CEPT ECC
Electronic Communications Committee

ECC Report 255

The use of Assisted-Global Navigation Satellite System (A-GNSS) capabilities to improve caller location information for emergency calls originating on mobile devices

Approved 23 November 2016

0 EXECUTIVE SUMMARY

This report concerns the use of satellite navigation technologies to help improve the quality and accuracy of location information that is provided to the emergency services in the event of a call from a mobile phone.

In particular, this report examines how assistance (known as Assisted Global Navigation Satellite System or A-GNSS) is, and potentially could be, provided to mobile phone handsets in order to improve the quality and accuracy of location information. It also looks at whether harmonisation of the different approaches available could be beneficial in order to minimise costs and offer consistent capabilities. Such an examination was advocated in a previous ECC Report that examined the general area of location information provision for emergency calls (ECC Report 225 [3]).

This report bases it findings predominantly on the results of a survey undertaken in 2015, in which Mobile Network Operators (MNOs), handset manufacturers, equipment providers and other stakeholders were asked:

- How and where A-GNSS location information is available in the EU;

  and
- Whether harmonised approaches would be necessary or beneficial for providing accurate location information for emergency calls.

As a result of the information obtained, the report goes on to examine the consequences of potential harmonised A-GNSS methods for onward conveyance of location information to Public Safety Answering Points (PSAPs).

It was found that while most modern mobile handsets are likely to be able to request and receive assistance data to help determine a position, this was generally achieved using a data connection to independent (third party) data sources. From the responses to the questions posed to industry, there appeared little evidence of adoption of Control Plane GNSS assistance (whereby the MNO provides information directly to the handset). Given that the provision of such functionality would incur both capital and operational costs, coupled with the widespread availability of independent assistance sources, there appears little motivation for MNOs to provide such assistance in the future. Consequently, harmonisation of approaches appears challenging at this time, although this may change over time in light of technological evolution and hence should be subject to regular review.

In the Report, the methods by which modern mobile handsets derive location information were investigated. These methods may acquire location data, including A-GNSS data, from a variety of sources in order for the handset to establish as accurate a location as possible (hybrid location method, as described in ECC Report 225). It may be therefore possible that the accuracy and reliability of location information derived and then conveyed to the emergency services could be sufficient to allow emergency services to dispatch prompt assistance, irrespective of whether or not assistance for GNSS was provided.

A-GNSS functions that are handled directly by the mobile handsets (via user plane), are intrinsically “best effort” and transparent to network operators, that is without any responsibility for mobile operators to validate and deliver the location information to the PSAPs. As discussed in Report 225, the availability and reliability of satellite-derived location information depends on a number of factors beyond the control of the network operator (e.g. acquisition of a satellite signal).

Autonomous terminal-based GNSS location delivery to PSAPs is provided independently from and in addition to the reliable and validated network provided location information that is currently provided by network operators for 112 emergency calls.

Ideally, in order to improve the accuracy of network-provided caller location information, over and above the “cell-id” information, solutions that complement terminal-based GNSS capabilities with information provided by mobile networks would be preferred.

This report therefore proposes that attention is turned also to the methods by which location information is determined in practice by modern mobile phones and to consider the implications of the adoption of these

approaches, in particular how the effectiveness of these techniques could be improved so as to give long-term confidence to the emergency services in the information they provide.

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LIST OF ABBREVIATIONS

Abbreviation	Explanation
A-GNSS	Assisted-Global Navigation Satellite System
AML	Advance Mobile Location - methodology launched in the UK to convey mobile location information to PSAPs via SMS
BeiDou	China's Global Navigation Satellite System
CEPT	European Conference of Postal and Telecommunications Administrations
EENA	European Emergency Number Association
ECC	Electronic Communications Committee
ETSI	European Telecommunications Standards Institute
Galileo	Europe's Global Navigation Satellite System
GLONASS	Globalnaya Navigazionnaya Sputnikovaya Sistema - The Russian Federation's Global Navigation Satellite System
GPS	Global Positioning System. US-based GNSS.
MNO	Mobile Network Operator
PSAP	Public Safety Answering Point
PT ES	Project Team Emergency Services established by the CEPT/ECC's Working Group Numbering and Networks
TTFF	Time To First Fix is a measure of the time required for a GPS receiver to acquire satellite signals and navigation data, and calculate a position
Wi-Fi	A short range wireless access technology that allows devices to connect to the internet (based on the IEEE 802.11x standards).

1 INTRODUCTION

1.1 LOCATION INFORMATION IS IMPORTANT FOR EMERGENCY CALLS

Over 160 million emergency calls are made in Europe per year using the European emergency number '112' and many further calls are made through national numbers [1].

To allow prompt dispatch of emergency assistance it is vital that the location of the caller is established as quickly as possible. Normally this is achieved by speaking with the caller and, where available, making use of 'Cell-ID'-based network derived location data.. However for a small fraction of calls this is not possible, perhaps because they are unable to speak, or because they do not know where they are. Given the large number of emergency calls that are made, even a very small percentage can constitute a great number of calls for which an emergency response is required, yet for which an accurate location may not be available from speaking with the caller.

Article 26 of the Universal Service Directive [2] states that: *"Member States shall ensure that undertakings concerned make caller location information available free of charge to the authority handling emergency calls as soon as the call reaches that authority. This shall apply to all calls to the single European emergency call number "112". Member States may extend this obligation to cover calls to national emergency numbers. Competent regulatory authorities shall lay down criteria for the accuracy and reliability of the caller location information provided".* Member States have subsequently transposed these provisions into their respective national legal frameworks.

1.2 LOCATION INFORMATION CURRENTLY PROVIDED FOR CALLS FROM MOBILE PHONES CAN ENCOMPASSES LARGE AREAS

With the increasing adoption and use of mobile phones, increasing numbers of calls to the emergency services are made from mobile handsets. The European Commission's Directorate-General for Communications Networks, Content and Technology ('DG-Connect') annually reviews the provision of emergency calling across Member States. With regards to the provision of caller location, in its latest review (2016) [1], it noted that "*No improvement is noticed on the implementation of more accurate caller location in Europe. Cell ID/Sector ID is a standard location requirement in Europe for mobile networks delivering accuracy between 30 meters and tens of kilometres.*"

In 2014 the PT ES examined the different approaches that could be adopted to improve the accuracy and reliability of emergency caller location. As part of this work programme the methods by which improved caller location information could be provided for calls from mobile phones was examined. This Report (ECC Report 225) [3] highlighted the benefits that Assisted-Global Navigation Satellite System (A-GNSS) methods could realise.

1.3 ECC REPORT 225 RECOMMENDED THAT A-GNSS BE EXAMINED IN MORE DETAIL

When caller location techniques were examined in 2014 by the PT ES, three conclusions were drawn with particular regard to the provision of enhanced location information from mobile phones. The two that are most relevant to this present report are:

- *"For mobile networks, A-GNSS-based positioning stands out of the list of available positioning methods in terms of accuracy, reliability and cost and should be implemented as a positioning method for emergency calls, as the first step of an overall programme for improvement, to complement the existing network-based methods rather than replacing them. Because of the somewhat limited availability of A-GNSS, network-based location methods will remain a critical component and ongoing improvements in the performance of the network-based caller location methods are likely to be necessary."*
- *"A harmonised European approach for the implementation of the caller location solutions (specifically for the different implementation options in the A-GNSS standards) would be beneficial for a number of*

reasons including achieving consistent interfaces and at least minimum results and an efficient and widespread improvement of caller location implementations for emergency calls throughout Europe."

The basis of the present report is to further examine these elements - the approaches that have been adopted to provide Assisted-GNSS across Europe and the implications for potential harmonisation.

The term 'harmonisation' can be interpreted in a number of ways:

- Harmonisation of regulatory criteria and/or overall outcomes irrespective of approaches/technologies adopted;
- Harmonisation of technical requirements/interfaces so as to allow interoperability of different approaches;
- Harmonisation of technical approaches/standards, in order to minimise development costs across the industry.

Unless stated otherwise, in this present report 'harmonisation' refers to technical approaches developed, and the questions posed to stakeholders, along with the responses received, are to be interpreted in this light,

1.4 AIMS AND SCOPE OF WORK ADDRESSED IN THIS REPORT

Consequentially, PT ES set up a project to evaluate the opportunities and barriers for harmonised approaches to A-GNSS location information and practical adoption for 112 calling. In particular this work had aims to:

- Understand how and where A-GNSS location information is available in Europe;
- Determine the nature and extent of the benefits that may be realised as a result of the adoption of harmonised approaches for the provision of accurate A-GNSS location information for emergency calls; and
- Examine the consequences of potential harmonised A-GNSS methods for onward conveyance of location information to PSAPs;
- However, the scope was limited to A-GNSS techniques and as such, did not attempt to examine other location gathering techniques such as Wi-Fi.

2 WHAT IS GNSS AND WHY WOULD ASSISTANCE HELP

2.1 WHAT IS GNSS?

Global Navigation Satellite Systems (GNSS) is the generic term given to positioning systems and applications that allow users to know where they are. They take advantage of signals received from orbiting satellites to find their position around the world and in some cases their altitude. These systems can be embedded in standalone devices such as in-car 'sat-navs' or implemented as one of a number of applications on other devices such as mobile phones (particularly smartphones). Indeed, many smartphone applications have been developed that use the positioning capabilities of the phone as one input of an overall tailored service to consumers.

While perhaps the most well-known GNSS system is the US Global Positioning System (GPS), other similar systems (or 'constellations') exist or are in advanced stages of deployment. These include those from Russia (GLONASS), China (known as 'Compass' or 'BeiDou') and the European Space Agency ('Galileo'). While these systems operate in their own right, device manufacturers (such as mobile phone manufacturers) are making chipsets that are able to access satellite signals from different constellations in order to determine a position. This maximises the chances of rapidly acquiring a position using satellites from different constellations as they may be more visible due to the terrain or environment that a user may be in when seeking their location.

GNSS satellites transmit time signals along with additional information to help recognise the satellite in the sky. To acquire a location, a satellite navigation system needs to scan a predetermined frequency range looking for a specific characteristic signal that will identify the satellite. The GNSS device can then use the received time signals to determine the distance (range) to the satellites. Thus if it is able to identify three or more satellites, it is able, by a process of triangulation, to determine its location anywhere on the planet. A device can normally pinpoint its outdoor location to within 10m and almost always within 100m of the correct position.

2.2 WHAT IS ASSISTED-GNSS?

Given sufficient time and appropriate visibility of the sky, a GNSS device is capable of deriving its location simply from the signals received from the satellites, with no additional assistance. However, in such circumstances, the time taken between seeking out satellites and determining a position can be quite long. This is because without any prior information, the device will not know which satellites may be visible in the sky at that place and at that time. As a result, the device will need to scan all possible frequencies in order to find any that may be available. This process can therefore significantly slow down the time taken to acquire a signal and consequently derive a location.

To help in this process, information could be provided to the handset/device that would allow searches and scans to be conducted in a targeted manner and hence be completed more quickly. There are a number of different ways in which initial information could be provided, listed in Table 1 below:

Table 1: Main GNSS Assistance parameters (Derived from: Mott MacDonald, 2012 [4] [5])

Assistance	Description
Reference time	Reference time to time stamp the assistance messages
Reference position	A rough estimate of the terminal position usually computed by the cellular network (e.g. via Cell ID)
Satellite navigation model	Mainly ephemeris (accurate, but time-limited, information about satellite positions) to speed up the satellite position computation
Satellite almanac	Almanac (coarse, but slowly varying information about the constellation and orbits) of GPS constellation
Satellite acquisition assistance	Mainly Doppler and code phase estimation
Satellite ionospheric model	Parameters for estimate of ionospheric delay

The provision of assistance information can help pinpoint a location in a shorter time than would have been achieved otherwise, or possibly improve the accuracy or reliability of the location that is obtained. The extent to which assistance will improve these metrics will depend on the specific parameter or parameters provided. Figure 1 shows the expected improvements in Time To First Fix (TTFF) with respect to a number of key parameters. The Signal Strength (x-axis) is the power of the signals received from the satellites - the stronger the signal the faster that scans can take place as it can be more readily distinguished from background noise.

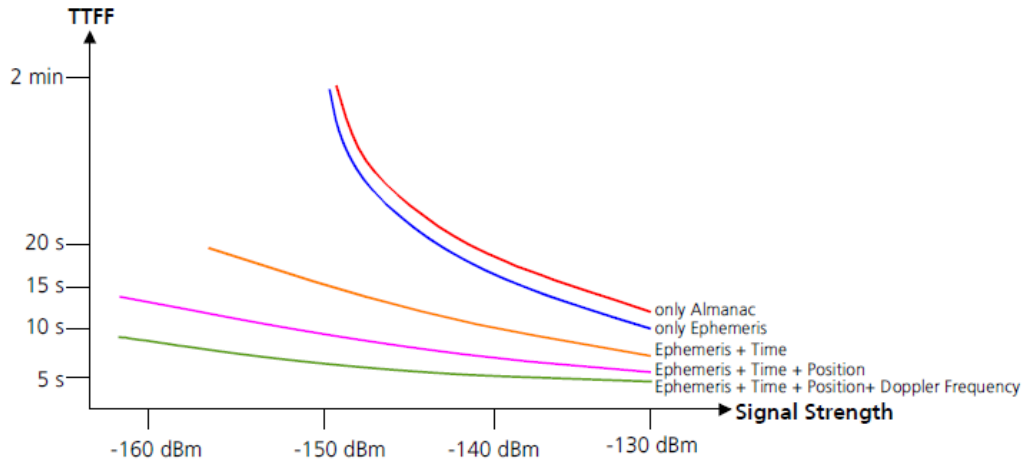

Figure 1: Time to First Fix (TTFF) with different assistance data as a function of signal strength (Source: uBlox AG "GPS Essentials of Satellite Navigation Compendium", 2009)

2.2.1 There are two broad approaches to provide assistance for GNSS

There are two distinct ways in which assistance could be provided to a mobile handset in order to facilitate GNSS location. The first approach is where the handset uses an IP data connection to contact a server in order to obtain the necessary information. This is known as 'User Plane'. The second is where the mobile network operator directly passes information to the handset - known as 'Control Plane'.

These two approaches have their own benefits and weaknesses. For example, the User Plane approach requires a data connection to be established, which may not be possible when making an emergency call (perhaps due to lack of credit, or too low signal strength to establish a reliable connection). However, the User Plane approach is able to work over any network and can use information from a number of sources in

the event that the favoured server is unavailable for some reason. On the other hand, the Control Plane approach would be available to all GNSS enabled handsets (not just smartphones), and would provide information without the need to establish a data connection to the Internet. However, the Control Plane approach requires that MNOs install and maintain relevant equipment within their networks in order to support this functionality, which could incur both capital and operational costs. While such costs could be significant with respect to User Plane approaches, they could be substantially lower than other network-based positioning methods offering similar levels of accuracy and reliability. Please see the findings of ECC Report 225 [3].

As discussed earlier the purpose of this report was to understand how and where GNSS assistance has been implemented within Europe (either Control Plane or User Plane and, if so, the specific information provided) and the opportunities for harmonisation of such approaches in the future.

3 THE RESULTS OF OUR QUESTIONNAIRE TO STAKEHOLDERS

To understand the practical implications of supporting A-GNSS in handsets and networks across Europe, PT-ES published a questionnaire (circulated on 15 July 2015 with responses requested by 28 September 2015) asking to what extent A-GNSS functionality was available and whether harmonisation of approaches was feasible. In this section, a summary of the questions and answers are provided. The details are listed in the Annex 1 of this Report.

3.1 QUESTIONS TO THE HANDSET MANUFACTURERS:

Seven questions were asked specifically of handset manufacturers. They were:

1 Do the handsets that you produce support A-GNSS?

2 If so, what approach(es) is (are) supported?

3 If not, do you have any plans to introduce this functionality into your handsets in the future?

4 Please state the percentage of the A-GNSS enabled handsets from the total number of handsets that you currently produce.

5 Please provide details on the different GNSS constellations and augmentation systems that your handsets support.

6 Please indicate the A-GNSS related protocols, procedures and architectures your handsets support.

7 Who provides the assistance and augmentation information for your handsets?

3.1.1 Summary of responses

In their response the handset manufacturers that responded indicated that A-GNSS was a function that was supported in the handsets available, with a number of associated approaches supported. They also reported that A-GNSS was widely available in the handsets that were commercially available. The predominant constellations supported were the US GPS and Russian GLONASS satellites, with the 3GPP protocols preferred. The handsets appear able to receive assistance information from the mobile network operator.

3.2 QUESTIONS TO THE MOBILE NETWORK OPERATORS

Two questions were asked specifically of MNOs:

8 Does your network support A-GNSS?

9 Hypothetically speaking, if all mobile network operators in Europe were required to implement A-GNSS in their networks, which approach(es) would you prefer?

3.2.1 Summary of responses

Currently MNOs do not appear to directly support assisted GNSS in Europe, although one highlighted that over the top communication with assistance servers was possible. A number of operators were of the opinion that further work in the area was necessary for any conclusion as to the most appropriate approach in the future. One respondent highlighted that modern GPS chipsets are able to perform a cold-fix in a short period of time. There was no clear consensus as to whether a Control Plane or User Plane approach for deriving assistance information would be preferable as arguments for each were made.

3.3 QUESTIONS FOR ALL STAKEHOLDERS

Finally four general questions were posed for all top consider and respond to:

10 Would your organisation support a European-wide initiative to harmonise A-GNSS approaches used in Europe to support emergency calling from mobile phones?

11 Further to your response to Question 10, would your [organisation] support for harmonisation be dependent on the approach ultimately adopted?

12 In what way do you think European bodies (policy, regulatory etc.) could facilitate common approaches?

13 PT ES may hold a workshop to explore the benefits and challenges of A-GNSS implementation. Please indicate whether your organisation would be willing to participate in such an event.

3.3.1 Summary of responses

Opinion was divided as to whether European-wide initiatives to harmonise A-GNSS would be supported, although the handset manufacturers appeared generally supportive of harmonisation. Others supported harmonisation provided that the resulting approaches had minimal cost implications on the industry. Those opposing harmonisation generally argued that it should be left for industry to develop effective solutions rather than having solutions imposed upon them.

In terms of the way in which European bodies could facilitate harmonisation, there were a number of calls for ETSI to actively participate in developing common solutions. However, a couple of respondents called for more formal regulatory intervention to direct industry (mobile network operators and/or handset manufacturers) to develop and adopt harmonised approaches.

Finally, almost all respondents indicated that their organisation would be willing to participate in a workshop to discuss in more detail the issues raised by these questions.

3.4 OVERALL CONCLUSIONS FROM RESPONSES

In conclusion, from the responses received it appears that many mobile handsets may already support assistance information for GNSS services (or could reasonably be expected to do so in the medium term). However, current mobile networks do not, in general, support Control Plane A-GNSS, and MNOs are suggesting that to do so could incur significant costs. Support for harmonisation is mixed, but an important element of such activity could be the involvement of ETSI[1] in developing technical standards for such an approach.

[1] In its response to the public consultation on this ECC Report, ETNO suggested that, as a prerequisite, Assisted-GNSS solutions would require standardisation activities by the relevant SDOs (e.g. ETSI/3GPP) regarding the dialogue between terminal handsets and mobile networks (especially a revision of the ETSI Technical Specification 124 008).

4 ADOPTION OF HANDSET-BASED GNSS FUNCTIONALITY FOR EMERGENCY CALLS

4.1 INTRODUCTION

To understand the handset-based solutions some of the existing approaches were also examined. In this section the benefits of such approaches are explored, with special consideration of a particular handset approach for which statistical performance information has been made available.

4.2 112 APPS

The ability for mobile handsets to derive their location for navigation and commercial applications is commonplace. As a result, a number of 'over the top' (OTT) apps have been developed whereby contact with, and the provision location information to, the emergency services is made possible. This is a rapidly developing area, hence an exhaustive list is not possible, but some examples include apps that are available in Italy ('where.areu') [6], Switzerland ('Echo 112') [7], Iceland [8] and the UK ('Realrider') [9].

As part of the functionality of these apps, the handset may attempt to use all available position derivation techniques at its disposal, including (A-)GNSS, in order to ascertain its location. The location information is then conveyed to the PSAP.

4.3 ADVANCED MOBILE LOCATION (AML)

In addition to the OTT apps highlighted above, an alternative approach whereby functionality is built into the operating system of the handset has been developed in the UK (known as Advanced Mobile Location - AML). Recent statistical analysis from emergency calls using this approach has been reported to EENA. This technique uses the location functionality that is available in the phone (such as GNSS, Wi-Fi and mobile cell site identification) to derive a location that is as accurate as possible within as short a time as possible. The location information derived is sent, by SMS, to the PSAP. Although the handset is able to request GNSS assistance over the data channel, it is not necessary in order for the protocol to work. The accuracy and timescales of location information derived using AML are outlined below.

4.3.1 Accuracy of AML location information:

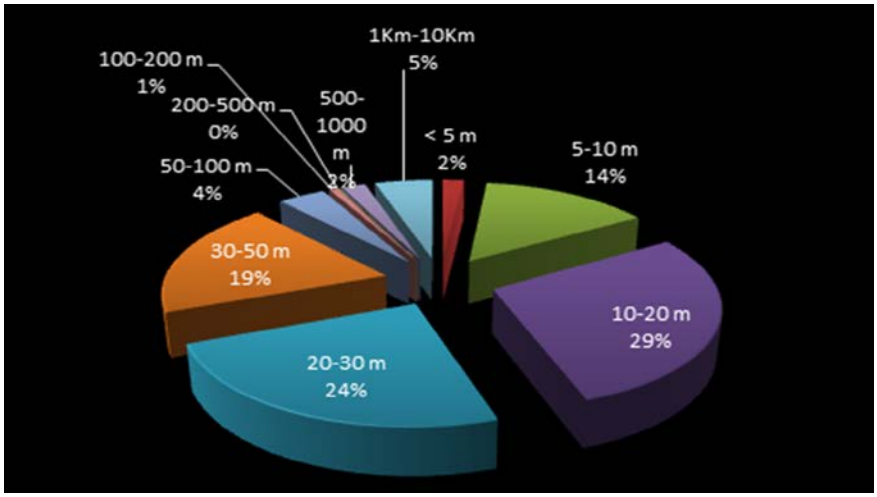

Figure 2: Accuracy of AML locations. Source BT (via EENA)

Note: 88% of received calls have accuracy of 50m.

Note also that received locations are compared and corroborated with network derived location (e.g. Cell-ID), leading to around 90% of received locations being used, with 10% disregarded.

4.3.2 Speed of AML location information:

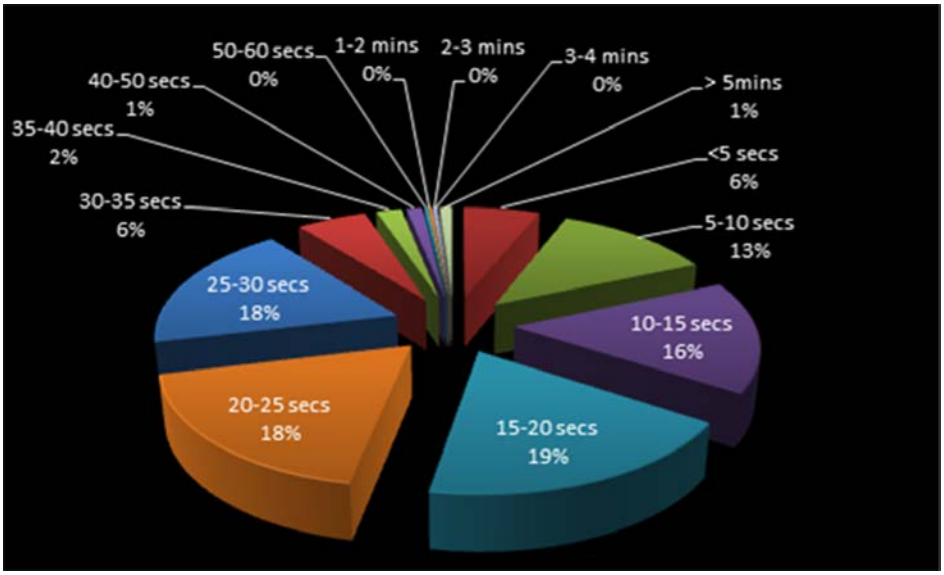

Figure 3: Speed of AML location information. Source: BT (via EENA)

Note: 90% of emergency calls are received with 30s.

Source: “AML Update – September 2015”, BT presentation to EENA

The above figures highlight that GNSS (with augmentation with additional sources of information) appears to be able to provide location information with improved accuracy that could materially assist the emergency services, and is able to do so in timescales that are commensurate with the time required to handle an emergency call and dispatch help. It should be noted that ETSI has already published a Technical Report regarding AML [10] in March 2016, and that practical implementation of AML has begun in some European states.

5 REPORT CONCLUSIONS

This report bases it findings predominantly on the results of a survey undertaken in 2015, in which Mobile Network Operators (MNOs), handset manufacturers, equipment providers and other stakeholders were asked:

- How and where A-GNSS location information is available in the EU;

  and

- Whether harmonised approaches would be necessary or beneficial for providing accurate location information for emergency calls.

As a result of the feedback received from stakeholders across Europe, this Report concludes that network-based (Control Plane) assistance to GNSS, as far as we know, has not been deployed in Europe and there appears little motivation for MNOs to invest in such functionality. On the other hand, mobile handsets do appear to be able to access assistance information over data channels (User Plane) and this is the prevalent manner by which Assisted-GNSS location information is derived.

Network-based A-GNSS is an area where technological change could be rapid, and therefore this situation needs to be kept under review. Given the increased functionality of modern handset-based positioning methods as highlighted above, it is concluded that further work should be directed at understanding the capabilities and limitations of these methods. This is set out in the section below.

6 OUTLOOK

The key purpose of this work was to examine the key benefits of A-GNSS with particular view to identify, where possible, opportunities for harmonisation. As a result of the work undertaken over the past year it appears that a narrow examination of these options is unlikely to derive useful additional information for most common scenarios. Modern mobile handsets derive location information from a wide variety of sources, frequently comparing and corroborating individual results in order to pinpoint a location in a short space of time (hybrid location methods). As shown above, the combination of all such sources can allow prompt, reliable and accurate information to be conveyed to the emergency services in the event of an emergency call. As a result, this Report proposes that the accuracy and reliability of multi-source handset approaches could warrant further examination and investigation.

In Report 225 [3], consideration was given to the relative merits and disadvantages of both handset and network-derived location information. It is a false dichotomy to assume that solutions should be either handset-based or network-based; both could be complementary, offering benefits of both. Such 'enhanced cell-id' solutions coupled with handset-derived A-GNSS capabilities could play a role in providing reliable and accurate location information to the emergency services. The availability and possible wider adoption of approaches such as AML (either on its own or in conjunction with enhanced network-based approaches) could raise questions to national regulatory authorities as to how best to benefit from the opportunities that exist to the best advantage of citizens. In line with the conclusions of ECC Report 225, these questions include:

- What criteria would be most appropriate given the different sources of information that may be available to a handset?
- Could and should the conveyance of location information from the handset to the PSAP be harmonised across Europe via
  - Defining requirements (e.g. for interoperability in terms of how caller location information is handled including the case of roaming)?
  - Developing standards for technical harmonisation (as a prerequisite for successful implementation)? and
  - Regulatory harmonisation (that could include regulations pertaining to both network and device capabilities)?
- How would the performance of such approaches be measured?
- What incentives could be established to encourage wider adoption and improved performance of such approaches?
- What is the level of regulatory jurisdiction necessary to ensure that capabilities are maintained over time given the number and variety of stakeholders involved in such approaches?
- What are the privacy concerns when comparing Control-Plane and User-Plane caller location techniques?

While some of these questions have been previously identified in ECC Report 225, it is evident from the work undertaken for this Report that technology has evolved and therefore it is appropriate to reconsider these questions in this light. However, it should be recognised that these questions remain complex and that establishing definitive answers to them may be challenging. In this context, further work in this area may be considered by ECC.

ANNEX 1: BREAKDOWN OF QUESTIONNAIRE RESPONSES

This questionnaire was circulated on 15 July 2015 with responses requested by 28 September 2015.

Question 1: (To Handset manufacturers): Do the handsets that you produce support A-GNSS?

Portugal Telecom	
Hutchison 3G, UK	
Qualcomm CDMA Technologies, Germany	
Sony Mobile Communications, Sweden	Yes. All
Samsung R&D Institute, UK	Yes. All high end phones support, in some European countries we sell feature phones without GPS
TeliaSonera, Sweden	
NOS Comunicações, S.A, Portugal	
Telefónica Group, Spain	Not applicable to Telefónica
Croatian Regulatory Authority for Network Industries, Croatia	
Ministry of Transport, Latvia	Not applicable
Telecom Italia, Italy	No

Question 2: (To handset manufacturers) If YES to Question1, do your handsets support -

Portugal Telecom	
Hutchison 3G, UK	
Qualcomm CDMA Technologies,	

Germany	
Sony Mobile Communications, Sweden	A variety of approaches. If a variety of approaches, do you have any evidence as to whether these approaches differ in either the accuracy or reliability of the data produced? Please provide details in the "Remarks" field below. Extended Ephemerides (proprietary), SUPL and Control Plane positioning is supported. In producing assistance data to the GNSS receiver all 3 have similar performance. In getting the GNSS location to the operator/rescue centre we believe Control Plane or AML SMS messages are the most reliable.
Samsung R&D Institute, UK	A variety of approaches. If a variety of approaches, do you have any evidence as to whether these approaches differ in either the accuracy or reliability of the data produced? Please provide details in the "Remarks" field below. A-GPS, when not available (in-building) Android supports cell-ID and Wi-Fi access point estimation
TeliaSonera, Sweden	
NOS Comunicações, S.A, Portugal	
Telefónica Group, Spain	Not applicable
Croatian Regulatory Authority for Network Industries, Croatia	Not applicable
Ministry of Transport, Latvia	
Telecom Italia, Italy	

Question 3: (To handset manufacturers) If NO to Question 1, do you have any plans to introduce this functionality into your handsets in the future? Please provide additional information in the "Remarks" field below.

Portugal Telecom	
Hutchison 3G, UK	
Qualcomm CDMA Technologies,	

Germany	
Sony Mobile Communications, Sweden	
Samsung R&D Institute, UK	
TeliaSonera, Sweden	
NOS Comunicações, S.A, Portugal	
Telefónica Group, Spain	Not applicable
Croatian Regulatory Authority for Network Industries, Croatia	
Ministry of Transport, Latvia	Not applicable
Telecom Italia, Italy	No

Question 4: (To handset manufacturers) Please state the percentage of the A-GNSS enabled handsets from the total number of handsets that you currently produce.

Portugal Telecom	
Hutchison 3G, UK	
Qualcomm CDMA Technologies, Germany	
Sony Mobile Communications, Sweden	100%
Samsung R&D Institute, UK	Commercially sensitive - but we say it is a high percentage
TeliaSonera, Sweden	
NOS Comunicações, S.A,	

Portugal	
Telefónica Group, Spain	Not applicable to Telefónica
Croatian Regulatory Authority for Network Industries, Croatia	
Ministry of Transport, Latvia	Not applicable
Telecom Italia, Italy	

Question 5: (To handset manufacturers) Please provide details on the different GNSS constellations and augmentation systems that your handsets support. If possible, please mention all combinations.

Portugal Telecom	
Hutchison 3G, UK	
Qualcomm CDMA Technologies, Germany	
Sony Mobile Communications, Sweden	GPS, GLONASS and BeiDou. Augmentation information is preferred to get over data connection instead of decoding from satellites for power consumption and reliability reasons.
Samsung R&D Institute, UK	Mainly GPS, but come Russian models support GLONASS
TeliaSonera, Sweden	
NOS Comunicações, S.A, Portugal	
Telefónica Group, Spain	Not applicable to Telefónica
Croatian Regulatory Authority for Network Industries, Croatia	
Ministry of Transport, Latvia	Not applicable

Telecom Italia, Italy	

Question 6: (To handset manufacturers) Please indicate the A-GNSS related protocols, procedures and architectures your handsets support. Please provide technical details, e.g. links to publicly available information

Portugal Telecom	
Hutchison 3G, UK	
Qualcomm CDMA Technologies, Germany	
Sony Mobile Communications, Sweden	Please see page 18 in this White Paper for typical support: http://dl-developer.sonymobile.com/documentation/whitepapers/Xperia_Z3_D6603_D6633_D6643_D6653_D6683_D6616_WP_4.pdf
Samsung R&D Institute, UK	3GPP A-GPS
TeliaSonera, Sweden	
NOS Comunicações, S.A, Portugal	
Telefónica Group, Spain	Not applicable to Telefónica
Croatian Regulatory Authority for Network Industries, Croatia	
Ministry of Transport, Latvia	
Telecom Italia, Italy	

Question 7: (To handset manufacturers) Who provides the assistance and augmentation information for your handsets?

Portugal Telecom	

Hutchison 3G, UK	
Qualcomm CDMA Technologies, Germany	
Sony Mobile Communications, Sweden	Mobile Network Operator-provided? A third party? Please provide details in the "Remarks" field below.
Samsung R&D Institute, UK	Mobile Network Operator-provided?
TeliaSonera, Sweden	
NOS Comunicações, S.A, Portugal	
Telefónica Group, Spain	Not applicable
Croatian Regulatory Authority for Network Industries, Croatia	
Ministry of Transport, Latvia	Not applicable
Telecom Italia, Italy	

Question 8: (To Mobile Network Operators) Does your network support A-GNSS? If YES, please provide details of the approaches that have been adopted in the "Remarks" field below.

Portugal Telecom	No. We do not use A-GNSS location for emergency services. We use Cell ID based location for emergency calls, PUSH.
Hutchison 3G, UK	No. We do not support any A-GNSS emergency location services. Our network based location solution is Cell Global Identity based only. In summary, the accuracy is extremely variable based upon the density/spread of cell sites in a given area. Typically, rural areas will yield a less accurate response than urban areas
Qualcomm CDMA Technologies, Germany	
Sony Mobile Communications, Sweden	

Samsung R&D Institute, UK	
TeliaSonera, Sweden	No
NOS Comunicações, S.A, Portugal	No. NOS Comunicações network does not support A-GNSS.
Telefónica Group, Spain	No
Croatian Regulatory Authority for Network Industries, Croatia	
Ministry of Transport, Latvia	No, mobile operators' networks do not support such function in the sense of A-GNSS server(s). However, in the sense of data transfer possibilities, some networks have packet switched data service available. If mobile station with GPS receiver has SIM card with packet switched data subscription, the mobile station can establish SUPL to global A-GNSS servers (“supl.nokia.com”, “supl.google.com”, “supl.apple.com”)
Telecom Italia, Italy	No, our network does not support standard A-GNSS (3GPP/OMA).

Question 9: (To Mobile Network Operators) Hypothetically speaking, if all mobile network operators in Europe were required to implement A-GNSS in their networks, which approach(es) would you prefer? Please describe your preferred technical solution (e.g. protocols, procedures and architectures).

Portugal Telecom	Our mobile network does not support the A-GNSS solution for emergency calls. Any support of this type of solution requires investment, development and implementation. It is an issue that requires further analysis.
Hutchison 3G, UK	The UK mobile operators have already engaged in discussions regarding this topic in 2014. The general consensus was that each of the operators agreed that a solely device based GPS solution would be preferable to an A-GNSS solution (where the network provides ephemeris data of the packet switched network) on the basis of its level of high level accuracy and quick time to market. This handset based solution would involve the manufacturers developing the underlying logic that would identify when an emergency call is dialled and immediately start up the GPS receiver on the device to obtain the device’s precise location. In-range Wi-Fi data would also be captured, and all of this data would be summarised within an SMS message and sent automatically to the emergency services. This service would be further supplemented with the existing (less accurate) CGI based location method to address scenarios where GPS location may not be available.

	The traditional method of network assisted GPS is considered less necessary than previously thought, due to the high performance of modern GPS chipsets that are able to perform a cold-fix in a short period of time. In addition, a packet switched data bearer cannot guarantee delivery of the network assisted data for all 999 calls due to limitations in the core network.
Qualcomm CDMA Technologies, Germany	
Sony Mobile Communications, Sweden	
Samsung R&D Institute, UK	
TeliaSonera, Sweden	As simple and least costly as possible
NOS Comunicações, S.A, Portugal	Although the Control Plane architecture require some alterations of the network infrastructure, we consider that this architecture is more adequate because has allows to provide the location information of the mobile terminal regardless of the existence of a valid data subscription. With the increasing processing capacity of the mobile terminals, the terminal-based mode is recommended due to the least risk of compatibility problems.
Telefónica Group, Spain	In order to answer this question it would be necessary to study the different possible approaches more deeply, not only from the technical point of view (the impact of each solution on net, handsets, platforms, etc.) but also from the demand and the profitability sides. The different starting points in each Country should also be taken into account.
Croatian Regulatory Authority for Network Industries, Croatia	
Ministry of Transport, Latvia	In order to provide more detailed information on preferred technical solution, mobile network operators need to have technical requirements for such service.
Telecom Italia, Italy	A User Plane solution is the preferred approach because it minimizes the cost/impact on the network. Among standards architectures, the OMA SUPL solution could be a reasonable starting point that could be eventually updated. Another option is to define a mandatory native E112 functionality on all the mobile terminals that will leverage on the positioning capabilities of the terminal (A-GNSS and/or other technologies).

Question 10: (To All Respondents) Would your organisation support a European-wide initiative to harmonise A-GNSS approaches used in Europe to support emergency calling from mobile phones?

Portugal Telecom	No
Hutchison 3G, UK	No
Qualcomm CDMA Technologies, Germany	Yes
Sony Mobile Communications, Sweden	Yes
Samsung R&D Institute, UK	No
TeliaSonera, Sweden	No
NOS Comunicações, S.A, Portugal	Yes
Telefónica Group, Spain	No
Croatian Regulatory Authority for Network Industries, Croatia	Yes
Ministry of Transport, Latvia	Yes
Telecom Italia, Italy	Yes

Question 11: (To All Respondents) Further to your response to Question 10, would your support for harmonisation be dependent on the approach ultimately adopted?

Portugal Telecom	We would support harmonization of an European-wide initiative to support emergency calling from mobile phones as long as its impact would be low for the operator.
Hutchison 3G, UK	Three recognises the importance of detailed emergency location information and believe the device driven model (with coarse network based location as fall back) to be the most effective. Harmonisation would be dependent upon this approach being adopted.
Qualcomm CDMA Technologies,	No, it would not be dependent on the approach ultimately adopted as

Germany	long as industry and public safety interests had been suitably taken into account.
Sony Mobile Communications, Sweden	Yes. We prefer performance based requirements instead of technology based to not prevent adoption of new technologies.
Samsung R&D Institute, UK	Yes - mobile location methods are well tried and tested. Need to support common method to transport data to PSAP (we support SMS in PSAP in UK) - 3GPP IMS already supported
TeliaSonera, Sweden	No, we are negative to AGPS. Too costly and too little gain. We have done tests with AGPS.
NOS Comunicações, S.A, Portugal	Yes, although we support the harmonization should be imperatively followed by choosing a solution that keeping the defined objectives, minimize the potential costs.
Telefónica Group, Spain	No. We believe that European bodies should let the market decide if it is necessary to get common approaches or not, without regulatory intervention.
Croatian Regulatory Authority for Network Industries, Croatia	yes we would
Ministry of Transport, Latvia	Yes. One of mobile network operators have pointed out that they would prefer the solutions, which do not require to re-build mobile networks (for example to have more base stations for better positioning or installation of specific equipment on each base station). The best solution would be country wide infrastructure, hold and supported by state authorities, where mobile operator network entities are interfaced to this infrastructure, using standard functionalities, provided by mobile network equipment vendors. However, such a solution is not examined/supported by the national authorities.
Telecom Italia, Italy	Yes, only if a common agreement on A-GNSS solution is reached in advance at EU level among all Administrations and different interested stakeholders. Just a unique common EU A-GNSS approach agreement could be a viable solution for networks and handsets.

Question 12: (To All Respondents) In what way do you think European bodies (policy, regulatory etc.) could facilitate common approaches?

Portugal Telecom	ETSI could facilitate common approaches.
Hutchison 3G, UK	The proposed solution would require the device manufacturers to adopt

	a common standard. This could be achieved by introducing policies/regulations upon the mobile manufacturers to adhere to a set of EU standards for sale of their devices within the EU. These standards could involve the inclusion of new devices being able to extract GPS location and Wi-Fi data and send to a central point via SMS when initiating an emergency call. I understand a number of device vendors are already starting to offer this functionality.
Qualcomm CDMA Technologies, Germany	Standardization within ETSI EMTEL is suggested addressing ECC Report 225 [3] and including opinions and requirements of network operators, public safety, vendors and consumer groups.
Sony Mobile Communications, Sweden	The EC tender launched is an excellent approach in our view. In addition to that we believe challenging functional and performance requirements could help.
Samsung R&D Institute, UK	ETSI standard for SMS transport. VoIP over non-regulated providers remains a major issue
TeliaSonera, Sweden	Concentrate on common protocols and usage of MLP for 112 services which needs some attention
NOS Comunicações, S.A, Portugal	These organizations can be decisive in the process, in order to: • Create and maintain the framework for the discussions and agreements between all stakeholders • Guarantee clear definition of the options to be adopted • Support documentation reference and repository • Promote contact exchange
Telefónica Group, Spain	See answer to question 11 above.
Croatian Regulatory Authority for Network Industries, Croatia	
Ministry of Transport, Latvia	Regulatory measures could facilitate common approaches. However some mobile network operators are of the view that caller location information is not a direct service for mobile operators and it adds expenses for new infrastructure nodes, software implementation and support. Therefore, the mobile network operators would be more supportive if an expenses would be partially co-financed by the European Union.
Telecom Italia, Italy	The European Commission should define at the regulatory level a unique technical approach to ensure enhanced location accuracy in EU; then the EC should identify appropriate standardization mandates towards the European technical standardization bodies.

Question 13: (To All Respondents) Depending on the answers received to this Questionnaire, PT ES may hold a workshop to explore the benefits and challenges of A-GNSS implementation. Please indicate whether your organisation would be willing to participate in such an event.

Portugal Telecom	Yes, my organisation would be willing to participate in such an event.
Hutchison 3G, UK	Yes, my organisation would be willing to participate in such an event.
Qualcomm CDMA Technologies, Germany	Yes, my organisation would be willing to participate in such an event.
Sony Mobile Communications, Sweden	Yes, my organisation would be willing to participate in such an event.
Samsung R&D Institute, UK	Yes, my organisation would be willing to participate in such an event.
TeliaSonera, Sweden	Yes, my organisation would be willing to participate in such an event.
NOS Comunicações, S.A, Portugal	Yes, my organisation would be willing to participate in such an event.
Telefónica Group, Spain	No, my organisation would not be willing to participate.
Croatian Regulatory Authority for Network Industries, Croatia	Yes, my organisation would be willing to participate in such an event.
Ministry of Transport, Latvia	Yes, my organisation would be willing to participate in such an event.
Telecom Italia, Italy	Yes, my organisation would be willing to participate in such an event.

ANNEX 2: LIST OF REFERENCE

[1] 'Implementation of the European emergency number 112 – Results of the ninth data-gathering round", COCOM 16-01, Feb 2016 https://ec.europa.eu/digital-agenda/en/news/implementation-european-emergency-number-112-results-ninth-data-gathering-round

[2] DIRECTIVE 2002/22/EC

[3] ECC Report 225, " Establishing Criteria for the Accuracy and Reliability of the Caller Location Information in support of Emergency Services", 2014: http://www.erodocdb.dk/Docs/doc98/official/pdf/ECCREP225.PDF

[4] Assessment of Mobile Location Technology – Update, Mott MacDonald 2012: http://stakeholders.ofcom.org.uk/binaries/consultations/emergency-mobiles-cfi/annexes/mobile-location-technology.pdf

[5] This table was itself derived from: Zekavat and Buehrer, 2012, Handbook of Position Location, Theory, Practice and Advances. Further explanations of the terms used (e.g. code phase estimation) can be found therein.

[6] http://where.areu.lombardia.it/

[7] http://www.echo112.com/

[8] http://safetravel.is/112-iceland-app/

[9] http://www.realrider.com/#features

[10] http://www.etsi.org/deliver/etsi_tr/103300_103399/103393/01.01.01_60/tr_103393v010101p.pdf