Help112 II

Contract No 629/PP/GRO/SAT/17/9889

DEPLOYMENT OF ADVANCED CALLER LOCATION SOLUTIONS FOR USE IN EMERGENCY CALLS TO PUBLIC SAFETY ANSWERING POINT

Deliverable D5.1

Project Management Report

Coordinating person: Laurent ARZEL, Telespazio France

Participant No*	Participant organisation name	Country	Acronym
A	Telespazio France (**Coordinator**)	FR	TPZF
B	European Emergency Number Association	BE	EENA
C	Creativity Software	UK/IE	CS
D	PTOLEMUS Consulting Group	BE	PTO
1	Croatian Ministry of Interior	HR	MoI
2	Danish Greater Copenhagen Fire Rescue Department	DK	GCFD
3	French Ministry of Interior	FR	DGSCGC
4	Integrated Control Centre of Freiburg	DE	ILSFR
5	National Infocommunications Service Company	HU	NISZ
6	Portuguese Ministry of Internal Administration	PT	SGAI
7	SOS Alarm	SE	SOS

CHANGE RECORDS

ISSUE	DATE	CHANGE DESCRIPTION	AUTHORS
0.0.0	20 Apr 2020	Creation of the Document	L. Arzel C. Morisot-Pagnon A. Gizikis B. Vivier C. Reeve A. Lodieu
1.0.0	18 Jun 2020	Review before submission	A. Pomies
1.1.0	28 Jul 2020	Correction of Final Review RIDs: - RID 18: Typo on Galileo OS declaration date - RID 19: Recommendation 9.1.1 changed to Monitoring AML deployment progress - RID 20: Rephrasing D1.3 description - RID 21: "GPS as primary constellation" removed - RID 22: NG112 : Recommendation 9.3.3 removed - RID 23: Clarification on AML deployment in EU MS - RID 24: Recommendation 9.1.3 changed to Awareness activities - RID 25: Correction of EC role in harmonised standards - RID 26: Wording "exploitation" changed to "usage" - RID 27: More details in recommendations 9.4.2/3/4 - RID 28: Addressees and priority order added to recommendations - RID 29: Proofreading - RID 30: Clarifications on adding speed/course/altitude - RID 31: Clarifications on figure 5-12 - RID 32: Rephrasing WP2 main conclusions - RID 33: More details on figure 5-15 - RID 34: Clarification on dual frequency impact Inclusion of DG-CNECT comments	A. Gizikis C. Morisot-Pagnon L. Arzel N. Stamps

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LIST OF ABBREVIATIONS

3GPP - 3rd Generation Partnership Project

A-GNSS - Assisted Global Navigation Satellite System

AML - Advanced Mobile Location

API - Application Program Interface

CAD - Computer-aided dispatch

CAPEX - Capital expenditures

EC - European Commission

EECC - European Electronic Communications Code

EGNSS - European Global Navigation Satellite System

EMTEL - Emergency Telecommunications

ETSI - European Telecommunications Standards Institute

EU - European Union

FOC - Full Operational Capability

FR - Final Review

GNSS - Global Navigation Satellite System

GPS - Global Positioning System

GSA - European GNSS Agency

GSM - Global System for Mobile Communications

IP - Internet Protocol

IPR - Intellectual Property Right

IR - Intermediate Review

KO - Kick-Off

KPI - Key Performance Indicator

LBS - Location based Services

LTE - Long-Term Evolution

MEP - Member of the European Parliament

MNO - Mobile Network Operator

MS - Member State

NG112 - Next Generation 112

NPV - Net Present Value

OPEX - Operating Expenditures

OS - Open Service

OS-NMA - OS Navigation Message Authentication

PCO - Project Control Office

PM - Progress Meeting

PPP - Precise Point Positioning

PSAP - Public Service Answering Point

PTR - Post Test Review

PVT - Position Velocity Time

R&D - Research & Development

RID - Review Item Discrepancy

RMS - Root Mean Square

RTK - Real Time Kinematics

SIM - Subscriber Identity Module

SLA - Service Level Agreement

SMS - Short Message Service

STD - STandard Deviation

SUPL - Secure User Plane Location

SV - Space Vehicle

TDOA - Time Difference of Arrival

TL - Task Leaders

TM - Technical Manager

TOA - Time of Arrival

TRR - Test Readiness Review

TS - Technical Specifications

TTFF - Time To First Fix

WP - Work Package

WPL - Work Package Leader

1. EXECUTIVE SUMMARY

Emergency caller location is the most important piece of information for both PSAPs and first responders. Ensuring it is accurate, reliable and timely saves lives and significant emergency services resources.

Back in 2016 and early 2017, the Help112 pilot project studied and evaluated the merits of different caller location solutions and concluded by proposing the use of handset-based technologies to improve the location of emergency callers. The Help112 pilot project demonstrated that handset-based location solutions 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. More specifically, the project proposed wider deployment of the handset-based caller location method, called **Advanced Mobile Location** protocol (AML), by demonstrating both the advantages and the feasibility of deploying it within four European Member States: Austria, Lithuania, Italy, and the UK.

The AML has been deployed in several countries during the last few years and has already provided observations proving its effectiveness in improving emergency response. The AML is one technological solution that can be deployed and operated by Member States to be compliant with the European Electronic Communication Code (Directive (EU) 2018/1972) that shall be transposed into national laws by the 21st of December 2020.

Building on the Help112 pilot project experience and success, combining their complementary expertise in project management, GNSS applications, mobile caller location technology, 112 emergency calls and AML, connectivity and location-based technology markets, the consortium core partners **Telespazio France, EENA, Creativity Software** and **Ptolemus** conducted the Help112 II project between November 2018 and June 2020 with seven Member States not using AML yet, represented by national and regional authorities: **Croatia** through the Ministry of Interior; **Denmark** through the Greater Copenhagen Fire Rescue Department; **France** through the Ministry of Interior; **Germany** through the Integrated Control Centre of Freiburg; **Hungary** through NISZ – National Infocommunications Service Company; **Portugal** through the Ministry of Home Affairs; **Sweden** through SOS Alarm.

The Help112 II project objectives were to:

❶ Deploy AML in Croatia, Denmark, France, Germany, Hungary, Portugal, and Sweden, and setting up live operation monitoring, and provide recommendation on improving the use of Galileo in emergency communications;

❷ Assess the benefits of Galileo in emergency caller location by conducting extensive field testing with mass market handsets in various environment and multiple scenarios in the seven Member States;

❸ Support the rest of European Member States in deploying AML, with the provision of an AML deployment and operation user guide, and its dissemination via a European workshop gathering as many representatives from Member States as possible;

❹ Analyse the economic impacts of deploying AML in the Member States that have already deployed AML, and assess the compliance of the AML deployment with European and National privacy laws.

Despite technical and legal hurdles related in particular to data privacy legislation and uneven MNOs support, the **AML** has been **deployed successfully on Android** in **all 112 PSAPs** in **Croatia**, **Denmark**, **Hungary**, and Sweden while **partially** in the three other countries but sill covering **87% of the population in France**, **79% in Germany**, and **95% in Portugal**.

AML performance live data have been collected to initiate the required monitoring process, showing an average AML success rate of 45% which is in line with what observed in countries that have deployed AML outside the project. The feedback from PSAPs and other stakeholders highlighted that enabling zero-rating for AML roamers with the common deployment solutions (SMS to a long number or HTTPs) was not possible without EU intervention to coordinate all European MNOs.

Thanks to Help112 II project, AML deployment in Europe reached more than 50% of European Member States.

Professional testing have been carried out in all these countries with the support of local PSAPs in various environments and multiple scenarios representative of emergency communications, demonstrating unequal handset behaviors and performance depending on various parameters such as the use of Galileo and dual frequency chipset, as well as the average optimal triggering time to send an AML with an improved accuracy (~25 seconds after call initiation).

AML deployment and operation guidelines have been developed and presented on May 5th 2020 to representatives of all EU member states that have not deployed AML yet, opening the floor to share extensively practical experience on deploying AML.

Cost-benefit analysis have been carried out for Austria, Belgium, Estonia, Finland, Lithuania, and The UK, **over a 10 year period** with **measurable benefits** per country such as:

- from 14 seconds to 45 seconds saved per call;
- between 379 and 5276 lives saved;
- between 5.30 every 100,000 calls to 18.67 every 100,000 calls benefit from AML that lead to a dispatch;
- total Net Present Value from €349 million to €11,102 million.

The Help112 II project **recommended further activities to improve the overall impact of the AML on European citizen safety**, regarding the availability of the AML to European citizens, the quality of the AML generated by the handset, the quality of the AML transmission from the handset to the PSAP, and the quality of the AML exploitation by the PSAP.

Although handset-derived location shall be implemented in emergency communications by all EU Member States with the application of the EECC directive before the 21st of December 2020, the timely **AML deployment** in the **nine remaining Member States** might be challenging due to the complexity of their respective national PSAP structures and administrative organisation also involving external and powerful market players such as Google and Apple. On top of **supporting these Member States**, the project recommends to focus on improving the AML success rate, **standardizing the AML computation** in the handset to ensure a higher level of accuracy and reliability, and **developing an AML performance monitoring system** to further optimize emergency responses. In addition, EU level coordination might be needed to ensure the O rating of caller location for all roaming end-users.

2. DOCUMENT OVERVIEW

2.1 SCOPE OF THE DOCUMENT

This document is the Final Report of the Help112 II project, recalling the project objectives, describing the performed activities, and concluding with a list of recommendations to support a further improvement and adoption of the advanced emergency caller location solution introduced with the Help112 initiative.

The final report covers the whole project period going from the project Kick-Off, 13th November 2018, until the completion of the project with the approval of the present document.

2.2 STRUCTURE OF THE DOCUMENT

The present document is structured as follows:

- Section 1 contains the Executive Summary;
- The present section contains the scope and the structure of this document;
- Section 3 reminds the project objectives and organization;
- Section 4 describes the WP1 activities: AML deployment;
- Section 5 describes the WP2 activities: AML and GNSS testing;
- Section 6 describes the WP3 activities: PSAP user guide;
- Section 7 describes the WP4 activities: Economic analysis;
- Section 8 describes the WP5 activities: Project management;
- Section 9 provides the Project recommendations;
- Section 10 concludes the document.

2.3 APPLICABLE & REFERENCE DOCUMENTS

2.3.1 Applicable Documents

AD	Title of the document & reference
AD1	Call for tender 629/PP/GRO/SAT/17/9889 from European Commission https://etendering.ted.europa.eu/cft/cft-display.html?cftId=2678

Table 2-1 – Applicable documents

2.3.2 Reference Documents

RD	Title of the document & reference
RD1	Help112 project https://ec.europa.eu/growth/content/help112-project_en

Table 2-2 – Reference documents

3. THE HELP112 II PROJECT

3.1 THE CHALLENGES

In 2015-2017, the Help112 project [RD1] studied and assessed several emergency caller location methods and concluded by proposing wider deployment of the Advanced Mobile Location protocol (AML) by demonstrating both the advantages and the feasibility of deploying it within four European Member States: Austria, Lithuania, Italy, and the UK.

With the Help112 II project, the European Commission aimed to expand this solution to seven other Member states, thus helping them to be compliant with the European Electronic Communications Code (Directive (EU) 2018/1972) that shall be transposed into national laws by 21st December 2020.

Additionally, the European Commission wanted to proceed with the recommendations exposed in the Help112 final reports, and in particular, to assess the impact of using Galileo being now widely adopted by the mobile phone industry is widely adopting it since December 2016 when Galileo Open Services have been declared.

The tender specifications [AD1] were translated into six high level objectives presented in Figure 3-1 showing also the way these objectives were fulfilled during the project.

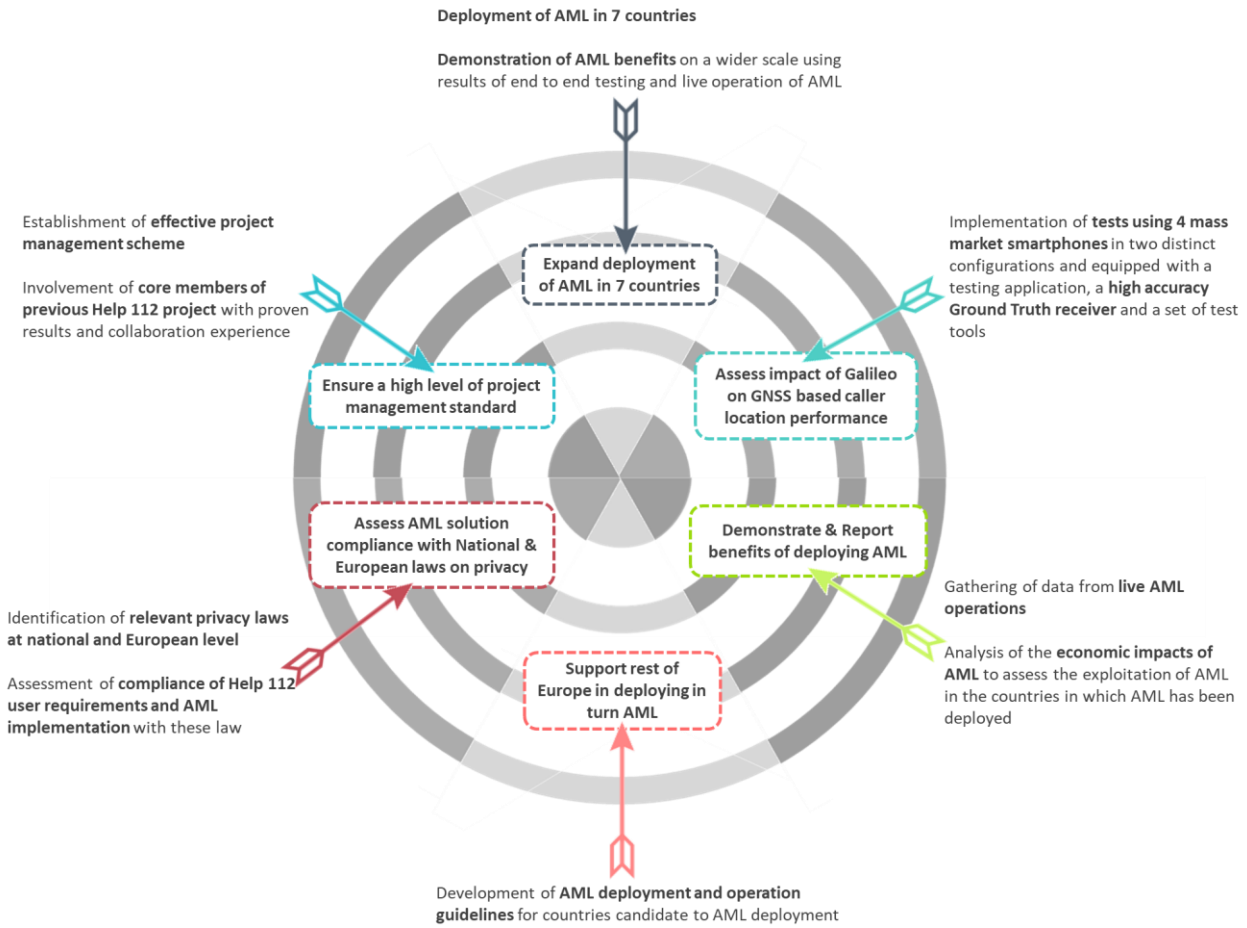


Figure 3-1 – Help112 II Objectives and their fulfilment

3.2 THE PROJECT

The implementation of the HELP112 II was structured in five work packages mapping the tasks identified in the Call for Tender [AD1], as represented here below:

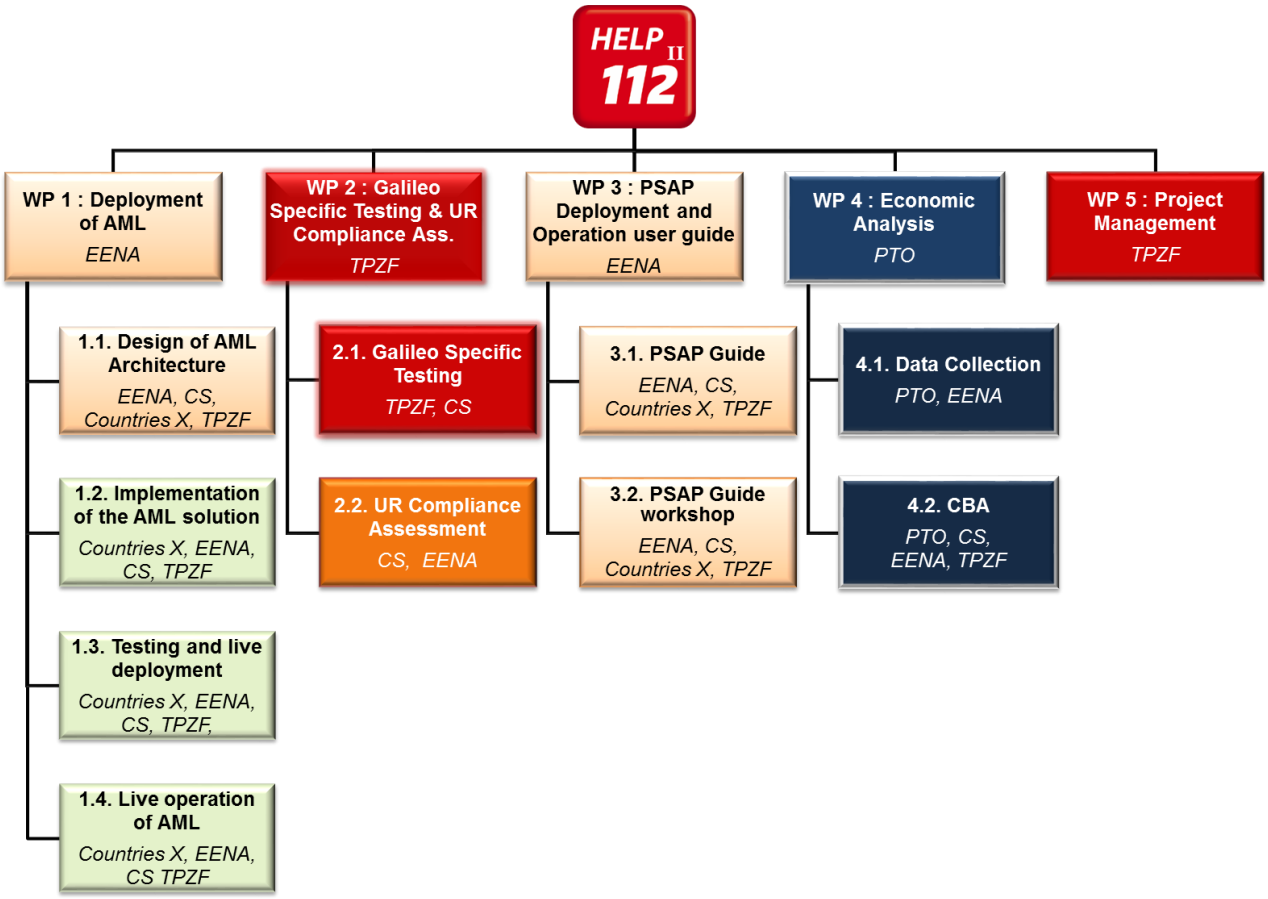


Figure 3-2 – Work Breakdown Structure

TPZF was in charge of coordinating the work of the consortium (WP 5) and to perform Galileo specific testing activities (WP 2).

EENA led and coordinated the deployment of AML in the selected Member States (WP 1), as well as the development of the AML deployment guide and operation user guide and the related dissemination activities (WP 3).

PTO was responsible for the economic analysis of AML deployment (WP 4).

CS acted as a technical support for AML deployment guidelines (WP3), and all testing activities (WP 1 and WP 2).

Countries were in charge of AML deployment in their territory along with the related testing and live operation monitoring activities (WP 1).

The project activities and deliverables are summarized by WP in the following tables.

Task	Leader	Activities	Deliverables
T1.1	EENA	• Specify the AML architecture of each Member State and how AML will be deployed • Prepare an implementation plan per Member State • Review the impact of Galileo and how AML handset-based locations can benefit from the availability of Galileo signals	D1.1.x[1]: Deployment of AML per country D1.3: Recommendations for fostering Galileo user uptake
T1.2	Each Member State	• Carry out and monitor the implementation plan • Ensure the necessary infrastructure is deployed	D1.2: Deployment Report (global)
T1.3	Each Member State	• Prepare the end to end test specification • Carry out the end to end testing to validate the functioning of AML • Report the end to end test results	No separate deliverable for this task. The results of this task have been reported in D1.1.x and an overview will be provided in D1.2.
T1.4	Each Member State	• Collect data from the live operation of AML • Derive statistics from the collected data	No separate deliverable for this task. The results of this task have been reported in D1.1.x and an overview will be provided in D1.2.

Table 3-1 – WP1 activities and deliverables

Task	Leader	Activities	Deliverables
T2.1	TPZF	• Testing equipment selection and procurement • Testing procedures and tools preparation • Testing sites selection • Test execution • Test result analysis	D2.1: Test plan D2.1.2: GNSS test report (cold) D2.1.3: GNSS test report (warm) D2.3: Report on all tests
T2.2	CS	• Critical analysis of the User Requirement • Test result analysis	D2.2.x: User requirement compliance assessment reports D2.3: Report on all tests

Table 3-2 – WP2 activities and deliverables

1 "x" is a figure representing the country where the AML were deployed and tests executed: 1 – Croatia, 2 – Denmark, 3 – France, 4 – Germany, 5 – Hungary, 6 – Portugal, 7 – Sweden.

Task	Leader	Activities	Deliverables
T3.1	EENA	• Develop a PSAP deployment manual and operation user guide • Develop procedures for live operation monitoring	D3.1: PSAP user guide
T3.2	EENA	• Organize a workshop to present the PSAP Deployment Manual and Operation User Guide, and share experience and best practices	D3.2: PSAP user guide introduction workshop

Table 3-3 – WP3 activities and deliverables

Task	Leader	Activities	Deliverables
T4.1	PTO	• Collect field data in relevant country organizations • Interview emergency operations stakeholders to evaluate AML benefits • Analyse compliance of AML implementations and the Help112 user requirements	No separate deliverable for this task. The results of this task have been used for D4.1.y[2]
T4.2	PTO	• Develop a country level cost-benefit analysis framework • Carry out an analysis of operational and social benefits of AML in the 7 countries • Evaluate the associated costs to implement AML in each of those countries • Organize a restitution of the results to the interested countries	D4.1.y: Economic analysis report of AML per country D4.2: Economic analysis report of AML (all analysed countries comparison)

Table 3-4 – WP4 activities and deliverables

[2] *"y" is a figure representing the country for which a CBA has been developed: 1 – Belgium, 2 – Estonia, 3 – Austria, 4 – Finland, 5 – Ireland, 6 – Lithuania, 7 – UK*

Task	Leader	Activities	Deliverables
T5	TPZF	• Set up an appropriate organization for management and decision making; • Develop and make operational the tools needed to implement management; • Address all legal and contractual obligations; • Carry on project monitoring; • Define and implement a risk management method	D5.1: Project management report

Table 3-5 – WP5 activities and deliverables

3.3 THE CONSORTIUM

The Help112 II has been carried out by a well-balanced and consistent consortium based on complementary skills, as well as a robust background and relevant references in the domain of E112 services and GNSS, supplemented by 7 Member States that have been selected for the project, namely Croatia, Denmark, France, Germany, Hungary, Portugal, and Sweden.

Figure 3-3 – Help112 II Consortium

TELESPAZIO
a LEONARDO and THALES company

Major player in Space Applications development

Telespazio is part of the Space Alliance with Thales Alenia Space, where Telespazio's role is to turn technologies developed by TAS into actual applications and services.

Telespazio France has a proven **record of management capabilities and quality processes** on projects ruled by Service Level Agreements (SLA) with demanding KPIs (Key Performance Indicators), thanks to multiple maintenance projects conducted for ESA, GSA, CNES (French Space Agency) and IRSN (French Nuclear Safety Institute). Telespazio France is member of the EENA advisory board since 2018. The Telespazio France Navigation team is deeply committed along with European institutions to developing innovative solutions for European citizen safety with projects such as **Help112** and **GRALLE**, as well as contributing to **Galileo Search and Rescue** Operations with CNES, which reflects Telespazio France ambition to be the **European Leader in satellite-based emergency services**.

Telespazio successfully led the previous Help112 project, and the project team members have a recognized expertise in GNSS systems and a thorough experience in conducting professional GNSS field testing which made them particularly suited to assume its responsibility in the Help112 II project.

EENA has a **recognised and extensive expertise in AML** and in all aspects related to 112 emergency calls, including mobile phone hardware and software, mobile networks, public service answering points and EU and national emergency call regulations.

EENA is closely **following the deployment of AML in many countries** and has played an important role in promoting the solution by travelling to the countries and bridging between the emergency services and Google Android. It is a strong advocate of the importance of **providing location information to emergency services** as the fundamental prerequisite for achieving rapid responses, locating callers who are not able to report their location, identifying false calls and optimizing emergency service resources.

eena
EUROPEAN EMERGENCY NUMBER ASSOCIATION

Non-profit association for promoting actions to improve the quality of emergency services in Europe.

EENA's strong expertise in 112 emergency calls and AML as well as its work towards improving emergency responses in Europe and beyond made it a key actor in the Help112 II project.

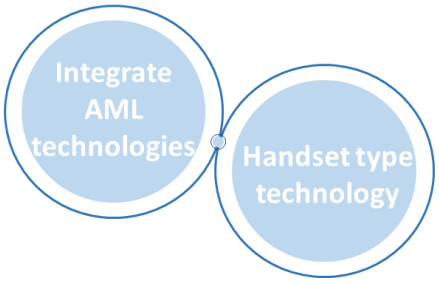
Creativity Software has developed technologies that enable the **location of mobile callers to emergency services** (and other customers) to be determined with up to 50 meters accuracy in urban areas, based on mobile network data only. Their technology is handset type independent and is audited daily – for instance by the government of Colombia where the company has also deployed AML.

CS has deployed their solutions in Latin America, Europe, Middle East, Africa and Asia, supporting the public safety, security and mobile operators. In total, CS solutions have been installed in networks that cover over 500 million mobile subscribers worldwide.

As a specialist in AML technology integration, CS was particularly suited to provide technical support in the Help112 II project.

creativity software

Global specialist supplier of mobile caller location technologies



PTOLEMUS Consulting Group

Highly-recognised strategy consulting firm focused on connected geo-location markets and technologies.

Since 2008, Ptolemus has performed more than 50 consulting assignments **focused on connectivity and location-based technologies and markets**. It published several reference reports on the location technologies and markets, notably the European Location Study, the Usage-based Insurance Global Study and the Electronic Toll Collection Global Study.

As an **advisory board member of EENA** since 2011, Ptolemus has been actively involved in the subject of caller location since then, notably by contributing to EENA's Operations Document "Caller Location in Support of Emergency Services".

Ptolemus is quoted by major publications such as The Economist, the Wall Street Journal or the Financial Times.

Since it has already helped clients such as the European Commission on emergency services and positioning-related subjects, Ptolemus was particularly suited to perform the economic analysis of AML deployment for the Help112 II project.

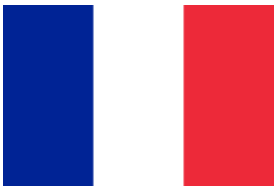
Croatian National Protection and Rescue Directorate

The State Protection and Rescue Administration (DUZS) was an independent, professional and administrative organization in the Republic of Croatia that prepares, plans and manages operational forces and coordinates the activities of all protection and rescue participants. This organisation joined the Ministry of Interior during the project.

DUZS is the **leading organization of protection and rescue of people, goods and environment acting nationwide**, in the Republic of Croatia. It has **established and maintains a modern protection and rescue system**, capable of responding to the needs of all available resources in protecting people, goods and the environment in the threats, sufferings and other challenges of modern society.

Danish Greater Copenhagen Fire Rescue Department

The Copenhagen Fire Rescue Department was established in 1687 and its tasks include an ambulance service, the smoke diver service and the pioneer service. In 1965, the Alarm and Control Room at the main fire station took over as the **emergency control centre for the entire Greater Copenhagen Area (112 PSAP)**. The patient transportation service was added in 1974, while the most recent addition is the civil emergency preparedness system which was created in 1998.



French Ministry of Interior

The entity in charge of the **organization of the reception of emergency calls like 112** is the Bureau for organization and missions of fire and rescue services, as part of the French Ministry of Interior and more especially of the general directorate of civil safety and crisis management (DGSCGC).

The DGSCGC is responsible for **crisis management** with planning, expertise, national capabilities (land and air forces), population alert and operational centre. In addition, it coordinates the fire-fighters department with training, text management, organization and missions of fire and rescue services.

German Integrated Control Centre of Freiburg

The Integrated Control Centre is a joint institution of the city of Freiburg, the district of Breisgau-Hochschwarzwald and the non-profit rescue service GmbH of the German Red Cross. The Integrated Control Centre Freiburg **receives all emergency calls from the area** of the city of Freiburg and the district of Breisgau-Hochschwarzwald and is **responsible to alert the responsible task forces**.

Hungarian National Infocommunications Service Company

The National Infocommunications Service Company (NISZ) provides governmental telecommunications and IT services.

NISZ has collaborated with other entities to deliver the Integrated Emergency System in 2014. The objectives of the new system are to **increase the speed of emergency response services and reduce the number of false calls**. The project also included the construction of two new Emergency Call Centres in Miskolc and Szombathely and a major **upgrade of the IT systems used at the Emergency Call Centres**, as well as the

modernization of info-communication tools (technologies, devices, systems) at the emergency services.

Portuguese Ministry of Internal Administration

The Ministry of Internal Administration is responsible for the public security, the civil defense, the electoral administration, the road traffic safety and the immigration and refugee affairs. The Critical Communications Division operating under the General Secretariat of Internal Administration is one of the entities of the Ministry of Internal Administration.

It is among other things **responsible for deployment of the 112.pt project**[3]. It liaise and **cooperate with the technical teams of the 112.pt solution** providers (outsourcing team), and ensures the correct implementation of the technical solution and **effectiveness of the 112.pt service**.

Swedish SOS Alarm

SOS Alarm is a publicly owned company founded in 1973, and is jointly owned by the Swedish State and the county councils and municipalities. SOS is appointed by the Swedish state to **handle calls on the single emergency number 112 in Sweden**. SOS Alarm also handle calls to the National Information Number 113 13 number (for the public to get/leave information in case of serious accidents or crisis situations) and the number 116 000 for Missing Children.

[3] http://www.112.pt/

4. WP1: DEPLOYMENT OF AML

This section describes the work completed in WP1 dealing with the deployment of AML the 7 selected Member States.

WP1 has been led by EENA.

4.1 OBJECTIVES & REQUIREMENTS

The objectives of WP1 according to the Call for Tender [AD1] were to:

1. Design the AML architecture and produce an implementation plan for each Member State;
2. Carry out the necessary AML implementation and end to end testing;
3. Deploy AML in a live operation environment;
4. Report the AML live operation monitoring;
5. Provide recommendations for Galileo user uptake.

In order to support these objectives, the Tender Specifications [AD1] provided the following requirements:

REQ-WP1-01 AML shall be deployed in at least 7 additional Member States where AML has not been deployed and which were not part of the Help112 pilot project, following European Telecommunications Standards Institute (ETSI) AML Technical Report (TR) 103 3936.

REQ-WP1-02 AML Full deployment shall be achieved in the entire territory of at least 4 Member States.

REQ-WP1-03 AML Partial deployment shall be achieved in at least three Member States covering at least 1/3 of all PSAPs (Public Safety Answering Point) in those countries.

REQ-WP1-04 AML roaming capability shall be demonstrated in the Member States in which AML is being deployed.

REQ-WP1-05 The possibility of facilitating use of Galileo signals within an upgraded PSAP architecture shall be investigated in the selected Member States.

The following clarification have been discussed and agreed during the course of the project:

AML full deployment (**REQ-WP1-02**) is fulfilled in a given Member State if AML is triggered when anyone calls 112 anywhere in the entire territory of the Member State, and the AML is received by the PSAP answering the 112 calls.

AML partial deployment (**REQ-WP1-03**) is fulfilled in a given Member State if at least one of the three following conditions is met:

- at least 1/3 of all Member State PSAPs can receive the AML,
- at least 1/3 of the Member State area is covered by PSAPs able to receive and the AM
- at least 1/3 of the Member State citizens are covered by PSAPs able to receive the AML

Roaming capability (**REQ-WP1-04**) is demonstrated if the technical solution is setup and agreed by the stakeholders (e.g. long number agreed with MNOs) although not implemented yet.

4.2 WORK ACHIEVED

4.2.1 Design of AML Architecture & Implementation Plan

All countries designed their AML architectures depending on the infrastructure already available and taking into account the existing PSAP structure. After the architecture was decided, an implementation plan was defined. The implementation plan was followed during the project and until the final deployment of AML. Initially, each country prepared a detailed implementation plan. The 7 detailed implementation plans were then cross-referenced to a unified plan, by referring each step of the national plans to one of the six generic processes that have been defined and agreed for the deployment of AML:

1. **AML Architecture**
    a. Architecture selection/design
    b. Implementation plan preparation
2. **Legal Arrangements**
    a. Legal assessment of AML and authorisation from the appropriate authorities
    b. Legal compliance is confirmed
3. **AML Implementation**
    a. All implementation needed on a central level to receive AML in all or some PSAPs of the member state, including SMS entry points, gateways, location server, procurement, etc. It should also include CAD integration at least for some PSAPs so that end to end testing can be carried out.
4. **End to End Testing**
    a. Testing to validate the operation of AML
5. **PSAP Integration**
    a. Enabling PSAPs or additional PSAPs to receive AML
    b. This step is mostly needed in member states with regional 112 implementations, which start deployment with a limited number of PSAPs and are later integrating more PSAPs.
6. **Live Deployment**
    a. Live deployment of AML with Android (and iOS when possible)

Process	Country	Nov 18	Dec 18	Jan 19	Feb 19	Mar 19	Apr 19	May 19	Jun 19	Jul 19	Aug 19	Sep 19	Oct 19	Nov 19	Dec 19	Jan 20	Feb 20	Mar 20	Apr 20
AML Architecture	Croatia	x	x	x															
	Denmark	x	x	x															
	France	x	x	x	x	x													
	Germany	x	x	x															
	Hungary	x	x	x															
	Portugal	x	x	x															
	Sweden	x	x	x															
Legal Arrangements	Croatia			x	x	x	x	x	x	x	x								
	Denmark			x	x	x													
	France									x	x	x	x						
	Germany			x	x	x	x												
	Hungary				x	x	x	x	x	x	x	x	x						
	Portugal			x	x	x	x	x	x	x	x	x	x	x					
	Sweden	x	x	x	x	x	x	x											
AML Implementation	Croatia				x	x	x	x	x	x	x	x	x	x	x				
	Denmark						x	x	x										
	France					x	x	x	x	x	x	x	x						
	Germany				x		x	x											
	Hungary			x	x	x	x	x	x	x									
	Portugal	x	x	x	x	x	x	x	x	x									
	Sweden			x															
End to End Testing	Croatia									x	x	x							
	Denmark								x										
	France											x	x						
	Germany						x												
	Hungary									x	x	x	x						
	Portugal							x	x	x	x	x	x						
	Sweden							x											
PSAP Integration	Croatia										x	x	x	x	x				
	Denmark									x									
	France										x	x	x	x	x				
	Germany							x	x	x	x	x	x	x	x				
	Hungary													x	x				
	Portugal	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	Sweden	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
AML Live Deployment	Croatia											x	x	x	x				
	Denmark								x	x	x	x	x	x	x				
	France													x	x	x	x	x	x
	Germany						x	x											
	Hungary													x	x	x	x		
	Portugal									x	x	x	x	x	x	x	x		
	Sweden								x	x	x	x							

Symbol	Meaning
x	Process is running
-	Process is not needed

Figure 4-1 – Implementation plans in the member states

The consortium experienced some deviations from the initial implementation plans. The deviations can be summarized and mostly attributed to 2 main reasons.

The first reason is the time needed for the confirmation of legal compliance. Legal arrangements require the involvement of several entities within each country, resulting in a more complicated and time-lengthy process. In some cases, a privacy impact assessment was required before the legal conformance, adding more time to the plan.

Technical issues are the second reason for deviation from the initial plans. They are experienced by some MNOs, in some countries, before or during the activation of AML by the OS vendors. Such issues are not identified during the end to end testing and are usually caused by specific network

configurations that prove to prevent AML or reduce it success rate. While they have proven easy to resolve, they can add additional time needs in the already existing implementation plans.

4.2.2 End to end testing

End to end testing refers to testing the AML functionality from the handset where AML is triggered to the PSAP that has answered the emergency call. The end to end tests have been designed to highlight functionality that would be expected of a typical AML deployment. However, functionality can be implemented at different layers depending upon the architectural considerations.

The end to end testing followed the test scenarios documented in section 5 of D1.2 Deployment Report (global) and are provided in Table 4-1. The test scenarios cover all aspects of the AML operation, including the AML trigger, the delivery timescales, the format and validation of the SMS and HTTPS message, the location server logic, the security of the infrastructure hosting the AML operation, and the PSAP CAD systems.

Test	Title	Description
Billing		
B001	Zero cost billing	Confirm that all MNOs and MVNOs have zero-rated all SMS to all numbers that will be used for AML. This will include long and short numbers where used. A statement from the MNO/MVNO that this has been actioned can be considered as evidence.
AML Trigger		
T001	All MNO AML support	Test the receipt of AML location for all MNOs and MVNOs within the country.
T002	Roaming support	Test the correct receipt of AML for a roaming number. It is recommended to validate against more than one roaming country
T003	Test multiple trigger numbers	Test cases T001, T002 for all trigger numbers.
T004	No data call	Turn data off – make an emergency call. Confirm that an AML location is generated (note this may be an « error » location)
T005	Long running call	Test a long running call – confirm that multiple AML locations are received according to the set schedule.
Delivery Timescales		
D001	Delivery time	Confirm the delivery time from call receipt to delivery of AML location is within the target time.

Test	Title	Description
AML Message Format		
A001	Binary message format	Confirm that binary message AML format is supported
A002	Text message format	Confirm that plain text AML message is supported.
AML Message Validation (SMS)		
V001	Standard success	Confirm correct parsing and validation of a standard AML message
V002	Invalid location rejection	Test rejection of location when validated against network location.
V003	No location	Confirm correct behaviour when no location is returned in AML message
V004	Invalid date	Test correct handling of location when date is in the future, or significantly in the past.
V005	Incorrect format – partial dataset	Confirm handling of incorrect/corrupt AML messages where not all fields are present
V006	Incorrect format – invalid data types	Confirm handling accidental or malicious AML messages with incorrect datatypes in fields (e.g. characters in longitude, latitude)
V007	Incorrect format – oversize fields	Confirm handling of fields (e.g. IMEI) where data is oversized to standard entries.
V008	Unsolicited AML	Test receipt of AML messages that are not associated with an emergency call
AML Message Validation (HTTPS)		
V009	Basic success case	Confirm basic validation of message with MSISDN present
V010	Missing MSISDN	Confirm correct behaviour when MSISDN is not present.
V011	Partial dataset	Confirm correct behaviour when partial datasets are received.
V012	Unsolicited data	Confirm handling of location data not relating to emergency calls. Large volumes of unsolicited data should be tested to confirm defence against malicious attack.
V013	Invalid data	Confirm rejection of data not related to network location

Test	Title	Description
V014	Malicious formatting	Confirm rejection of partial datasets, excessive data content and invalid datatypes
Location Server Logic		
L001	Correlation HTTPS & SMS	Confirm correlation between SMS and HTTPS data where applicable
L002	Best location	Confirm best location is delivered to CAD system, where single best location strategy is being used.
Infrastructure & Security		
I001	Security review	Confirm a cyber security review has been made of the platform, including penetration tests for deployments where HTTPS endpoints are exposed.
I002	Google Vendor Security Assessment	Run the AML server operating entity (i.e. PSAP or other organisation) through the Google Vendor Security assessment process.
I003	Failover & failback	Confirm testing of failover and failback on local ang geographical basis.
PSAP CAD (once per software vendor)		
C001	Success case	Test basic success case, call is accepted, and location is correctly displayed on CAD system
C002	No location	Test no location available scenario
C003	Multiple location	Confirm correct CAD behaviour for multiple location data.
C004	Multiple datasource	Confirm CAD correctly identifies locations from multiple datasources where this data is available
C005	Best location	Confirm the best location is offered to the CAD user
C006	Call & location	Confirm call is received and location supplied without affecting the call
C007	Confidence level	Confirm a consistent confidence level is used for all locations displayed to the agent.

Table 4-1 – AML deployment dates per member state and OS

Since the tests depend on the choice of AML transmission methods (SMS/HTTPS) and the deployment configuration, e.g. the predefined intervals of receiving location information, some of the test scenarios are not applicable in some deployments. To clearly indicate this in the reports, a list of possible results for each test was used, which can contain any of the values described in Table 4-1.

Result	Description
Pass	indicates that the test has been successful
Fail	indicates that the test has not been successful
Not Tested	indicates that the test has not been performed, e.g. not yet or it could not be tested/completed
Not Applicable	indicates that the test is not applicable due to the AML architecture, implementation strategy or configuration.

Table 4-2 – Definition of possible values of end to end test results

When the result value is "Not Tested" or "Not Applicable", explanations have been provided in the test reports. Table 4-2 shows the end to end test per test result value and member state.

Result	Croatia	Denmark	France	Germany	Hungary	Portugal	Sweden
Pass	23	25	22	26	24	35	22
Fail	0	0	0	0	0	0	0
Not Tested	1	0	2	1	1	0	2
Not Applicable	11	10	11	8	10	0	11
Total	**35**	**35**	**35**	**35**	**35**	**35**	**35**

Table 4-3 – End to end test per test result value and member state

Each member state performed the end to end testing according to their implementation plan and reported the results in the respective D1.1.x deliverables. Additionally, an overview is provided in D1.2 and Table 4-4 below. All member states have selected the tests to perform, completed the tests and considered the testing successful before the activation of AML on Android and iOS.

Test	Title	Result						
		Croatia	Denmark	France	Germany	Hungary	Portugal	Sweden
Billing								
B001	Zero cost billing	Pass	Pass	Not Tested[4]	Pass	Pass	Pass	Pass
AML Trigger								
T001	All MNO AML support	Pass	Pass	Pass	Pass	Pass	Pass	Pass
T002	Roaming support	Pass	Pass	Pass	Pass	Pass	Pass	Pass
T003	Test multiple trigger numbers	Not Applicable[5]	Pass	Pass	Pass	Pass	Pass	Not Applicable[6]
T004	No data call	Pass	Pass	Pass	Pass	Pass	Pass	Not Applicable[7]
T005	Long running call	Not Applicable[8]	Pass	Pass	Pass	Pass	Pass	Not Applicable[9]
Delivery Timescales								

[4] *Confirmation from MNOs*

[5] *Tested only 112 emergency number*

[6] *112 only*

[7] *SMS only*

[8] *Not available on ELS Manager App*

[9] *2 positions from Android and 1 from iOS*

Test	Title	Result						
		Croatia	Denmark	France	Germany	Hungary	Portugal	Sweden
D001	Delivery time	Pass	Pass	Pass	Pass	Pass	Pass	Pass
AML Message Format								
A001	Binary message format	Pass	Pass	Pass	Pass	Pass	Pass	Pass
A002	Text message format	Not Applicable[10]	Pass	Pass	Pass	Pass	Pass	Pass
AML Message Validation (SMS)								
V001	Standard success	Pass	Pass	Pass	Pass	Pass	Pass	Pass
V002	Invalid location rejection	Not Tested[11]	Not Applicable[12]	Not Applicable[13]	Not Applicable[14]	Not Applicable[15]	Pass	Pass
V003	No location	Pass	Pass	Pass	Pass	Pass	Pass	Pass
V004	Invalid date	Pass	Pass	Pass	Pass	Pass	Pass	Pass

[10] *Not supported at endpoint*

[11] *Invalid location rejection is the task of the operator*

[12] *No validation against network location*

[13] *Validation against network location not possible. Different systems handle the locations from the network and AML.*

[14] *Network received location sometimes covers the whole jurisdiction of the PSAP*

[15] *Network received location sometimes covers the whole jurisdiction of the PSAP*

Test	Title	Result						
		Croatia	Denmark	France	Germany	Hungary	Portugal	Sweden
V005	Incorrect format – partial dataset	Pass	Pass	Pass	Pass	Pass	Pass	Pass
V006	Incorrect format – invalid data types	Pass	Pass	Pass	Pass	Pass	Pass	Pass
V007	Incorrect format – oversize fields	Pass	Pass	Pass	Pass	Pass	Pass	Pass
V008	Unsolicited AML	Pass	Pass	Not Applicable[16]	Pass	Pass	Pass	Pass
AML Message Validation (HTTPS)								
V009	Basic success case	Not Applicable (SMS only)	Not Applicable (SMS only)	Not Applicable (SMS only)	Pass	Not Applicable (SMS only)	Pass	Not Applicable (SMS only)
V010	Missing MSISDN	Not Applicable (SMS only)	Not Applicable (SMS only)	Not Applicable (SMS only)	Pass	Not Applicable (SMS only)	Pass	Not Applicable (SMS only)
V011	Partial dataset	Not Applicable (SMS only)	Not Applicable (SMS only)	Not Applicable (SMS only)	Pass	Not Applicable (SMS only)	Pass	Not Applicable (SMS only)
V012	Unsolicited data	Not Applicable (SMS only)	Not Applicable (SMS only)	Not Applicable (SMS only)	Pass	Not Applicable (SMS only)	Pass	Not Applicable (SMS only)
V013	Invalid data	Not Applicable (SMS only)	Not Applicable (SMS only)	Not Applicable (SMS only)	Pass	Not Applicable (SMS only)	Pass	Not Applicable (SMS only)
V014	Malicious formatting	Not Applicable (SMS only)	Not Applicable (SMS only)	Not Applicable (SMS only)	Pass	Not Applicable (SMS only)	Pass	Not Applicable (SMS only)
Location Server Logic								

[16] *Not possible to check unsolicited AML messages because the receipt of the emergency calls is not known at the location server.*

Test	Title	Result						
		Croatia	Denmark	France	Germany	Hungary	Portugal	Sweden
L001	Correlation HTTPS & SMS	Not Applicable (SMS only)	Not Applicable (SMS only)	Not Applicable (SMS only)	Pass	Not Applicable (SMS only)	Pass	Not Applicable (SMS only)
L002	Best location	Pass	Pass	Not Applicable[17]	Pass	Pass	Pass	Not Applicable (SMS only)
Infrastructure & Security								
I001	Security review	Pass	Not Applicable (SMS only)	Pass	Pass	Not Applicable (SMS only)	Pass	Not Tested[18]
I002	Google Vendor Security Assessment	Pass	Pass	Not Applicable[19]	Pass	Not Applicable[20]	Pass	Not Tested
I003	Failover & failback	Pass	Pass	Not Tested	Not Tested[21]	Not Tested[22]	Pass	Pass
PSAP CAD								
C001	Success case	Pass	Pass	Pass	Not Applicable[23]	Pass	Pass	Pass

[17] *Single best location strategy is not used in France.*

[18] *Already established SMS infrastructure is used*

[19] *Google Vendor Security Assessment is not required in France*

[20] *Not necessary as AML deployment is done by a governmental agency*

[21] *Postponed, Berlin fallback system not ready in all parts*

[22] *Redundant PSAPs' infrastructure in Miskolc and Szombathely*

[23] *Tests on all vendors not possible. Too many different applications. Footnote also applicable to C002 – C007*

Test	Title	Result						
		Croatia	Denmark	France	Germany	Hungary	Portugal	Sweden
C002	No location	Pass	Pass	Pass	Not Applicable	Pass	Pass	Pass
C003	Multiple location	Pass	Pass	Pass	Not Applicable	Pass	Pass	Pass
C004	Multiple datasource	Not Applicable	Not Applicable[24]	Pass	Not Applicable	Pass	Pass	Pass
C005	Best location	Pass	Pass	Pass	Not Applicable	Pass	Pass	Pass
C006	Call & location	Pass	Pass	Pass	Not Applicable	Pass	Pass	Pass
C007	Confidence level	Pass	Pass	Pass	Not Applicable	Pass	Pass	Pass

[24] *Datasource not visible on CAD*

4.2.3 AML Deployments

The Help112 phase II project achieved the deployment of AML in the 7 countries participating in the consortium. The deployments were completed at different times during the project and they contribute to different parts of the emergency call chain. This section describes the details of each deployment.

4.2.3.1 AML availability timeline on existing handset Operating Systems (OS)

The following table reports the AML deployment dates per member state and OS.

Member State	Android Activation Date	iOS Activation Date
Croatia	Oct 2019	Dec 2019 (for 1 MNO)
Denmark	Jul 2019	Dec 2019
France	Apr 2020	Not deployed until May 2020
Germany	May 2019	Dec 2019
Hungary	Feb 2020	Mar 2020
Portugal	Feb 2020	Mar 2020
Sweden	Sep 2019	Sep 2019

Table 4-4 – AML deployment dates per member state and OS

4.2.3.2 Availability in case of calling different emergency numbers

Table 4-4 shows a summary of the 112, Police, Fire and Rescue Service (FRS) and Emergency Medical Service (EMS) emergency numbers triggering AML per member state.

Member State	112	Police	FRS	EMS
Croatia	**Yes**	**Yes**	**Yes**	**Yes**
Denmark	**Yes**	n/a	n/a	n/a
France	**Yes**	No	**Yes**	No
Germany	**Yes**	No	n/a	n/a
Hungary	**Yes**	No	No	No
Portugal	**Yes**	n/a	n/a	n/a
Sweden	**Yes**	n/a	n/a	n/a

Table 4-5 – 112, Police, FRS and EMS emergency numbers triggering AML per MS

AML is deployed for 112 in all member states and additionally for some of the national emergency numbers in some countries.

4.2.3.3 Territory coverage

AML may be available only in a part of a Member State's territory, i.e. a predefined territory of the country may sometimes be excluded from the AML deployment[25]. Territory coverage refers to the part of the territory of a member state where AML is available, i.e. AML would be triggered assuming all other prerequisites are met. The following table indicates the AML territory coverage per Member State.

Member State	Territory coverage
Croatia	All of Croatia
Denmark	All of Denmark
France	Deployed in mainland France[26], excluding the overseas territories
Germany	All of Germany
Hungary	All of Hungary
Portugal	Deployed in mainland Portugal, excluding the Autonomous Regions of Madeira and Azores
Sweden	All of Sweden

Table 4-6 – AML territory coverage per MS

AML has been deployed in the mainland territories of all 7 member states, excluding the overseas territories of France and the two autonomous regions of Portugal.

4.2.3.4 PSAP coverage

In relation to AML availability in the PSAPs, Table 4-6 presents the PSAPs receiving AML per member state. 112 PSAPs refer to the PSAPs answering 112 calls.

Member State	% of 112 PSAPs receiving AML	% of all PSAPs receiving AML	Estimated citizen/area coverage
Croatia	100%	35%	100%
Denmark	100%	100%	100%
France	85%	19%	87% of the population
Germany	70%	32%	79% of the population
Hungary	100%	100%	100%

[25] *Also refered to as geofencing*

[26] *Excluding iOS devices as described in section 4.3.2.1.*

Member State	% of 112 PSAPs receiving AML	% of all PSAPs receiving AML	Estimated citizen/area coverage
Portugal	50%[27]	96.83%	95% of the population
Sweden	100%	64%	Not available

Table 4-7 – AML PSAP coverage per MS

Out of the 7 Member States in the Help112 consortium, in 2 member states all PSAPs are able to receive AML, Denmark and Hungary. In Member States where not all PSAPs are able to directly receive AML, specific procedures[28] are in place for the provision of AML to PSAPs or emergency services that may be in need of AML information:

- In Croatia, AML is transferred to competent PSAPs or emergency services through voice communication and data exchange.
- In France, AML can be retrieved by the PSAPs either from the location server or by using the web interface of the GEOLOC 18-112 application.
- In Germany, most PSAPs are retrieving the AML caller location from the location server. A few PSAPs (around 35) had no possibility to integrate AML in their CAD in a short period of time and they receive it by push to a 3rd party web application. The AML endpoint pushes AML reports to URLs the PSAPs have provided. Most of the PSAPs use existing GIS web applications to retrieve the data, but the use of other applications would be possible too. It is not planned to include more PSAPs in this test in the future because the goal is that all PSAPs receive the data from the location server.
- In Sweden, AML can be transferred when needed by SOS Alarm, by voice to the EMS, Coast Guard and Police stage 2 PSAPs, which cannot directly receive AML.

According to the criteria defined in section 4.1:

- AML was fully deployed in Croatia, Denmark, Hungary and Sweden.
- AML was partially deployed in France, Germany and Portugal.

4.2.4 Roaming capability

Requirement REQ-WP1-04 AML described in section 4.1 states that roaming capability shall be demonstrated in the Member States in which AML is being deployed and the roaming capability is demonstrated if the technical solution is setup and agreed by the stakeholders (e.g. long number agreed with MNOs) although not implemented yet. All member states participating in the Help112 consortium have ensured that the necessary technical solutions are setup for AML roaming capability.

AML international roaming is not working if AML SMS messages are sent to a short number because the AML SMS will be returned to the home country's SMS Centre for routing and not to the SMS

[27] 50% of 112 PSAPs corresponds to the two PSAPs of the mainland out of the four total 112 PSAPs in Portugal. The other two 112 PSAPs are in the autonomous regions and have been outside the scope of this project. The two PSAPs of the mainland cover approximately 95% of the population.

[28] The time needed to follow these procedures and successfully provide AML is not reported by the Member States and expected to vary on a case by case basis, but it is expected to be longer than the time that would have been needed if the PSAP was directly retrieving AML from the location server.

Centre of the hosting network. There are three possible ways to support AML international roaming described in the next 3 sections.

4.2.4.1 Route AML SMS messages to a long number

This solution is described in section 6.2.4.1 of the ETSI Technical Specification 103 625 V1.1.1 and is quoted below:

"*One option that may be used is, for example, to send a message from a phone in the UK with a foreign SIM to the UK AML destination using a "long number": a full length E.164 number including country code, e.g. +44NNNNNNNNN (N representing digits in a normal UK telephone number), which although it looks like a normal mobile phone number is a "virtual mobile number" as it doesn't terminate on a mobile phone, but can be routed by the hosting mobile network to a network termination point, in this case a PSAP. This avoids the issue of the foreign SIM's home SMSC not being able to route the normal 999 code for UK AML messages back to the UK AML destination. However it does mean that the SMS is not automatically zero charged.*"

4.2.4.2 Use HTTPS as AML transmission method

When HTTPS is used as the AML transmission method, HTTPS POST messages[29] are used to transfer the emergency location information and associated data to the location server, as described in section 6.3 of the ETSI Technical Specification 103 625 V1.1.1. In this case, AML messages for international roaming are reaching the AML location server in the visiting country with no problems, but sometimes they lack the MSISDN in the data message sent by HTTPS, as described in section 6.3.8.1 of the ETSI Technical Specification 103 625 V1.1.1, and is quoted below:

"*Emergency services need to be able to match the voice call with the data message, and to do so they can use the MSISDN (Mobile Subscriber ISDN Number). In some instances, the MSISDN can be accessed by the handset's AML functionality (e.g. from the SIM card or information entered by the subscriber) and it shall therefore be included in the HTTPS data. However, in other instances the MSISDN is not accessible and therefore emergency services can't directly match the voice call with the location data string.*

One option to allow matching is to receive AML messages using both SMS and HTTPS, then to match them by using the IMSI information received in both, and then match to the emergency voice call using the MSISDN within the SMS message. This can be useful if the PSAP requires the additional fields present in the HTTPS message, but not within the SMS message."

4.2.4.3 Change of the SMSC address in case of international roaming

A new solution has been recently tested in Belgium to overcome the limitation for AML international roaming when SMS is used as the AML transmission method[30]. The limitation is introduced in the case of international roaming because all SMS are sent to the home network's SMSC and hence

[29] *HTTPS POST messages are data messages between a client and server exchanged by the HTTPS protocol. HTTPS is one of the 2 possible AML transmission methods currently available.*

[30] *The information in this section reports the solution as described in the GSMA Technical Note of 11 Oct 2019, by Marc Balon and Eddy Goffin (Orange) and the note in section 6.2.4.1 of the ETSI Technical Specification 103 625 V1.1.1.*

cannot reach the visiting network's SMSC. Consequently, the AML SMS cannot reach the PSAP in the visiting country. The piloted solution involves the handset changing the SMSC address not to use the home SMSC but the visited SMSC and hence preventing the AML SMS from leaving the visiting country and ensuring it will reach the PSAP in the visiting country.

The SMSC address is changed by the AML implementation in the OS of the device by using the format <Mobile Country Code – MCC of visited network><Emergency Number, e.g. 112 or 911>. For example, the SMSC address in case of international roaming in Belgium, where the solution was tested, would be SMSC=+32112, where 32 is Visited Country Code. The visited network will route the SMS to the visited SMSC (instead of the home SMSC) and hence the SMS will reach the PSAP. The pilot was successful, and the solution is now used in Belgium and it is totally free to the user, including international roamers.

4.2.4.4 Summary of the solutions for AML international roaming

The three solutions described in the previous sections are currently the only solutions available to support AML in the case of international roaming. The solution to route AML SMS messages to a long number requires agreement and actions to be taken between MNOs to make the AML messages zero rated. The solution of using HTTPS as the AML transmission method can experience technical issues in many cases with the lack of the MSISDN in the AML data and it is also not zero rated.

The solution of changing the SMSC address in case of international roaming has been piloted and it is now operational in Belgium. The experience gathered from the pilot reports that it is simple to put the solution in place and can also achieve zero rated AML for international roamers[31].

4.2.4.5 International roaming capability in the member states

As the Belgian roaming solution pilot had not completed in the duration of the project, currently most member states in Help112 II support AML international roaming by routing AML messages to a long number. Table 4-7 reports the solution for international roaming capability used in each member state.

Member State	Roaming capability
Croatia	By routing AML SMS messages to a long number
Denmark	By routing AML SMS messages to a long number
France	By routing AML SMS messages to a long number
Germany	By using HTTPS as AML transmission method
Hungary	By routing AML SMS messages to a long number
Portugal	By routing AML SMS messages to a long number
Sweden	By routing AML SMS messages to a long number

[31] *See slides of the webinar "New & effective solution for AML roaming", https://eena.org/webinars/solution-aml-roaming/, last accessed 2 Jul 2020.*

Table 4-8 – AML roaming support per MS

In Croatia, Hungary and Portugal although the necessary technical solutions have been setup, AML for roaming callers has not been activated yet. Croatia and Hungary reported that AML has not been activated for international roaming until it is ensured to be free of charge. In Portugal AML for international roaming activation is postponed until AML is deployed and available in all of Portugal, including the 2 autonomous regions where AML is currently not available.

4.2.5 Live Operation Monitoring

All Member States reported data from the live operation of AML during a 2 months period. The report template that was used to report the data is provided in section 6.3.2 "Statistics Report Format" of D3.1 PSAP User Guide. The data of each Member States has been reported in the respective Annex to D1.1.X and an overview report from all Member States has been provided in the Annex to D1.2.

Table 4-9 shows the data reported by the Member States for the AML Call Rate, the AML Location Success and the Valid AML Success rate, as they have been defined in D3.1.

AML Call Rate is the percentage of calls with an AML message received. The AML Call Rate is calculated by dividing the "Volume with AML Message" with the "Total Call Volume".

AML Location Success is the percentage of calls with an AML message received, which contain a location. The AML Location Success is calculated by dividing the "Volume with AML Location" with the "Total Call Volume". Comparing the AML Location Success with the AML Call Rate indicates the percentage of calls with AML error messages.

Valid AML Success Rate is the is the percentage of calls with an AML message received, which contain a location and the location is validated and not rejected due to not being of good quality or not matching a network location. The Valid AML Success Rate is calculated by dividing the "Volume with Valid AML Location" with the "Total Call Volume". Only Portugal has been able to report the Valid AML Success Rate.

All percentages reported in Table 4-9 have been rounded to the nearest integer number to improve the table readability.

In France, it was not possible to report data for the "Total Call Volume" from all the PSAPs receiving AML. Therefore, the data in Table 4-9 show the success rate for the Fire brigades of the Department of the North. The "Total Call Volume" for France includes all the calls that are answered by an operator, give rise to an intervention, and a request is made to the national server to retrieve the AML information. The "Volume with AML Message" for France includes the calls for which the request has successfully retrieved a location from the national server.

(1) AML Success Rate								
Member State	Time Period	Total Call Volume	Volume with AML Message	AML Call Rate %	Volume with AML Location	AML Location Success %	Volume with Valid AML Location	Valid AML Success Rate %
Croatia	1/2 – 29/2	55,556	17,495	31%	17,147	31%	17,147	31%
	1/3 – 31/3	106,288	61,550	58%	60,556	57%	60,556	57%

Denmark	1/2 – 29/2	17,902	9,885	55%	9,885	55%	9,885	55%
	1/3 – 31/3	17,475	9,675	55%	9,675	55%	9,675	55%
France	1/4 – 30/4	12,850	7,150	55%	7,150	55%	6,994	54%
	1/5 – 31/5	13,165	6,900	52%	6,900	52%	6,732	51%
Germany	1/12 – 31/12	177,134	75,598	43%	75,598	43%	75,598	43%
	1/1 – 31/1	197,187	106,907	54%	106,907	54%	106,907	54%
Hungary	1/3 – 31/3	368,844	65,499	18%	55,457	15%	55,457	15%
	1/4 – 30/4	356,995	62,103	17%	52,671	15%	52,671	15%
Portugal	13/2 – 13	336,034	101,294	30%	92,119	27%	85,059	25%
	14/3 – 13/4	317,404	94,751	30%	87,203	27%	79,401	25%
Sweden	1/11 – 30/11	147,484	59,136	40%	59,136	40%	59,136	40%
	1/12 – 31/12	155,733	60,688	39%	60,688	39%	60,688	39%

Table 4-9 – AML Success Rate

Figure 4-2 shows the Valid AML Success rates during the second reporting period of each Member States.

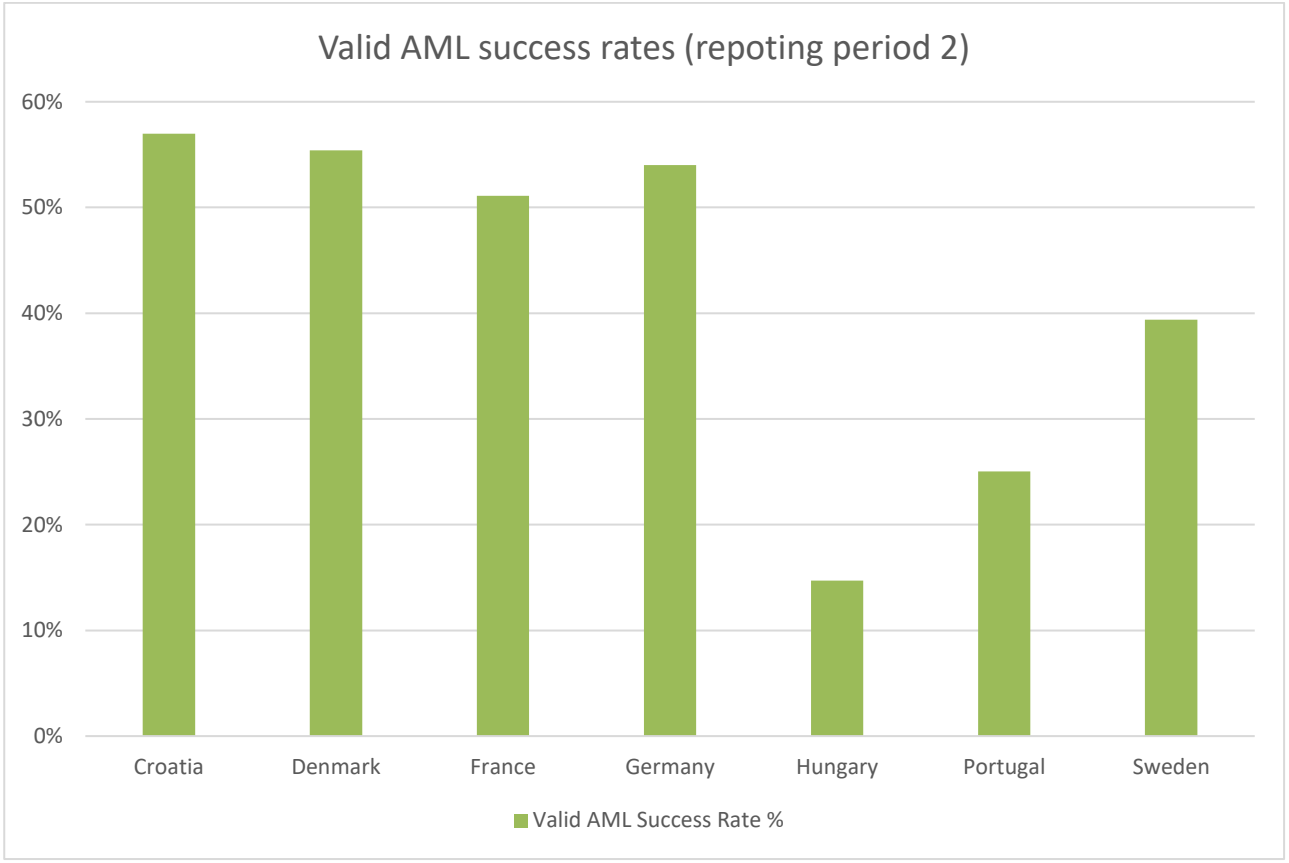


Figure 4-2 – Valid AML success rates during reporting period 2

The maximum Valid AML Success Rate is 57% for Croatia and minimum is 15% for Hungary. It should be noted that AML in Croatia is activated for both Android and iOS for a few months before the reporting period, although iOS has been activated only for 1 of the 3 MNOs. In Hungary and Portugal, both Android and iOS are activated but iOS was activated late in the reporting period and it safe to assume that it has not reached its full potential during the reporting period.

When considering the data for Member States that have AML activated in both Android and iOS for at least 1 month, i.e. Croatia, Denmark, Germany and Sweden, the minimum Valid AML Success Rate is 39% for Sweden and the maximum is 57% for Croatia.

Data for France has been excluded from the chart, see note above Table 4-9.

Table 4-10 shows the AML location source distribution between GNSS, Wi-Fi and handset based[32] Cell information in Android and iOS devices, when available, as reported by each Member State.

[32] Handset Cell based locations are typically not the same as network generated cell id based locations. Handset cell locations will typically be crowd sourced, whereas network cell id locations will represent the true coverage of a cell from the network planning tools. Size of the result (radius) should not be considered a measure of "better" for cell id only locates.

	(1) AML Source							
Member State	Time Period	Operating System	Total AML Locations	GNSS %	Wi-Fi %	Cell %	Unknown %	Error %
Croatia	1/2 – 29/2	Android	173,558	35%	54%	9%	2%	0%
	1/3 – 31/3	Android	608,428	32%	59%	7%	2%	0%
Denmark	1/2 – 29/2	iOS	6,305	54%	45%	1%	0%	0%
	1/2 – 29/2	Android	3,580	16%	72%	12%	0%	0%
	1/3 – 31/3	iOS	6,336	55%	45%	0%	0%	0%
	1/3 – 31/3	Android	3,339	17%	74%	10%	0%	0%
France	1/4 – 30/4	Android	2,241,900	34%	60%	5%	2%	0%
	1/5 – 31/5	Android	2,505,114	37%	56%	5%	2%	0%
Germany	9/11 – 9/12	Android	242,859	31%	58%	8%	2%	0%
	9/11 – 9/12	iOS	611	57%	35%	0%	7%	0%
	9/12 – 9/1	Android	992,882	30%	60%	8%	2%	0%
	9/12 – 9/1	iOS	230,318	59%	33%	0%	7%	0%
Hungary	1/3 – 31/3	Android/iOS	426,492	30%	60%	8%	2%	0%
	1/4 – 30/4	Android/iOS	414,550	33%	58%	7%	2%	0%
Portugal	13/2 – 13/3	Android	977,305	25%	64%	9%	0%	3%
	13/2 – 13/3	iOS	79	54%	38%	0%	0%	8%
	14/3 – 13/4	Android	1,162,388	21%	69%	7%	0%	2%
	14/3 – 13/4	iOS	1,821	41%	47%	1%	0%	11%
Sweden	1/11 – 30/11	Android	37,905	45%	52%	3%	0%	0%
	1/11 – 30/11	iOS	21,231	61%	39%	1%	0%	0%
	1/12 – 31/12	Android	37,653	43%	53%	4%	0%	0%
	1/12 – 31/12	iOS	23,035	59%	40%	1%	0%	0%

Table 4-10 – AML Source

Figure 4-3 shows how the AML source varies in Android devices during the second reporting period of each Member State. The data for Hungary includes both Android and iOS, because the implementation does not allow a separate analysis of iOS and Android AML messages. However, iOS data are only a small percentage of the data set, because AML was activated in iOS in Hungary late in the second reporting period.

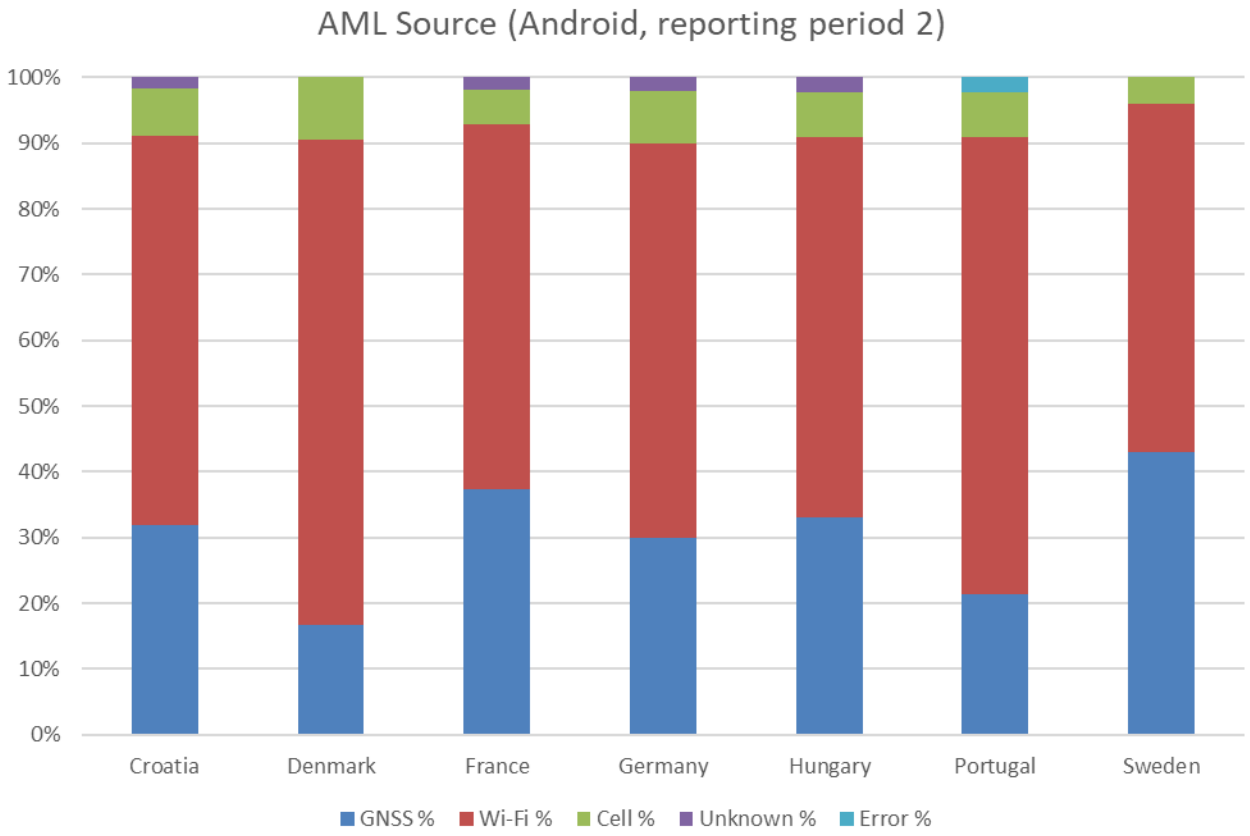


Figure 4-3 – AML Source distribution in Android devices during reporting period 2

AML estimated by Wi-Fi is the mostly reported location source, with 53% - 74% of AML messages estimated on the basis of Wi-Fi information[33]. AML estimated on the basis of GNSS information is the second mostly reported location source, with 17% - 43% of AML messages estimated on the basis of GNSS, while AML estimated on the basis of handset based Cell information is below 10%. Unknown and error AML messages are less than 3%.

Table 4-10 shows the AML radius range reported by all Member States.

(2) AML Radius							
Member State	Time Period	Total AML Locations	<20m %	20-100m %	100-250m %	>250m %	No location
Croatia	1/2 - 29/2	173,558	59%	26%	3%	10%	2%
	1/3 - 31/3	608,428	60%	27%	3%	9%	2%
Denmark	1/2 - 29/2	9,885	40%	54%	1%	5%	0%
	1/3 - 31/3	9,675	40%	56%	1%	3%	0%
France	1/4 – 30/4	2,241,900	63%	26%	4%	7%	0%
	1/5 – 31/5	2,505,114	59%	31%	3%	8%	0%

[33] *This is indicative of locations in urban areas, or calls made from inside buildings.*

Germany	9/11 - 9/12	524,160	66%	24%	2%	8%	0%
	9/12 - 9/1	2,315,988	64%	27%	2%	7%	0%
Hungary	1/3 - 31/3	426,492	13%	64%	10%	10%	0%
	1/4 - 30/4	414,550	17%	62%	9%	9%	0%
Portugal	13/2 - 13/3	950,855	11%	68%	10%	11%	0%
	14/3 - 13/4	1,138,434	9%	73%	9%	9%	0%
Sweden	1/11 - 30/11	73,246	24%	66%	5%	6%	0%
	1/12 - 31/12	80,354	23%	67%	5%	6%	0%

Table 4-11 – AML Radius

Figure 4-4 shows the range of the AML radius in the Member States during the second reporting period. Note that the handset may send a "No location" message indicating that the AML locate procedure did trigger, but that no location could be obtained in required timescale.

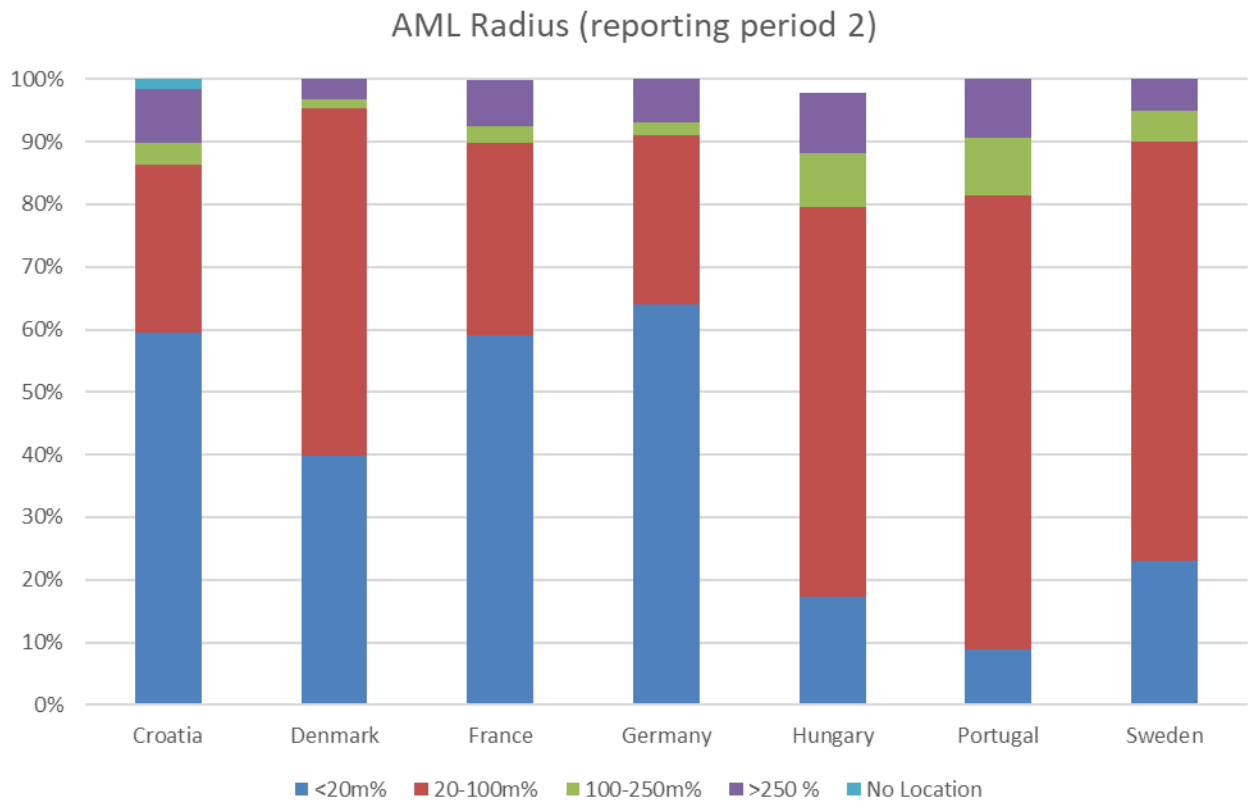


Figure 4-4 – AML Radius range during reporting period 2

In Croatia, France and Germany more than 50% of the AML estimations have a radius below 20m and in Denmark, around 40% of the AMLs have radius below 20m (Table 4-10, Figure 4-4). In Hungary, Portugal and Sweden AML with radius below 20m is lower and varies between 9% in Portugal to 23% in Sweden. AML radius of up to 100m is received in more than 80% of the reported cases in all member states. In Denmark, AML radius of up to 100m is received for 96% of the reported cases.

The deliverables of France, Germany, Portugal and Sweden report the AML radius in more detailed ranges, which can be found in the corresponding D1.1.x Annex. Radius ranges have been unified in this report to be able to show the results from all member states. For example, Portugal reports that 52 - 58% of the AML messages have a radius between 20m and 50m and 14 - 15% have a radius between 50m and 100m, while Figure 4-4 shows that 73% of the AML messages have a radius between 20m and 100m.

The relatively large percentage of messages with more than 500m radius (3% - 9%) should be the result of AML estimated by Cell information available on the handset, previously shown in Figure 4-3 and Table 4-9.

4.2.6 Recommendations for fostering Galileo user uptake

To support the European Commission effort to promote Galileo and to foster its adoption, a dedicated analysis has been carried out to "investigate the possibility of facilitating use of Galileo signals within an upgraded PSAP architecture" [AD1], and to issue recommendations to the European Commission.

In their current architectures, PSAPs don't use directly GNSS signals to localize the emergency caller but two different types of information: A position based on the GSM network, called Network Based Location (NBL), and a position derived from the handset, called Advanced Mobile Location (AML). The AML is based on three sources of information: Cell-ID, Wi-Fi access points, GNSS signals (including Galileo).

Ultimately, PSAPs look for improving their operations to reduce the consequences of injuries, the number of casualties and the property damages. In the current PSAP architectures, improvement can be obtained by receiving the caller location derived from a greater number of handsets, in a faster way and with a better accuracy and better reliability.

The recommendations will address **How to improve the use of Galileo in the PSAP** which has been split into:

- How to improve the use of Galileo in the GNSS-based location (in the handset),
- How to improve the use of GNSS-based location in the AML,
- How to improve the use of AML in the PSAP.

The analysis has been carried out with the following steps: 1) recall of the Help112 project recommendations, 2) AML ecosystem description (stakeholders, legislation, standardisation), from which are derived technical barriers to Galileo adoption, 3) Assessment of Galileo adoption in emergency communications, and 4) Identification and characterization of the recommendations.

In the frame of Help112 project, several recommendations were proposed, involving various stakeholders: PSAPs, MNOs, handsets and chipset manufacturers, and Operating System providers. Some of these recommendations have been applied even since, paving the way to a proper AML deployment and use.

From the study element by element of the AML ecosystem, the following barriers were identified:

- GNSS performance requirements are too wide to reach relevant performance for the AML;
- Google and Apple have no requirement on how to use GNSS in the AML protocol;
- Other Operating System providers are not providing AML service yet;
- Nine Member States had still not deployed AML at the end of Help112 II project.

The main elements potentially influencing Galileo adoption in emergency communications were analysed and put together in a timeline. Various approaches were considered, going from Galileo timeline at infrastructure and service level, to the deployment of AML in EU and next generation of

emergency calls NG112. The handsets and wearables market perspective were also assessed. Moreover, the Help112 II testing activities highlighted the following Galileo differentiators for handset derived location: Better accuracy with dual frequency Galileo-capable handsets, and better reliability with a higher percentage of Galileo satellites used.

Based on the previous steps of the analysis, the following recommendations were proposed:

- To alleviate technical barriers to Galileo uptake:
  - Improving handset GNSS performance requirements;
  - Standardizing AML computation (fusion algorithm) ;
  - Promoting the availability of AML service in all handset operating system;
  - Monitoring AML deployment in Member States and supporting them if needed.
- To boost Galileo uptake: no further recommendation needed considering the delegated regulation 320/2019 is already binding smartphone vendors to provide Galileo capability in all handsets sold in the EU single market from March 2022 onwards;
- To leverage Galileo added values:
  - Setting more stringent handset GNSS minimum performance requirements.
- To create new Galileo added values:
  - Extending GNSS signals availability in deep indoor environment;
  - Extending AML information content with GNSS-based altitude and speed;
  - Making raw measurement available in all handsets/wearables;
  - Implementing Galileo OS-NMA (authentication service) in all handsets.

4.3 OUTCOMES AND LESSONS LEARNT

WP1 has achieved the deployment of AML in all 7 Member States participating in the consortium. The deployments include the Android OS and in most member states also the Apple iOS. AML is triggered when calling 112 in all 7 member states and in some cases, it is also triggered for other emergency numbers nationally available. AML deployments cover the entire territories of Croatia, Denmark, Germany, Hungary and Sweden. In Portugal it covers all the mainland of Portugal, excluding the 2 autonomous regions of Madeira and Azores. In France, it covers all the mainland of France, excluding the overseas territories.

The achieved PSAP coverage ranges across the member states and depends on whether the PSAP structure follows a centralised versus a regionalised model. In Croatia, Denmark, Hungary and Sweden all 112 PSAPs receive AML. In France, Germany and Portugal, where not all 112 PSAPs can receive AML, the AML deployments cover a significant percentage of the population. Specifically, the estimations indicate that 87% of the population is covered in France, 79% in Germany and 95% in Portugal. In member states, where some non 112 PSAPs cannot receive AML messages, it is due to the lack of a pre-existing data exchange capability and it is believed that when needed, PSAPs can exchange this information by voice. Lastly, AML roaming capability has been put in place in all 7 member states. However, the roaming capability is not used in Croatia, Hungary, Portugal and Sweden. In Denmark, France and Germany, where AML in case of international roaming is used, it is not zero rated for the caller.

WP1 and the Help112 II project has been driving the AML deployments. They have been the most important activity of WP1, it has been successfully completed and has immediately enabled the citizens of the 7 member states to benefit from the deployments.

Roaming end-users however, do not fully benefit from the accurate caller location ensured by the AML implementation. In particular, the transmission of caller location in case of international roaming was not achieved in Croatia, Hungary, Portugal and Sweden, although the all technical requirements are in place. In Denmark, France and Germany although AML for international roamers is available, zero-rating of the AML messages was not achieved and the free of charge transmission of caller location is insured only for domestic end-users, because there is no technical nor legal arrangement allowing zero-rating roamers in their home country. Although a number of solutions are being developed, these would need to be supported in specific wholesale and retail level obligations for mobile network operators to implement technical and contractual measures that would ensure free of charge provision of AML information for international roaming end-users.

The project showed that a key factor to launching the live AML system is passing all legal validations of the system with both Google and Apple. It is recommended that the engagement with both parties are initiated as soon in the project as possible, and that the legal position for AML be clarified as an initial step in the project lifecycle.

Whilst AML currently provides a standardised interface for transmission of location data, it does not specify all the features and capabilities of the AML solution in the handset. There are a number of variances in the configuration options and operational behaviour between Android and iOS – resulting in a better service being able to be delivered for one operating system. It is recommended that the AML specification be enhanced to more clearly define the responsibilities of the handset solution in addition to the transmission.

Having deployed AML and achieved the required deployment level does not mark the completion of the monitoring. AML operation should be closely monitored continuously and the statistics that have been devised in this project are a good starting point. The statistics collected as part of the live operation monitoring show that the success rate and other parameters of the AML operation are varying across the countries, although in some cases the deployments are similar. Although, some countries show for example better statistics or higher success rates, a procedure for continuous monitoring needs to be established, so the relevant entities have the technical means to ensure AML performance remains at the desired level. Similarly, in cases when statistics indicate lower AML success rate, more detailed studies, involving all necessary stakeholders including MNOs, should be conducted to identify the reasons and ways to improve the AML operation and achieve better performance. Lastly, the live operation monitoring shows a low level of success for AML in roaming calls. As roaming emergency calls are a case when caller location becomes very important, it should also be studied to examine if it can be improved.

4.4 WP1 IN A NUTSHELL

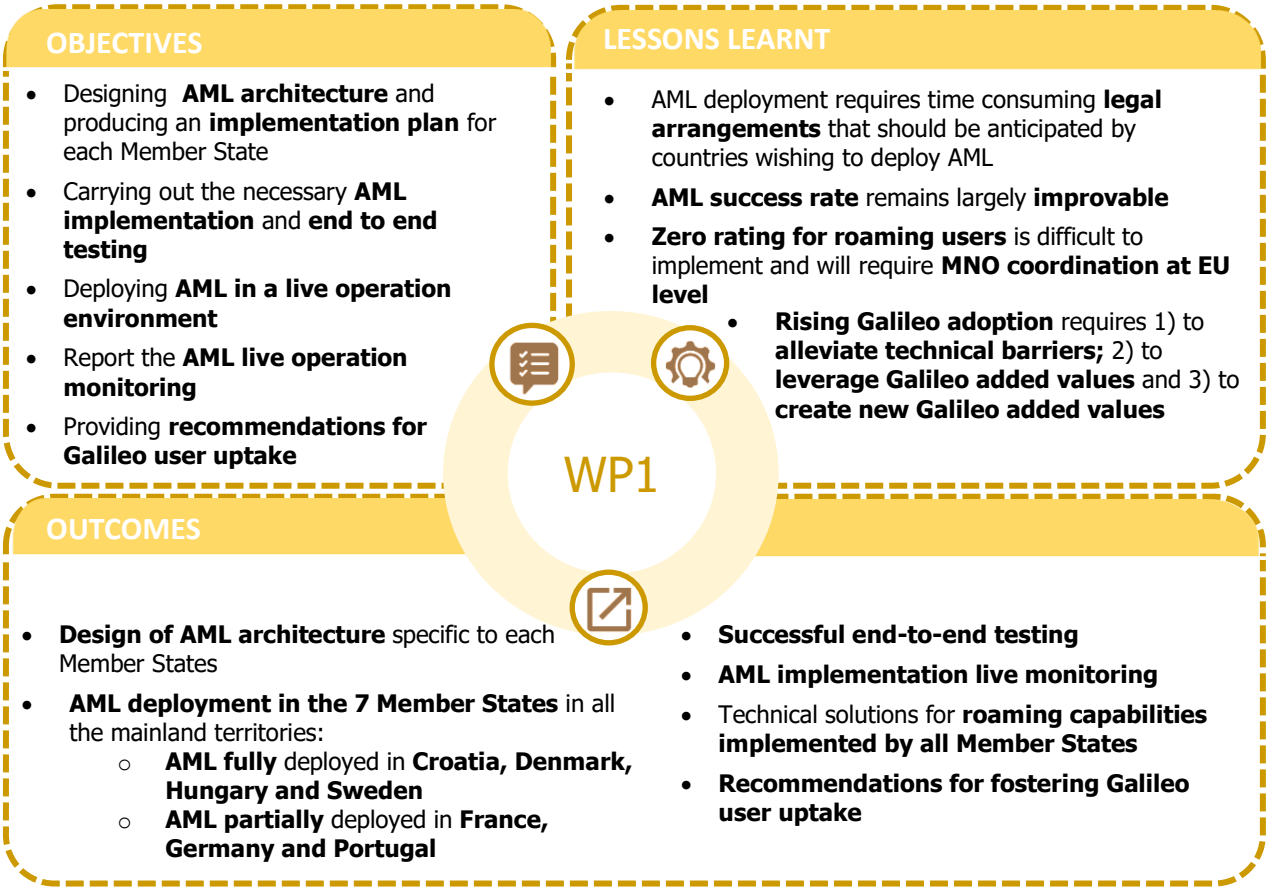


Figure 4-5 – WP1 in a nutshell

5. WP2: GALILEO SPECIFIC TESTING AND USER REQUIREMENT COMPLIANCE ASSESSMENT

This section describes the work completed in WP2 dealing with the the Galileo specific testing and User Requirement compliance assessment.

WP2 has been led by Telespazio France.

5.1 OBJECTIVES & REQUIREMENTS

The objectives of WP2 according to the Call for Tender [AD1] were:

1. to assess the benefits of using Galileo in the accuracy of the position transmitted to the PSAP;
2. to analyze the compliance of the deployed system with the User Requirement established during Help112 pilot project, for each of the seven member states selected for and participating to the project.

In order to support these objectives, the Tender Specifications [AD1] provided the following requirements:

REQ-WP2-01 EGNSS specific tests shall be performed using 4 different Galileo enabled handset models in each country where AML is deployed in order to assess the benefits of using Galileo in the accuracy of the position transmitted to the PSAP.

REQ-WP2-02 Equipment and configuration shall be chosen in such a way that it can be assured that the smartphone(s) will use a combination of GPS and Galileo to calculate the position.

REQ-WP2-03 The testing shall be conducted in each of the 15 user scenarios identified in Help112 pilot project and recalled in the tender specifications [AD1].

REQ-WP2-04 Tests shall be performed to compare accuracy of positioning determined using both GPS and Galileo against GPS only.

REQ-WP2-05 Tests shall be performed to compare accuracy of positioning determined using only Galileo against the baseline.

REQ-WP2-06 Tests using assisted GNSS shall also be performed:

- Tests shall be performed to compare accuracy of positioning determined using GPS-assisted plus Galileo data against GPS-assisted only;
- Tests shall be performed to compare accuracy of positioning determined using GPS-assisted plus Galileo-assisted data against GPS-assisted only.

REQ-WP2-07 The testing shall be professionally conducted and documented following testing good practices (e.g. RCA DO-178, ECSS-E-ST-40, etc.) adequately adapted to the project's scope.

REQ-WP2-08 Tests shall be properly documented and using a template containing the following guidance:

- Test scenarios;
- Pass/fail criteria;
- Traceability to the user scenarios.

REQ-WP2-09 Compliance of the User Requirements identified as part of the Help112 pilot project shall be analyzed.

During the establishment of the test plan, requirements **REQ-WP2-01** to **REQ-WP2-06** have been reworked with the cooperation of the GSA to collect and analyze representative AML and GNSS samples, in particular:

- 1 handset not Galileo-enabled to be compared with 3 handsets Galileo-enabled, of which 1 is dual frequency;
- 10 different scenarios with 15 waypoints each, each waypoint with 3 times 40 seconds of measurements;
- 4 handsets in warm start configuration (with GNSS receiver already tracking at the start of the test), and the same 4 handsets in cold start configuration (with GNSS receiver starting to acquire the signal at the start of the test).

Moreover the User Requirements compliance assessment (**REQ-WP2-09**) have been done following 3 methods:

- **By design**: the requirement compliance has been assessed by analysing the design (through design documentation review) in the scope of the WP1;
- **By AML testing**: the requirement compliance has been performed as part of the AML and GNSS testing in the scope of WP2;
- **By End-to-End testing**: the requirement compliance has been performed by the PSAP as part of the AML deployment in each Member State in the scope of WP1.

5.2 WORK ACHIEVED

In order to fulfil the objectives identified for WP2, three main phases were conducted by the consortium and are presented in Figure 5-1.

Figure 5-1 – WP2 implementation phases

5.2.1 Preparatory phase

The preparatory phase consisted in various management and technical activities aiming at insuring efficient and smooth conduction of the tests:

- Selection and development of required hardware and software equipment that made the testing board
- Definition of the tests procedures, protocols, collected data and scenarios
- Organisation of the tests in the different countries, anticipating potential issues and difficulties.

Testing board

Various technical activities were conducted to have the testing board ready as presented by Figure 5-2.

Figure 5-2 – Testing board for Help112 II project

First of all, **handsets** were selected, procured and validated. The handsets selected for the tests are presented in Figure 5-3. A baseline was selected to be used as reference for the tests results analysis, since it is not Galileo compatible. Each of this handset was present twice in the test board:

one configured to use assisted GNSS data and referred to as Warm configuration, and one without referred to as Cold configuration.

A **testing application**, developed by CS, was installed on each of the handset and provided the possibility to:

- Collect the required samples for further analysis (both AML and GNSS samples)
- Manage the testing schedule by providing the possibility to select the scenarios and waypoints ongoing to ease post-processing.
- Providing a map view to the testing operators.

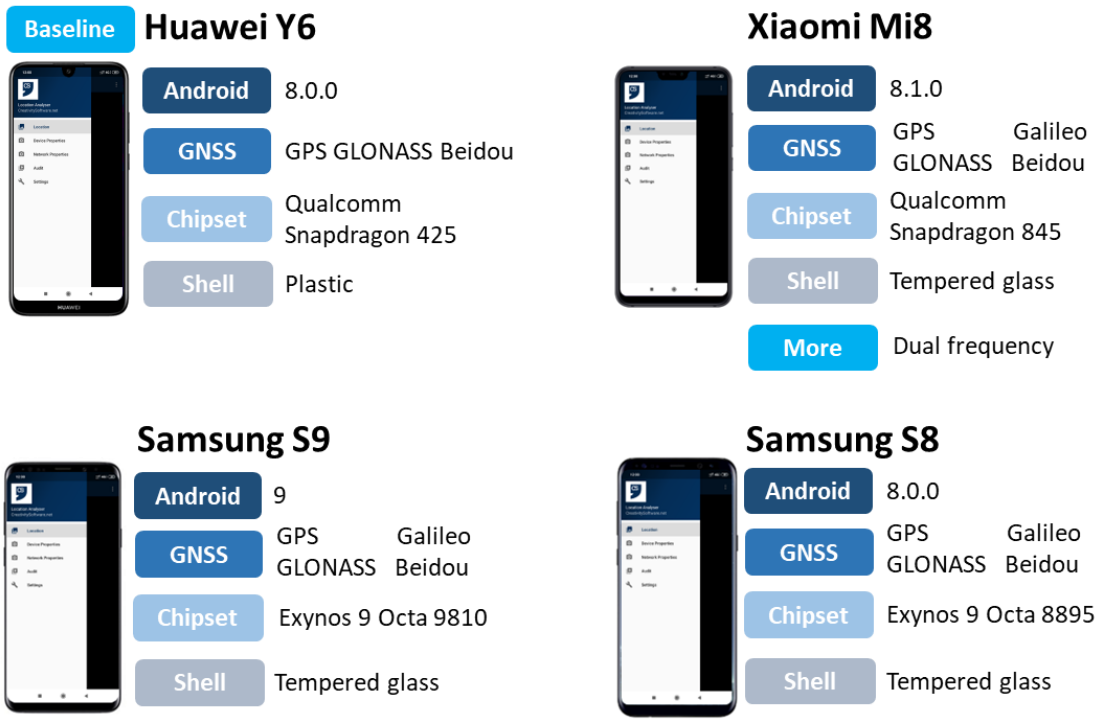


Figure 5-3 – Handsets selected for testing activities

The second key component of the testing board was the **Ground Truth equipment**, aiming at providing the reference position for computing the performance metrics. The Septentrio AsteRx-SB receiver is a high-accuracy GNSS receiver able to provide PPP or RTK positions, which will be used as reference positions

If available, RTK is preferred to PPP for several reasons. RTK is less sensitive to environment (masking, multipath, interference), and it does not need 20 minutes of warm-up period in open-sky before to start the test as PPP does.

Since the availability of RTK corrections requires the presence of RTK base stations nearby the testing sites, this type of correction was available only in France, Hungary and Portugal.

PPP corrections were therefore used in the other countries because of the lack of nearby base stations.

The Ground Truth equipment allowed to reach good accuracy levels in all environments, as presented in which presents the maximum standard deviation (STD) of the ground truth position all

countries merged. For instance, the maximum STD observed in rural environment was around 8 centimeters, which proves a good overall accuracy in this environment.

Environment	Max STD (m)
Urban	0.7
Suburban	0.074
Rural	0.086
Mountain	0.12
Forest	0.10

Table 5-1 – Ground Truth performances in all environments

Additional equipment was also prepared to cope with operational needs. For instance, power banks were necessary to power supply the Ground Truth equipment but also to recharge the handsets during the day since using GNSS on handsets is very power consuming.

In parallel of the testing board development, a **post-processing tool** was also developed To analyse the huge amount of samples collected by the testing application during the tests in the countries, and to generate the key performance metrics.

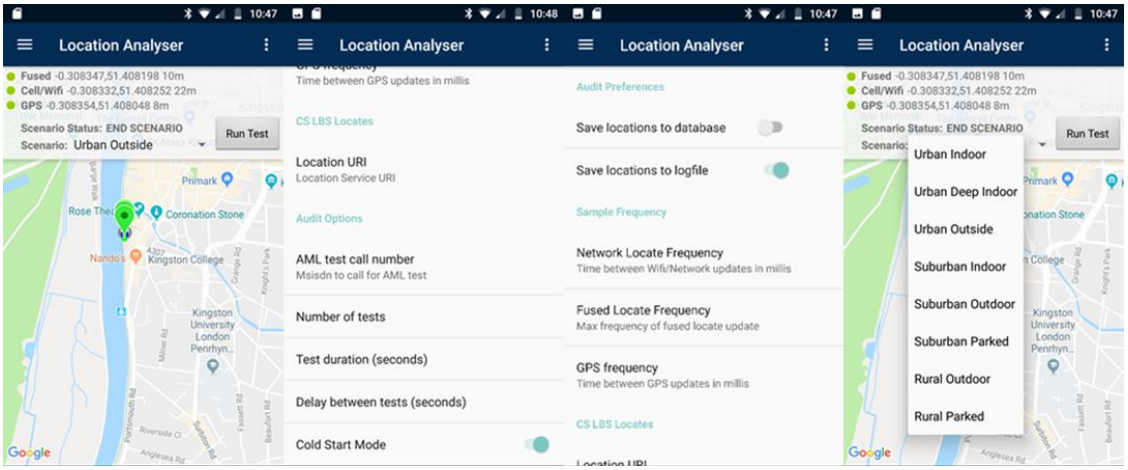


Figure 5-4 – Views of the testing application

Testing protocols

Ten scenarios were prepared for each country to ensure the variety of environment tested: Urban, Suburban, Rural, Mountain and Forest and also in various contexts: indoor and outdoor testing were prepared and also inside cars. All these scenarios were presenting various profiles in terms of Wi-Fi, Cell and GNSS coverage.

In each scenario, **15 waypoints** were defined as well as routes to reach them. It was done a priori using Google Earth by choosing best places: environment, enough variance in location to be

representative, without incurring significant travel overheads. The waypoints were separated by at least 100m of distance to ensure different Wi-Fi sources to be detected.

At each waypoint, a test was run on each handset using the testing application. The test had the following structure: **3 sets of 40 seconds**, separated by 10 seconds. All this ensured the collection of an important amount of samples representative of typical situations in which emergency calls can occur.

To help operators performing the tests which were very focus demanding and which required a strict organisation, some tests procedures were written and provided to the operators with clear lists of actions to perform and check lists.

A **dry-run** session organised in France prior to first travel to identify any corrective or improvement actions to be carried out before the actual test. It allowed to:

- Check the validity of the testing board and fix bugs in the testing applications.
- Familiarise the operators with the testing board and procedures
- Training the operators
- Enriching the testing procedures
- Collecting an initial set of samples to start the post-processing tool development.

5.2.2 Measurement campaign

The testing has been carried oud successfully from 20th May 2019 to 23rd August 2019. The dates, places and participants are presented in Figure 5-5.

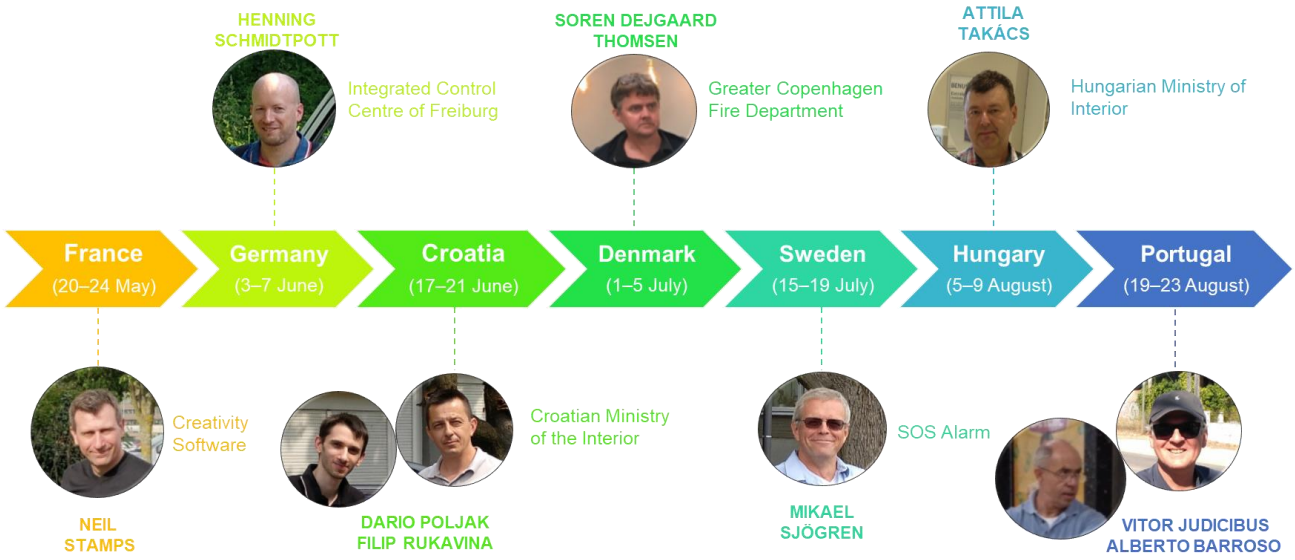


Figure 5-5 – Test dates, places and participants

With the support of the local points of contacts, scenarios executions went without trouble and were performed as depicted in Figure 5-6 according to the countries geography (e.g. no mountains in Denmark for instance).

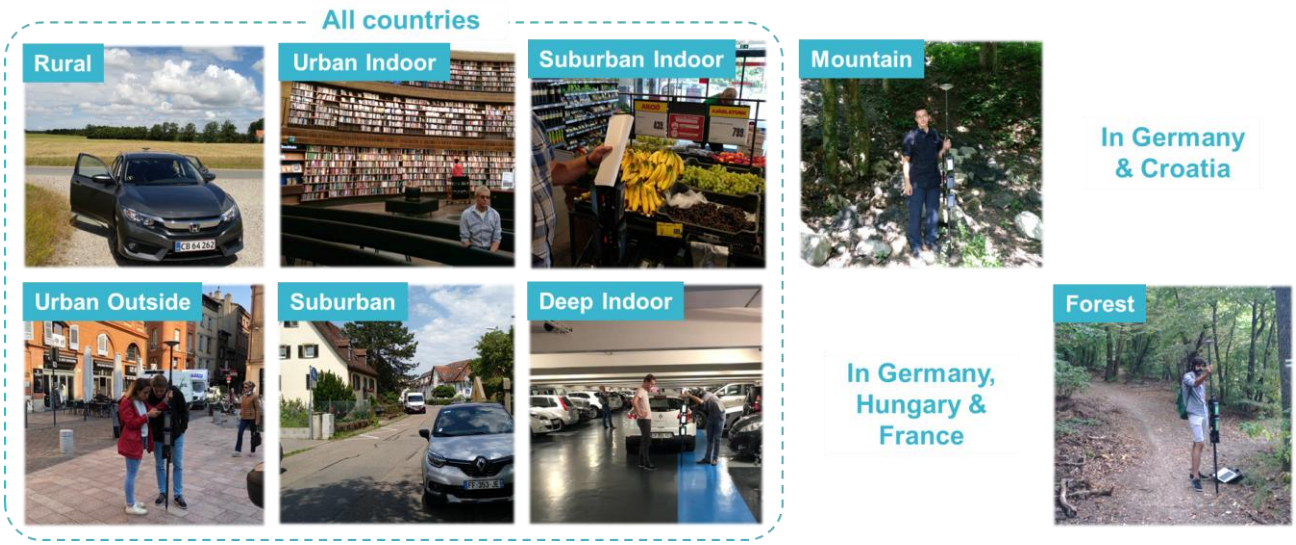


Figure 5-6 – Test scenarios

Figure 5-7 provides an overview of all the waypoints in which tests were run during the tests. This figure helps realizing the variety of environments in which the tests were performed.

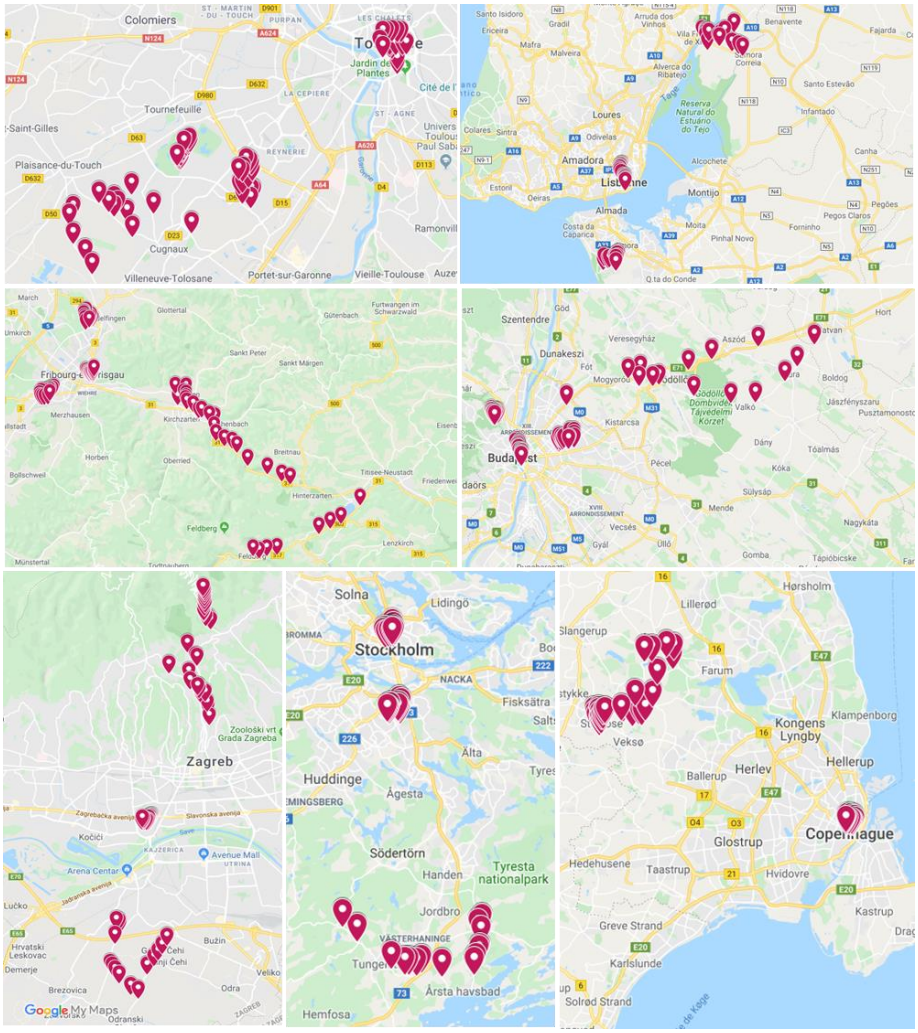


Figure 5-7 – All waypoints performed in the seven countries

In the end, the measurement campaign allowed the collection of a total of more than 1 000 000 GNSS and AML samples, with approximately 150 hours cumulated of tests.

In addition to the important work performed with the points of contact in each country to organise the testing weeks with respect to the schedule, the travels preparation and the scenarios validation, some procedures were implemented to ensure the smooth running of each week test.

At the beginning of each week, a Test Readiness Review (TRR) was organised with the local points of contacts to determine if all conditions were gathered to execute the test scenarios. All the TRR meetings were successful, leading to the execution of the tests. The TRR have been particularly helpful when some equipment delivery were delayed to find backup solutions.

Then, the tests were conducted following:

- The test scenarios in the various environments as established in collaboration with the local points of contact.
- The tests procedure established and validated during the Dry-run phase.

At the end of the testing week, a Post-Test Review (PTR) was organised to gather issues or observations and to draw conclusions on them. Each PTR allowed to improve the process for the next testing week.

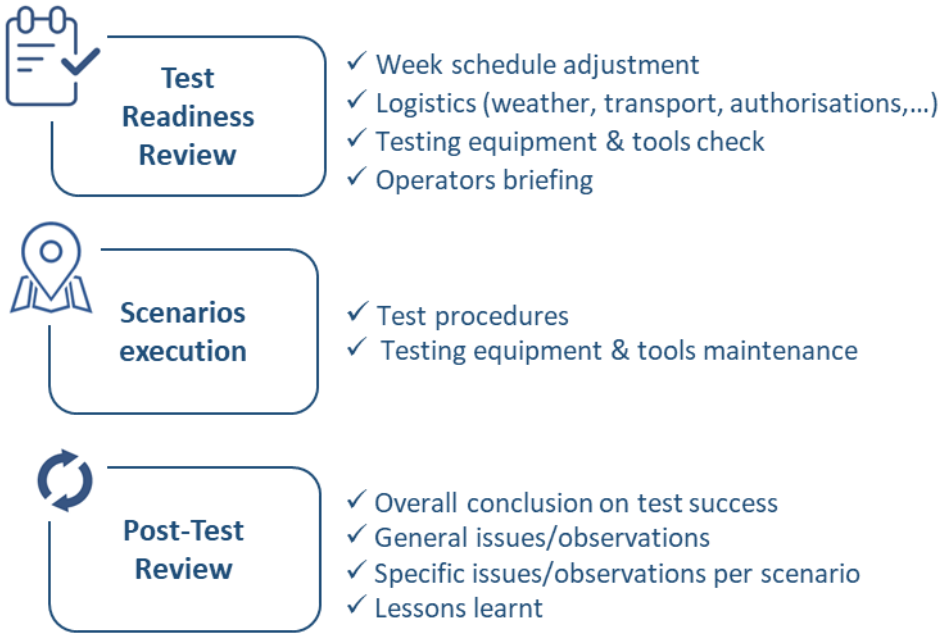


Figure 5-8 – Test conduct scheme

Despite the tight control on the organisation, several contingencies occurred during the test campaign:

- **Equipment delayed delivery** (due to the airline company) for both Croatia and Sweden, and recovered on Tuesday morning.
    - The week has been rescheduled to perform the indoor scenarios on Monday (no need of Ground truth)

- Testing boards have been improvised to replace the skewer.

- A **Galileo outage** occurred during the testing week in Sweden. Therefore, GNSS samples collected in Sweden have not been used in the GNSS analysis while AML samples have been maintained. This lead to a lower amount of samples available for GNSS analysis study, but also gave the opportunity to make a complementary analysis of the handsets behaviour without Galileo, which could have not been done by configuration.

5.2.3 Results generation

The generation of the results lead to the computation of synthetic key performance metrics from the big amount of raw data collected during the testing weeks.

These raw data recorded by the testing application on each handset during the tests can be classified into two categories:

- GNSS data that were used to assess Galileo benefits
- AML data that were used to assess the compliance of AML with User Requirements defined in the Help112 pilot project.

Both AML and GNSS raw data contained the following location parameters: longitude, latitude with an associated radius and timestamp. For the GNSS data, the location is computed with GNSS only while AML location is a fused Android location, potentially merging various location sources: Cell-ID, Wi-Fi and GNSS.

More raw data are available on GNSS side: GNSS status and satellites data like for instance which satellites are being tracked, which satellites are used in fix and what constellations are they from.

The main steps of the key performance metrics generation from these raw data are presented by Figure 5-9.

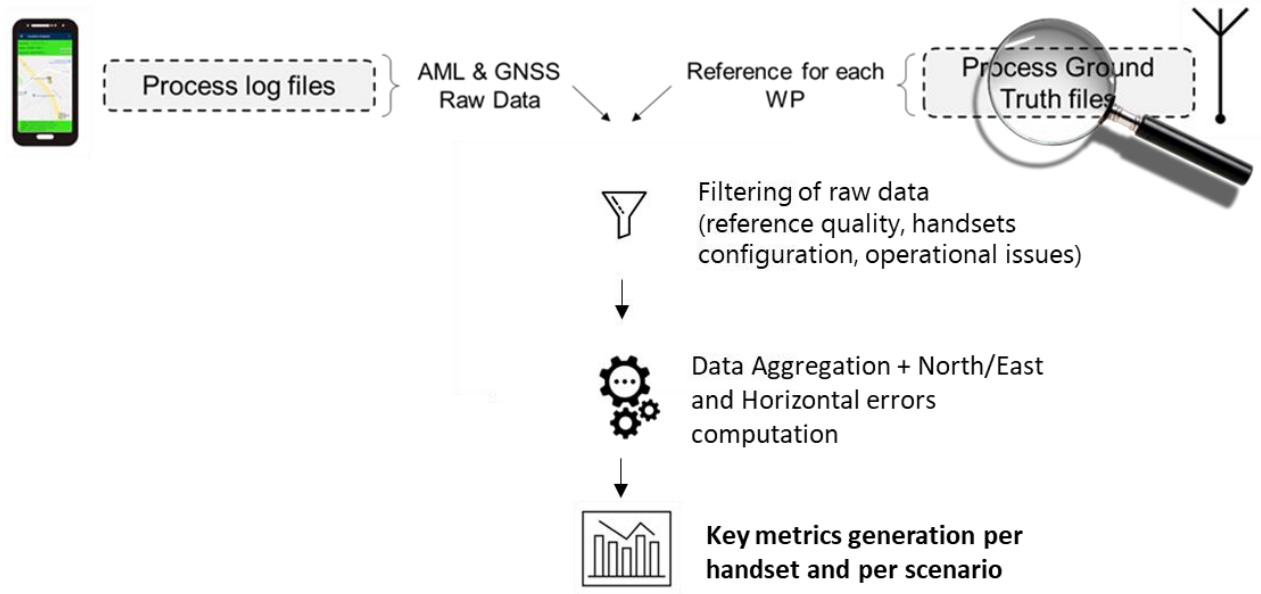


Figure 5-9 – AML/GNSS data processing

5.2.4 Main GNSS results

The objective of the analysis is to compare the performances of the different handsets in terms of accuracy and reliability and to assess the potential benefits of Galileo.

The analysis was twofold: one global analysis gathering the results of all the environments combined was performed, followed by one per environment.

These results were analysed regarding the characteristics of the handsets at stake, such as their constellation compatibilities, the OS, the chipset, their price range and their capacity to implement the dual frequency functionality. These characteristics are showed by Figure 5-10.

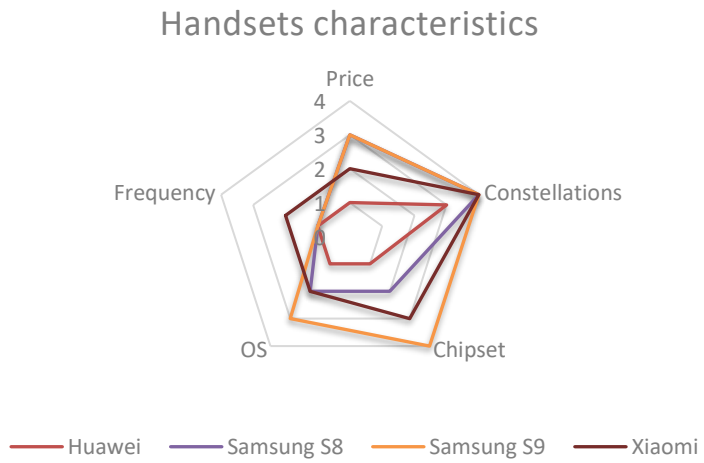


Figure 5-10 – Handsets characteristics synthesis

This analysis provided various interesting results. First, all the handsets provide correlated positions as illustrated by Figure 5-11.This has drastically reduced the number of independent samples for the statistical analysis.

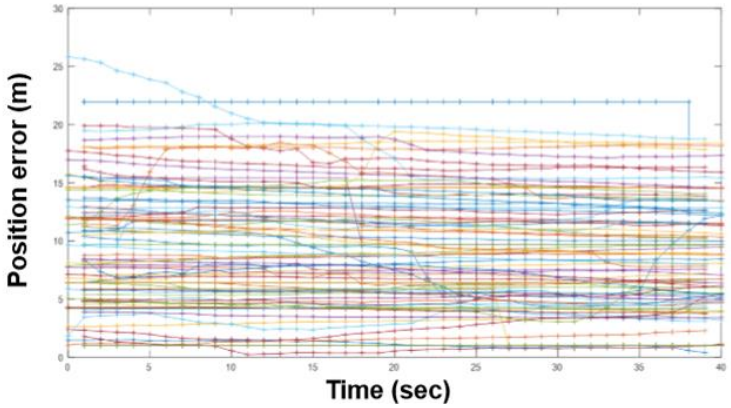


Figure 5-11 – Illustration of sample correlation (Samsung S8)

Figure 5-12, that represents the distribution of the horizontal errors in percentage, and Figure 5-13 provide some major results of the analysis. The initial assumption, claiming that the performance differences observed would only be due to Galileo usage or not, was directly challenged by these figures. Indeed, the fact that our baseline (Huawei), which is not Galileo-capable, provides better performances than one of the Galileo-capable handsets (Samsung S8) proved that the OS, hardware and chipset also play a role in the positioning performance of the smartphone.

This analysis also highlighted some interesting points. For instance, the overall good performances of the Xiaomi handset are likely to show the positive effects of dual frequency with respect to accuracy performances. Figure 5-12 shows that in warm start configuration, 24% of horizontal errors of the Xiaomi are around 2 meters, with only 16% for Huawei and Samsung S9 and 8% for the Samsung S8.

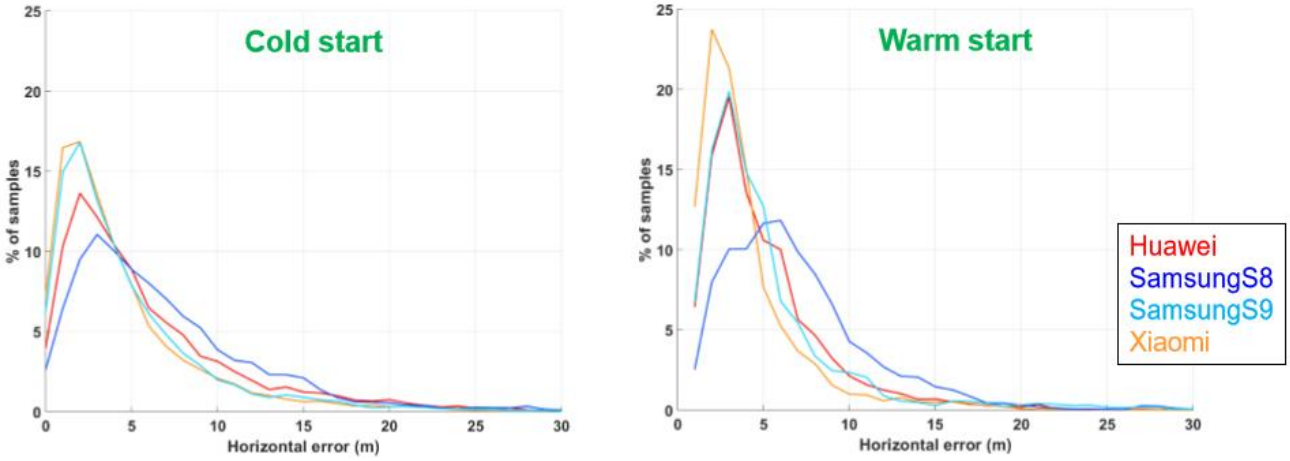


Figure 5-12 – Position error distribution

Moreover, the most reliable handsets are those using Galileo-satellites the most in their PVT computation.

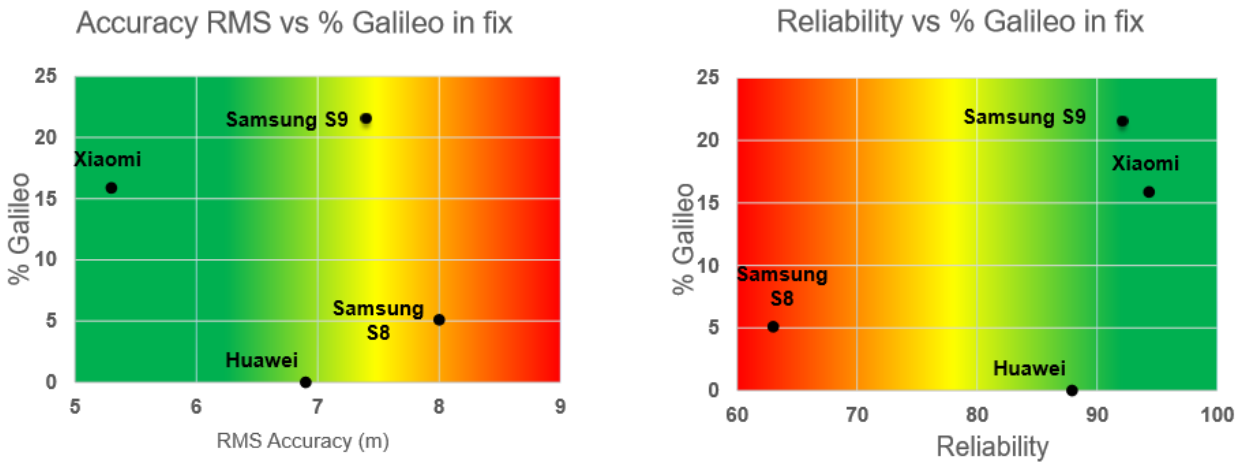
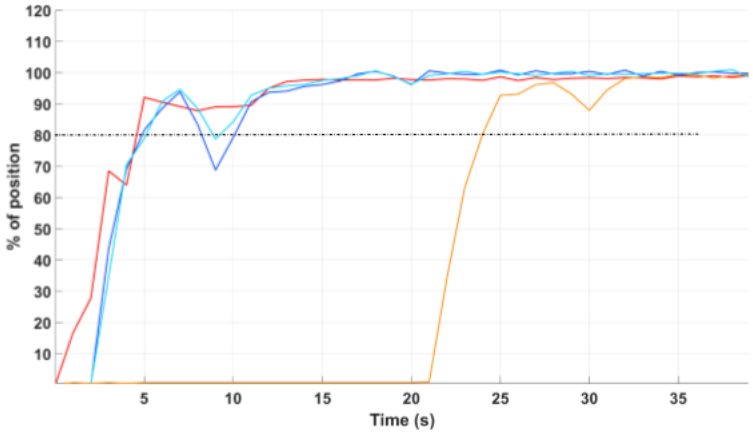


Figure 5-13 – Performance metrics according to Galileo % in fix

Another major observation is that the handsets present various time to first fix, from 5 to 25 seconds as showed in Figure 5-14. This will have a significant impact in the context of emergency calls.



Handset	TTFF (s)
Huawei	5
Samsung S8	5
Samsung S9	6
Xiaomi	24

Figure 5-14 – TTFF - % of position fix vs time (40 seconds tests)

Finally, this study highlights that the only way to assess the effect of Galileo in the performances of a handset would be to have the capacity of configuring the constellations tracked by each handset, to fix other parameters which obviously strongly impact performances. There are too many parameters at stake to clearly observe the effect of Galileo from one phone to the other. The chipset, the android version and the smartphone manufacturer choices play a role in the performance regarding:

- The satellite selection and acquisition,
- The GNSS filter characteristics (Static mode, choice of the SV to use in PVT, filter tuning, measurement error model),
- The material used for the back shell probably plays a role in the quality of the satellite tracking.

Focus on Galileo outage tests results

The Galileo outage that occurred during the testing week in Sweden provided an opportunity to get GNSS results from the handsets without Galileo, which was not feasible by configuration.

Thus, a comparison between performances in Sweden and Denmark was conducted to try to assess the impact of Galileo (Denmark was chosen for having the closest latitude to the Sweden's one, allowing comparable DOPs values). Only the rural and suburban scenarios were considered to ensure that the environment did not play a major role in the observed performance.

Some very similar performances in terms of accuracy, reliability and convergence time were obtained in both country, meaning a small influence of Galileo in these performances metrics, as shown for example by Figure 5-15. This observation is moderated by the very low number of samples available to perform the statistical analysis and by the average small proportion of Galileo satellites used in the handsets in general.

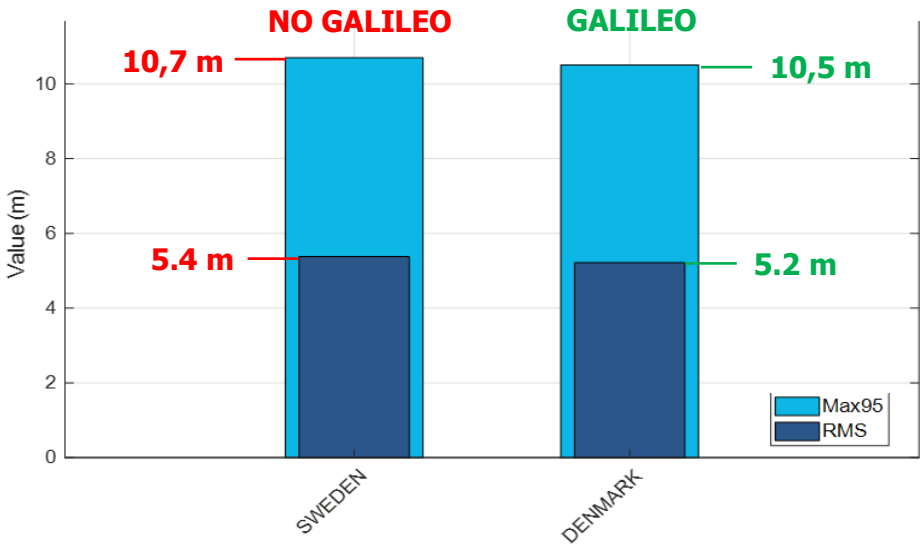


Figure 5-15 – Max95/RMS Accuracy in warm configuration in both Sweden and Denmark

5.2.5 Main AML results

The following AML results have been generated all handsets combined and are presented by environments.

Urban environment

Figure 5-16 provides the AML results in urban environment per countries with indoor and outdoor combined.
The relatively flat accuracy and AML radius is driven by the majority of results being Cell or Wi-Fi based, which is particularly true of indoor locations.

An interesting point is the significant improvement in urban outside likely due to GNSS use for PVT computation. Moreover, in some countries like Sweden, it seems that indoor GNSS repeaters also contributed to improve accuracy.

Variances in accuracy and AML Radius (precision) may be due to fluctuations in Wi-Fi signal strength and serving cells over time.

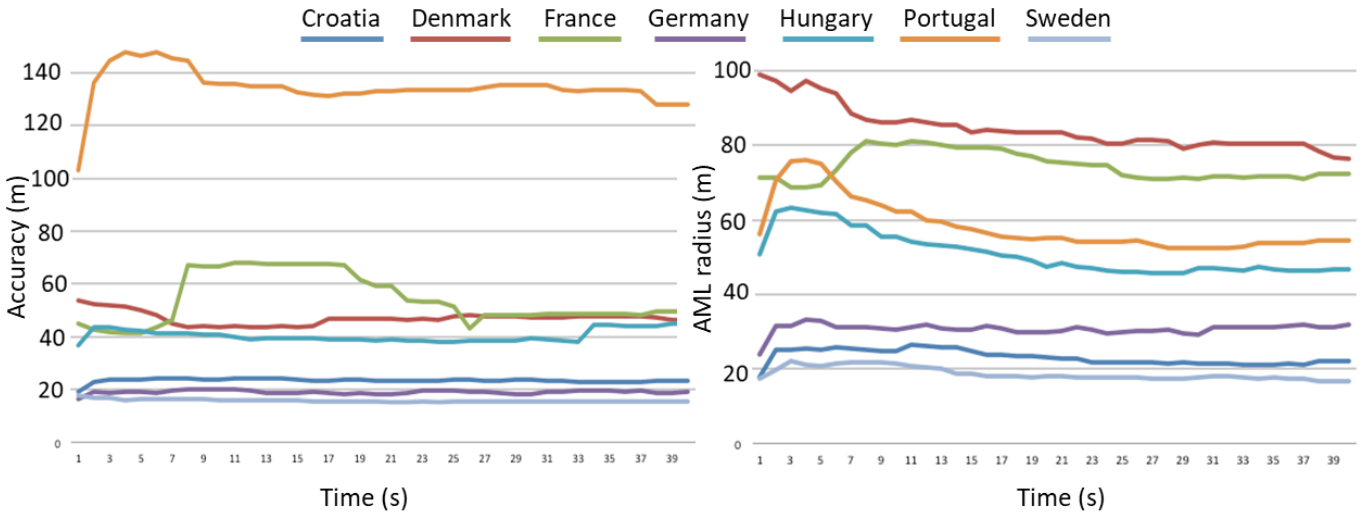


Figure 5-16 – Average Accuracy and AML radius vs Time in Urban environment

Suburban environment

Figure 5-17 provides the AML results in suburban environment per countries with indoor and outdoor combined.

Suburban testing showed strong improvement in accuracy and AML radius from GNSS. Initial results were generally Wi-Fi or Cell based, however these were supplemented by GNSS data within the first 10 seconds leading to more accuracy and precise results. Only little change was observed between testing inside cars and outside, both benefitted from GNSS rapidly with a good level of accuracy and precision.

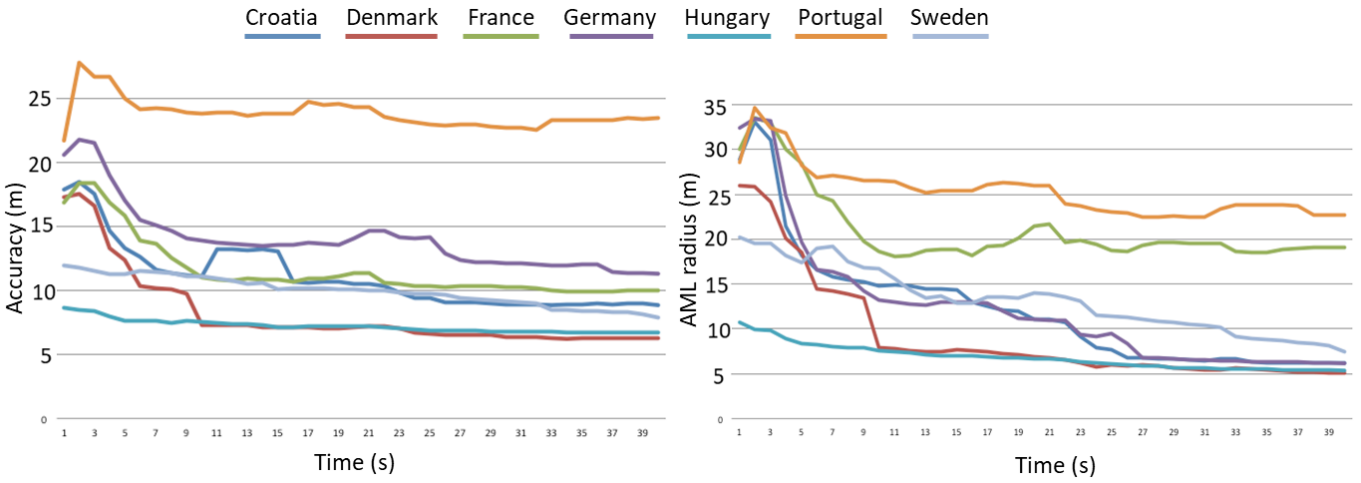


Figure 5-17 – Average Accuracy and AML radius vs Time in Suburban environment

Rural environment

Figure 5-18 provides the AML results in rural environment per countries with indoor and outdoor combined.

GNSS locations were able to be obtained in most environments, leading to a good level of accuracy and precision. Cold start devices did show a deviation in behaviour from warm start devices, typically taking 25 seconds to achieve a good (below 10m accuracy) level of location. Some devices did not report an AML location for a significant period of time, possibly indicating a lack of cell or Wi-Fi information and a slow time to first fix.

Rural testing indicates a significant improvement in accuracy by 6 seconds and then a further improvement at 25 seconds. This improvement at 25 seconds was largely driven by two outlying devices (Huawei & Xiaomi), however these are popular devices in the marketplace and choosing a trigger time to reflect this behaviour could prove beneficial.

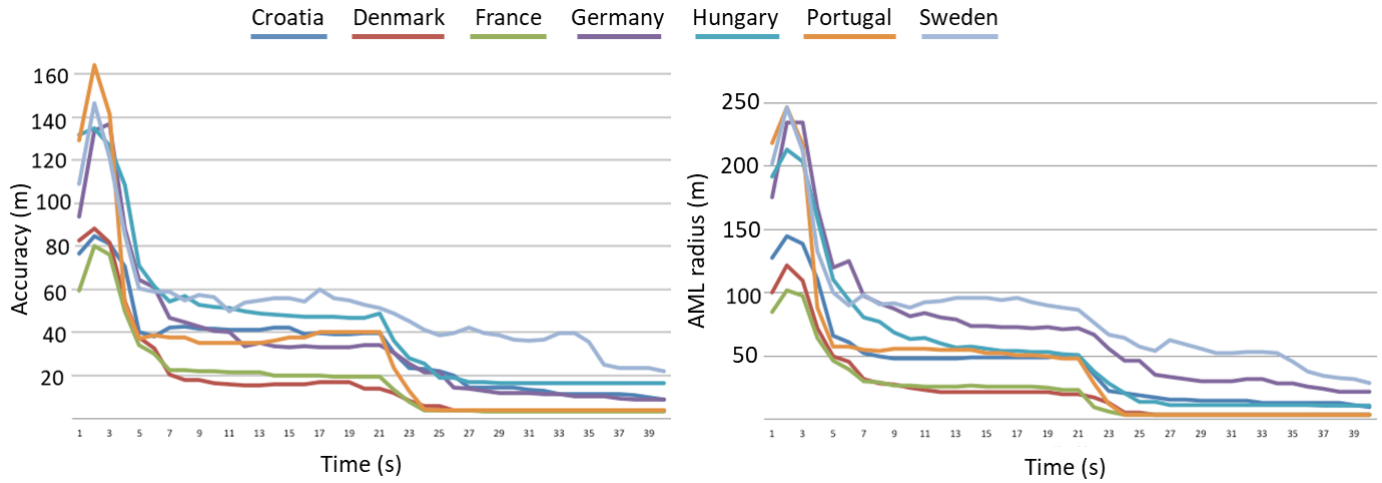


Figure 5-18 – Average Accuracy and AML radius vs Time in Rural environment

5.3 OUTCOMES AND LESSONS LEARNT

5.3.1 Outcomes

The joint analysis of the AML and GNSS results helped understanding some key elements.

The GNSS shows a positive impact on the AML results in outside environments and more specifically in areas where the cell and Wi-Fi coverage is light. But according to various parameters (handsets models, environment, cold or warm configuration) the GNSS receiver embedded in the handsets requires a certain time to provide a first position, up to 25 seconds for one of the tested handset. This should be taken into account in the decision of AML triggering times.

The tested handsets are top in the marketplace but provide unequal performances in terms of accuracy and reliability. Some of the handsets provide untrustworthy radiuses, which shall therefore be used with cautions by PSAPs. Anyway, the performances reached are globally standard GNSS performances, and provide good levels of accuracy.

5.3.2 Improvement of testing

Under the hypothesis of a potential new testing session, the following points should be taken into considerations in the preparation of the testing activities:

- In order to counter the static mode implemented by the handsets, tests should be realised with a bigger number of waypoints to obtain more independent and less correlated samples, and only one set per waypoint shall be considered.
- In order to comprehensively assess the potential benefits of Galileo:
  - The handsets should allow the possibility to enable/disable the Galileo constellation tracking on the phones so that we have every other parameter identical except the constellation.
  - OR, GNSS signals could be recorded on the field and replayed in an anechoic chamber, to allow the comparison of the same handset but with different signals to be replayed (with Galileo VS without Galileo).
- Only one unique test can be done at each WP location because of the high correlation of the consecutive positions due to the "static mode".
- Consequently, tests should be realized in a bigger number of locations to obtain a bigger number of independent samples. Note that this would thus require a longer testing period.

5.3.3 Use of AML data

Use AML radius with caution

The GNSS and AML results showed that some handsets are not reliable and may provide untrustworthy radiuses. In particular it was observed that a reduction in AML radius below 10m was not reflected in improved accuracy. Thus, this information shall be used with caution by the PSAPs. Moreover, an AML radius-capping principle could implemented by the handsets.

Choose best AML triggering time

Call connection times in mobile networks can take up to 6 seconds to connect. If the PSAP wishes to obtain a location very early in the call to defend against dropped calls, the testing indicates that a significantly more accurate location will be returned by selecting a location at 6 seconds rather than 1 second. As AML will fire at call initiation rather than connection – this will effectively be a location at the start of the call connection.

A common configuration for AML triggering is 20 seconds (based upon a target delivery to the PSAP by 30 seconds). Testing has indicated that sampling at 25 seconds does yield an improvement in accuracy. However, if operationally the PSAP requires positions to be delivered by 30 seconds a sample at 20 and then a subsequent sample would be a valid strategy.

5.3.4 Guidelines to improve AML

Implement AML Radius Capping

The testing has shown that for small AML radiuses (below 10 meters), the reduction in radius is not reflected in accuracy. One possible solution is to consider a minimum level of radius to display to the end user, testing has shown that a 10m radius would be an appropriate cut-off point. This would also potentially benefit the end user as the location would be more visible on the map due to the slightly larger radius.

Foster indoor GNSS repeaters

Some AML results pointed out the potential benefits of installation of indoor GNSS repeaters. Whereas Wi-Fi based locations do provide an improved level of accuracy over basic cell, GNSS

repeaters showed value particularly in deep indoor scenarios (e.g. in the Swedish subway). The expansion of GNSS coverage in indoor environments could be envisaged in indoor public places.

Improve GNSS performances in handsets

The GNSS results highlighted potential factors for better GNSS performances:

- The implementation of the dual frequency technology shows positive effects on the accuracy. The tested dual frequency handset shown significant better accuracy results in particular in open-sky environment where the most remarkable difference was the use of dual frequency.
- The use of plastic for the back shell instead of tempered glass for instance seems have positive impacts on GNSS performances.

Complete the AML message

The AML message could be complemented with the altitude/height information, or even more specific, a floor information for indoor. A speed/course information could also be provided in the message, for specific case of call from a person moving against his/her will.

Conversion of the raw AML information into dispatchable location

The AML position is provided as a latitude and a longitude. This information could be converted into dispatchable locations (street name and number for instance) to ease and optimise the dispatch of emergency teams. This could be particularly helpful in dense environments, with multi-level road infrastructures. This responsibility for generation of dispatchable location could be placed upon the stage 1 location server, rather than the AML handset.

5.4 WP2 IN A NUTSHELL

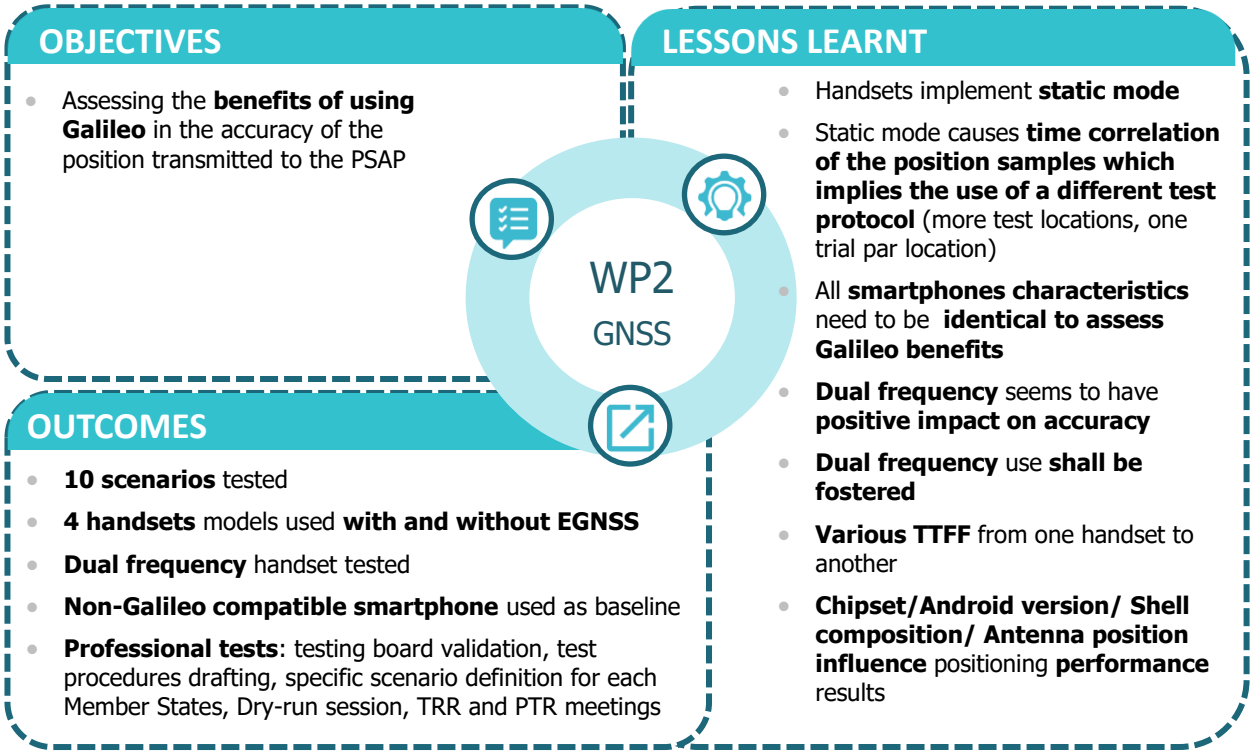


Figure 5-19 – WP2 GNSS focus in a nutshell

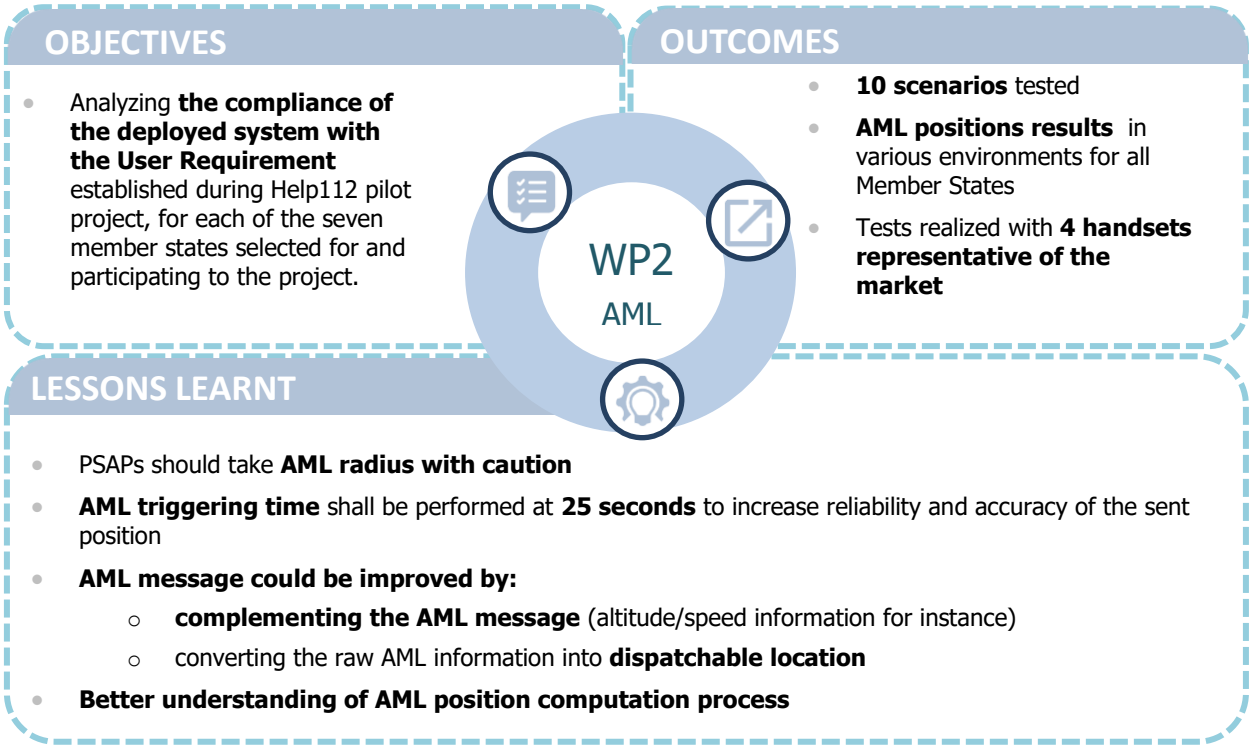


Figure 5-20 – WP2 AML focus in a nutshell

6. WP3: PSAP DEPLOYMENT AND OPERATION USER GUIDE

This section describes the work completed in WP3 dealing with the PSAP user guide and associated dissemination.

WP3 has been led by EENA.

6.1 OBJECTIVES & REQUIREMENTS

The objectives of WP3 according to the Call for Tender [AD1] were:

1. to produce a PSAP User Guide, providing an AML deployment and operational manual;
2. to develop a data gathering procedure for collecting AML live operation monitoring statistics;
3. to share the experience and best practices gathered during the AML deployments.

In order to support these objectives, the Tender Specifications [AD1] provided the following requirements:

REQ-WP3-01 A PSAP user guide shall be designed.

REQ-WP3-02 The PSAP user guide shall serve as a manual for the deployment of AML starting from scratch and/or for the upgrading of already-existing infrastructure.

REQ-WP3-03 The PSAP user guide shall help call takers and PSAPs manage the AML caller location information received, and to identify the most reliable location information to consider when Cell-ID and GNSS/Wi-Fi information data differ.

REQ-WP3-04 The PSAP user guide provide data-gathering procedure in order to gather time series with regards to the accuracy and reliability of handset based caller location.

REQ-WP3-05 A conference/workshop shall be organised in which the PSAP user guide will be introduced to PSAPs, including countries in which AML has been deployed, and those where it has not, in order to share experiences and best practices, as well as to inform PSAPs of the best possible use of AML.

REQ-WP3-06 The participation of PSAPS in at least 4 Member States that have not yet deployed AML shall be secured.

6.2 WORK ACHIEVED

6.2.1 PSAPs user guide

The main deliverable of WP3 is D3.1 PSAP user guide which has been split in 3 parts:

- Part I – Deployment Manual

- Part II – Operation User Guide
- Part III – Live operation monitoring

The user guide was prepared from the experience gathered during the Help112 pilot project and the various publications about AML, including the latest ETSI Technical Specification TS 103 625 V1.1.1 (2019-12).

In addition to the deployment manual, Help112 II also proposed an ideal AML architecture to be followed on a per country basis. AML is one of the sources of location data currently available and should be used in addition to other existing location data. As no single source of location data is able to provide high accuracy and resilience 100% of the time, a hybrid approach to provide location services is desirable. Taking all available data from multiple sources into consideration aims to increase the reliability of the location estimations, simplify the work of PSAP operators, and provide a better emergency location ecosystem for Europe.

The deployment user guide covers the architectural guidelines for centralised deployment and validating estimations from multiple location sources. Considerations such as the legislation, data storage, cyber security and redundancy options are explained. The included deployment plan goes through all the necessary steps to deploy AML and the engagements needed with MNOs, OS providers and PSAPs. The deployment manual describes the suggested deployment testing and the flexibility given by the AML configuration in terms of timescales and communication channels.

The recommendations provided in the operational user guide have been prepared after gathering and studying the experience and feedback of countries that have been using AML, in addition to the previously mentioned sources. Semi-structured interviews were done with representatives from 9 countries that have been using AML in an operational environment. The feedback gathered from the interviews led to the 5 recommendations listed in the operational guide and aim to provide guidance on how to validate AML, how to interpret the different estimations especially when they are conflicting with estimations from other sources, selecting the appropriate time points to receive AML, integrating AML in the PSAP systems and training the PSAP operators.

Lastly, the live operation monitoring guide builds on the importance of monitoring the operation AML, even when the deployment is completed and provides a template for reporting operational statistics. The statistics template has been used during the project to report the live operation in the 7 Member States during a 2 months period.

6.2.2 PSAP Workshop

The concluding activity of WP3 was the PSAP workshop, which despite the change of plan due to the COVID-19 outbreak, it took place on May 5th 2020 with great attendance and an engaging discussion at the end of it. Representatives had the opportunity to get answers to their questions and discuss the benefits, challenges and known issues with AML. The workshop has been successfully completed and it gave the opportunity to the consortium to share the AML implementation experience gathered during the project, in an attempt to guide future implementation in more member states and drive the future development of AML.

The workshop was attended by representatives from member states that have deployed AML (Austria, Denmark, Estonia, Finland, France, Germany, Hungary, Lithuania, and Romania) and all member states that had not deployed AML at the time of the workshop, specifically Bulgaria, Cyprus, Czech Republic, Greece, Italy, Latvia, Luxembourg, Malta, Poland, Slovakia, and Spain.

An event report containing the slides prepared for the workshop was provided to all the participants.

6.3 OUTCOMES AND LESSONS LEARNT

A comprehensive PSAP Guidelines and Operation manuals have been prepared based on interviews with Member States using AML in operational environment, and presented during the PSAP workshop.

The workshop included open discussion between the consortium and the participants, triggered by questions about the implementation of AML. The questions have driven a discussion around the AML implementation and the following topics:

- Availability of opt out in Android and iOS
- Applicable legislation defined in the ELS agreement and reactions of the member states
- Establishing close cooperation with Google and using statistical data or business intelligence systems to identify potential issues with MNOs early in the implementation
- Missing MSISDN in messages by HTTPS, percentage of messages with missing MSISDN and solutions identified by member states
- Zero rating AML messages from roaming callers is not yet ensured and member states need to identify solutions. Cooperation of MNOs throughout the EU is necessary to ensure that AML SMS and data connection is zero rated. Member states (Croatia) find it difficult to contact all MNOs around the EU to ensure free provision of caller location.
- Proposal to use ITU international Emergency numbers (but fear about high cost)

6.4 WP3 IN A NUTSHELL

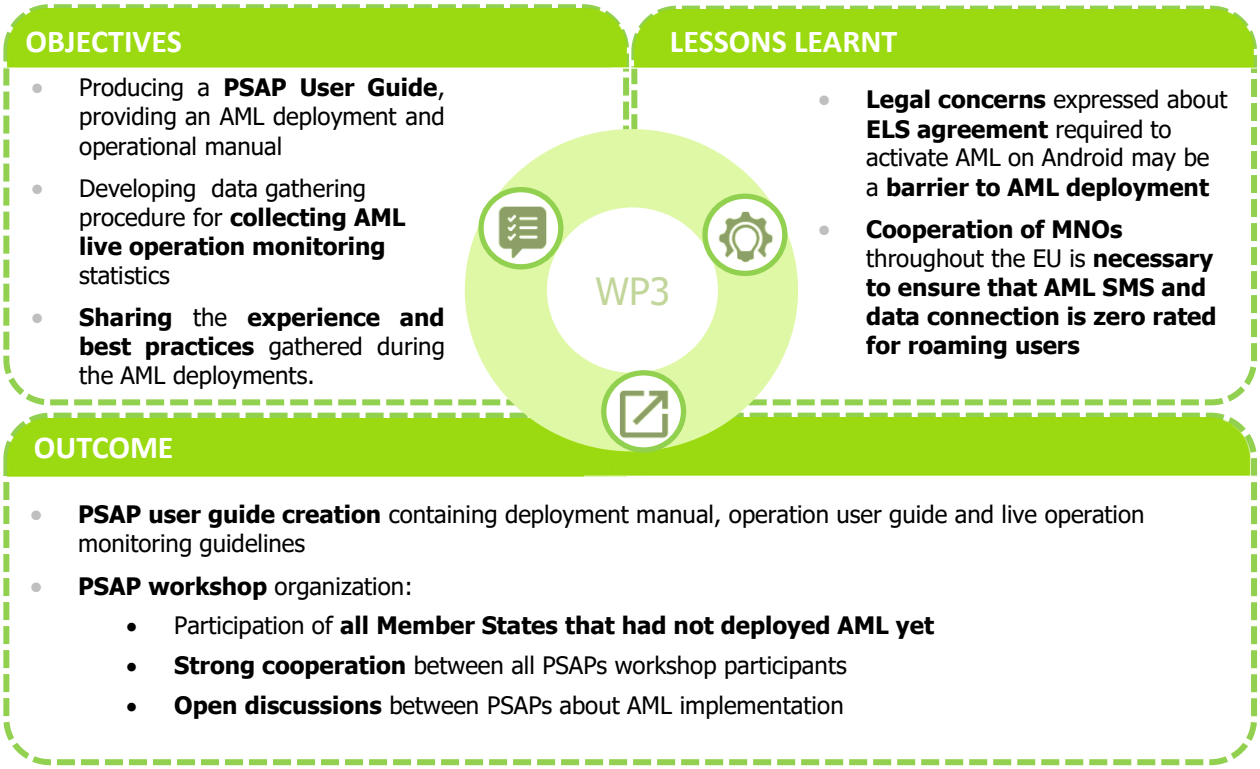


Figure 6-1 – WP3 in a nutshell

7. WP4: ECONOMIC ANALYSIS

This section describes the work completed in WP4 dealing with the economic analysis of the AML benefits in Member States where AML has already been deployed.

WP4 has been led by PTOLEMUS.

7.1 OBJECTIVES & REQUIREMENTS

The objectives of WP4 according to the Call for Tender [AD1] were to:

1. Carry out an analysis of public benefits of AML in the countries in which AML has already been deployed;
2. Validate that the user requirements abide by the appropriate legal standards of the EU and those countries/regions;
3. Gather critical inputs to model public benefits of AML implementation;
4. Evaluate the associated costs to implement AML in each of those countries;
5. Build the cost-benefit analysis for each country using live implementation data.

In order to support these objectives, the Tender Specifications [AD1] provided the following requirements:

REQ-WP4-01 The contractor shall carry out an analysis of public benefits of AML in the countries in which AML has already been deployed and data is available, whether as a result of EU funding or otherwise.

REQ-WP4-02 The structure of the cost-benefit analysis shall be used to provide an analysis of the extent to which AML deployment led to concrete measurable improvements in variables such as emergency service response time and efficiency of resource deployment at the PSAP level.

REQ-WP4-03 The extent to which the user requirements (outlined in Annex 2 of the tender specifications [AD1]) abide by the appropriate European and National legal standards shall be assessed.

REQ-WP4-04 The extent to which the user requirements (outlined in Annex 2 of the tender specifications [AD1]) comply with EU and Member State privacy (including, but not limited to data protection) laws shall be assessed.

7.2 WORK ACHIEVED

WP4 is structured in 2 tasks:

1. Data collection
2. Cost-benefit analysis

The economic analysis have been performed for 6 Member States in which AML has already been deployed:

- Austria
- Belgium
- Estonia
- Finland
- Lithuania
- The UK

Ireland was removed from the scope because the team responsible for AML was not able to provide the required data for the analysis. After multiple requests, Ireland did not provide the emergency services statistics and AML datasets needed to build the CBA. As mitigation action, several meetings to validate assumptions and extrapolate data from other countries into the CBA model of Ireland have been organised. Unfortunately, such meetings did not happen.

When they were finally going to provide inputs, COVID crisis stroke them, and they communicated that it was not possible to provide the required data.

After presenting the different alternatives going forward to the EC and consortium members, it has been jointly decided that the best action was to remove Ireland from the scope of WP4.

7.2.1 Data collection

All selected Member States have been contacted to present the project and successfully obtain information from all PSAPs. Real AML datasets and statistics have been obtained regarding the distribution of emergency cases. Finally, the regulation have been analysed at EU and country level.

An official letter, to assist in the data collection, has been prepared by the European Commission explaining the purpose of the project and requesting cooperation of the relevant PSAPs.

Sub-task	Progress
Understand PSAP models in each country	Completed for all countries
Present scope, objectives, tasks and expected results in each country	Completed for all countries
Collect data on emergency calls and AML implementation	Completed for all countries.
Analyse concrete emergency cases	Completed for all countries.
Collect costs and key data regarding AML deployment	Completed for all countries
Identify regulation /national privacy laws	Performed desk research for most countries and interviewed the PSAPs in all countries to collect data regarding regulation and privacy laws.
Adjust and clarify data per country	Visited Belgium and Estonia PSAPs and met with the rest of the countries at EENA conference to introduce the project, followed by multiple virtual meetings to review inputs and outputs of each country's CBA.

Table 7-1 – Detail on data collection progress

7.2.2 Cost-benefit analysis

Before estimating the benefits and presenting them to the countries, the methodology for the cost-benefit analysis has been built, presented and validated it with the consortium members and the European Commission.

Sub-task	Progress
Build country level model	Reviewed and agreed the CBA methodology with the European Commission and the consortium members.
Adjust model for each country	Adjusted model to the specific conditions of each country and input all data available for the estimations.
Economic analysis of AML deployment	Performed an economic analysis for all countries.
Analyse the technology evolution at national level	Identified technology evolution trends in all countries analysed.
Analyse improvements brought by AML	Performed quantitative and qualitative analysis of the improvements brought by AML at the different steps of the emergency value chain.
Analysis of compliance with EU & Member State Privacy Laws	Mapped relevant EU legislation vs. country-specific regulation.
Identify regulation impacts of the CBA for each country	Reviewed the relevant regulation in each country and compared it to the user requirements as defined in Help112 pilot project.
Estimate AML deployment evolution in each country	Reviewed of the state of development for each country and their new developments and integrations.
Write country report	Produced 6 individual country reports and 1 report that integrates and compared all 6 countries, including main findings and conclusions.

Table 7-2 – Detail on CBA progress

7.3 OUTCOMES AND LESSONS LEARNT

After **18 months of analysis and information exchange with the PSAPs of each country**, we learned that AML brings significant benefits at a cost for emergency services of less than €120,000 per country.

PTOLEMUS has found that:

- In all countries save Austria, at least 50% of the mobile emergency calls benefited from AML during 2019;
- AML improved the precision of the location by 460% in Lithuania and up to 1790% in the UK;
- Depending on the country, AML saved between 14 and 45 seconds per mobile emergency call each year.

Thus, PTOLEMUS estimated that, over a 10-year period:

- AML will save 236 lives in Estonia and up to 5,276 in the UK during the first 9 after the deployment;

- On average, the number of lives impacted by AML (i.e. either when lives were saved or when the seriousness of the injury was mitigated) will range from 5.3 in Lithuania to 18.7 in the UK out of every 100,000 relevant34 calls during the first 9 years after the deployment;
- AML will generate a very significant Net Present Value per country, from €349 million for Estonia up to €11.1 billion for the UK.

Key findings	Austria	Belgium	Estonia	Finland	Lithuania	The UK
% of calls benefiting from AML (2019)	17%	58%	70%	74%	64%	56%
AML precision improvement per call (vs. base case scenario)	17.67x	7.31x	6.27x	12.6x	4.61x	17.86x
Average time saved per call (seconds)	39	27	19	38	14	45
Number of lives saved and injury seriousness reduced (10 years period)	1,090	1,069	236	1,532	379	5,276
Number of lives impacted every 100,000 calls benefiting from AML that lead to dispatch (average during the analysed timeframe)	16.44	10.92	8.40	15.35	5.30	18.67
AML CAPEX (€ thousand)	113	63	15	93	58	97
NPV per country (€ million)	2,628	2,375	349	3,604	548	11,102

Source: PTOLEMUS estimates

Table 7-3 – Summary of key AML figures in the analysed countries

We can conclude that the implementation of AML has been successful in all 6 countries:

- Today, all countries have or are in the process to have iOS and Android supporting AML in their country;
- All emergency services are benefiting or in the process of benefiting from AML;
- The AML deployment has been cost-effective everywhere, as it has leveraged existing systems (i.e. smartphones, Cell ID networks, GNSS constellations, Wi-Fi and fixed broadband connections, PSAPs' call handling and GIS systems and smartphone's positioning sensor fusion software);
- At the same time, we forecast the benefits to be significantly higher than the investments and operational costs.

[34] *Calls benefiting from AML that lead to a dispatch*

Completed Partial Not completed

Key findings	Austria	Belgium	Estonia	Finland	Lithuania	The UK
AML was quickly deployed	✗	~	✓	✓	✓	~
OS providers support AML	~	✓	✓	✓	✓	✓
Emergency services are effectively using AML	~	✓	✓	✓	✓	~
Emergency numbers are AML-enabled	~	~	✓	✓	~	✓
AML-enabled roaming calls	✓	✗	✗	✗	✗	✓
HTTPS as additional location transmission method	✓	n.a.	n.a.	n.a.	n.a.	n.a.
AML leverages the existing infrastructure	~	✓	✓	~	✓	✓
Cost effective AML implementation	✓	✓	✓	✓	✓	✓

Source: PTOLEMUS with data from the PSAPs

Table 7-4 – Summary of AML implementation results in the analysed countries

Moreover, we have identified certain **best practices** that permit PSAPs to have smoother implementations and to obtain full benefits from day 1:

- 112 as the unique emergency number;
- A lean PSAP structure to manage the end-to-end AML data related processes;
- The involvement of PSAPs internal IT teams in the development of AML instead of full outsourcing;
- The development of a system to monitor the performance of AML;
- Setting the solution so as to trigger multiple location messages for each call;
- The inclusion of additional communication channels (HTTPS) to transmit the location.

7.4 WP4 IN A NUTSHELL

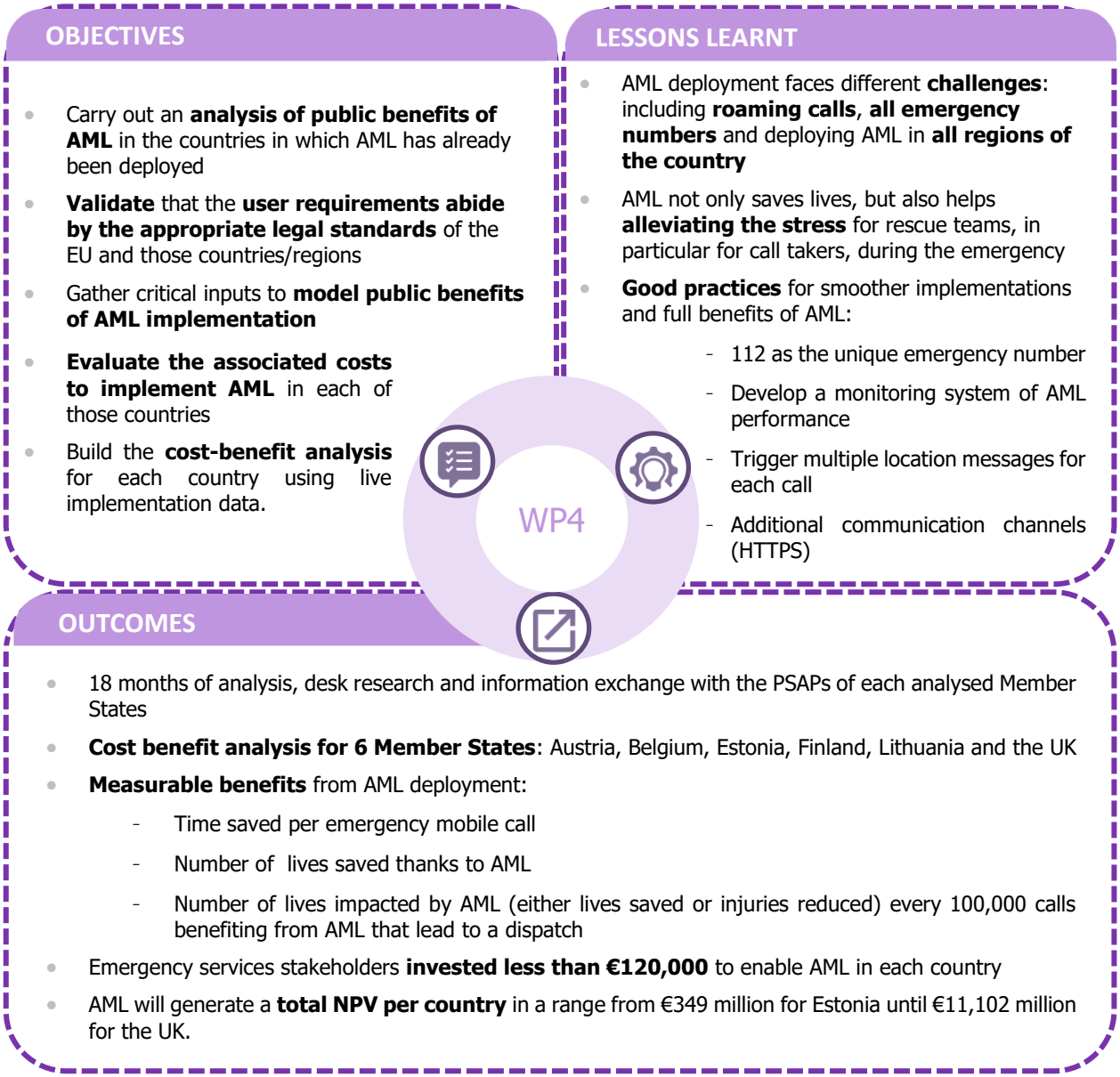


Figure 7-1 – WP4 in a nutshell

8. WP5: PROJECT MANAGEMENT

This section describes the work completed in WP5 dealing with the overall project management.

WP5 has been led by Telespazio France.

8.1 WP5 OBJECTIVES AND REQUIREMENTS

WP5 gathers all project management activities that ensured the proper planning, execution and close-out of the project according to the tender specifications [AD1], in particular:

1. Managing the overall contract in interface with the European Commission;
2. Monitoring the project requirement fulfilment;
3. Managing the project deliverables and the project reviews;
4. Ensuring the coordination within the consortium;
5. Monitoring and controlling the risks.

In order to support these objectives, the tender specifications [AD1] provided the following requirements:

REQ-WP5-01 Periodic reviews shall be performed both internally by the contractor and at regular meetings with the Commission.

REQ-WP5-02 The task shall provide the overall management for the contract and ensure the quality of the deliverables as well as schedule, cost and risk control.

REQ-WP5-03 The project management report shall provide an assessment of the results with regards to the objectives laid in the proposal for each work package.

REQ-WP5-04 The minutes of all meetings shall be annexed to the project management report.

Since all minutes of meeting have been provided in separate documents, **REQ-WP5-04** has been withdrawn by EC project officer during the preparation of the present document.

8.2 PROJECT REQUIREMENT FULFILMENT

The requirements for each work package have been recalled in the WP dedicated sections. The project requirement list initially came from the translation of the tender specifications [AD1] into technical requirements. Some of the WP1 and WP2 requirements have been clarified and reworked during the course of the project.

All requirements have been fulfilled.

The fulfilment of each of these requirements is summarized here below:

ID	Short Description	Fulfilment
REQ-WP1-01	AML deployment in 7 Member States	AML successfully deployed in Croatia, Denmark, France, Germany, Hungary, Portugal and Sweden.
REQ-WP1-02	Full deployment in 4 Member States	AML fully deployed in Croatia, Denmark, Hungary and Sweden.
REQ-WP1-03	Partial deployment in 3 Member States	AML partially deployed in France, Germany and Portugal.
REQ-WP1-04	AML roaming capability	Necessary technical solutions implemented in the 7 Member States.
REQ-WP1-05	Recommendation on Galileo uptake	Recommendations provided to alleviate technical barriers to Galileo uptake, to leverage and to create Galileo added values.
REQ-WP2-01	Testing with 4 different handsets	Reworked with the cooperation of the GSA. Fulfilled by 1) Performing the tests with 1 handset not Galileo-enabled to be compared with 3 handsets Galileo-enabled, of which 1 is dual frequency 2) Implementing 10 different scenarios with 15 waypoints each, each waypoint with 3 times 40 seconds of measurements and 3) Performing the tests with 4 handsets in warm start configuration (with GNSS assistance data), and the same 4 handsets in cold start configuration (without GNSS assistance data).
REQ-WP2-02	Equipment selection	
REQ-WP2-03	Testing in the 15 scenarios	
REQ-WP2-04	Comparison Galileo+GPS against GPS	
REQ-WP2-05	Comparison Galileo against GPS	
REQ-WP2-06	Testing with assistance data	
REQ-WP2-07	Testing conducted professionally	Preparatory phase leading to testing board validation, test procedures drafting, specific scenario definition in each Member States and concluded by a Dry-run session. Testing week opened and closed respectively by TRR and PTR meetings.
REQ-WP2-08	Testing documentation	AML/GNSS test plan provided as deliverable D2.1.
REQ-WP2-09	Compliance with User Requirement	Assessed following 3 methods: 1) by design performed in WP1, 2) by AML testing performed in WP2 and provided in D2.2.x and in D2.1.2 /D2.1.3 and 3) by end-to-end testing performed in WP1 and provided in D1.2 and D1.1.x.
REQ-WP3-01	PSAP user guide	Provided as deliverable D3.1.
REQ-WP3-02	PSAP user guide as a manual for AML deployment	Provided in Part I of D3.1 named AML Deployment Manual.
REQ-WP3-03	PSAP user guide helping PSAP to manage AML data	Provided in Part II of D3.1 named Operation user guide.
REQ-WP3-04	PSAP user guide with procedure for data gathering	Provided in Part III of D3.1 named Live Operation Monitoring.
REQ-WP3-05	PSAP workshop	Took place on May 5th 2020.

REQ-WP3-06	PSAP workshop participation	Attended by all Member States that had not deployed AML at the time of the workshop: Bulgaria, Cyprus, Czech Republic, Greece, Italy, Latvia, Luxembourg, Malta, Poland, Slovakia and Spain.
REQ-WP4-01	CBA of AML in Member States where deployed	CBA performed for 6 Member States in which AML had already been deployed.
REQ-WP4-02	Measurable AML benefits	Provision of % of calls benefiting from AML, AML precision improvement per call, Average time saved per call, number of lives saved and injury seriousness reduced and number of lives impacted every 100 000 calls benefiting from AML that lead to dispatch.
REQ-WP4-03	User Requirement compliance with legal standards	Provided in section 3.3 of all D4.1.x deliverables.
REQ-WP4-04	User Requirement compliance with EU and national privacy laws	Provided in section 3.3 of all D4.1.x deliverables.
REQ-WP5-01	Periodic reviews	Organisation of weekly teleconferences with the consortium, 6 PMs all along the project with the EC, Kick of Meeting, Intermediate and Final Review.
REQ-WP5-02	Contract management	
REQ-WP5-03	Project report demonstrating objectives fulfilment	Provided in sections 4.1, 5.1, 6.1, 7.1 and 8.1 of the present document and summarized in Table 8-1.
REQ-WP5-04	Project report with all minutes of meeting	Finally not required by the EC.

Table 8-1 – Help112 II requirement fulfilment

8.3 PROJECT DELIVERABLES

The deliverables for each work package have been recalled in the WP dedicated sections. They have all been submitted to EC project officer as specified in the Call for Tender [AD1], with the following exceptions:

Deliverable delayed submission

D1.1.3 "AML Deployment in France" submission which has been significantly delayed due to a change in the French team organization with the establishment of the French Digital Agency for Civil Protection ("Agence du Numérique de la Sécurité Civile"), which undertook the AML deployment activity, thus causing delays in the architecture design and the implementation activities.

Deliverable renaming

The "AML/GNSS test plan" which was initially named D2.1.1 at PM1 and then renamed to D2.1 to ensure a better consistency in the project documentation naming to follow the AML/GNSS test plan content agreed during PM2.

Additional deliverables

- Live Operation Monitoring results initially intended to be in D1.1.x, which were documented in separate reports called "Annex to D1.1.x";
- Live Operation Monitoring synthesis initially intended to be in D1.2, which were documented in a separate report called "Annex to D1.2"
- A complementary technical analysis carried out to compare GNSS test results between Sweden and Denmark, and documented in a separate report called "Annex to Deliverable D2.1.2&D2.1.3";

Cancelled data

CBA Ireland (D4.1.5) which has been cancelled during the course of the project due to the unavailability of the PSAP data.

All deliverables have been approved.

The final version of the project deliverables are summarized here below:

WP	Deliverable	Version	Date	Status
WP1	D1.1.1 AML deployment in Croatia	3.1.0	19 Feb 2020	Approved
WP1	Annex to D1.1.1 AML Live operation monitoring in Croatia	1.1.0	05 May 2020	Approved
WP1	D1.1.2 AML deployment in Denmark	3.1.0	17 Dec 2019	Approved
WP1	Annex to D1.1.2 AML Live operation monitoring in Denmark	1.0.0	09 Apr 2020	Approved
WP1	D1.1.3 AML deployment in France	3.2.0	06 Apr 2020	Approved
WP1	Annex to D1.1.3 AML Live operation monitoring in France	1.1.0	12 Jun 2020	Approved
WP1	D1.1.4 AML deployment in Germany	3.1.0	15 Jan 2020	Approved
WP1	Annex to D1.1.4 AML Live operation monitoring in Germany	1.1.0	19 Feb 2020	Approved
WP1	D1.1.5 AML deployment in Hungary	3.2.0	05 Mar 2020	Approved
WP1	Annex to D1.1.5 AML Live operation monitoring in Hungary	1.0.0	12 May 2020	Approved
WP1	D1.1.6 AML deployment in Portugal	3.3.0	19 Feb 2020	Approved
WP1	Annex to D1.1.6 AML Live operation monitoring in Portugal	1.0.0	12 May 2020	Approved
WP1	D1.1.7 AML deployment in Sweden	3.1.0	17 Dec 2019	Approved
WP1	Annex to D1.1.7 AML Live operation monitoring in Sweden	1.0.0	14 Jan 2020	Approved
WP1	D1.2 Deployment Report (global)	2.2.0	09 Apr 2020	Approved
WP1	Annex to D1.2 AML Live operation monitoring (global)	1.1.0	13 Jul 2020	Approved
WP1	D1.3 Recommendations for fostering Galileo user uptake	2.2.0	27 Jan 2020	Approved

WP2	D2.1 AML/GNSS Test plan	1.3.1	18 Oct 2019	Approved
WP2	D2.1.2 GNSS test report (Cold start)	2.1.0	29 Nov 2019	Approved
WP2	D2.1.3 GNSS test report (Warm start)	2.1.0	29 Nov 2019	Approved
WP2	Annex to D2.1.2&D2.1.3 GNSS test report Comparison between Sweden and Denmark	1.1.0	03 Feb 2020	Approved
WP2	D2.2.x UR Compliance Assessment Report for Country x	2.0.0	30 Oct 2019	Approved
WP2	D2.3 Report on all tests	1.1.0	29 Nov 2019	Approved
WP3	D3.1 PSAP user guide	4.0.0	17 Jan 2020	Approved
WP3	D3.2 PSAP workshop event report	1.2.0	25 Jun 2020	Approved
WP4	D4.1.1 Cost Benefit Analysis - Belgium	1.4.0	28 Jul 2020	Approved
WP4	D4.1.2 Cost Benefit Analysis - Estonia	1.4.0	28 Jul 2020	Approved
WP4	D4.1.3 Cost Benefit Analysis - Austria	1.2.0	28 Jul 2020	Approved
WP4	D4.1.4 Cost Benefit Analysis - Finland	1.2.0	28 Jul 2020	Approved
WP4	D4.1.6 Cost Benefit Analysis - Lithuania	1.2.0	28 Jul 2020	Approved
WP4	D4.1.7 Cost Benefit Analysis - The UK	1.2.0	28 Jul 2020	Approved
WP4	D4.2 Cost Benefit Analysis - Synthesis	1.3.0	28 Jul 2020	Approved

Table 8-2 – Help112 II deliverable status

NB: All deliverables D4.1.x have been first approved in their previous version on 5 June 2020. Following the Final Review, they have been enriched with complementary information.

8.4 PROJECT REVIEWS

Project reviews have been held tentatively as required in Tender Specifications [AD1], to present the current project status, the work achieved and the work planned.

On July 26th 2019, the consortium held a Steering Committee to take decision on postponing the IR until November 13th 2019, and subsequently the PM5 until 15th January 2020, due to the significant delays experienced in the AML deployment.

The meeting dates, locations and attendances are summarized here below:

Meeting	Schedule	Planned date	Actual Date	Locations	Participants
Kick-off meeting	T0+1m	13 Dec 2018	12 Dec 2018	EC premises Brussels	EC, Full consortium
Progress meeting 1	T0+2m	13 Jan 2019	23 Jan 2019	EC premises Brussels	EC, Full consortium
Progress meeting 2	T0+4m	13 Mar 2019	19 Mar 2019	EC premises Brussels	EC, Full consortium

Progress meeting 3	T0+6m	13 May 2019	15 May 2019	EC premises Brussels	EC, Full consortium
Progress meeting 4	T0+11m	13 Oct 2019	16 Oct 2019	EC premises Brussels	EC, Full consortium
Intermediate review	T0+9m	13 Aug 2019	13 Nov 2019	EC premises Brussels	EC, Full consortium
Progress meeting 5	T0+13m	13 Dec 2019	22 Jan 2020	EC premises Brussels	EC, Full consortium
Progress meeting 6	T0+16m	13 Mar 2020	17 Mar 2020	Webconference	EC, TPZF, EENA, CS, PTO, FRA, GER, HUN, PRT
Final review	T0+18m	13 May 2020	11 Jun 2020	Webconference	EC, Full consortium

Table 8-3 – Help112 II project reviews

From March 2020 onwards, the COVID-19 crisis impacted the project and the consortium by preventing the progress meeting 6 and the final review to be held physically in EC premises, and by generating some delays in the finalisation of the deliverables and thus delaying the Final Review by one month.

The comparison of the project review actual dates with the planned dates is depicted here below:

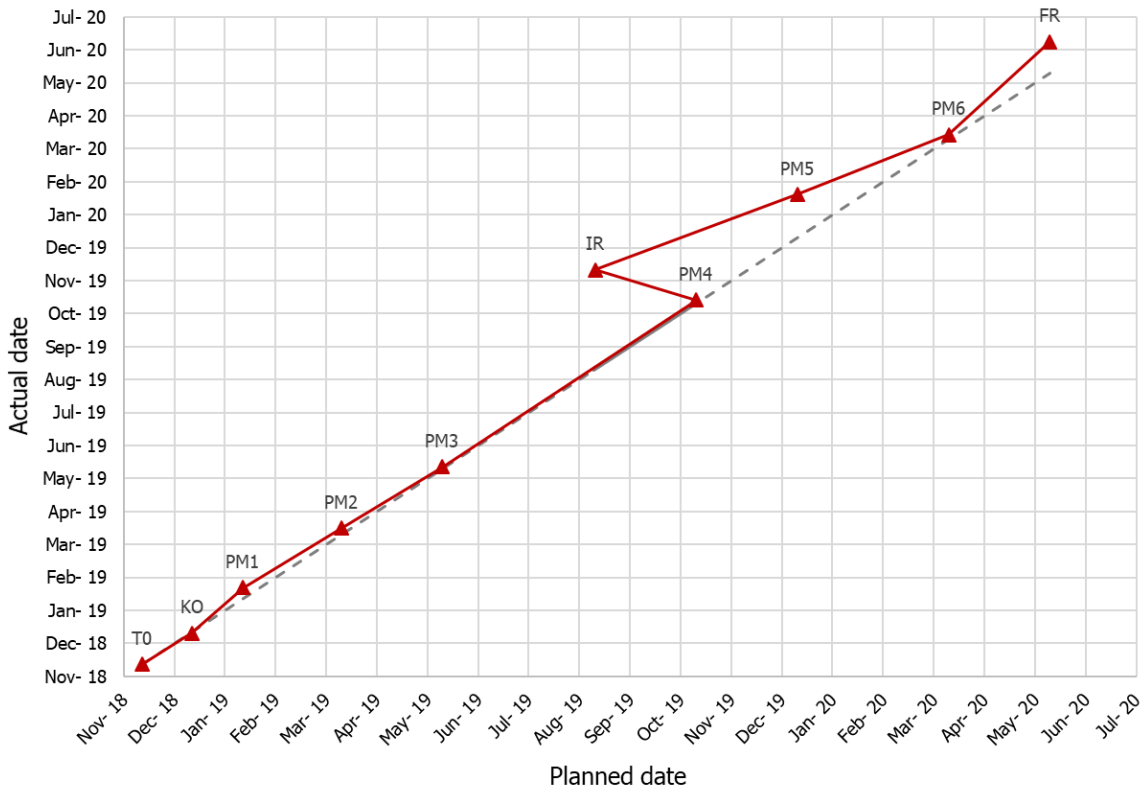


Figure 8-1 – Project review actual dates VS planned dates

The main decisions and outcomes are summarized here below:

Meeting	Decisions and outcomes
KOM	No key decision.
PM1	• WP1: AML architectures and implementation plans presented and received well for 6 out of the 7 member states, except for France. Deliverables accepted pending the revisions suggested by the feedback from the EC. • WP2: GNSS testing is a benchmark testing (i.e. comparing performance of several devices). Handset using dual frequency is considered as a must have by GSA.
PM2	• WP1: AML implementation plans updated, received well while some expected deployment delays are noted. Deliverables accepted, except D1.1.3. End to end test specification accepted. • WP2: AML Testing will be performed with AML recorded in the phone to avoid interfering with PSAP operations and to not depend on AML deployment schedule, if it is proven that the AML recorded in the phone is the same as the one sent to PSAP.
PM3	• WP1: Confirmed delays for France and Hungary. Potential delay for Sweden, Portugal and Denmark due to legal barriers. • WP2: Testing activities on-track but with a very tight planning. Delayed outputs from WP1 will delay the WP2 D2.2.x delivery. • WP4: On track, CBA assumptions and methodology will be consolidated during coordination meeting with EC/PTO/TPZ/EENA/CS.
PM4	• WP1: AML deployment still to be completed for France (End of Nov), Portugal (5-Dec), Hungary (13-Nov). • WP3: Workshop Agenda amended. PSAPs from all Member States to be invited. • WP4: D4.2 Table of content agreed. Comments on D4.1.1, D4.1.2 will be provided after the meeting.
IR	• PM 5 scheduled on January 22nd, at EC premises. • WP1: Completion pending. AML deployment in the seven countries, Tender requirement clarification, Deliverable corrections following RIDs. • WP2: Successful pending the revision of the deliverables following RIDs.
PM5	• Workshop on Project recommendations and lessons learnt on March 16th PM, at EC premises. • PM6 scheduled on March 17th, at EC premises. • IR and interim payment is pending AML deployment completion and deliverable update
PM6	• WP1: AML deployment in France is on hold pending resolution of mismatching AML success rate monitored by Google and MNO "Bouygues". Risk of long delay due COVID-19 crisis to be assessed. • WP4: CBA reports under review by EC, except Ireland CBA which is pending PSAP data not provided despite multiple requests. • WP5: Final review date is maintained to 13th of May, but may need to be reassessed depending on COVID-19 crisis impact on the project. Project extension need and partial payment need will be assessed. • PSAP workshop on May 5th, Face-to-face or webconference. • Final Review on May 13th, to be confirmed.
FR	• WP1: AML success rate is around 50-60% as observed in other countries for all member states except Portugal and Hungary. AML roaming is activated only in France, Germany and Denmark. Zero-rating for roamers not possible due to lack of coordination between MNOs at EU level. • Project successful pending: Remaining deliverables to be processed : Annex D1.1.x and D1.2, D3.2, D4.1.x, D4.2, D5.1

Table 8-4 – List of project review decisions and outcomes

8.5 CONSORTIUM MEETINGS AND WORKSHOPS

To ensure the necessary coordination of the consortium, teleconferences have been held on a weekly basis during the whole project period.

Dedicated workshops have been also organized to address specific topics as summarized here below:

Meeting	Date	Locations	Participants
Workshop 1 – WP2	05 Feb 2019	CS premises Kingston UK	TPZF, CS
Workshop 2 – WP2	19 Mar 2019	EC premises Brussels	EC, Full consortium
Workshop 3 – WP4	25 Jun 2019	EC premises Brussels	EC, GSA, PTO, CS, EENA, TPZF
Workshop 4 – WP4	17 Sept 2019	Teleconference	EC, GSA, PTO, CS, EENA, TPZF

Table 8-5 – List of project workshops

Workshops 1 and 2 have been held to support the progress of WP 2:

- In February 2019, to assess the technical aspects of the testing activities (equipment, procedures, tools), involving only TPZF and CS;
- In March 2019, along with PM2, to introduce to the countries the methodology to select the testing site and to prepare the organizational aspects (offices, invitation letters, briefing/debriefing meetings …), involving the whole consortium.

Workshops 3 and 4 have been held to support the progress of WP 4 to present and validate the CBA methodology in June 2019 and September 2019.

8.6 TRAVELS AND PROCUREMENTS

The travels executed for the project are summarized here below:

Date	Place	Participants	Purpose
12 Dec 2018	EC premises, Brussels, Belgium	EC, Full consortium	KOM
23 Jan 2019	EC premises, Brussels, Belgium	EC, Full consortium	PM1
05 Feb 2019	CS premises, Kingston, UK	TPZF, CS	WP2 - Technical Workshop
19 Mar 2019	EC premises, Brussels, Belgium	EC, Full consortium	PM2
04-05 Apr 2019	PSAP, Belgium	PTO	WP4 - Data Collection
10-12 Apr 2019	EENA Conference Dubrovnik, Croatia	PTO	WP4 - Data Collection
15 May 2019	EC premises, Brussels, Belgium	EC, Full consortium	PM3
20-24 Apr 2019	Toulouse, France	TPZF, CS	WP2 - AML/GNSS testing
03-06 Jun 2019	Freiburg, Germany	TPZF	WP2 - AML/GNSS testing

17-21 Jun 2019	Zagreb, Croatia	TPZF	WP2 - AML/GNSS testing
01-05 Jul 2019	Copenhagen, Denmark	TPZF	WP2 - AML/GNSS testing
15-19 Jul 2019	Stockholm, Sweden	TPZF	WP2 - AML/GNSS testing
05-09 Aug 2019	Budapest, Hungary	TPZF	WP2 - AML/GNSS testing
19-23 Aug 2019	Lisbon, Portugal	TPZF	WP2 - AML/GNSS testing
16 Sep 2019	PSAP, Belgium	PTO	WP4 – Data Collection
25-27 Sep 2019	PSAP, Estonia	PTO	WP4 – Data Collection
16 Oct 2019	EC premises, Brussels, Belgium	EC, Full consortium	PM4
13 Nov 2019	EC premises, Brussels, Belgium	EC, Full consortium	IR
22 Jan 2020	EC premises, Brussels, Belgium	EC, Full consortium	PM5

Table 8-6 – List of travels

From March 2020 onwards, all planned travels have been cancelled and replaced by webconference due to the COVID-19 crisis.

The procurement made for the project are summarized here below:

WP	Item	Description
WP2	Septentrio AsteRx-SB receiver	Ground truth receiver
WP2	PolaNT MF antenna	Ground truth antenna
WP2	Huawei Y6	Handset under test, 2 units
WP2	Samsung S8	Handset under test, 2 units
WP2	Samsung S9	Handset under test, 2 units
WP2	Xiaomi Mi8	Handset under test, 2 units
WP2	SecorX-C licence	Annual PPP correction licence
WP2	Testing accessories	Cables, power banks, antenna mounting, handset mountings, waterproof sleeves, …

Table 8-7 – List of procurements

8.7 RISK MANAGEMENT

The risks identified all along the project are of different are classified in the following category:

- Risks related to the AML deployment
- Risks related to testing activities
- Risks related to the assessment of AML benefits.

In this section, these risks are presented by category and analysed in terms of evolution and resolution all along the duration of the project. The risks are characterized by the overall criticality obtained by multiplying the probability of occurrence of the risk and the impact of the risk.

The risk probability was set according to the following scale:

- High = more likely to happen than not (>50%);
- Medium = fairly likely to occur (20-50%);
- Low = low, but not impossible (<20%).

The risk impact was set according to the following scale:

- Critical = significant impact on technical, financial and schedule objectives;
- Major = impact requires to perform a risk mitigation procedure;
- Significant = impact limited to some function, could be solved as part of normal work.

Impact	**Overall Risk Criticality**		
Critical = 3	3	6	9
Major = 2	2	4	6
Significant = 1	1	2	3
	Low = 1	Medium = 2	High = 3
	Probability		

Table 8-8 – Overall risk criticality scale

8.7.1 AML Deployment

Legal barriers

The AML deployment have experienced legal barriers due to conflicts with the national legislation of each country.

Figure 8-2 presents the evolution of this risk for each country during the project:

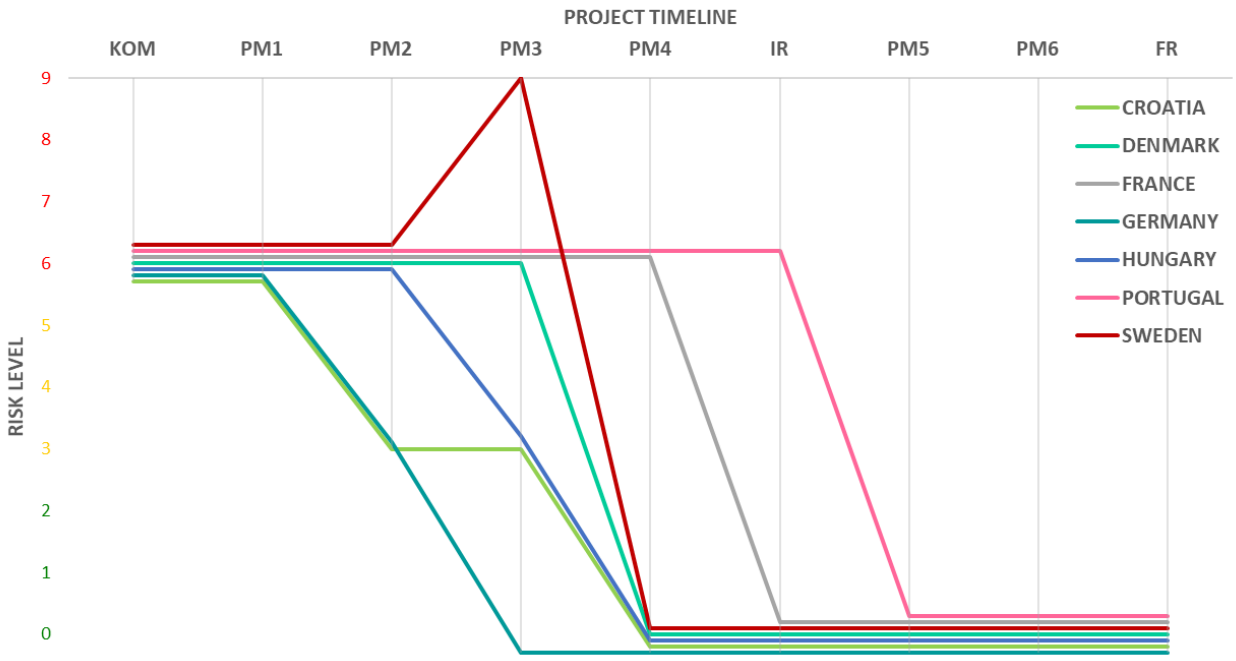


Figure 8-2 – Evolution of legal barriers risks all along the project

In **Germany**, AML solution implementation was accepted by legal authorities between PM2 and PM3.

In **Croatia**, the national law already covered 95% of this implementation. A law upgrade was expected with no expected issue and occurred between PM3 and PM4.

In **France**, assumption was made that AML solution was covered by current legal national framework. This assumption was confirmed between PM4 and IR.

Some legal amendments had to be submitted to Google by **Portugal** to deal with legal barriers issues. A legal amendment being a long process, the issue was solved between IR and PM5.

In **Sweden**, legal authorities didn't react during the first months of the project to the notification by SOS alarm on AML planned implementation. The risk was increased during PM3 after learning that the Swedish law might need to be changed in the end, such change taking potentially months or even years to occur. Finally, the issue was solved between PM3 and PM4.

Lack of support from MNOs

Previous experience showed that MNOs are not always supporting the deployment of AML. The lack of support from MNOs is usually encountered in the need to change the network configuration to allow sending SMS and HTTPS messages during an emergency call and zero rate the SMS message.

Figure 8-3 presents the evolution of this risk for each country during the project:

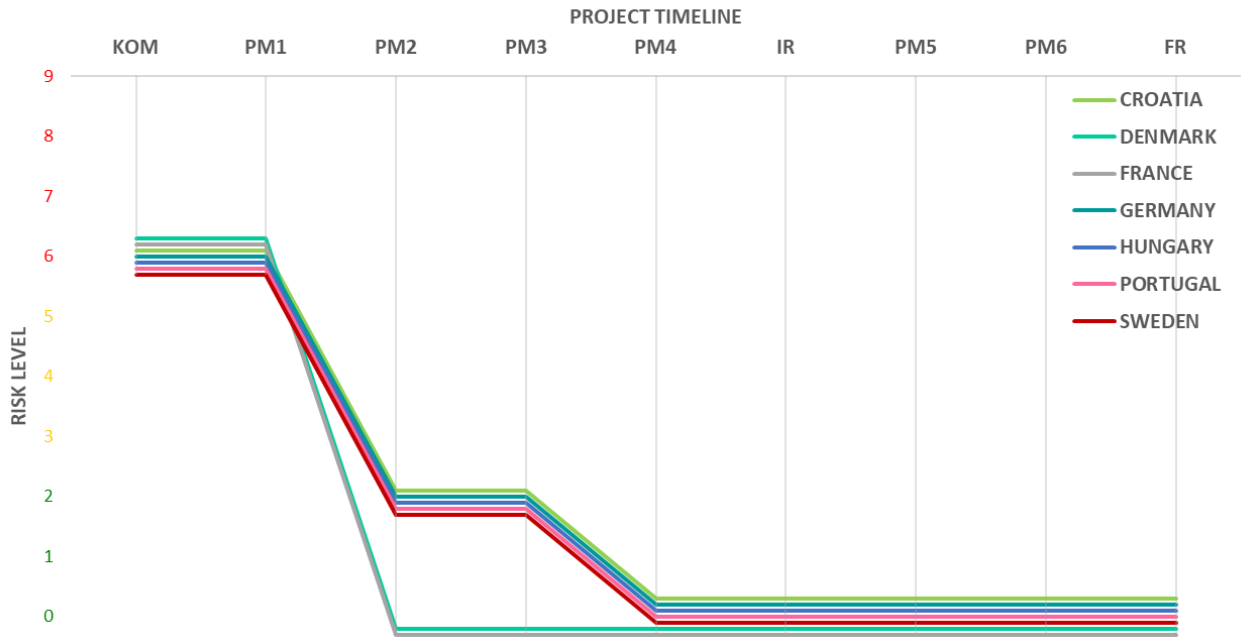


Figure 8-3 – Evolution of MNOs support risk all along the project

In **Croatia**, MNOs were cooperative since the very beginning of the project. Short and long number were accepted following agreement between MNOs and HAKOM (Regulatory authority for network industries) and the risk was terminated between PM3 and PM4.

In both **Denmark** and **France**, the risk was considered low and fully under control and was terminated very early in the project between PM1 and PM2.

In both **Germany** and **Hungary**, MNOs were not supporting zero-rating for AML users. This issue was solved between PM3 and PM4, when contracts with MNOs have been setup. Even though zero-rating for roamers was not possible.

Specific case of AML deployment in France

The AML deployment in France has been significantly delayed due to an organizational change in the French team with the establishment of the French Digital Agency for Civil Protection ("Agence du Numérique de la Sécurité Civile"), which undertook the activity, thus causing delays in the architecture design and the implementation activities.

The risk has been raised at PM2 with a medium probability and a high impact, and terminated at PM5 once the deployment under control.

8.7.2 Testing activities

Testing activities raised both technical and organisational issues:

- Difficulty to configure the handsets for GNSS testing which could have reduced the feasibility of some scenarios;
- Tight testing schedule that provided no margin for deviation;

- Testing equipment transportation by air meaning risk of delays and denied boarding at airport;
- Testing equipment utilisation in 7 countries inducing risks of delays due to neighbourhoods and local authorities.

Figure 8-4 presents the apparition and evolution of these risks during the project:

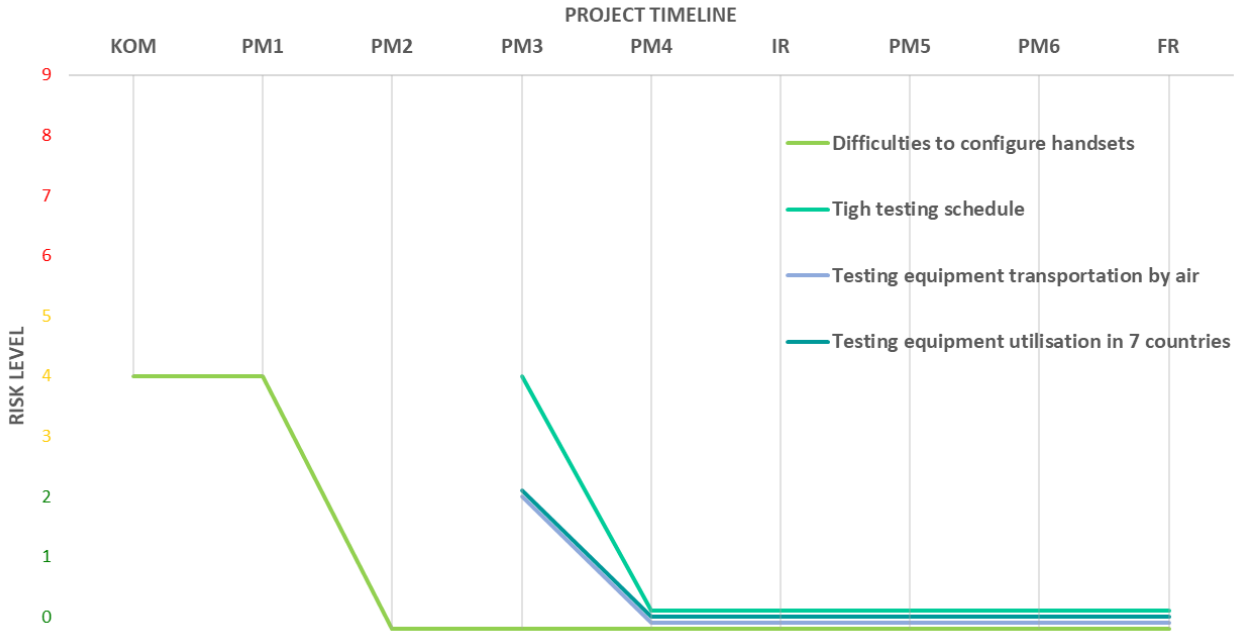


Figure 8-4 – Evolution of testing activities risks all along the project

The difficulty to configure the handsets appeared at the very beginning of the project. Test requirements were modified to cope with handsets capabilities and the approach consisting in comparing different smartphones was approved by EC/GSA and documented in the Test Plan (D2.1). The risk was terminated at PM2.

The remaining risks were all concerning the running of the tests, and terminated with the completion of WP2 declared during the Intermediate Review.

The transportation of the equipment (around 10 smartphones, the Ground truth equipment and the antenna, power banks, etc.) by air could have been problematic due to risks of delays or denied boarding at the airport. To facilitate security controls, the EC prepared an official letter describing the project and equipment. None of the operators travelling with the equipment finally had these kind of issues.

Another risk concerned potential delays during scenarios executions due to neighbourhoods and local authorities. The official letter from the EC as well as specific letters written by each country officials were used to legitimate the testing activities. These letters were particularly useful for indoor testing, for which the operators had to ask permission for proceeding inside private premises.

8.7.3 Assessment of AML benefits

Countries with AML have different PSAP structures and regulations. In countries where there is central stage 1 PSAP distinct from the stage 2 PSAPs, it was difficult to obtain the data needed to properly assess benefits or costs of AML. But enough data were finally collected to allow extrapolations of these data for areas with similar characteristics in terms of urbanisation and technology availability to estimate values in the different countries. Moreover, some interviews were conducted to validate the main assumptions with technical and operating experience at PSAPs. Thanks to these interviews, the risk was decreased at PM4.

Legal constraints were also an obstacle to obtain adequate data sets for all countries. This risk was anticipated because early researches had shown that Member state regulations might prevent emergency services from sharing data about AML implementation and specific emergency operations cases (e.g. Ireland). To overcome this, the official letter from the European Commission was shared with each Member State for support. A backup plan was also prepared foreseeing to extrapolate values from other countries in case the issue was maintained for one country. This actually was the case for Finland due to data storage issues. That's why the risk remained relatively high during the whole project.

In addition to the two previous risks, it was anticipated that data available at PSAP/emergency services level could not allow a precise assessment of AML benefits. Countries might not be able to share the same indicators for AML and non-AML calls because they haven't set in place a results follow-up system, resulting in complexity to measure the added benefits of AML. This risk was mitigated by talking to local emergency representatives with technical and operator experiences and remained relatively insignificant during the project.

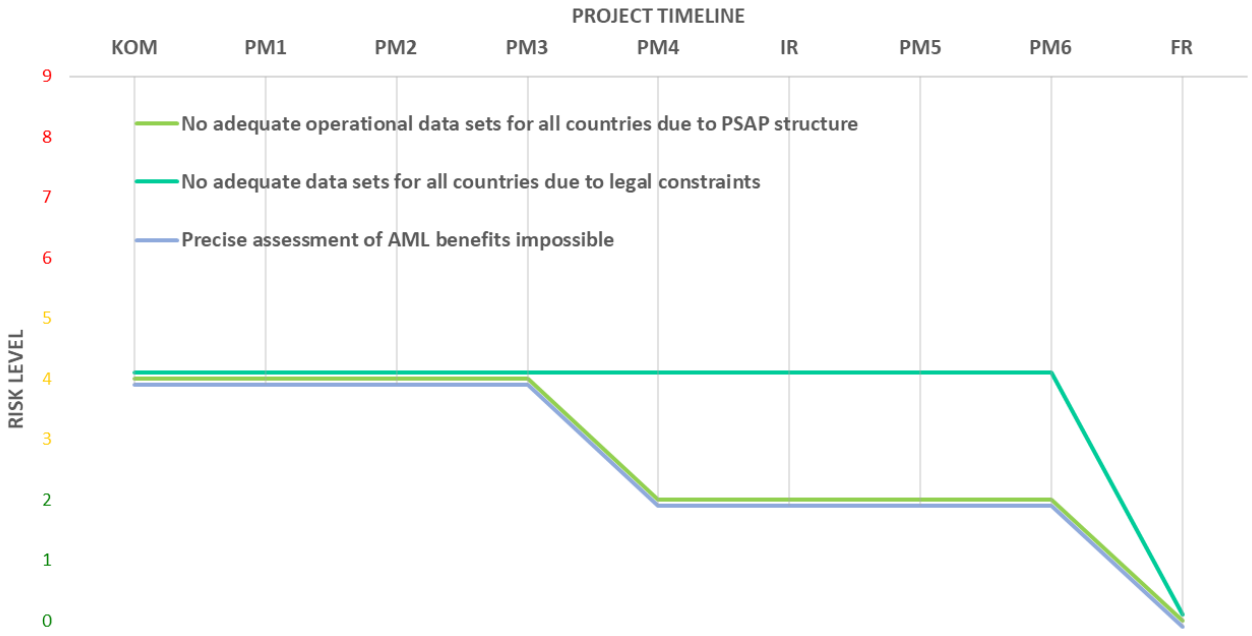


Figure 8-5 – Evolution of assessment of AML benefits risks all along the project

8.8 OUTCOMES AND LESSONS LEARNT

The Help112 II project has been managed successfully thanks to an outstanding collaboration and mutual assistance to solve technical and planning issues, sometimes on a daily basis. Delays has been experienced due a very complex legal environment involving GAFAM companies, and independent national data protection authorities on which the consortium had very little or no lever. These delays have been mitigated by a very close monitoring of the progress and by fostering the exchanges between PSAPs and with the Google ELS team.

With the Help112 II project, the consortium members increased their knowledge in technical, legal and economic fields linked to the AML deployment, and shared it with European PSAP community.

8.9 WP5 IN A NUTSHELL

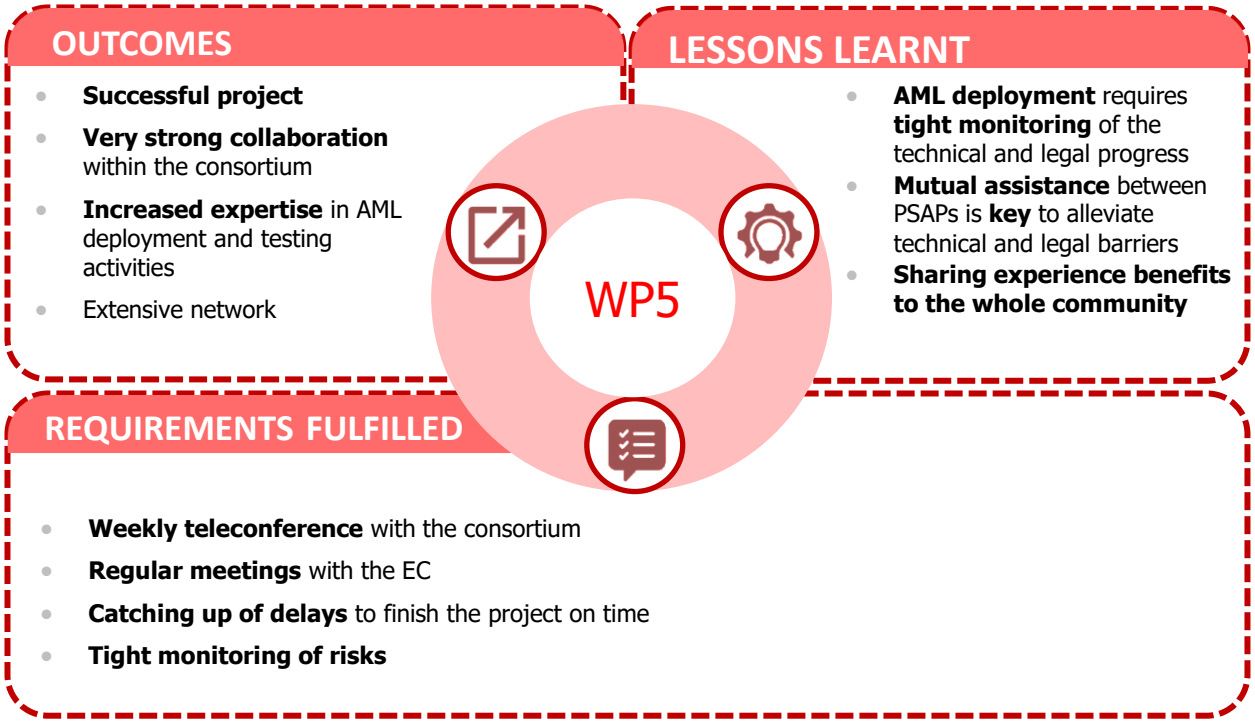


Figure 8-6 – WP5 in a nutshell

9. PROJECT RECOMMENDATIONS

The Help112 II project has been carried out successfully, fulfilling all project requirements. Going beyond these requirements, the project consortium placed a particular effort into identifying recommendations to the European Commission to **improve the impact of the Emergency caller location for European citizen safety**.

In the previous sections, recommendations have been introduced for each work package. They are recalled here after, complemented and structured following the four complementary improvement categories depicted in Figure 9-1:

Figure 9-1 – Project recommendations

Following the scope of the project, the emergency caller location considered hereafter is limited to handset-derived location implemented through the AML standard.

The recommendations are prioritized based on their urgency and impact assessed on 3-level scales:

The urgency gives the time horizon for implementing the recommendation:

- **High**: <1 year
- **Medium**: 1 to 2 years
- **Low**: >2 years

The impact gives the relative improvement on the number of EU citizens covered by the AML service when calling 112, the positioning performance of the AML, or the PSAP operations:

- **High**: >25%
- **Medium**: 5% to 25%
- **Low**: < 5%

When there is no direct quantification that can be used to assess the relative improvement, the impact is assessed roughly on the European citizen safety (lives).

The priority order is given from rank ★★★★ (highest priority) to rank ★ (Lowest priority), derived from the assessed impact and the urgency:

		Impact		
		High	Medium	Low
Urgency	High	★★★★	★★★	★★
	Medium	★★★	★★	★
	Low	★★	★	★

Table 9-1 – Recommendation priority ranking

9.1 AVAILABILITY OF ENHANCED EMERGENCY CALLER LOCATION

These recommendations aim at maximizing the number of Emergency calls placed within Europe benefitting from the AML.

9.1.1 Monitoring AML deployment progress in Member States

This recommendation has been identified in WP1 as a result of the Recommendations for fostering Galileo user uptake.

The European Electronic Communications Code - EECC (Directive (EU) 2018/1972)[35] sets the framework for emergency communications and has to be transposed in national laws by all Member States starting from 21st December 2020. In particular Article 109 states that both network-based and handset-derived location information shall be made available to the most appropriate PSAP, free of charge for the end-user and the PSAP.

AML is a standardized protocol (ETSI TR 103 393[36] and TS 103 625[37]) enabling handset-derived location. This is a technical solution compliant with the legal requirement of handset based location availability. In January 2020, AML was already deployed in 22 countries worldwide, through the two mainstream mobile phone Operating Systems Android and iOS which represents 99.5% of the EU market[38], making AML the most adopted solution to implement handset-derived location for emergency communications. AML is implemented on Android through the Emergency Location

[35] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018L1972&from=EN

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

[37] https://www.etsi.org/deliver/etsi_ts/103600_103699/103625/01.01.01_60/ts_103625v010101p.pdf

[38] https://gs.statcounter.com/os-market-share/mobile/europe

Service (ELS), and on iOS through the Hybridized Emergency Location (HELO) but in significantly less countries than ELS.

During the Help112 II project, the AML deployment in the 7 Member States took between 6 months (Germany) and 18 months (France), including the design, the legal arrangement, the implementation, the technical validation, the PSAP integration and the Live deployment. The high variability between countries in the AML deployment duration is explained by the PSAP structure complexity which differs from one country to the other, as well as the numerous stakeholders that had to be involved: Google, Apple[39], MNOs, National data protection authorities, CAD providers…

At the time of writing the present document, 18 Member States have already deployed AML.

Despite the legal obligation, based on Help112 II project experience, there is a risk that not all EU Member States will be able to comply with the EECC by December 2020 which is less than 6 months after the end of Help112 project.

The European Commission should closely monitor the progress of AML deployment in the remaining Member States, and, if needed, support them with:

- Organizing workshops with PSAPs to address AML practical deployment (technical and legal), and proper monitoring based on Help112 project materials and consortium experience;
- Participating when needed to the regular meetings between the PSAPs and Google/Apple experts to facilitate the swift deployment;
- Providing technical support from experts for the design and development of the most adequate implementation.

This recommendation has a high impact because 9 MS out of 27 are concerned, and should be applied with high urgency to minimize the period of time during which late Member States could be not compliant with the EECC.

9.1.2 Fostering adoption of AML services in alternative handset OS

This recommendation has been identified in WP1 as a result of the Recommendations for fostering Galileo user uptake.

AML is only implemented by Android and iOS operating systems that share 99.5% of the handsets European market. The remaining shares are divided among marginal OS, mainly based on Android or Ubuntu for instance. The market shares for operating system on tablets[40] and wearables are similar. These OS are not provided by the vendors but installed by the users after the purchase.

[39] *Even if not required by the Help112 II project, AML deployment on iOS has been achieved by 6 of the 7 MS.*

[40] https://gs.statcounter.com/os-market-share/tablet/worldwide

Harmony OS, developed by Huawei, is intended to capture 2% of the global operating system market[41] share by the end of year 2020. However the Harmony OS deployment roadmap doesn't include smartphones in the next 3 years[42].

This recommendation aims at minimizing the current 0.5% gap of handsets in Europe on which end users have installed alternative OS with no AML capability, and helping new market players such as Huawei to implement seamlessly AML service in their OS.

It is recommended to undertake awareness activities on AML services towards the Open Source community in participating to Linux foundation events[43], and new Operating System providers in participating to GSMA events.

This recommendation has a low impact (0.5% of the EU handsets) and should be implemented in the 2 next years in particular before Huawei starts deploying Harmony OS on smartphones in the EU market.

9.2 QUALITY OF THE EMERGENCY CALLER LOCATION

These recommendations aim at minimizing the time between the emergency call and the rescue team arrival on-scene by improving the caller location information provided to PSAP.

9.2.1 Standardizing AML computation algorithm

This recommendation has been identified in WP1 as a result of the Recommendations for fostering Galileo user uptake.

AML conveys two major data to provide caller location to PSAPs: a position made of latitude and longitude, and a radius. This couple position/radius provides a precise position of the user as computed by the handset, and the radius represents the radius of a circle centred in the true user position in which the computed user position shall be inside.

While the accuracy represents the capacity of the handset to provide a position close to the true position, the reliability represents the capacity of the handset to provide a radius larger than the accuracy.

The algorithm allowing the computation of these two parameters is not standardized at the time this document is written. It means that according to the OS, the handset brand and model, the accuracy and reliability of the AML position can differ significantly from one handset to another in the exact same environment. This offset in accuracy and reliability between handsets has been demonstrated by the results of WP2. One interesting results was the difference of performance observed between the Samsung S9 and Samsung S8: same phone brand, chipset brand and line of product but these

[41] https://www.huaweicentral.com/hongmeng-os-to-capture-2-share-of-the-global-operating-system-market-by-2020-report/

[42] https://www.huaweicentral.com/harmony-os-heres-the-roadmap-for-developer-plan-and-ecosystem-development/

[43] https://events.linuxfoundation.org/

two handsets showed very different results in terms of accuracy and reliability in open-sky environment (Scenario Rural):

	Accuracy 95%	Reliability
Samsung S8	15 meters	57%
Samsung S9	7 meters	99%

Table 9-2 – Handset accuracy and reliability

The OS and the chipset generation was different, but with no huge gap in the versions (Android v9.0.0/Android V8.0.0, Exynos 9 Octa 9810/Exynos 9 Octa 8895 as shown in Figure 5-3).

Although more than 95% of companies that produce smartphone chips for satellite navigation make chips that enable Galileo, WP2 GNSS results showed that the percentage of Galileo satellites used in fix was still below the % of GPS satellites used, which proved the implementation of a GPS first solution inside the tested handsets, while the reliability had been proven to better when the % of Galileo satellites used is higher (see Figure 5-13). Since April 2020, 3GPP standards have been updated (TS 36.171 version V15.1.0 and V16.0.0 as well as for TS 38.171 V15.3.0). With regard to the power level and satellite allocation, the relevant note now states: "*GNSS-1, i.e. the system having the satellite with high signal level, shall be selected by the device manufacturer*" instead of "*For GPS capable receivers, GNSS-1, i.e. the system having the satellite with high signal level, shall be GPS*".

A PSAP receiving an AML position associated with a radius should be able to process it with pre-defined procedures (e.g. allocating rescue teams depending on the location and the radius amplitude). The fact that the performances may vary significantly from one handset to another brings ambiguity in how to use AML radius. This parameter is particularly important for PSAPs since it represents the confidence the PSAP can have in the position received. Having a high level of confidence into the radius would allow PSAP to dimension their response to a call without ambiguity.

This recommendation aims at standardising the AML position/radius algorithm to increase the AML reliability and thus increase the PSAP operator confidence in using the AML.

It is recommended to standardize the AML computation algorithm to force all OS providers to compute the AML in a consistent way, and setting a minimum requirement for AML reliability. The standardized computation could be part of the AML technical specifications from ETSI (TS 103 625[44]) discussed in the ETSI EMTEL committee. The Help112 II project materials and experience could be used for the technical studies required to prepare the new standard.

This recommendation has a high impact since WP2 results shown a potential reliability improvement from 57% to 99%, and should be implemented in the short-term in particular because the PSAP operator confidence in using AML will grow up progressively over time.

[44] https://www.etsi.org/deliver/etsi_ts/103600_103699/103625/01.01.01_60/ts_103625v010101p.pdf

9.2.2 Standardizing more stringent GNSS minimum performance

This recommendation has been identified in WP1 as result of the Recommendations for fostering Galileo user uptake.

The minimum performance requirements on handset GNSS are set by a standard called **3GPP TS 45.005**[45] and more precisely in annexes M and O (minimum performance requirements for Assisted GPS and Assisted Galileo and Additional Navigation Satellite Systems (A-GANSS)). These minimum values are not stringent enough to force chipset manufacturer improving GNSS performances in terms of accuracy or time-to-first-fix. For instance, the requested 2-D position error minimum requirement in dynamic range is set to 100 meters. Thus, there is a wide range of GNSS performances provided by mass market handsets. This results in a wide range of accuracy in AML position received at PSAP level.

The unequal performances from one handset to another has been demonstrated by the results of WP2 focusing on GNSS testing. Figure 5-12 shows the gap between the errors on positions computed by the Xiaomi (95% of samples below 4 meters), and those computed by the Samsung S8 (95% of samples below 15 meters). Figure 5-14 shows a huge difference between the time-to-first-fix of Xiaomi compared to other handsets (around 19 seconds of gap), which can have a significant impact on AML according to the choice of AML triggering time by PSAPs.

This recommendation aims at setting more stringent GNSS performance requirement to insure more accurate GNSS positions which will directly impact the quality of the computed AML data.

It is recommended to request an update of **3GPP TS 45.005** to set more stringent the GNSS performance requirements. The minimum requirements values shall be calculated on the basis of a statistical study analysing the performances of the mass market handsets. The minimum shall be stringent enough to force an important percentage of handsets to provide better performances, without forcing chipset to become significantly more expensive to avoid discouraging the chipset manufacturer, following dual frequency capable handset examples (Xiaomi and Huawei).

This recommendation has a high impact since WP2 results showed a significant difference on the measured accuracy depending on the tested handset models, and should be implemented in the short-term in particular because accuracy has a direct impact on the rescue team operations while updating 3GPP standard is a long process. The Help112 II project materials and experience could support the technical studies required for updating the standard.

9.2.3 Promoting the use of GNSS raw measurement by PSAP

This recommendation has been identified in WP1 as a result of the Recommendations for fostering Galileo user uptake.

GNSS raw measurements consists in all the raw data taken as input by GNSS receivers to compute the position. Raw measurements are available from Android version 7.0.0 but still few handsets

[45] https://www.etsi.org/deliver/etsi_ts/145000_145099/145005/10.00.00_60/ts_145005v100000p.pdf

support this functionality. A standardisation request on the use of GNSS raw measurements is currently drafted by the European Commission and will be shortly issued to the ETSI[46].

The availability of raw measurements in handsets opens the door to a wide range of possibilities. For instance, mobile app developers could integrate the use of PPP or RTK corrections into positioning algorithms to compute a high accuracy position in the handsets. Another example would be the remote AML computation consisting in sending handset raw measurements to the PSAP and let the PSAP to compute the AML. Thus, the availability of raw measurements in all mass market handsets would allow uniformity in the computation process. Raw measurements would also allow a real fast position computation, called snapshot positioning[47], which could be useful in the context of AML for very short calls for instance.

It is recommended to carry out awareness activities to inform PSAPs about the possibilities brought by GNSS raw measurements availability on handsets. A technical demonstration could be setup with PSAPs to assess the feasibility and the benefits of high accuracy, snapshot and remote positioning using handset providing access to GNSS raw measurements.

This recommendation should be implemented in the next 2 years so that PSAPs will be able to start using GNSS raw measurements when widely available in handsets. The recommendation might have a significant impact by inventing a new way of computing emergency caller location to cover more difficult emergency situations.

9.2.4 Standardizing the use of Galileo OS-NMA in all handsets

This recommendation has been identified in WP1 as a result of the Recommendations for fostering Galileo user uptake.

GNSS technology is widely used to provide positions to many applications. But it is intrinsically subject to various attacks. For instance, interference, or jamming when intentional, can prevent the GNSS receiver from computing the position. Another kind of attack, called spoofing, mislead the GNSS receiver that computes a non-genuine position. These two kinds of attacks can be operated by hackers with very few knowledge and means. GNSS attacks are a growing concern, and can deeply impact the quality of emergency caller location when occurring.

It already exists various techniques to detect or more rarely to mitigate these kind of attacks. The implementation by the GNSS chipsets manufacturer of countermeasures against GNSS attacks would insure the integrity of the computed position, and therefore of the AML position. In the case of AML, it would be worse to use a fake GNSS position than to have no GNSS position at all. Thus, spoofing mitigations techniques shall be particularly targeted. Among the existing techniques, some imply implementations at receiver levels, which again raises the problem of various levels of implementations by chipset manufacturers. Other techniques rely on the structure of the GNSS signal itself: this is the case of Galileo OS-NMA - Open Service Navigation Message Authentication. OS-

[46] https://www.gsa.europa.eu/sites/default/files/expo/1.3_katarzyna_porzuc_-_ec_.pdf

[47] https://insidegnss.com/what-is-snapshot-positioning-and-what-advantages-does-it-offer/

NMA allows the authentication of the signal by the GNSS receiver and is only implemented by Galileo on open service signals.

It is recommended to standardize the use of OS-NMA in all EU handsets to increase the AML reliability by mitigating GNSS attacks. Awareness activities should also be performed towards the European safety and emergency community about GNSS weakness and Galileo unique mitigation feature. Technical demonstration could be setup with PSAPs to showcase and to assess the impact of OS-NMA in the AML position reliability.

This recommendation has a low impact since the percentage of emergency calls under GNSS attacks might be relatively small. It should be implemented once the OS-NMA service is made available, the urgency is set to medium.

9.2.5 Extending GNSS signals availability in indoor/deep indoor

This recommendation has been identified in WP2 as a result of the AML testing.

GNSS signals are not available in indoor environments. But it is possible to extend GNSS signal availability in indoor/deep indoors using GNSS repeaters in public spaces such as subway stations, shopping malls or underground parking.

The spread of GNSS repeaters installation in deep indoor environments would participate to improve AML accuracy mainly in urban/suburban harsh environments with potentially highly frequented areas. During Help112 II testing activities in Lisbon, Portugal, the person contacted in the Lisbon metro public company to get authorization to proceed with the testing inside subway stations expressed a great interest into the results of the campaign.

WP2 results on AML testing showed that the presence of GNSS repeaters in deep indoors improved the AML position accuracy: ~15 meters in Stockholm where GNSS repeaters are installed[48], while ~150 meters in Budapest and ~350 meters in Lisbon where not.

This recommendation aims at maximizing the number of emergency calls positioned more accurately in deep indoor environment thanks to GNSS signals availability enabled by GNSS repeaters.

It is recommended to carry out awareness and demonstration activities towards public authorities of large European cities in particular those with large underground subway network. The amplitude of the AML accuracy improvement and the amount of the concerned emergency calls should be assessed to encourage the spread of GNSS repeaters installation by public authorities.

This recommendation may impact a significant number of emergency calls given the high frequentation of subway stations in large cities (more than 4 million daily users in Paris in 2015[49]) by decreasing the caller location accuracy by one order of magnitude. It might be implemented in

[48] https://www.gpsworld.com/syntony-gnss-chronos-technology-partner-on-gnss-underground-coverage/

[49] https://en.wikipedia.org/wiki/Paris_M%C3%A9tro

the short-term since the technology is being implemented in few cities across Europe (Stockholm, Toulouse …).

9.2.6 Adding speed and altitude information in the AML standard

This recommendation has been identified in WP2 as a result of the AML testing.

AML data currently provides the location of the caller through the provision of latitude/longitude parameters.

It is already foreseen to add the altitude of the caller to future AML implementations as described in the ETSI technical specification TS 103 625[50]. This information is indeed very useful, noticeably in dense urban areas were multi-levels roads and/or buildings cohabitate, since it would allow a more efficient dispatch of the emergency services. This altitude information would also be very useful to convert the AML data into a dispatchable location. In the United States, 911 shall be able to provide dispatchable location by 2022. For that purpose, the use of altitude parameter is foreseen. But currently, GNSS technology does not provide sufficient vertical accuracy. And even if sufficient levels of accuracy were to be reached in the near future, it would still be very challenging to convert the Height Above Ellipsoid into a floor level. That's why 911 plans to rely mainly on Wireless technologies for collecting such data. This could be envisaged as well in countries having deployed AML.

Other information would be valuable in the context of AML: the provision of the speed of the user would inform the emergency services of the status static/dynamic of the user and therefore gives an idea on the reliability of the location conveyed by AML. In addition to the speed, the provision of the course of the user would allow some rough trajectory reconstruction. Even if rough, these trajectories would bring valuable information to PSAPs and rescue teams.

It is recommended to update the AML standard to integrate altitude, speed and course data into the AML basic data set. To support this recommendation, a PSAP consultation could be carried out at European level to quantify the % of emergency calls where altitude and/or speed would have made a positive difference in processing the emergency response. As assessed in a preliminary analysis made in the US[51], the level of impact is expected to be high, and following the deployment timeline in the US, the urgency is set to medium.

9.3 QUALITY OF THE EMERGENCY CALLER LOCATION TRANSMISSION TO PSAP

These recommendations aim at maximizing the percentage of valid location data received at the PSAP level with respect to the location data sent during emergency calls.

9.3.1 Improving AML success rate

This recommendation has been identified in WP1 as a result of the AML live operation monitoring.

[50] https://www.etsi.org/deliver/etsi_ts/103600_103699/103625/01.01.01_60/ts_103625v010101p.pdf

[51] https://www.federalregister.gov/documents/2020/01/16/2019-28483/wireless-e911-location-accuracy-requirements

The AML success rate is the percentage of calls from a mobile phone where an AML position is received.

The Help112 II project provides the following results based on the Live Operation Monitoring activities updated during the project Final Review:

- Croatia: 57% in March 2020
- Denmark: 60% in May 2020
- France: 51% in May 2020 (for only one department where the data was available)
- Germany: 54% in January 2020
- Hungary: 15% in April 2020
- Portugal: 25% in April 2020
- Sweden: 55% in May 2020

EENA provides the same figure for other countries in the AML report card 2019[52]: Austria 65%, Finland 50%, Ireland 50%, Lithuania 45%, The Netherlands 40%, Norway 50% and completed with the figures intended to be published in the upcoming AML report card 2020: Belgium: 80% , Romania 39%, Moldova 40%, Slovenia 21%, The UK 75% .

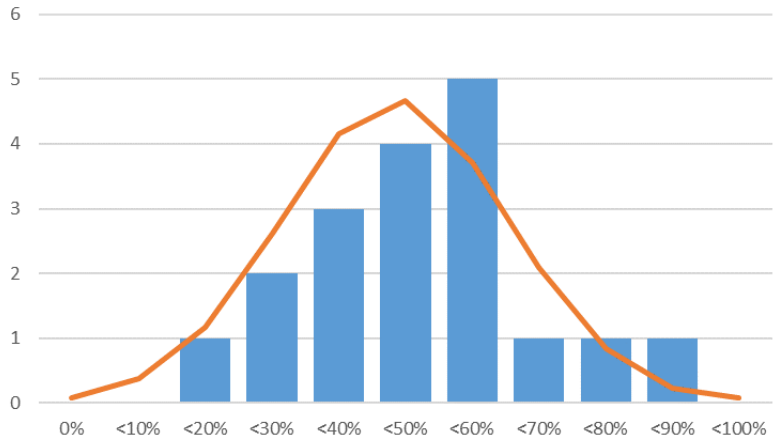


Figure 9-2 – AML success rate distribution across Europe

The average observed success rate is 48%, with a standard deviation of 17%. The variability of the AML success rate distribution might be explained by the variability of the PSAP maturity in processing the AML, the variability of MNOs infrastructure modernity and performance, and the variability of AML-capable handset penetration in the national market.

The AML transmission relies on a chain of transmission from AML generation in the handset to AML reception at PSAP. Any element of this chain can contribute to decrease the AML success rate.

A preliminary analysis in the case of roaming is provided hereafter to highlight some potential root causes. Where a country has not implemented a virtual SMSC solution (piloted by Belgium and

[52] https://eena.org/document/advanced-mobile-location-report-card-2019/

presented via an EENA webinar[53]) to roaming SMS, there are a number of possible failure points in routing a roaming SMS via the home network, and then back to the roaming network SMSC.

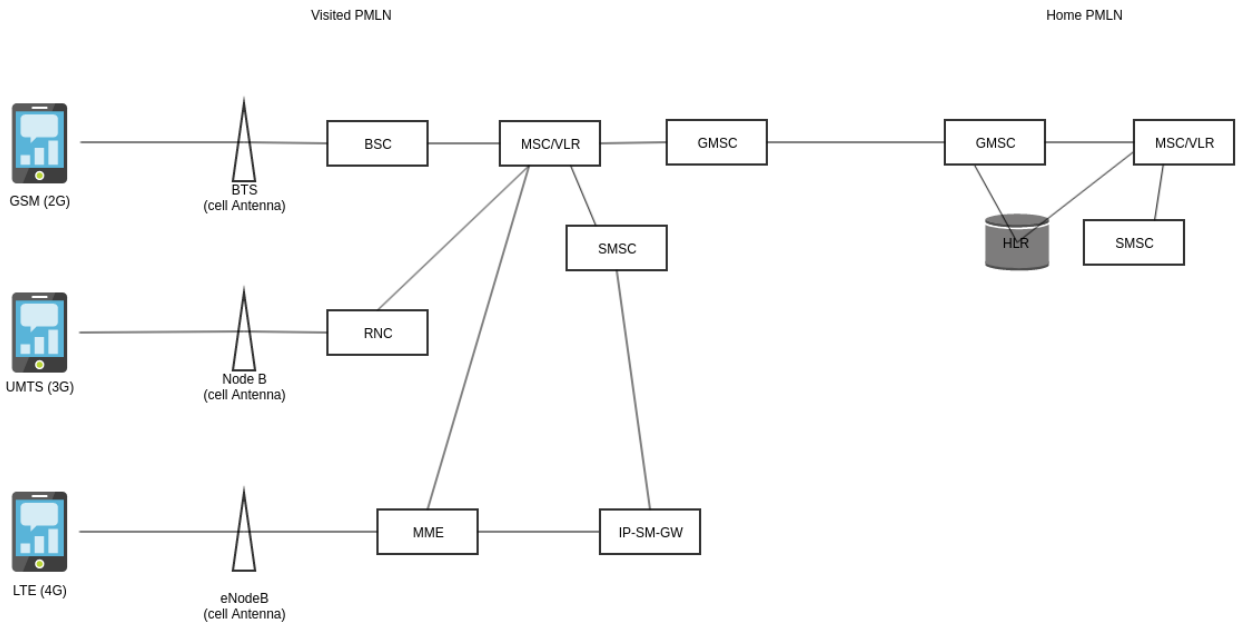


Figure 9-3 – AML SMS flow

When a roaming user (connected to the V-PMLN) makes an E112 call, and AML triggers an SMS message, there are many different network elements involved (see Figure 9-3).

The precise elements will vary based on:

- Network technology (2G, 3G, 4G …);
- Operator policies/processes;
- Roaming agreements with the home network;
- Security tools that an operator may or may not have in place.

The network elements are:

- BSC - Base Station Controller. Controls one or more base transceiver stations (BTS). Key BSC functions include radio network management (such as radio frequency control), BTS handover management and call setup.
- BTS - Base Transceiver Station. Facilitates wireless communication between a device and network. BTS is also known as a base station (BS), radio base station (RBS) or node B (eNB) depending upon network technology.
- eNodeB - LTE functional equivalent of the BTS
- GMSC - Gateway Mobile Switching Centre. Interconnects between networks.
- HLR - Home Location Register. Registration of home subscribers.

[53] https://eena.org/webinars/solution-aml-roaming/

- IP-SM-GW - IP Short Message Gateway. Handles SIP based messaging.
- MME - Mobility Management Entity. Controlling entity, similar orchestration responsibilities to RNC/BSC. Handles handover from LTE to 2/3G.
- MSC - Mobile Switching Centre. The MSC is mostly associated with communications switching functions, such as call set-up, release, and routing.
- Node B - 3G Equivalent of a BTS
- PLMN - Public Land Mobile Network.
- RNC - Radio Network Controller. A governing element in the UMTS radio access network and is responsible for controlling the Node Bs that are connected to it.
- SMSC - Short Message Service Centre. The controlling entity for SMS messages. Responsible for routing the message to the correct endpoint (account or connection to PSAP)
- VLR - Visitor Location Register. Registration of roaming subscribers.
- V-PLMN - Visited Public Land Mobile Network. The network on which a subscriber is roaming.

Essentially, every pair of networks will potentially have a unique combination of configuration, elements and roaming agreements in place. All of these can disrupt the ability of a device to send an SMS - particularly in the sensitive circumstances of an emergency call.

In the particular case of roaming, potential disruptions may come from:

- Device configured to allow sending of SMS when making an emergency call;
- MSC configured to allow sending of SMS when making an emergency call;
- Home routing of SMS messages being enabled can cause the G-MSC to need to send the SMS back to the home network, which will then attempt to deliver it to the final recipient (one of the problems of using short codes and why long numbers were recommended, to return the long number message back to a network in the country the user is roaming in - this could be different to the originating network of course);
- SMS firewalls can commonly be configured to block binary SMS messages; whilst the V-PMLN may have enabled binary messages for the specific target MSISDN, it's possible other links in the chain have not - e.g. elements in the H-PMLN or in between depending on the routing required to get between the two networks;
- Roaming agreements need to support the user being able to send SMS.

This recommendation aims at helping particular Member States well below average to increase their AML success rate to the average level, and increasing the average AML success rate for all Member States.

It is recommended 1) to analyse the chain of transmission and to identify main potential points of failure, 2) to assess good practices in countries worldwide well above average and to apply them to EU Member States well below average, 3) to develop a monitoring system to quantify transmission fault at the main identified point of failure, analyze the causes and propose corrective measures.

This recommendation have a high impact since directly increasing the percentage of valid AML received a PSAP from 15%-20% observed in some countries to the average 50% observed

worldwide. The two first part should be implemented in the short term, while the third part might be a longer term activity.

9.3.2 Enabling Zero-rating for AML international roaming users

This recommendation has been identified in WP1 as a result of the AML deployment and underlined in WP3 during the PSAP workshop.

2,300,000 emergency calls were placed by roaming users between July 2018 and June 2019[54].

Roaming is a functionality to be activated by the Operating System providers. At the time of writing the present document, iOS actual capacity to provide the roaming functionality is not known, while Android provides it but under Google's conditions which are not fully known and vary between Countries. As a result of Help112 II project roaming has been activated on Android in France, Denmark and Germany only, whereas not in Portugal, Hungary, Croatia and Sweden for various reasons such as 1) AML is not deployed on the full national territory, 2) Emergency long number not notified to all PSAPs worldwide to make it zero-rated, 3) Emergency long number not free of charge.

AML roaming is currently implemented with two transmissions solutions: HTTPS and SMS to a long number. In both cases, zero-rating for roaming users is possible if applied by the visited country MNOs and by the visitor home country MNOs. As a consequence, with the current AML roaming implementations, zero-rating would be possible only if all European MNOs knew all European emergency long numbers and made them all zero-rated.

German and Hungarian MNOs didn't agree on zero-rating a long number, and at EU level there is no coordination nor regulation binding all EU MNOs to zero-rate all EU emergency long numbers.

A pilot project has been undertaken in Belgium to prevent SMS messages from leaving the country, thus negating the issue of zero rating at the home network, and improving reliability. The solution consists in adding a country code before the SMS reception number (e.g. +32112). The pilot in Belgium was successful and is now live and totally free to the user[55].

This recommendation aims at making all emergency communications free of charge for all EU citizens within EU Member States territory as per EECC directive, with three different type of actions:

1) To avoid roaming activation differentiated by country, it is recommended in the short term to request Google and Apple their conditions to activate the roaming functionality, and then to organize workshops with all EU PSAPs to define a common strategy to fulfil them.
2) To proceed with the solution implemented in Belgium by assessing the technical and legal feasibility of deploying it all Europe Member States.
3) Impose on MNOs through binding EU legislation the obligation to ensure in the roaming wholesale agreements free of charge transmission of caller location.

These recommendation should be applied in the short term ensure that Member States could comply with the EECC. However the impact should be limited since the cost incurred individually should not discourage roamers to call 112 in case of emergency.

[54] https://ec.europa.eu/digital-single-market/en/news/2019-report-implementation-european-emergency-number-112

[55] https://eena.org/webinars/solution-aml-roaming/

9.3.3 Expanding AML standard

The current AML specifications define requirements for performing a self-locate and transmission of the location data either via SMS or HTTPS as described in the ETSI technical specification TS 103 625[56]. However there are significant differences in the two current solutions (Apple and Google) with regards to when the AML mechanism is triggered, where the location data should be delivered to and how often should a locate be performed (automatic retries). This has resulted in a different level of service depending upon the handset in particular for roaming callers.

This recommendation relates specifically to the definition of the handset behaviour, and does not affect the processing of AML locations at the PSAP. It is recommended that the concept of AML be extended from the current trigger and message format definitions to include the functions that are needed by the emergency services, and are currently utilised on some handsets - thus it is relevant to consider the AML functions on the handset a "service".

A review of the current capabilities of the AML solutions and the requirements of the emergency service community. It is recommended that the following capabilities are considered as part of this review:

- Multiple trigger numbers – to support countries with multiple emergency numbers, not just 112
- Identify trigger numbers – either through specific endpoints or including trigger in AML message
- Specify locate frequency – the ability to locate multiple times in the duration of a call
- Trigger based upon voice and SMS – to support locate for Text to 112
- Trigger based upon VOIP calls
- Location confidence – allow the PSAP to define the required confidence level of the location
- Support for long and short number SMS endpoints
- Support for custom SMSC address – to support zero rating roaming solutions

The review of the AML service to define a more comprehensive set of desirable capabilities can be considered separately from a legislation view.

This recommendation should be implemented with high urgency since Apple is not flexible in some key configurations, and the roaming solution implemented in Belgium will require modifications from the handset as well as the networks. The level of impact is limited to medium since the AML works as it standardised and its implementation provides successful results.

9.4 QUALITY OF THE EMERGENCY CALLER LOCATION USAGE BY PSAP

These recommendations aim at maximizing the efficiency of the PSAP and rescue team operations by improving the usage of the location data received at PSAP.

[56] https://www.etsi.org/deliver/etsi_ts/103600_103699/103625/01.01.01_60/ts_103625v010101p.pdf

9.4.1 Developing automatic dispatchable location system

This recommendation has been identified in WP2 as a result of the AML testing.

The AML position is provided as latitude/longitude parameters. This couple of parameters can provide an ambiguous position to the emergency services in a dense urban environment with multi-leveled roads and skyscrapers, sprawling warehouse or multi-building campus. The concept of dispatchable location has emerged as an important concept to improve rescue operations. A dispatchable location is a physical address including the street address of the caller and additional information, such as room or floor number, necessary to adequately locate the caller. In the United States, 911 shall be able to provide dispatchable location by 2022.

In the context of AML, the automatic conversion of latitude/longitude at PSAP level into dispatchable location could facilitate an efficient intervention of emergency services, by providing them with navigation assistance to reach the caller location. Moreover, knowing that the addition of floor information is already included as a future parameter in the AML standard, the automatic conversion of dispatchable location could be more efficient with this data as an input.

This recommendation aims at developing and testing technical solutions and to foster the deployment of the selected solution in European PSAPs.

It is recommended 1) to perform demonstration activities with PSAPs and CAD providers in European cities with dense urban areas aiming at testing various technical solutions and assessing the benefits, 2) to present the tested technical solutions and the estimated benefits to the European PSAP community.

These recommendation should be applied in the short term to quantify the potential impact in particular in large and dense European cities. The level of impact is set to medium by default.

9.4.2 Developing AML performance monitoring system

This recommendation has been identified in WP4 as a result of the PSAP consultation.

AML has been deployed in many Member States and performance data have been collected for the need of the Help112 II project. But this data collection turned out to be complicated and did not provide uniform data sets in each Member State. Moreover the actual AML location performance (accuracy, reliability) is not measured nor collected by the PSAPs.

This recommendation aims at developing a monitoring system for AML performance data such as total number of emergency calls received, total number of mobile emergency calls received, % of emergency calls for which an AML messages with location was received at PSAP level, % of emergency calls for which an AML messages without location was received at PSAP level, share of false calls, share of calls leading to dispatch and % of calls leading to dispatch that benefited from an AML message. The monitoring system should also include actual location information collected by the rescue team on scene (e.g. actual position, floor …) typically with a smartphone app for instance providing a map on which the actual emergency caller position could be pinpointed.

It is recommended 1) to create a dedicated working group involving European PSAPs to specify the monitoring system and to define the common metrics to be collected, and 2) to perform a pilot project with PSAPs and rescue teams to develop a proof of concept to measure the actual emergency caller location on scene and to derive actual AML location performance (accuracy and reliability), 3) to present the monitoring system and the proof of concept and preliminary results to the European PSAP community.

The AML monitoring system will enable further AML data post-processing as proposed in the following recommendations. It will also support the AML success rate improvement as proposed in a previous recommendation by helping to identify potential points of failure in the AML transmission chain. The level of impact and urgency is set to high because monitoring is the first necessary step to improve the AML service.

9.4.3 Developing big data analysis based on AML performances

This recommendation has been identified as a follow-up of the previous recommendation on the AML performance monitoring system.

An AML performance monitoring system implementation in all Member States would enable the collection of a huge amount of data during significant periods of time paving the way for Big Data analysis. Such analysis could lead to the assessment of AML impact on a global scale. Such analysis could also produce and assign performance patterns to specific areas, periods, or a combination of these two.

The identification of trends could lead to the generation of predictive models supporting decision-making at PSAP levels and improving operational management. For instance, an analysis of AML locations data in a specific area over a significant period could make arise some particularly bad or good precision levels in this area. Thus, the emergency services could use this information to dynamically adopt their response prior to dispatch in this area by either reducing or growing the team size according to the pattern identified.

Some quantitative statistics could also inform the PSAPs on the mapping of calls from a specific area during a specific period. For instance, a PSAP operator in Copenhagen, Denmark, testified during the AML testing that it was common knowledge that during the working week, more calls were emitted from 7 to 9 AM and from 5 to 7 PM because it corresponds to rush hours in cycling lanes during which many incidents occur. Thus this empiric knowledge is used to over dimension the responding team during these specific periods of the day. Big data analysis could bring a statistical and tangible information to take this kind of decision on scientific basis and to optimise resources. Other patterns could be identified on the AML location performances depending for example on the position and the time of the emergency call, the brand and model of the handset …

Big data analysis could also support authorities to assess the tangible benefits as modelled in the WP4.

It is recommended to undertake a pilot project for testing big data analysis in a selected PSAPs with sufficient AML monitoring capability, to assess the benefits and to perform awareness activities towards the European PSAP community in large events gathering the European PSAP community.

The impact of this recommendation is difficult to assess but big data analysis has a high potential in detecting patterns and improving the usage of AML by the PSAPs and the rescue teams. The level of impact is set to medium. The recommendation should be implemented in the next 2 years when AML monitoring enhanced capabilities will be more widely available within European PSAPs.

9.4.4 Developing AML performance EU reporting system

This recommendation has been identified as a follow-up of the previous recommendation on the AML performance monitoring system.

The European Commission issues a yearly report[57] that examines the state of play of the 112 EU-wide emergency number. Every year Member States submit data to analyse the efficiency and effectiveness of the single European emergency number - 112. Particularly, the assessment focuses on the volume of emergency calls made to 112, the answering time, an equivalent access for disabled users, as well as the availability and accuracy of the caller's location. The findings are intended to be used to further optimise access to emergency support services. To collect the required data, the European Commission sends questionnaires to the different PSAPs.

Instead of manually sending questionnaires, gathering the data via email, which implies a stringent status follow up, an implementation based on a network interconnecting the PSAPs with a central database host in the European Commission premises could be envisaged. This reporting network would carry standardized metrics that could be processed by a central computer either in real time or *a posteriori* to compute AML operational performance data at European scale. A bidirectional approach could be also implemented, in which the European Commission would send back to PSAPs some processed and summarized data to enrich their experience. Moreover, these global AML performance data could be used by the European Commission to monitor regularly the compliance by Member States with obligations related to the functioning of 112, thus enabling the establishment and the monitoring of minimal performance requirements that could be used in the frame of a European service level agreement.

This recommendation aims at facilitating the monitoring of the AML performance by the European Commission and paving the way to the establishment of a European service level agreement for the provision of advanced caller location solution for use in emergency communications to PSAP.

It is recommended to undertake a pilot project for testing big data analysis in a selected PSAPs with sufficient AML monitoring capability, to assess the benefits and to study the technical and legal feasibility of the potential deployment of a European reporting system in coordination with the European PSAP community. It is a long term activity with limited direct impact on European citizen safety, but still necessary to reach a sustained high level of AML performance.

[57] https://ec.europa.eu/digital-single-market/en/news/2019-report-implementation-european-emergency-number-112

9.5 PROJECT RECOMMENDATION SUMMARY

The project recommendation are summarized in the next table:

Recommendation	Better availability (1)	Better location (2)	Better transmission (3)	Better usage (4)	Type of activities	Impact	Urgency	Priority
Monitoring AML deployment in MS	✓				Technical support, facilitation	High	High	★★★★
Fostering AML in alternative OS	✓				Awareness	Low	Medium	★
Standardizing AML computation		✓			Standardization	High	High	★★★★
Setting stringent GNSS performances		✓			Standardization	High	High	★★★★
Promoting use of raw measurements in PSAP		✓			Technical demonstration, awareness	Medium	Medium	★★
Standardizing OS-NMA in handsets		✓			Standardization	Low	Medium	★
Extending GNSS signals in indoor		✓			Technical demonstration, awareness	Medium	High	★★★
Adding Speed and Altitude in AML		✓			Standardization	High	Medium	★★★
Improving AML success rate			✓		Technical analysis	High	High	★★★★
Enabling zero-rating for AML roamers			✓		Technical and Legal analysis	Low	High	★★
Expanding AML standard			✓		Standardization	Medium	High	★★★
Developing dispatchable location system				✓	Technical demonstration, awareness	Medium	High	★★★
Developing AML monitoring system				✓	Technical demonstration, awareness	High	High	★★★★
Developing AML big data analysis				✓	Technical demonstration, awareness	Medium	Medium	★★
Developing AML reporting network				✓	Technical demonstration, Legal analysis	Medium	Low	★

Table 9-3 – Project recommendation summary

10. CONCLUSIONS

The Help112 II project ran from November 2018 to June 2020 with the objective of deploying the AML solution in seven European Member States, testing its performance on the field with mass-market handsets embedding Galileo, disseminating the AML deployment experience from technical and legal perspective, and assessing the economic benefits generated by its use in other European Member States where AML was already deployed.

Despite technical and legal hurdles related in particular to data privacy legislation and MNOs support, the AML has been deployed successfully on Android in Croatia, Denmark, France, Germany, Hungary, Portugal, and Sweden. On April 6th 2020, France was the last Member State in the consortium to have the AML deployed. AML performance live data have been collected to initiate the required monitoring process, showing an average AML success rate of 45% which is in line with what observed in other countries. Extensive discussions between PSAPs and relevant stakeholders highlighted that enabling zero-rating for AML roamers was not possible without EU intervention to coordinate all European MNOs.

Professional testing have been carried out in all these countries with the support of local PSAPs in various environments and multiple scenarios representative of emergency communications, demonstrating different handset behaviors depending on various parameters such as the use of Galileo and dual frequency chipset, as well as the average optimal triggering time to send an AML with an improved accuracy (~25 seconds after call initiation).

AML deployment and operation guidelines have been developed and presented on May 5th 2020 to representatives of all EU member states that have not deployed AML yet, opening the floor to share practical experience on deploying AML.

Cost-benefit analysis have been carried out for Austria, Belgium, Estonia, Finland, Lithuania, and The UK, with measurable benefits such as time saved per call, number of lives saved, number of lives impacted. The total Net Present Value have been estimated per country from €349 million to €11,102 million.

Future works for improving the AML impact on European citizen safety have been sketched out as four types of improvement recommendations: AML availability, AML location quality, AML transmission quality, AML exploitation quality. The most critical recommendations concern the AML success rate, the standardization of the AML computation in the handset, and the development of AML performance monitoring system.

The Help112 projects play a major role in making the most out Galileo and maximizing Galileo and 112 mutual benefits. This, with the ultimate goal to save even more lives!

END OF DOCUMENT