European Commission

Pilot project on the design, implementation and execution of the transfer of GNSS data during an E112 call to the PSAP

Contract No 440/PP/GRO/PPA/15/8308

Deliverable D1.3 Gap Analysis

Alexis Gizikis, Benoit Vivier, Cristina Lumbreras
July – 2017

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	Responsibility-Office-Company	Date	Signature
Prepared by	Alexis Gizikis, Benoit Vivier, Cristina Lumbreras	23 May 2016	
Verified by	Tony O'Brien	23 May 2016	
Approved by	Gary Machado	23 May 2016	

ENREGISTREMENT DES EVOLUTIONS / *CHANGE RECORDS*

ISSUE	DATE	§ : DESCRIPTION DES EVOLUTIONS § : CHANGE RECORD	REDACTEUR AUTHOR
1.0	03/02/2016	Deliverable outline as discussed during the KOM.	A. Gizikis
1.1	29/02/2016	Revision of the deliverable outline.	A. Gizikis
1.2	21/03/2016	List of requirements in section 2.	L. Bellon
1.3	04/04/2016	Add sections 1 – 6. 1st full draft version.	A. Gizikis, B. Vivier, C. Lumbreras, T. O'Brien, G. Machado
1.4	18/04/2016	Document revision based on feedback.	A. Gizikis
1.5	23/05/2016	Document revision based on feedback regarding compliance with accuracy requirements (sections 2, 3.1.2 and 3.2) and other minor comments.	I. Embaby, A. Gizikis

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LIST OF ABBREVIATIONS

3GPP - 3rd Generation Partnership Project

A-GNSS - Assisted Global Navigation Satellite System

ACE - Accredited Center of Excellence

AML - Advanced Mobile Location

API - Application Program Interface

C&C - Command & Control

CAD - Computer-aided dispatch

CAPEX - Capital expenditures

CERN - European Organisation for Nuclear Research

CIRTT - Cell ID and Round Trip Time

CITA - Cell ID and Timing Advance

CITARX - Cell ID, Timing Advance and Received Signal levels

CNES - French Space Agency

EC - European Commission

ECAS - Emergency Call Answering Service

ECC - Electronic Communications Committee

EE - British mobile phone operator, formerly Everything Everywhere

EGNOS - European Geostationary Navigation Overlay Service

EISEC - Enhanced Information System for Emergency Calls

ESA - European Space Agency

ESSN - Emergency Services Staff Network

ETC - Electronic Toll Collection

ETSI - European Telecommunications Standards Institute

EU - European Union

FP7 - Framework Programme 7

GNSS - Global Navigation Satellite System

GPS - Global Positioning System

GSM - Global System for Mobile Communications

ICE - In Case of Emergency

IP - Internet Protocol

IPR - Intellectual Property Right

IRSN - French Nuclear Safety Institute

KPI - Key Performance Indicator

LBS - Location based Services

LTE - Long-Term Evolution

MEP - Member of the European Parliament

MNO - Mobile Network Operator

NBL - Network Based Location

NG - Next Generation

NG112 - Next Generation 112

NRA - National Regulatory Authority

OPEX - Operating Expenditures

OTDOA - Observed Time Difference Of Arrival

PCO - Project Control Office

PEMEA - Pan-European Mobile Emergency Application

PSAP - Public Service Answering Point

R&D - Research & Development

RF - Radio Frequency

RFPM – Radio Frequency Pattern Matching

RTT – Round Trip Time

Rx - Received Signal level

SIM - Subscriber Identity Module

SLA - Service Level Agreement

SMS - Short Message Service

SUPL - Secure User Plane Location

TA - Timing Advance (between an MS and its serving BTS)

TDOA - Time Difference of Arrival

TL - Task Leaders

TM - Technical Manager

TOA - Time of Arrival

TTFT - Time To First Fix

WP - Work Package

WPL - Work Package Leader

1. INTRODUCTION

1.1 PLACE OF THIS DOCUMENT AND OBJECTIVES

This document is the "Gap analysis", identified as D1.3 in the list of project deliverables.

It is generated as part of the contract 440/PP/GRO/PPA/15/8308.

The objectives of the document are to:

1. describe if each of the four existing caller location solutions studied in the context of HELP112 satisfy the requirements and to what extent
2. identify and report the barriers to achieve the deployment of a precise and accurate caller location solution
3. cover the needs for technological solutions and regulation supporting caller location for emergency calls originating from mobile devices
4. provide recommendations for the technical implementation

The following chart defines the place of this document and its interaction with other work package deliverables.

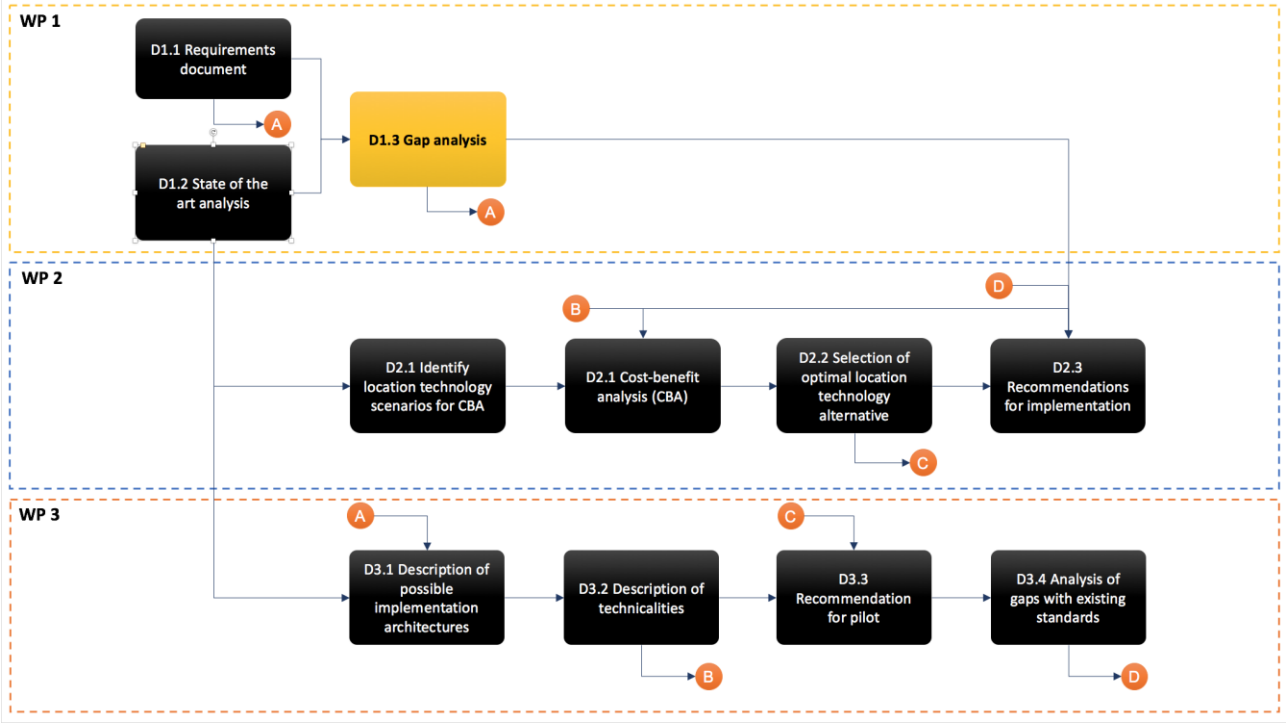

Figure 1: HELP112 Deliverable flow chart

The goals of each work package deliverables are:

- WP1:
  - D1.1: Defines the **user requirements and formulates a set of user scenarios** that will lead the implementation and evaluation of the architecture.
  - D1.2: Analyses and compares the **existing solutions and the underlying technologies** for the provision of caller location.

- D1.3: Analyses how **existing solutions satisfy the requirements,** reports the **barriers for deployment** and provides **recommendations for the implementation.**

- WP2:
  - D2.1: Defines the **key location and transmission technology scenarios** and assess the **costs and benefits of each scenario.**
  - D2.2: Recommends **the optimal scenario(s) for the help112 caller location** based on the results of the cost-benefit analysis.
  - D2.3: Provides **a more detailed assessment of the costs linked to implementation of the selected technology scenario(s)** as well as **key operational and financial recommendations.**
- WP3:
  - D3.1: **Defines possible implementation architectures for the pilot sites**, covering location/transmission tech. alternatives of WP1.
  - D3.2: Describes **technicalities of these architectures** and recommendations for their implementation.
  - D3.3: **Selects the architecture to be deployed** for the pilots based on outputs of WP2.
  - D3.4: **Analyses the gaps between the selected architecture and the existing standards** (eCall, 3GPP, ECC-REP-225).

1.2 FOREWORD

Emergency caller location is the most important piece of information for both PSAPs and first responders. Ensuring it is accurate, reliable and timely will save lives and significant emergency services resources. Not having it will mean negative outcomes for our citizens.

In the absence of a detailed and prescriptive regulatory framework, emergency mobile caller location information in Europe has typically relied on Cell-ID. Often, Cell-ID is inadequate because the cell radius is too large, notably in rural areas.

Developments in location technologies and the proliferation of GNSS enabled smartphones are leading to improved location information being available in the handset. Making such handset derived positioning information available to PSAPs during emergency communications in a secure and reliable manner is highly desirable.

This consortium, known as the HELP112 consortium, will demonstrate that accurate and reliable caller location information is highly effective and is also highly efficient. It will also demonstrate that it can be deployed across Europe in a cost effective manner, securing better outcomes for our citizens and simultaneously not placing any additional burden on the emergency services, mobile network providers or public authorities.

1.3 APPLICABLE DOCUMENTS

AD	Title of the document & reference
AD 1	Contract 440/PP/GRO/PPA/15/8308
AD2	Help112 Consortium Agreement

Table 1: Applicable documents

1.4 REFERENCE DOCUMENTS

RD	Title of the document & reference
RD 1	Help112 Technical, Management & Financial Proposal TPZF/SSA-T2015-PP-0451 is1.0 31/07/2015

Table 2: Reference documents

2. HELP112 REQUIREMENTS

This deliverable reports how each of the four existing caller location solutions, studied in the context HELP112, satisfy the requirements of the pilot sites, as documented in D1.1 Requirements document. A list of the HELP112 requirements is therefore considered as a prerequisite to performing the gap analysis. This section provides the list of requirements as extracted from D1.1 and will be used in the following section.

The requirement ids are in the form:

Requirement id: XXXX_NNN

where

XXXX is a four character abbreviation identifying the requirement category and

NNN is a three digit number identifying the requirements in each category

The category's four character abbreviations are:

ACCU for accuracy and reliability requirements

RESP for response time requirements

PRES for presentation of the caller location in the PSAP

PRIV for privacy requirements

ACCE for requirements regarding the acceptance of the solution

SECU for security requirements

LOCA for requirements regarding the use of different positioning methods

BATT for requirements regarding the battery life of the handset

CHAR for requirements regarding the charges that a caller may occur

TRAN for data transmission requirements

ROAM for roaming caller's requirements

AML for AML specific requirements

Id	Requirement description	Source (section of D1.1)
ACCU_001	The precision[1] of the estimated location shall be transmitted in metres.	4.1.3
ACCU_002	The confidence radius of the location measured shall be less than 30 meters in urban areas for 67% of calls.	4.3.4
ACCU_003	The confidence radius of the location measured shall be less than 100 meters in urban areas for 95% of calls.	4.3.4
ACCU_004	The confidence radius of the location measured shall be less than 30 meters in rural areas for 67% of calls.	4.3.4
ACCU_005	The confidence radius of the location measured shall be less than 50 meters in rural areas for 95% of calls.	4.3.4
ACCU_006	The accuracy[2] of location estimate should always be less than its precision, i.e. the actual position should always be within the radius define by the precision criterion.	4.1.1
RESP_001	The response time[3] shall be less than 5 seconds for a Cell-ID location solution.	4.2.3
RESP_002	The response time shall be less than 30 seconds for any solution that provides more accurate and precise caller location and satisfies the precision and accuracy requirements.	4.2.3
PRES_001	The caller location has to be received on the GIS available at the call taker's terminal that has answered the call.	4.4
PRES_002	No additional task shall be assigned to the call taker to get caller's location through the HELP112 solution.	4.4
PRES_003	The caller's location could either be pushed from the HELP112 solution to the call taker CAD, or pulled by the call taker CAD.	4.4
PRES_004	The caller's location data shall use the WGS84 coordinate system.	5 (D1.2)

[1] *The term "precision" is defined in section 4.1.1 of D1.1 Requirements document.*

[2] *The term "accuracy" is defined in section 4.1.1 of D1.1 Requirements document.*

[3] *The term "response time" is defined in section 4.2.1 of D1.1 Requirements document.*

Id	Requirement description	Source (section of D1.1)
PRIV_001	The HELP112 solution shall ensure that the caller location is available only to respond to emergency calls. Privacy restrictions for uses not related to emergency calls shall be maintained and strictly enforced.	4.5
PRIV_002	Storage of caller location at the time of the emergency call in the PSAP shall be in agreement with the PSAPs operating policy and the national data protection legislation.	4.5
PRIV_003	The caller's data storage shall be protected from unauthorized access. Only PSAP and legal authorities shall have access to the caller's data.	4.5
PRIV_004	The caller's location data obtained during an emergency call shall not be stored on the handset during or after the call.	4.5
PRIV_005	The caller shall not be able to suppress or degrade the availability of the location information for a 112 call.	4.5
ACCE_001	The HELP112 solution shall be available for the widest range of handset types.	4.6
ACCE_002	The process to initiate the estimate and transmission of the caller location to the PSAP shall be initiated without the need for caller intervention.	4.6
ACCE_003	The estimate and transmission of the location information to the PSAP shall not be visible or accessible to the user.	4.6
ACCE_004	The location process and the transmission of location data to the PSAP shall not interfere with the voice call.	4.6
SECU_001	The HELP112 solution shall always be available to the entities authorized to access it. For example it must remain available even if wide-scale attacks are performed, e.g. denial of service, or access with appropriate privileges is gained that can make the service unavailable or unusable.	4.7
SECU_002	HELP112 solution shall be protected from attacks that attempt to block the HELP112 solution to specific callers or to take advantage or profit from transmitting the location to other sources.	4.7
LOCA_001	The HELP112 solution shall estimate the caller location by the GNSS capabilities of the handset if available and if the battery power level is sufficient.	4.8

Id	Requirement description	Source (section of D1.1)
LOCA_002	The HELP112 solution shall make use of, trial and demonstrate the advantages of estimating the caller location by EGNOS and Galileo.	4.8
LOCA_003	The HELP112 location solution shall combine multiple positioning methods, when possible, in order to fit the requirements as widely as possible.	4.8
LOCA_004	In the case that a location method fails to provide accurate caller location with regards to the accuracy requirements, the HELP112 solution shall ensure that a fall-back location solution would be available to provide a more accurate caller's location than the one estimated by Cell-ID.	4.11
BATT_001	The HELP112 solution shall ensure that in cases of low battery power level, priority shall be given to the emergency voice call.	4.9
BATT_002	In the HELP112 solution, the battery power level needed and expected to use either A-GNSS, stand-alone GNSS, or WiFi without GNSS, shall be different for each type of location solution, and dependant on the battery capacity of the handset.	4.9
CHAR_001	The HELP112 solution shall ensure that the data channel is used for the processes of estimating and transmitting the location if and only if the data connection is already activated on the handset.	4.10
CHAR_002	The HELP112 solution shall ensure that if a SMS is used to transmit the location information to the PSAP, it shall be recognised as an E112 SMS by the network and shall be free of charge for the caller.	4.10
TRAN_001	HELP112 shall study the possibility of using the IP channel to transmit the caller's location data to the PSAP.	4.14
TRAN_002	If the data connectivity is not available or is deactivated on the caller's handset, HELP112 solution shall ensure that a fall-back solution that doesn't use the data channel is available to transmit the location data to the PSAP.	4.11
ROAM_001	HELP112 shall study ways to be robust to a caller from a home HELP112 enabled country A that use the E112 service in a visited HELP112 enabled country B.	4.12

Id	Requirement description	Source (section of D1.1)
AML_001	HELP112 shall study the possibility to transmit extra data related to the caller's location in addition to the ones already expected in the current AML solution, such as Cell-ID, Radio Measurement Report, floor, and altitude when available.	4.14
AML_002	HELP112 shall examine ways to configure the AML solution to be triggered when an emergency SMS is sent.	4.14

Table 2: List of HELP112 requirements

Clarifications:

The deliverable D1.1 Requirements Document describes specific requirements for emergency calls originating from SIM less devices. However, emergency call support from SIM less devices may vary among the member states and it depends on the legislation in each country. For the purposes of the analysis in WP1 and WP3, SIM less 112 calls are not approached as a requirement, but as a user scenario to be tested during the trial phase, in pilots where legislation requires a SIMless emergency call to be possible.

3. REQUIREMENTS SATISFACTION

This section studies if each of the four existing caller location solutions can satisfy the requirements of HELP112 and to what extend. Table 2 provides an analysis of the requirements that can be met by each of the four solutions. Sections 3.1.1 - 3.1.13 summarise the analysis in a table per requirement category, while section 3.2 provide an overview of the requirements satisfaction per requirement category.

The analysis in this section considers eCall as a possible and existing caller location solution. eCall is caller location solution for vehicles and does not directly fit the HELP112 project, which is looking for caller location solutions for 112 calls originating from mobile phones. However, a personal eCall solution for mobile phones has been discussed and is described in deliverable D1.2. In this respect, the gap analysis of this deliverable considers a potential personal eCall solution and reports how it could fit the end user requirements.

Requirement ids are alphabetically ordered in the following table.

		Can each solution satisfy the listed requirement?			
Id	**Requirement description**	**NBL**	**AML**	**112 Apps**	**eCall (personal eCall)**
ACCE_001	The HELP112 solution shall be available for the widest range of handset types.	Yes	Only supports devices with GNSS or WiFi connectivity.		Potentially yes, but depends on the device – implementation on the handset may be needed to implement the in band modem.
ACCE_002	The process to initiate the estimate and transmission of the caller location to the PSAP shall be initiated without the need for caller intervention.	Yes	Yes	No, caller must use the app, considered as a needed intervention.	Yes
ACCE_003	The estimate and transmission of the location information to the PSAP shall not be visible or accessible to the user.	Yes	Yes	Yes	Yes, in case of SMS, the message may remain visible to the user.
ACCE_004	The location process and the transmission of location data to the PSAP shall not interfere with the voice call.	Yes	Yes	Yes	No
ACCU_001	The precision of the estimated location shall be transmitted in metres.	Yes	Yes	Yes	Yes

		Can each solution satisfy the listed requirement?			
Id	**Requirement description**	**NBL**	**AML**	**112 Apps**	**eCall (personal eCall)**
ACCU_002	The confidence radius of the location measured shall be less than 30 meters in urban areas for 67% of calls.[4]	Only GNSS positioning methods can satisfy the precision requirements.	Yes, excluding Cell ID positioning which is already received by the PSAPs and is not satisfactory.		Yes
ACCU_003	The confidence radius of the location measured shall be less than 100 meters in urban areas for 95% of calls.	Only GNSS & O-TDOA positioning methods can satisfy the precision requirements.	Yes, assuming Cell ID positioning is already received by the PSAPs and is not satisfactory.		Yes
ACCU_004	The confidence radius of the location measured shall be less than 30 meters in rural areas for 67% of calls.	Only GNSS positioning methods can satisfy the precision requirements.	Yes	Yes	Yes
ACCU_005	The confidence radius of the location measured shall be less than 50 meters in rural areas for 95% of calls.	Only GNSS & O-TDOA positioning methods can satisfy the precision requirements.	Yes	Yes	Yes
ACCU_006	The accuracy of location estimate should always be less than its precision, i.e. the actual position should always be within the radius define by the precision criterion.	Yes	Yes	Yes	Yes

[4] Reliability measurement for requirements ACCU_002, ACCU_003, ACCU_004 & ACCU_005 can only be confirmed by trial. Compliance with precision requirements is based on the expected precision of each positioning method provided in Table 6, p. 34 of D1.2 Analysis of the state of the art.

		Can each solution satisfy the listed requirement?			
Id	**Requirement description**	**NBL**	**AML**	**112 Apps**	**eCall (personal eCall)**
AML_001	HELP112 shall study the possibility to transmit extra data related to the caller's location in addition to the ones already expected in the current AML solution, such as Cell-ID, Radio Measurement Report, floor, and altitude when available.	n/a	Not yet, but possible.	n/a	n/a
AML_002	HELP112 shall examine ways to configure the AML solution to be triggered when an emergency SMS is sent.	n/a	Not yet, but possible.	n/a	n/a
BATT_001	The HELP112 solution shall ensure that in cases of low battery power level, priority shall be given to the emergency voice call.	n/a	Yes	Yes, depending on implementation.	Possible in a personal eCall solution.
BATT_002	In the HELP112 solution, the battery power level needed and expected to use either A-GNSS, stand-alone GNSS, or WiFi without GNSS, shall be different for each type of location solution, and dependant on the battery capacity of the handset.	n/a	Yes	Yes, depending on implementation.	Possible in a personal eCall solution.

		Can each solution satisfy the listed requirement?			
Id	**Requirement description**	**NBL**	**AML**	**112 Apps**	**eCall (personal eCall)**
CHAR_001	The HELP112 solution shall ensure that the data channel is used for the processes of estimating and transmitting the location if and only if the data connection is already activated on the handset.	Yes	Yes	Yes	n/a
CHAR_002	The HELP112 solution shall ensure that if a SMS is used to transmit the location information to the PSAP, it shall be recognised as an E112 SMS by the network and shall be free of charge for the caller.	n/a	Yes, mainly depends on MNOs.		n/a
LOCA_001	The HELP112 solution shall estimate the caller location by the GNSS capabilities of the handset if available and if the battery power level is sufficient.	n/a	Yes	Yes	Possible in a personal eCall solution.
LOCA_002	The HELP112 solution shall make use of, trial and demonstrate the advantages of estimating the caller location by EGNOS and Galileo.	No, for control plane. Yes, for user plane.	Yes	Yes	Yes
LOCA_003	The HELP112 location solution shall combine multiple positioning methods, when possible, in order to fit the requirements as widely as possible.	Yes, (multiple NBL methods and GNSS can be combined – not WiFi)	Yes	Yes	Possible in a personal eCall solution.

		Can each solution satisfy the listed requirement?			
Id	**Requirement description**	**NBL**	**AML**	**112 Apps**	**eCall (personal eCall)**
LOCA_004	In the case that a location method fails to provide accurate caller location with regards to the accuracy requirements, the HELP112 solution shall ensure that a fall-back location solution would be available to provide a more accurate caller's location than the one estimated by Cell-ID.	This requirement can be achieved by deploying complimentary caller location solutions, based on network-based location solution (either through AML or conventional NBL solution).			
PRES_001	The caller location has to be received on the GIS available at the call taker's terminal that has answered the call.	Yes, depends mostly on CAD implementation.	Yes, depends mostly on CAD implementation.	Yes, depends mostly on CAD implementation.	Yes, depends mostly on CAD implementation.
PRES_002	No additional task shall be assigned to the call taker to get caller's location through the HELP112 solution.	Yes, depends mostly on CAD implementation.	Yes, depends mostly on CAD implementation.	Yes, depends mostly on CAD implementation.	Yes, depends mostly on CAD implementation.
PRES_003	The caller's location could either be pushed from the HELP112 solution to the call taker CAD, or pulled by the call taker CAD.	Yes, depends mostly on CAD implementation.	Yes, depends mostly on CAD implementation.	Yes, depends mostly on CAD implementation.	Yes, depends mostly on CAD implementation.
PRES_004	The caller's location data shall use the WGS84 coordinate system.	Yes	Yes	Yes	Yes

		Can each solution satisfy the listed requirement?			
Id	**Requirement description**	**NBL**	**AML**	**112 Apps**	**eCall (personal eCall)**
PRIV_001	The HELP112 solution shall ensure that the caller location is available only to respond to emergency calls. Privacy restrictions for uses not related to emergency calls shall be maintained and strictly enforced.	Yes, a privacy assessment of the solution is suggested.			
PRIV_002	Storage of caller location at the time of the emergency call in the PSAP shall be in agreement with the PSAPs operating policy and the national data protection legislation.	Yes	Yes	Yes	Yes
PRIV_003	The caller's data storage shall be protected from unauthorized access. Only PSAP and legal authorities shall have access to the caller's data.	Yes, a privacy assessment of the solution is suggested.			
PRIV_004	The caller's location data obtained during an emergency call shall not be stored on the handset during or after the call.	Yes	Yes	Yes	Yes
PRIV_005	The caller shall not be able to suppress or degrade the availability of the location information for a 112 call.	Yes, a privacy assessment of the solution is suggested.			
RESP_001	The response time shall be less than 5 seconds for a Cell-ID location solution.	Yes	n/a	n/a	n/a

		Can each solution satisfy the listed requirement?			
Id	**Requirement description**	**NBL**	**AML**	**112 Apps**	**eCall (personal eCall)**
RESP_002	The response time shall be less than 30 seconds for any solution that provides more accurate and precise caller location and satisfies the precision and accuracy requirements.	Yes	Yes	Yes	Yes – should be confirmed because of no assistance data is used and TTFF may be longer, although in the case of personal eCall assistance data could be used.
ROAM_001	HELP112 shall study ways to be robust to a caller from a home HELP112 enabled country A that use the E112 service in a visited HELP112 enabled country B.	Yes	Not in its current implementation, but it is possible.	Yes, a pan European approach is needed, like the architecture suggested by EENA (PEMEA).	Yes
SECU_001	The HELP112 solution shall always be available to the entities authorized to access it. For example it must remain available even if wide-scale attacks are performed, e.g. denial of service, or access with appropriate privileges is gained that can make the service unavailable or unusable.	Yes, a security assessment of the solution is suggested.			
SECU_002	HELP112 solution shall be protected from attacks that attempt to block the HELP112 solution to specific callers or to take advantage or profit from transmitting the location to other sources.	Yes, a security assessment of the solution is suggested.			

		Can each solution satisfy the listed requirement?			
Id	**Requirement description**	**NBL**	**AML**	**112 Apps**	**eCall (personal eCall)**
TRAN_001	HELP112 shall study the possibility of using the IP channel to transmit the caller's location data to the PSAP.	n/a	Not in its current implementation, but it is possible.	Yes, depending on implementation.	No, possible in the case of a NG eCall solution.
TRAN_002	If the data connectivity is not available or is deactivated on the caller's handset, HELP112 solution shall ensure that a fall-back solution that doesn't use the data channel is available to transmit the location data to the PSAP.	n/a	Not in its current implementation, but it is possible.	Yes, depending on implementation.	No, possible in the case of a NG eCall solution.

Table 3: Requirements satisfaction by the four caller location solutions

3.1 COMPLIANCE OF SOLUTIONS

This section describes the compliance of the four solutions with each requirement category.

3.1.1 Acceptance (ACCE)

- The only existing caller location solution that can satisfy all the acceptance requirements is the **Network Based Location** because it does not depend on the capabilities or existing technologies on the handset.
- **AML** can satisfy all acceptance requirements except the first one because it can only support devices with GNSS or WiFi capabilities.
- **112 Apps** can also only support devices with GNSS or WiFi capabilities and may experience barriers to satisfying ACCE_002 specifying that the caller location should be available to the PSAP without the need for caller intervention. 112 Apps require the caller to be aware of the app and remember to use it in the case of emergency, which can be considered as a needed caller intervention. Additionally, if the user has switched off the location services on the device, the app can not use the handset's capabilities to estimate a location. Lastly, in the case of SMS as a transmission method, the message may remain visible to the user.
- Compliance of a **personal eCall** implementation with the user requirements should be further clarified, because of the need of having an inband modem available on the device, which may exclude some devices.

3.1.2 Precision, accuracy and reliability (ACCU)

- Compliance of a **Network Based Location** with the accuracy and precision requirements depends on the positioning method used by the NBL solution. O-TDOA and GNSS positioning can possibly satisfy the precision requirements required for 95% of the calls, while only GNSS positioning can satisfy the precision requirements required for 67% of the calls, in both urban and rural areas.
- **AML** and **112 Apps** can satisfy the accuracy requirements because they rely on the GNSS and Wi-Fi capabilities of the handset.
- A **personal eCall** implementation could also satisfy the precision requirements, assuming it uses the handset's GNSS and/or Wi-Fi capabilities.

Since currently there are no data to prove that the solutions can satisfy the reliability requirements across the broad range of locations, compliance with reliability requirements can only be confirmed by collecting the necessary data for all calls during the trials.

3.1.3 AML (AML)

AML requirements have been introduced as an extension of the AML solution. They only apply to the AML solution, which does not satisfy them yet, but compliance of the next version of AML is possible and within the scope of the HELP112 project.

3.1.4 Battery life (BATT)

- Battery life requirements are not applicable to a **Network Based Location** solution because it does not depend on the handset capabilities.
- **AML** satisfies all battery life requirements.
- **112 Apps** can satisfy all battery life requirements, depending on the implementation of the app.
- A **personal eCall** solution could also satisfy the battery life requirements.

3.1.5 Incurring charges (CHAR)

All the solutions satisfy the requirements related to achieving a solution that is free of charge to emergency callers. Providing the SMS containing the location information free of charge depends on the MNOs. In the case of a personal eCall solution, these requirements are not applicable, since an eCall is already or will be provided by MNOs as a free call.

3.1.6 Requirements related to the method of estimating the location information (LOCA)

- **NBL** positioning methods at present can not make use of EGNOS and Galileo and it is highly unlikely that MNOs will deploy a Galileo-ready location platform during the HELP112 project and in the near future, due to the resulting cost and their lack of interest for a location platform including GNSS.
- **AML, 112 Apps** and a **personal eCall** can satisfy all requirements. The use of Galileo as described in requirement LOCA_002 depends on the availability of a Galileo enabled chip on the handset.

Requirement LOCA_004 is suggesting complementary solutions and having a fallback solution if the first solution can not provide location data. Requirement LOCA_004 can be achieved by deploying complimentary caller location solutions (i.e. network based solution) and hence does not apply to individual solutions.

3.1.7 Presentation of the location (PRES)

The presentation requirements depend on integrating the location information in the CAD system used by the PSAP. All solutions can satisfy the presentation requirements, assuming the integration is possible.

3.1.8 Privacy (PRIV)

All solutions can satisfy the privacy requirements. However a privacy assessment of the solution is suggested.

3.1.9 Response time (RESP)

All solutions can satisfy the response time requirements. The current implementation of eCall does not use assistance data, which results in longer response times. However, a personal eCall for mobile devices could also use assistance data and reduce the TTFF, but it will still involve a longer time than other transmission methods to transmit the location data from the handset to PSAP, due to using the voice channel. Compliance with the response time requirements by eCall should be validated.

3.1.10 Roaming (ROAM)

- A **Network Based Location** can satisfy the roaming requirements.
- **AML** does not currently support roaming callers. Two approaches are considered and satisfaction of the roaming requirements is envisaged within the timeframe of HELP112.
- **112 Apps** do not satisfy roaming requirements. A pan European approach is needed, like the PEMEA architecture proposed by EENA.
- **eCall** supports roaming callers.

3.1.11 Security (SECU)

All solutions can satisfy the privacy requirements. However, a security assessment of the solution is suggested.

3.1.12 Method transmission (TRAN)

- Method transmission requirements do not apply to a **Network Based Location** solution.
- **AML** does not currently support the transmission methods described in the requirements, the next version of AML can achieve compliance.
- **112 Apps** can satisfy the method transmission requirements, depending on the implementation.
- Method transmission requirements do not apply to **personal eCall**.

3.2 COMPLIANCE OVERVIEW

This section provides an overview of the requirement categories satisfied by each solution. Requirements aiming to extend the AML solution have not been included in the table. The overview below is based on two assumptions:

- The compliance of 112 Apps with the requirements depends on the implementation of the application. The following table assumes an 112 App that can satisfy all requirements possible.
- eCall is not a caller location solution for mobile devices. The following table assumes a personal eCall implementation.

	Can each solution satisfy the requirements (per category)?			
Requirement category	**NBL**	**AML**	**112 Apps**	**eCall**
Acceptance	Yes	Partially, being available on devices supporting GNSS capabilities or WiFi connectivity.	Partially, being available on devices supporting GNSS capabilities or WiFi connectivity. Caller must use the app, considered as a needed intervention.	Yes, if an in band modem can be available in all devices.
Accuracy	Yes, but only some positioning methods in some clutter types can satisfy the precision requirements.	Yes	Yes	Yes
Battery	n/a	Yes	Yes	Yes
Charges incurred	n/a	Yes	Yes	Yes

	Can each solution satisfy the requirements (per category)?			
Requirement category	**NBL**	**AML**	**112 Apps**	**eCall**
Location methods	Partially, except the use of Galileo and EGNOS, also no Wi-Fi positioning.	Yes	Yes	Yes
Presentation	Yes	Yes	Yes	Yes
Privacy	Yes	Yes	Yes	Yes
Response time	Yes	Yes	Yes	Yes – should be confirmed.
Roaming	Yes	No, needs further implementation.	No, requires a pan European architecture.	Yes
Security	Yes	Yes	Yes	Yes
Transmission method	n/a	No, needs further implementation.	Yes	No, only in the case of a NG eCall solution.

Table 4: Overview of requirements satisfaction per category

4. BARRIERS EXPERIENCED IN THE DEPLOYMENT OF SOLUTIONS

The analysis of WP1, as documented in D1.1 Requirements document and D1.2 Analysis of the state of the art, shows that there are several technologies, approaches, and solutions that can enable PSAPs to receive more precise and accurate caller location than the one computed by Cell ID. The gap analysis in the previous section indicates that existing solutions have the potential to satisfy the HELP112 requirements. Considering that the HELP112 requirements are representative of all PSAPs in Europe, two questions are raised. Why haven't these solutions reached a wide deployment across Europe and what barriers are experienced in their potential deployment? The answer to the first question varies for each solution while the answer to the second question mainly depends on the motivation of actors involved, the associated cost and return on investment. This section aims to provide possible answers to the previous questions.

4.1 NETWORK BASED LOCATION

NBL solutions can provide more precise location information than the Cell ID basis currently available in Europe. NBL solution can achieve wide acceptance due to the support of all handsets types. More precise NBL solutions are currently deployed in the international market. Deploying an NBL requires the location platform to be integrated with the Mobile Networks, hence investment in time, efforts and money would likely be required from the Mobile Operators and partly from their network suppliers (by enabling the required interfaces for integration). The lack of feasible Return on Investment (RoI) might be one of the factors limiting the opportunities of having NBL solutions being deployed on a wider scale.

In countries where NBL location platforms are deployed, MNOs are committed to provide accurate location information to the Authorities through Regulation.

Location services are already widely available on smart devices and a vast number of apps make use of them.

4.2 AML

AML is a relatively new solution. It was first deployed in the UK in July 2014, only on handsets of one manufacturer and available on one mobile network. Since the initial deployment, the solution is reaching more handsets and networks. AML has attracted the interest of other countries and its deployment is currently being considered in other member states. A barrier to the deployment of AML is its dependence on the capability of the PSAP to receive SMS messages. However, it should be noted that 20 EU member states provide SMS access to emergency services, while 10 countries provide SMS access to 112[5]. Regardless of the availability of SMS access to emergency services in many countries, AML can also be sent to an IP end point, via HTTPS, providing an alternative to PSAPs that can not receive SMS.

[5] *EENA, "Public Safety Answering Points in Europe, 2015 edition", November 2015, Annex 1, p. 231*

The mobile handset capability to support AML is the second barrier to deployment. AML may be implemented either on the handset operating system or the handset manufacturer's software. Some handset manufacturers have shown support and AML is expected to reach even greater deployment in the next months as one leading OS provider is planning to deploy it and make it available on numerous devices. However, AML should continue to seek support from other OS providers and handset manufacturers to achieve greater acceptance. Interest and deployment of AML have been rapidly increasing because it requires less effort from MNOs compared to other solutions and some handset manufacturers and OS providers have implemented it.

4.3 112 APPS

112 Apps have been one of the first solutions and they were initially considered as a useful approach that can quickly and easily improve caller location. Nine out 28 the member states in Europe currently offer apps[6] and their coverage may vary from national to regional. 112 Apps have received increased attention and rapid deployment because their implementation is straightforward and does not require the involvement of MNOs or handset manufacturers. A PSAP or a NRA only needs to commission the development and operation of an app from an application provider and have the infrastructure to receive the location information in the PSAP. Despite the greater deployment of 112 Apps compared to other solutions, emergency services have realised that apps can not reach a great level of acceptance, because of the disadvantages already described and mainly due to the need for the caller to remember to use the app. Additionally, the need for a pan European architecture for apps or a pan European app has also been acknowledged to satisfy the roaming requirements. A pan European app would experience delays in making it widely available as it assumes close collaboration with manufacturers and defining the entity that would develop and maintain the app.

4.4 ECALL

eCall is a solution for caller location of vehicles involved in accidents. Its concept and design has started more than ten years ago and it is currently in the last stages of deployment. The Member States, including PSAPs and MNOs, will deploy the required infrastructure for receiving and handling eCalls until 1 October 2017 while all new models of passenger cars and light commercial vehicles will be equipped with the eCall system from 31 March 2018.

Personal and NG eCall are studied in the context of HELP112, as solutions for mobile devices originating from eCall. Both personal and NG eCall are solutions that are not currently finalised or implemented, but they are mostly at a conceptual stage. Personal eCall may experience barriers in its deployment due to the need for having an inband modem available on the handset. On the other hand, the availability of the eCall infrastructure to receive emergency calls in the PSAPs is a factor that can help its deployment, but at the same time it should be noted, that in some countries different PSAPs answer 112 calls and eCalls. While NG eCall has the potential to satisfy

[6] *HELP112, "D1.2 Analysis of the state of the art", section 2, p. 10*

the caller location requirements, its dependence on LTE networks will be a barrier to short term deployment.

Although eCall has been in the development phase for a long time, its regulation on 29 April 2015 by the European Parliament and the Council of Europe has driven its deployment to the final stages. Such a regulatory approach provides opportunities to speed the deployment of personal eCall and also other caller location solutions.

5. NEEDS TOWARDS THE DEPLOYMENT OF A CALLER LOCATION SOLUTION

The WP1 analysis clearly shows that there is no need for implementation of new technologies. On the contrary, existing technologies can presently satisfy the requirements of emergency services to receive more precise and accurate caller location. The availability of GNSS and network based positioning methods can provide the required precision and reliability, while the availability of Galileo, in the near future, is expected to improve it even more.

Considering there is no technology gap in reaching a solution, the question shifts to how positioning and transmission methods can be bundled in an architecture. The architecture may create a new solution or reuse an existing one that can reach the maximum number of citizens, in all locations, urban and rural, and in the most cost efficient deployment and operation. HELP112 studies this question on a European level. The challenge of accurate caller location can be technically solved soon as all prerequisites are already met by existing technologies. If the current technologies are used, a high impact on caller location can be achieved and certainly significantly better than what is currently provided by Cell ID.

HELP112 will study and compare the different technologies and collect the necessary data during the trials. The data is collected with the aim to provide enough evidence to lead the formulation of recommendations for the most appropriate emergency caller location architecture and the supporting regulatory framework. A regulatory framework can provide the missing link between end user requirements and the solution deployment and may focus on:

- Support of solutions such as AML or personal eCall by handset manufacturers
- The provision of more precise and accurate network based caller location
- The necessary infrastructure that can solve the roaming caller location requirements
- Free SMS or data transfer for emergency calls or caller location
- The development of a pan European 112 App
- The availability of Galileo enabled chips in mobile devices.

6. RECOMMENDATIONS FOR HELP112

This section provides recommendations for the HELP112 architecture and technical implementation scenarios as a conclusion of the comprehensive analysis performed in WP1.

6.1 DEPLOYMENT OF EXISTING SOLUTIONS

When considering the deployment of the four solutions studied in WP1, it should be noted that all solutions except NBL share some similarities. AML, 112 Apps, and personal eCall include the same positioning methods, different transmission methods and operate on a different software layer. AML uses SMS, 112 Apps can use SMS or IP data and a personal eCall solution would use the voice channel. AML and personal eCall are solutions that operate on the device's operating system or the manufacturer's software while 112 Apps operate on the environment offered by the operating system. This defines the difference of how the process of location estimation and transmission will initiate. In AML and personal eCall the process will initiate automatically when the caller places an emergency call and in an 112 App, the process will initiate only if the user uses the app to launch the emergency call. In this respect, AML and personal eCall could be considered as an 112 app running on the OS layer, resulting in automatic activation of the location calculation process, but also bypassing the potential barrier of the user having switched off the location services of the handset.

When it comes to proposing the deployment of one of these three solutions, 112 Apps would not be suggested, because the need for caller intervention that would require significant effort to raise citizen awareness. This does not mean that 112 Apps should not be developed as they already are, but it should be recognised that these apps can reach a limited percentage of citizens who are aware of the app, download it and will remember to use it when in an emergency. Even a European 112 App being pre-installed on all handsets, wouldn't overcome the need for user intervention.

Furthermore, 112 Apps require a pan European approach to support roaming or even different apps within one country. Resolving the roaming emergency calls is possible and EENA has already been working towards this with PEMEA.

The main difference between AML and a potential personal eCall solution is the location data transmission method. Using the voice channel to transmit the data is not considered appropriate for 112 calls, mainly because the voice call will need to be interrupted and also because it is considered an old fashioned method that may result in long transmission duration and requires implementation of an inband modem on the handset. It should also be considered that a personal eCall solution does not currently exist, it is not standardised and requires further development.

In this respect and taking into account the similarities between AML, 112 Apps and personal eCall, AML would be the only existing solution to be proposed for deployment. AML is already operating for almost two years with good performance, it is currently under standardisation and its extension is already being considered, including a plan to fulfil the roaming requirements.

NBL is a different solution to AML, 112 Apps and eCall and can use the mobile network to calculate the location. This provides the significant advantage of a NBL solution - to be handset and user

independent. However, NBL can satisfy precision requirements only in some cases, e.g. in urban areas or with the lower precision requirement, i.e. greater than 100 metres and with given preconditions on the inter site distance, which may not always be met in remote areas. Nevertheless, NBL should be considered as a good safety net when handset based positioning methods are not available, because of the location type, the atmospheric conditions or because handsets do not have such capabilities. In this respect, NBL may offer higher reliability because of its great availability and despite its lower precision. This conclusion should be proved with the necessary data during the pilots.

The short term recommendations of WP1 on the deployment of existing solutions are:

- Deployment of AML, with implementation of the AML specific requirements and including support of roaming callers.
- Deployment of a NBL solution as a fallback solution if AML can not provide location information.

The above recommendations also comply to the requirement for complementary solutions and the request of the pilot sites that there should be fallback options if the first option can not provide a location.

6.2 RECOMMENDATIONS FOR TECHNICAL SCENARIOS

The previous section looked at existing solutions and provided recommendations inspired by the detailed analysis of each of the four solutions that has been performed in the previous 2 deliverables of WP1. When existing solutions are analysed against the objectives of HELP112 and the end user requirements, one could draw a conclusion that no solution can currently fully satisfy all requirements. Acknowledging the similarities of AML, 112 Apps and personal eCall, AML appears as the solution closest to satisfy most requirements, but some further development is still needed. The technical design and implementation of the architecture that will follow in WP3 will not look at the level of solutions but will analyse possible combinations of positioning and transmission methods to devise the possible technical implementation scenarios. The analysis in WP1 provides the following recommendations for the formulation of technical implementation scenarios, a term that is identical to the term "solution" used in WP1 deliverables.

- Based on the state of the art analysis and the requirements, the ideal caller location solution would use:
    - A hybrid positioning method to estimate the location, including use of GNSS and Wi-Fi.
    - NBL if a hybrid method can not provide a location, or even if it does. NBL can provide an additional location estimate significantly better than Cell ID to confirm the hybrid estimation. NBL is useful in cases Wi-Fi positioning is used, because such locations can not always be trusted due to being prone to inaccurate locations.
    - IP data or SMS to transmit the location. SMS should be used if data connectivity is not available.
    - An automatic method to initiate the location estimation method.
- GNSS positioning can satisfy the precision and accuracy requirements of the HELP112 solution and Galileo has been reported with the potential to improve accuracy and TTFF.

Considering this expected added value of Galileo, HELP112 should consider such implementation scenarios and compare their performance with other methods in the domain of emergency caller location. As soon as mobile devices are equipped with Galileo enabled chipsets and the service is operational, there should be no barrier in using Galileo in the HELP112 solution for E112 calls.

- Considering the lack of data to define precision, accuracy, reliability and response time requirements, it is important to collect such data during the trials.
- Using an IMS based transmission method could be taken into account in the scenarios as a method that is not yet widely available, but will be in the future.

The above suggestions do not provide an exhaustive list of technical scenarios, but only provide recommendations to consider while formulating the scenarios.

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