database system of the fixed operator;
- /// **Mobile caller location** based upon the best location information available to the mobile operator.

6.2.2.2 Other actions recommended for operators, and governments are to:

- /// Continue and where necessary strengthen co-operation to ensuring a **seamless migration to higher levels of location performance** resulting from more accurate mobile location technologies whilst also helping to provide a full roaming functionality across network and country borders.
- /// **Reduce the overall cost** of implementation to all parties where feasible, through increased cooperation and the development of common solutions.

These should be based, where possible, upon widely available commercial standards.

- ✍ Consider the need, and where necessary pursue, further measures that **would limit operators' liability** and protect them against damage claims resulting from poor performance or wrong location information. In the US, Congress passed law to this end that was felt a necessary pre-requisite for operators to pursue with the progression of location enhancement of emergency calls.

6.2.2.3 In support, it is recommended that the Commission undertakes the following specific actions:

- ✍ With the Member states and in the context of CGALIES, **monitor the progress of E-112 implementation.**
- ✍ With the Member States, after two years year of operation (by 2005), **assess the need for additional measures** including possible regulatory measures, aimed at raising the 'baseline' performance across Europe and speeding implementation. It is considered that by 2005, further information will be known regarding user requirements, the progress of E-112 implementation and mobile operators' plans for infrastructure roll-out.
- ✍ **Contract relevant studies** (as required) to support this review.

6.2.2.4 It is recommended that CGALIES gives careful consideration to these recommendations and, based on this, agrees on a common implementation path.

A Glossary of terms

3GPP	Third Generation Partnership Project
A-GPS	Assisted GPS
API	Application Protocol Interface
CGALIES	Co-ordinating Group on Access to Location Information for Emergency Services
CLI	Caller Line Identification
EA	Emergency Authority
E-CGI	Enhanced Cell Global Identity
ECS	Emergency Call Services
E-OTD	Enhanced Observed Time Difference
ERC	Emergency Response Centre
ETSI	European Telecommunication Standards Institute
FCC	Federal Communications Commission
GAD	Geographical Area Description
GMLC	Gateway Mobile Location Centre
GPRS	General Packet Radio Service
GPS	Global Positioning System
GSM	Global System for Mobile Communication
IETF	Internet Engineering Task Force
IP	Internet Protocol
LAN	Local Area Network
LBS	Location based services
LIF	Location Interoperability Forum
LMU	Location Measurement Unit
LOCUS	Location of Cellular Users for Emergency Services
OpenGIS	Geographic Information System Consortium
PBX	Private Branch Exchange
PPP	Public Private Partnership
PSAP	Public Safety Answering Point
PTO	Public Telecommunications Operator
SIG	Special Interest Group
TA	Timing Advance
UMTS	Universal Mobile Telecommunications System
WAN	Wide Area Network
WAP	Wireless Application Protocol

B Legal framework

B.1 Location information

B.1.1 With the adoption of the new regulatory package on 14 February 2002, the Council and the European Parliament has made the forwarding of caller location by operators obligatory. Article 26 from the Directive (2000/0183) “on universal service and users’ rights relating to electronic communications networks and services” (adopted in February 2002) states that:

“Member States shall ensure that undertakings which operate public telephone networks make caller location information available to authorities handling emergencies, to the extent technically feasible, for all calls to the single European emergency call number 112”.

B.2 Consumer’s rights and privacy

B.2.1 Personal data is protected by Directive 95/46/EC “on the protection of individuals with regard to the processing of personal data and on the free movement of such data.” Traffic data is protected by Directive 97/66/EC “concerning the processing of personal data and the protection of privacy in the telecommunications sector”. Directive 97/66/EC will be replaced by Directive (2000/0189) “concerning the processing of personal data and the protection of privacy in the electronic communications sector”. This proposal for a Directive specifically differentiates between traffic data and location data.

B.2.2 Article 26 from Directive (2000/0183) on universal service and users’ rights relating to electronic communications networks and services, states that Member States shall ensure that calls to the single European emergency call number ‘112’ are appropriately answered and handled in a manner best suited to the national organisation of emergency systems and within the technological possibilities of the networks.

B.2.3 In the case of emergency calls, rights for life and for health protection take precedence over rights for privacy. Therefore, data processing may be used in some cases even without the user’s consent. The exception for emergency services is provided in a special clause (Article 10 – Exceptions) in the new data protection Directive as follows:

“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:

- a) the elimination of the presentation of calling line identification, on a temporary basis, upon application of a subscriber requesting the tracing of malicious or nuisance calls; in this case, in accordance with national law, the data containing the identification of the calling subscriber will be stored and be made available by the provider of a public communications network and/or publicly available electronic communications service;*
- b) 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.”*

B.3 Databases

- B.3.1 Several databases are required for a location-enhanced emergency service. These databases may include information about personal information, traffic and location data, street plans and other information for the specific service that is going to be provided (hotels, buses, trains, etc). Protection of these databases in their use, storage and access may come from privacy security or through property rights.
- B.3.2 Member States shall prohibit the processing of personal data revealing racial or ethnic origin, political opinions, religious or philosophical beliefs, trade-union membership and the processing of data such as sexual preference and health. This ban may not be lifted to obtain medical information when attending an emergency call.
- B.3.3 Considering databases as a compilation of data, whose owner has to be determined, protects property rights. At this point not only EU legislation is applicable, but also international law as the General Agreement Trade and Tariff that the EU signed within the World Trade Organisation or the treatments with the World Intellectual Property Organisation, (included in the proposal for the directive).
- B.3.4 It is also very important that databases are kept up to date, as the holders of the database may be held responsible for the accuracy of the information.

B.4 Liability

- B.4.1 This issue is covered in IST – 1999-14093¹⁹. The provision of any kind of service may involve a complex net of operators and service providers. Different types of agreements and/or contracts with different clauses and conditions are established in order to establish obligations and responsibilities of the parties. The majority of obligations imposed to the mobile telecommunications industry are the same as ones established for fixed telephone networks.
- B.4.2 Directive 2000/31 “on certain legal aspects of information society services, in particular electronic commerce, in the Internal Market’ is also applicable, with Articles 12 to 15 regulating liability exemptions of intermediary services.
- B.4.3 As far as the use of location information is concerned, a new situation arises. The proposal for a directive concerning the processing of personal data and the protection of privacy in the electronic communications sector establishes that operators will have to give location information (if any) when calling 112.
- B.4.4 If an operator makes a commitment or is obliged by law to provide an estimation of user’s position with a specified performance, then it will be possible to consider this operator as responsible for achieving the expected performance. All location technologies have a limited level of performance that may be outside the operators’, PSAPs’ or EAs’ control. This will have to be taken into account when considering any issues of liability or regulation.

¹⁹ *IST-1999-14093 Locus Deliverable 2, addendum on institutional issues*

C User requirements

C.1 General

C.1.1 Provisional user requirements have been determined through a questionnaire that was sent to all Member States' civil protection representatives and through the work of CGALIES. The following sections summarise the key requirements that were reflected as consensus by CGALIES and supplemented where appropriate by information from Member States.

C.1.2 These requirements should be regarded as provisional and subject to further experience and understanding. The requirements have been based upon data received from Member States that is not necessarily based upon valid statistics and demonstrates a wide variance.

C.2 Location information

C.2.1 Minimum level of accuracy

C.2.1.1 The accuracy requirements for location information are shown in Table C-1. The requirements refer to the call handling stages defined in Section 3.2. The requirements here are not precise, and in general, for the early stages of the call handling procedure, call routing, less accuracy is required.

	Urban	Suburban	Rural
"Call routing" requirements	~ 1 km	~ 10 km	Up to ~ 35 km
"Call clustering" requirements	~ 150m	~ 500m	500m
"Dispatching" requirements	~ 500 m	~ 5 km	up to ~ 35 km

Table C-1: Requirements for the first three levels²⁰

C.2.1.2 A higher level of accuracy is required for caller finding, and can be stated more precisely. In terms of the level of information that the caller can provide, the requirements – as obtained through the questionnaire - are summarised in Table C-2. (The figures indicated between parentheses correspond to the requirements originating from CGALIES). Note that "Caller cannot provide any information" represents approximately 6% of mobile emergency calls, according to the statistics provided by Member States.

²⁰ CGALIES, strawman paper version 2.0, 13/08/2001

Level of information provided	Indoor	Urban	Suburban	Rural	Highway Crossroads
Caller can provide general information	10 - 50 m	10 - 50 m (25 - 150 m)	30 - 100 m (50 - 500 m)	50 - 100 m (100 - 500 m)	20 - 100 m (100 - 500 m)
Caller cannot provide any information	10 - 50 m	10 - 50 m (10 - 150 m)	10 - 100 m (10 - 500 m)	10 - 100 m (10 - 500 m)	10 - 100 m (10 - 500 m)

Table C-2: Location requirements for “Caller finding”

C.2.2 Quality of information

C.2.2.1 EAs require an indication of the quality of accuracy estimate for the location information, in order to be able to judge the level of confidence in the data.

C.2.2.2 The accuracy of the location estimate is not only determined by the technology, but also by other factors. For example, if the caller is moving, their location is dependent on both speed and direction. For fixed calls, the PSAP databases containing the billing addresses would need to be updated regularly in order for the information to be accurate.

C.2.3 Latency

C.2.3.1 Latency is defined as the time between a caller dialling the emergency services and an action ending, such as the call being answered, routed, delivery of service to caller etc. It is important that enhancements to 112 do not compromise the speed that the voice call is answered. Table C-3 summarises the reported latencies that are considered tolerable in existing systems.

	Tolerable latency (seconds)
Reception of the emergency caller’s voice	< 20
Reception of the “initial” location information	< 20
Reception of “final” location information	< 60

Table C-3: Tolerable latency for several actions²¹

C.2.3.2 The requirements change as the call is processed. It may be useful to have an initial estimate of the position, which is then followed by a more sensitive estimate of location when the emergency services are trying to actually locate the caller.

²¹ Questionnaires from Member States

C.2.4 Vertical accuracy

- C.2.4.1 Member States have stated that awareness of vertical positions is also useful in dealing with incidents in high-rise buildings or underground. The level of vertical accuracy deemed as useful was to 10m-15m, which is equated to 3-4 floors. For this to be useful to EAs, information will be required on standardised reference heights for each building to a resolution of 10m. This requirement is however considered of secondary importance compared to horizontal accuracy.

C.3 Functional requirements

- C.3.1 A number of key functional requirements have been specifically raised by CGALIES in order for E-112 to operate most effectively, namely:²²

- /// **Fixed call location:** A system will be required that will support the provision of location information based on the installation address for fixed lines or terminal location information for mobile calls.
- /// **Automatic CLI:** Automatic provision of CLI will be necessary to provide a unique identifier such that the EA can use the information to retrieve information from the PSAP and also associate voice and data calls.
- /// **Name of caller and operator:** Databases need to contain the line renter's name and installation address information for fixed lines. Also, databases need to contain handset location information and owning network for all mobile numbers.
- /// **PBX numbers:** PBX extension numbers must be located automatically.
- /// **EA data access:** Access by EAs to name and address information for fixed calls and location information for mobiles needs to be permitted for all 112 calls by a secure, restricted method. Information for non-published numbers also needs inclusion.

- C.3.2 Although these outline functional requirements have been raised, further analysis is required to assess whether they represent mandatory or desirable requirements, which will eventually depend upon costs. Furthermore, CGALIES has not yet specified where the responsibility falls for providing each function and associated technical solution.

C.4 Technical requirements

- C.4.1 The following technical issues have also been raised by CGALIES as requiring consideration:

- /// **Standard interfaces:** The exchange of position estimate and other information between the operator and PSAP should take place across a standardised interface.
- /// **EA operational systems:** The accuracy of location information should not be constrained by the systems in use by the EA. These include mapping displays, GIS (geographical information systems) and incident management systems. At present, not all EAs make use of digital maps, and continue to rely upon text based systems and displays.

²² CGALIES – Work Package 2 (WP2)

- /// **Data quality:** Information on the quality of the accuracy information needs to be available for use, which will be dependent on the EA's operational system capability and the specific incident requirements.
- /// **Location reference datum:** An agreed location reference system is required.
- /// **Database currency:** Databases of fixed caller installation addresses need to be available every day for 24 hours, updating occurring within 24 hours for all changes and kept accurate and in line with local digital maps/databases.
- /// **Latency requirements:** E-112 must not increase latency above that achievable via un-enhanced services.
- /// **Future migration:** The system architecture should be independent of positioning technology and able to support new technology as it evolves.

C.4.2 Once again, further analysis is required in order to assess whether these technical requirements are mandatory or desirable.

D Mobile location technologies

D.1 Technology development

- D.1.1 The emergence of commercial LBS is driven by the availability of the necessary enabling location technologies. A wealth of different technologies are being considered by the industry and may ultimately be deployed. These include technologies that are currently available or may become available in the longer term including Galileo, Loran-C, A-OTD and new methods based upon CDMA.
- D.1.2 Whilst there is much variance between operator plans, it is important to construct a general picture of the likely future development. Work Package 1 (WP1) of CGALIES has developed a consensus (within its terms of reference) regarding the likely performance and future rollout of location technologies. Four specific technologies have been considered and presented by CGALIES that are all available today, namely:
- /// Cell ID and Timing Advance (Cell ID + TA);
 - /// Enhanced Cell Global Identity (E-CGI);
 - /// Enhanced Observed Time Difference (E-OTD);
 - /// Assisted Global Positioning System (A-GPS).
- D.1.3 **Cell ID + TA:** The Cell ID is the identity number associated with a cell, which is designated by the network operator. This information is used in the network during normal operation to identify the connection point of the mobile to the network. The operator knows the co-ordinates of each cell site, typically to an accuracy of 30m and can therefore provide the approximate position of the connected mobile. Across a network, cell sizes vary considerably.
- D.1.4 Also, a parameter called the Timing Advance (TA) is used in normal GSM operation and is a measure of the range of the connected mobile from the cell site. TA can also be used to improve accuracy. Cell ID and Timing advance are parameters that are available for all mobiles in all networks.
- D.1.5 **E-CGI:** E-CGI improves upon the Cell-ID + TA location method by performing measurement reports of the field strength data. In the present GSM the field strength data is available each 0.48s. Whilst this method has not been included within the current GSM standards, it potentially offers an immediate solution with legacy handsets.
- D.1.6 **E-OTD:** E-OTD is a standardised positioning technology in GSM, which is based upon triangulation. The mobile station measures the arrival time of signals from three or more cell sites in a network. The network measures the transmission time of these signals from the relevant cell sites. Combining these two pieces of information enables the position of the mobile to be estimated.
- D.1.7 E-OTD is not supported by existing handsets and will require each subscriber to purchase a new handset to have access to this service. Also, the network does not presently support the measurement of transmission time of signals from cell sites and will need to be upgraded by the planning and deployment of thousands of measurement devices (Location Measurement Units (LMUs)) throughout the network.
- D.1.8 E-OTD relies upon visibility to at least three cell sites in order to estimate a position. Typically, this will be problematic in rural areas, where the cell site

separation is large. In areas of high cell site density (urban) it will work well and also gives good penetration indoors.

D.1.9 **A-GPS:** A-GPS is a standardised positioning technology in GSM and also in other radio access networks. A-GPS is not supported by existing handsets and will require the subscriber to purchase a new handset.

D.1.10 Conventional GPS is a navigation system that utilises transmissions from a constellation of US government satellites. The system has been around since 1978 and is widely used in many non-military applications.

D.1.11 The satellite signals were designed for outside operation and there remain problems with getting a position estimate indoors, or in situations where there is poor visibility of the sky. This is because the mobile requires visibility of at least 3 satellites for a 2 dimensional position estimate. To address this problem assistance data can be provided directly from the network operator to enable a GPS receiver to provide a position fix, even in challenging environments. The use of network assistance data to improve the performance of GPS is called A-GPS.

D.2 Comparison of performance

D.2.1 Table D-1 summarises the horizontal accuracy capabilities of each technology according to the material developed within CGALIES. The definitions for the environments in this table according to CGALIES are:

/// **rural:** sparsely inhabited areas, field and forests;

/// **suburban:** populated areas, residential houses, villages;

/// **urban:** densely populated area, multi-story buildings, offices and city centres;

(No definitions have been found in relation to the other categories).

Technology	Rural	Rural extreme	Sub-urban	Sub-urban extreme	Urban	Urban extreme	Indoor user
Cell ID	1-35 km	1-100 km	1-10 km	1-10 km	50m-1km	50m-1km	No change unless there is a pico-cell
Cell ID and Timing Advance	1-35 km	1-100 km	1-10 km	1-10 km	50m-1km	50m-1km	No change unless there is a pico-cell
E-CGI	250m-8km		250-2.5km		50-550m		50-550m
E-OTD	50-150m	50-150m or unavailable if not 3 BTS	50-150m	100-250m	50-150m	100-300m	Slight degradation but penetrates well indoors
A-GPS	10m	10m	20m	50-100m	30-100m	50-100 if available	In-building coverage by windows but not deep inside.

Table D-1: Summary of technology capability (horizontal accuracy)

D.3 Cost of enabling technologies

- D.3.1 The cost of implementing the necessary positioning technology within the mobile network varies between operators and is difficult to assess in the public domain. It is therefore neither possible nor appropriate to conduct a detailed cost benefit analysis.
- D.3.2 The incremental costs associated with the first three solutions in Table D-1 are minimal, primarily due to the fact that they are supported by legacy handsets. The step to more accurate solutions, whether it be network or handset based, requires a significant cost increase both in terms of infrastructure and devices.
- D.3.3 Estimated network costs for E-OTD is said to vary from 10 and up to 100 M Euros²³, depending on the size of the country and the number of base stations that would need to be equipped with timing reference stations. The incremental terminal cost for E-OTD would be small (maximum of 25 Euros based upon current estimates).
- D.3.4 A-GPS which would cost below 10 M Euro to implement in a single network, but would also increase the initial cost for terminals by up to 150 Euros, dropping to 50 Euros in the long term. Implementation of A-GPS will start within the next 2-4 years, and may expect to reach a penetration between 25% and 75% by the end of 2006. However, some operators expressed the view that, due to high cost of terminals, the penetration would be less than 20%.
- D.3.5 About one third of operators that responded believe that implementation of Enhanced Observed Time Difference (E-OTD) technology would be too expensive for them to justify the expenditure. These operators would opt for an Assisted-Global Positioning System (A-GPS) solution only. Some other operators said they have plans for the introduction of E-OTD over the next 2-4 years. Sparsely populated countries expressed interest for GPS based solutions, whilst more densely populated countries in mainland Europe plan to roll out GSM network solutions (eg E-OTD).
- D.3.6 It is worth noting that whilst the incremental *infrastructure* costs are significant, they could be outweighed by the potential incremental *handset* costs. If one applies an incremental terminal cost of just 10 Euros across all of Europe's 250m mobile subscribers, then this equates to a total of approximately 2.5 billion Euros. Furthermore, it should be noted that this is a recurring cost (albeit potentially not to the same extent) that is incurred at every handset replacement.

²³ Response to CGALIES WP3 questionnaire issued to mobile operators