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

Contract No 440/PP/GRO/PPA/15/8308
Deliverable D3.2 - Technical Description Document

Loïc Bellon
July – 2017
Contract No 440/PP/GRO/PPA/15/8308

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<th>Full Form</th>
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<tr>
<td>3GPP</td>
<td>3rd Generation Partnership Project</td>
</tr>
<tr>
<td>A-GNSS</td>
<td>Assisted Global Navigation Satellite System</td>
</tr>
<tr>
<td>A2C</td>
<td>Authorities to Citizens communication</td>
</tr>
<tr>
<td>ACE</td>
<td>Accredited Center of Excellence</td>
</tr>
<tr>
<td>AML</td>
<td>Advanced Mobile Location</td>
</tr>
<tr>
<td>API</td>
<td>Application Program Interface</td>
</tr>
<tr>
<td>BSC</td>
<td>Base Station Controller (2G)</td>
</tr>
<tr>
<td>BSSAP-LE</td>
<td>LCS Extension for Lb, Lp and Ls interfaces</td>
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<td>BSSMAP-LE</td>
<td>BSSMAP LCS Extension</td>
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<tr>
<td>BSSLAP</td>
<td>BSS LCS Assistance Protocol</td>
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<td>C&amp;C</td>
<td>Command &amp; Control</td>
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<tr>
<td>C2A</td>
<td>Citizens to Authorities communication</td>
</tr>
<tr>
<td>CAD</td>
<td>Computer-aided dispatch</td>
</tr>
<tr>
<td>CAPEX</td>
<td>Capital expenditures</td>
</tr>
<tr>
<td>CEN</td>
<td>European Committee for Standardisation</td>
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<td>CERN</td>
<td>European Organisation for Nuclear Research</td>
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<td>CNES</td>
<td>French Space Agency</td>
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<td>EC</td>
<td>European Commission</td>
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<tr>
<td>E-CID</td>
<td>Enhanced Cell ID</td>
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<tr>
<td>ECAS</td>
<td>Emergency Call Answering Service</td>
</tr>
<tr>
<td>ECC</td>
<td>Electronic Communications Committee</td>
</tr>
<tr>
<td>EE</td>
<td>British mobile phone operator, formerly Everything Everywhere</td>
</tr>
<tr>
<td>EGNOS</td>
<td>European Geostationary Navigation Overlay Service</td>
</tr>
<tr>
<td>E-GNSS</td>
<td>European Global Navigation System</td>
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<tr>
<td>EISDEC</td>
<td>Enhanced Information System for Emergency Calls</td>
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<td>ESA</td>
<td>European Space Agency</td>
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<td>ESSN</td>
<td>Emergency Services Staff Network</td>
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<td>ETC</td>
<td>Electronic Toll Collection</td>
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<td>GMLC</td>
<td>Gateway Mobile Location Center</td>
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<td>Global Navigation Satellite System</td>
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<td>GPS</td>
<td>Global Positioning System</td>
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<td>GSM</td>
<td>Global System for Mobile Communications</td>
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<tr>
<td>HSS</td>
<td>Home Subscriber Server</td>
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<td>ICE</td>
<td>In Case of Emergency</td>
</tr>
<tr>
<td>IETF</td>
<td>Internet Engineering Task Force</td>
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<tr>
<td>IP</td>
<td>Internet Protocol</td>
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<tr>
<td>IPR</td>
<td>Intellectual Property Right</td>
</tr>
<tr>
<td>IRSN</td>
<td>French Nuclear Safety Institute</td>
</tr>
<tr>
<td>Iupc</td>
<td>Interface between RNC and SAS (RNC interface)</td>
</tr>
<tr>
<td>IVE</td>
<td>in-vehicle equipment</td>
</tr>
<tr>
<td>IVS</td>
<td>in-vehicle systems</td>
</tr>
<tr>
<td>KPI</td>
<td>Key Performance Indicator</td>
</tr>
<tr>
<td>LAC</td>
<td>Location Area Code</td>
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<td>LBS</td>
<td>Location based Services</td>
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<tr>
<td>LCS</td>
<td>LoCation Services</td>
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<tr>
<td>LCS-AP</td>
<td>LCS Application Protocol</td>
</tr>
<tr>
<td>LPP</td>
<td>LTE Positioning Protocol</td>
</tr>
<tr>
<td>LTE</td>
<td>Long-Term Evolution</td>
</tr>
<tr>
<td>LPP</td>
<td>LTE Positioning Protocol</td>
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<tr>
<td>MAC</td>
<td>Media Access Control</td>
</tr>
<tr>
<td>MEP</td>
<td>Member of the European Parliament</td>
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<td>MLC</td>
<td>Mobile Location Centre</td>
</tr>
<tr>
<td>MME</td>
<td>Mobility Management Entity (4G)</td>
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<tr>
<td>MNO</td>
<td>Mobile Network Operator</td>
</tr>
<tr>
<td>MSD</td>
<td>Minimum Set of Data</td>
</tr>
<tr>
<td>MSG</td>
<td>Mobile Standard Group</td>
</tr>
<tr>
<td>MT-LR</td>
<td>Mobile Terminating Location Request</td>
</tr>
<tr>
<td>NG</td>
<td>Next Generation</td>
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<td>NG112</td>
<td>Next Generation 112</td>
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<td>Operating Expenditures</td>
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<td>OS</td>
<td>Operating System</td>
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OTDOA - Observed Time Difference Of Arrival

PCAP - Positioning Calculation Application Part

PCO - Project Control Office

PEMEA - Pan-European Mobile Emergency Application

PSAP - Public Service Answering Point

R&D - Research & Development

RNC - Radio Network Controller (3G)

Rx - Received Signal level

RRLP - Radio Resource Location services Protocol

RTT – Round Trip Time

SAS - Standalone SMLC

SET - SUPL enabled terminal

SIM - Subscriber Identity Module

SIP - Session Initiation Protocol

SL - SUPL Location

SLA - Service Level Agreement

SLC - SUPL Location Center

SLP - SUPL location platform

SMLC - Serving Mobile Location Center

SMS - Short Message Service

SSID - Service Set IDentifier

SUPL - Secure User Plane

TDOA - Time Difference of Arrival

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

TL - Task Leaders

TLRR - Trigger Location Reporting Request

TM - Technical Manager

TOA - Time of Arrival

TTFT - Time To First Fix

WP - Work Package

WPL - Work Package Leader

UE - User Equipment (mobile)

UMTS - Universal Mobile Telecommunication System

URI - Uniform Resource Identifier

URN – Uniform Resource Name

WGS84 - World Geodetic System Datum 84

VoLTE - Voice over LTE
1. INTRODUCTION

1.1 PLACE OF THIS DOCUMENT AND OBJECTIVES

This document is the “Technical Description Document”, identified as D3.2 in the list of project deliverables.

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

The objectives of this document are to describe the tasks that need to be implemented in each architecture defined in WP3 deliverable D3.1, describe the architecture of each sub-system involved in the whole architecture by relating the potential needed modifications to existing standards if any. Based on this description, for each architecture, the integration process will be described for each stakeholder. The chart below defines the place of this document and its interaction with others work packages deliverables:

As a reminder, here are the goals of each work package’s deliverable:

- WP1:
  - D1.1: Defines the user requirements and formulates a set of user scenarios that will lead the implementation and evaluation of the architecture.
  - D1.2: Analyses and compares the existing solutions and the underlying technologies for the provision of caller location.
  - D1.3: Analyses how existing solutions satisfy the requirements, reports the barriers for deployment and provides recommendations for the implementation.
WP2:
  o D2.1: Defines the key location and transmission technology scenarios and assess the costs and benefits of each scenario.
  o D2.2: Recommends the optimal scenario(s) for the help112 caller location based on the results of the cost-benefit analysis.
  o D2.3: Provides a more detailed assessment of the costs linked to implementation of the selected technology scenario(s) as well as key operational and financial recommendations.

WP3:
  o D3.1: Defines possible implementation architectures for the pilot sites, covering location/transmission tech. alternatives of WP1.
  o D3.2: Describes technicalities of these architectures and recommendations for their implementation.
  o D3.3: Selects the architecture to be deployed for the pilots based on outputs of WP2.
  o D3.4: Analyses the gaps between the selected architecture and the existing standards (eCall, 3GPP, ECC-REP-225).

1.2 FOREWORD

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

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

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

This consortium, known as the HELP112 consortium, aims demonstrate that accurate and reliable caller location information is highly effective and is also highly efficient. It also studies possible deployment strategies across Europe in a cost effective manner, securing better outcomes for our citizens and simultaneously not placing any additional burden on the emergency services, mobile network providers or public authorities.
## 1.3 Applicable Documents

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<td>AD 2</td>
<td>Help112 Consortium Agreement</td>
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Table 1 – Applicable documents

## 1.4 Reference Documents

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<td>Help112 Technical, Management &amp; Financial Proposal TPZF/SSA-T2015-PP-0451 is1.0 31/07/2015</td>
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Table 2 – Reference documents
2. ARCHITECTURE 1: HANDSET BASED HYBRID POSITIONING METHOD USING SUPL SERVER + AUTOMATED ACTIVATION + SMS TRANSMISSION

2.1 ARCHITECTURE OVERVIEW AND I/F

This architecture is based on a smartphone with a data connectivity available at the moment of the emergency call. To compute the location of the caller, the handset connects to a SUPL (Secure User Plane Location) server that is assisted E-GNSS enabled (Galileo and EGNOS). This server could be provided by Telespazio during the trial phase of HELP112. In the case where Galileo-ready smartphones would not be available on the market for the trial phase of HELP112, Telespazio could provide a Galileo chipset USB dongle developed by ST Microelectronic, in order to test the advantages bring by Galileo in the location estimate. The activation process is entirely automated and an SMS containing the HELP112 location MSD\(^1\) (Minimum Set of Data) is used to transmit the location information to the PSAP through a HELP112 location server.

In this architecture, the mobile handset determines its precise location by using the external SUPL server. The location methods used depend on the user’s settings:

- GNSS standalone if the handset location service is set to use device sensors only.
- WiFi and Cell-Id if the handset location service is set to “battery saving” mode.
- E-GNSS using network capabilities if the handset location service is set to “high accuracy” (With Galileo assistance data and EGNOS data available).

The activation and transmission process is according to both the HELP112 automated activation process and the transmission of HELP112 location MSD using SMS described in HELP112 deliverable D3.1 (Description of the scenarios). These methods of activation and transmission derive from Advance Mobile Location process standardised by ETSI in ETSI TR 103 393\(^2\).

The chart below shows both the components involved in this architecture and the interfaces between them:

---

\(^1\) HELP112 Deliverable D3.1, Description of the Scenarios Document, Section 5.2.1

\(^2\) ETSI TR 103 393, Advanced Mobile Location for emergency calls, latest version
The different components are defined hereafter. To depict the current level of implementation of each component, the following color coding is used: \textit{Exists and no modification is needed}, \textit{Exist and need to be modified}, \textit{Does not exist}.

- **E-GNSS SUPL server:**

  The interface between the SUPL server and the handset’s SUPL client is using SUPL (Secured User Plane Protocol) with LPP (LTE Positioning Protocol) data format. SUPL and LPP are standards for location services defined by the Open Mobile Alliance (OMA). It is worth mentioning that the assistance data received by the client is LPP ASN1 encoded. ASN1 (Abstract Syntax Notation One) is a joint standard of the International Organization for Standardization (ISO), International Electrotechnical Commission (IEC), and International Telecommunication Union Telecommunication Standardization Sector ITU-T, that describes rules and structures for representing, encoding, transmitting, and decoding data in telecommunications and computer networking.

  The SUPL server provided by Telespazio is connected to the RX Networks server in Canada that provides the GNSS assistance data. For emergency calls to 911 in the United States, RX Networks is the reference provider for GNSS assistance data. The GNSS assistance data generated and provided by the RX Networks server is listed hereafter:

  - **Coarse position:** computed from a worldwide database of WiFi and/or cell tower. This computation is performed by using the list of WiFi and/or cell tower information spots detected by the user terminal.
- Real time assistance data: this information is obtained from a worldwide network of GNSS receiver (GRN).

The SUPL server implements SFTP (Secured File Transfer Protocol) requests to get real time assistance data while it uses HTTP requests to get coarse location from RX networks server.

In addition, the SUPL server is connected to the EGNOS receiver (NOVATEL Flexpack6 receiver) in order to receive a new type of assistance data: differential corrections, either for GPS (as obtained from EGNOS) or for GALILEO (as obtained from the EGNOS server linked to the Novatel receiver).

Requests to the SUPL server are possible on any network (2G, 3G, 4G) as long as the data connectivity is available on the handset.

- **Handset’s SUPL client:**

In case of emergency call, the handset’s SUPL client is connecting to the E-GNSS SUPL server instead of the default configured SUPL server. The SUPL client is using the handset’s location services that shall handle Galileo assistance data. This could require modifications to the existing SUPL client.

- **HELP112 mobile handset’s software:**

The HELP112 mobile handset’s software is the heart of the location process. It is triggered by a 112 emergency call or SMS, and then initiates the location process using the E-GNSS SUPL server. Once a location estimate using GNSS is computed or after a configured timeout, this software formats the HELP112 location SMS and initiates the HELP112 location SMS transfer.

- **GNSS chipset:**

The handset’s GNSS chipset is an E-GNSS ready chipset (Galileo and EGNOS enabled). Such smartphone GNSS chipset does not exist yet, but the first chipset of this type is foreseen to be available before the end of year 2016.

- **SMSC:**

The SMSC (Short Message Service Center) is a network element in the mobile network. Its function is to store, forward, convert and deliver Short Message Service (SMS) messages. In this architecture, the SMSC is responsible for recognizing the HELP112 location SMS sent from a mobile phone using SM-AL (Short Message – Application Layer) protocol, and forwards it to the
corresponding SMS Gateway using SMPP (Short Message Peer to Peer) protocol. It has to be programmed to send emergency location SMS via an SMS gateway to the HELP112 location server that handles emergency location SMS.

- **SMS Gateway:**

The SMS gateway is making the interface between the network (SMSC) and the emergency services (HELP112 location server). The protocol used to forward the HELP112 location SMS to the HELP112 location server is HTTPS.

- **HELP112 location server:**

The HELP112 location server is used to store the location information of the caller transmitted into the HELP112 location SMS, and make it reachable from the PSAP. It could also compare the information from the handset (via the location SMS) with the location information from the mobile network (provided by a GMLC) for the MSISDN of the emergency caller, before making it available to the PSAP. This comparison allows to remove invalid WiFi/GNSS location estimates.

- **PSAP CAD system:**

The PSAP CAD (Computer Assisted Dispatch) system retrieves the location information from the HELP112 location server in normal way, without any additional task for the call taker. In countries where no location server exists yet, it is recommended to pull the location information from the HELP112 location server using HTTPS.

Hereafter are the steps of an E112 emergency call using this architecture:

- A person in distress calls 112 or sends a 112 SMS (where this facility exists e.g. for deaf people) using his mobile handset.

- Call session:
  - The call is routed to the most appropriate PSAP as it is done for existing 112 emergency calls. The voice call is not impacted by this E112 architecture.

- Get location:
The HELP112 software is triggered by the call to 112.

If necessary, the HELP112 software switches ON the location services of the handset.

The HELP112 software uses the handset’s SUPL client to connect to the Galileo-ready SUPL server.

All the available location methods are used to estimate the location of the caller (taking into account the handset’s “User Settings” and the battery power level).

To get assistance data (E-GNSS, coarse position), the SUPL client connects to the SUPL module via TCP/IP, using the port 35429, in order to initiate the SUPL transaction.

When the TCP connection is established, the SUPL client sends a SUPL START message to start a session (identified by a session id) with the SUPL server and indicates its capabilities (setCapabilities: posTechnology, prefMethod), the current serving cell and WiFi Access Point (locationId) and the QoP (horizontal accuracy and maximum location age).

The handset capabilities are verified by the SUPL server, especially the positioning method supported (Galileo, EGNOS, GPS, ...). The SUPL server then responds with a SUPL RESPONSE message with the same session id and a posMethod (supportedNetworkInformation, gnssPosTechnology). A coarse location based on the serving cell and WiFi access points in the range of the caller is returned into this message.

A SUPL POS INIT message is then sent by the SUPL client to the SUPL server using the same session id (setCapabilities: posTechnology, prefMethod; requestedAssistData; locationId). This message contains a request for a subset of assistance data (requestedAssistData).

The SUPL server extracts the requested assistance data from its internal storage. The server then provides the requested assistance data in a binary payload following 3GPP RRLP standard\(^3\). Upon receiving that data, the SUPL client may request more data until it has all the assistance data needed for its positioning. The position is then computed by the SUPL client and returned back to the SUPL server.

\(^3\) 3GPP TS 44.031, Radio Resource LCS Protocol (RRLP), Release 13, 2016-01
Once the position calculation is completed, the SUPL server terminates the transaction with a **SUPL END** message containing the location information in WGS84 coordinate system.

If previously switched ON, the HELP112 software switches OFF the location services of the handset.

- Send location data to the PSAP:
  
  Once the estimate of the caller location has been made using GNSS or after HELP112 configured timeout, the HELP112 MSD is formatted in an SMS as described in section 5.2.2 of WP3 deliverable D3.1. The AML SMS in Annex A is a good example of location SMS containing the HELP112 location MSD.

  The location SMS is routed to the home network SMSC of the caller. The SMSC forwards the HELP112 location SMS to the HELP112 location server through an SMS gateway.

  To be routed to the corresponding location server, the SMS is identified by an SMS number such as 112, or a dedicated full length MSISDN of the PSAP.

  The SMS gateway could be provided by an SMS aggregator which takes SMPP (Short Message Peer to Peer) output from the SMSC’s of all mobile networks.

  The SMS gateway then sends an HTTPS message containing the HELP112 location MSD to the HELP112 location server.

  The access to HELP112 location information from the PSAP depends on how PSAP obtains location in country concerned (Pull or Push).

  The PSAP then validates the handset based location by comparing it to the location provided by mobile network’s GMLC if such capability exists at the PSAP level.

The diagram hereafter illustrates the algorithm above:
Figure 2 - Architecture 1: SUPL E-GNSS + HELP112 automated activation + SMS transmission diagram
• HELP112 location SMS sending loop in Limited Service State (LSS: The handset cannot successfully register to an available network)
  o Try to send the HELP112 location SMS.
  o If the HELP112 location SMS cannot be sent due to LSS, it should be stored on the handset.
  o Retry transmission every 30 seconds.
  o If after 30 minutes the handset has not been able to transmit the HELP112 location SMS, then no further attempt should be made and the SMS should be discarded.

2.2 RECOMMENDATIONS TO ARCHITECTURE STAKEHOLDERS

2.2.1 Handset manufacturers/OS providers
The recommendations which potentially could be addressed to handset manufacturers/OS providers are listed in the following table:
### HELP112 software implementation

<table>
<thead>
<tr>
<th>Item</th>
<th>Recommendation</th>
</tr>
</thead>
</table>
| HELP112 software implementation | - OS providers or handsets manufacturers have to develop a HELP112 software which can be triggered by 112 emergency call or 112 SMS, and can interact with the SUPL client of the handset to get the location of the caller.  
- The HELP112 location SMS shall only be sent in HELP112 ready countries based on MCC/MNC.  
- HELP112 activation process and timeout shall follow the requirements defined for AML in ETSI TR 103 393, and make use of the E-GNSS SUPL server instead of the common location services used for calls that are not emergency calls.  
- OS providers or handsets manufacturers shall define battery power level threshold for each type of location method available and for simultaneously allowing a 5 minutes voice call.  
- OS providers or handsets manufacturers shall ensure that HELP112 location SMS is a silent SMS (Class-Zero SMS), i.e. it cannot be seen by the caller, does not incur any charge, and it is not stored on the handset. |

### Location estimate

<table>
<thead>
<tr>
<th>Item</th>
<th>Recommendation</th>
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</table>
| Location estimate | - The handset of the caller shall be able to use a data connection (2G, 3G, or 4G) in order to compute the location estimate by using a SUPL server.  
- The handset SUPL client triggered by the HELP112 software shall be able to compute a location estimate by using the E-GNSS SUPL server. Based on the user’s settings all location methods available shall be used to compute the location of the caller as quickly, precisely, and accurately as possible (Cell-Id, WiFi, GNSS, E-GNSS).  
- Handset manufacturers /OS providers shall ensure that SUPL exchanges can take place during the emergency voice call.  
- Handset manufacturers/OS providers shall contact GNSS chipsets providers so that they develop E-GNSS chipsets (Galileo and EGNOS) |

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**Table 2 - Architecture 1 - Recommendations to handset manufacturers/OS providers**

### 2.2.2 E-GNSS SUPL server provider

The recommendations which potentially could be addressed to E-GNSS SUPL server provider are listed in the following table:

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4 ETSI TR 103 393, Advanced Mobile Location for emergency calls, Apr 2016
### 2.2.3 Mobile Network Operator

The recommendations which potentially could be addressed to MNOs are listed in the following table:

<table>
<thead>
<tr>
<th>Item</th>
<th>Recommendation</th>
</tr>
</thead>
</table>
| SUPL server implementation       | • E-GNSS SUPL provider shall contact handset manufacturers/OS providers developing HELP112 software to ensure that they use the E-GNSS SUPL server to get the caller's location in case of emergency call.  
  • E-GNSS SUPL provider shall ensure that the SUPL server is reliable and can handle the total amount of HELP112 emergency calls in Europe. Several SUPL servers might be needed.  
  • E-GNSS SUPL provider shall ensure that all 112 emergency callers will have access to the E-GNSS SUPL server. |
| Location estimate                 | • E-GNSS SUPL server provider shall ensure that at least a simple Cell-Id location will be returned by the server. |

Table 3 - Architecture 1 - Recommendations to E-GNSS SUPL server provider
**HELP112 routing**
- In the case of an emergency call, MNOs shall ensure that they are able to handle emergency call and route the call and HELP112 location SMS to the appropriate PSAP (Same PSAP for call and location SMS).
- MNOs shall ensure that HELP112 location SMS is priority.
- MNOs shall carry HELP112 location SMS free of charge for end users.
- MNOs shall ensure with network equipment providers that the SMS can be sent during the emergency call (change the values of the switch parameter(s) if needed).
- MNOs shall agree with network equipment providers that a data connection to the SUPL server can be used by the handset during the emergency call.

**HELP112 implementation**
- MNOs would have to contact handset manufacturers/OS providers so that they deploy the required HELP112 implementation.

**Test**
- MNOs will have to test this HELP112 implementation with handset manufacturers/OS providers that have developed handset’s HELP112 software, E-GNSS-ready SUPL server provider, and PSAPs.

### Table 4 - Architecture 1 - Recommendations to Mobile Network Operators

2.2.4 Public authority/PSAP

The recommendations which potentially could be addressed to Public authority/PSAP are listed in the following table:

**HELP112 implementation**
- PSAP shall ensure that they are able to receive the HELP112 location SMS (regular and Data SMSs) first by integrating a HELP112 location server, extract HELP112 location data from the location SMS, and then display the information on the call taker’s GIS.
- PSAPs would have to ask MNOs to contact handset manufacturers/OS providers so that they deploy this HELP112 implementation software.
- PSAPs shall decide guidance/process for call takers to compare between the Cell-Id location (if available), and HELP112 location data.

### Table 5 - Architecture 1 - Recommendations to Public authority/PSAP
2.2.5 Regulatory authorities

The recommendations which potentially could be addressed to Regulatory authorities are presented in the following table:

<table>
<thead>
<tr>
<th>Item</th>
<th>Recommendation</th>
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<tbody>
<tr>
<td>HELP112 implementation</td>
<td>• If this solution is the chosen one, regulatory authorities would have to make sure that PSAPs are merging to this solution.</td>
</tr>
</tbody>
</table>
| HELP112 location estimate     | • Regulatory authorities shall encourage/request the development and use of E-GNSS chipsets for smartphones.  
                                | • Besides, legislation would have to be made in order to use the E-GNSS-ready SUPL server. |

Table 6 - Architecture 1 - Recommendation to Regulatory authorities

2.3 Implementation roadmap in pilot sites

The first obstacle that could jeopardize the implementation of this architecture during the trial phase of the project, and therefore the test of the added value brought by Galileo to get the emergency caller’s location, is the availability of Galileo ready chipsets for mobile phones before the end of year 2016. This issue could nevertheless be overcome by using the ST-microelectronics Galileo chipset USB dongle used for GSA H2020 ELAastic project (Telespazio France/ST microelectronics/Rx Networks/Novero) to compute the location of the caller using Galileo signal.

The other obstacle to overcome is the use of assistance data for Galileo. Indeed, in order to compute a location using Galileo before the configured timeout, assistance data could be required. Such assistance data are currently not provided by Google (or other OS providers) SUPL server, and are currently not handled by mobile phones (SUPL client). Besides, it is not in the roadmap of Google or handset manufacturers such as Sony to implement assistance data for Galileo during the timeframe of HELP112. For instance, that means that if assistance data are available for GPS (e.g.: Google SUPL server and most of smartphones), if a GNSS location solution is available before the configured timeout, it will most of the time be computed using only GPS (which is assisted). Galileo will not be used even if the chipset is Galileo ready.

As a consequence and in order to be able to test Galileo added value in the pilots, it would be possible to use the ELAastic SUPL server and specific SUPL client for offline testing of A-GNSS positioning method using Galileo during the trial phase of the project. In addition and if needed, the Galileo chipset USB dongle from ST microelectronics could be used.
2.3.1 UK

Should either the Handset Manufacturer (i.e. Sony or Samsung) or an OS provider (i.e. Google/Android) implements the HELP112 software to the handset, enabling the use of a different SUPL server (E-GNSS ready), and a handset with an E-GNSS-ready chipset is provided, BT would likely be able to test this architecture during the trial phase of HELP112. Otherwise, BT could still test the SMS transmission method by using AML and conduct in parallel offline testing to get the location by using the E-GNSS SUPL server and client provided by Telespazio.

2.3.2 Lithuania

The Lithuanian pilot is in the same case as the UK pilot. It will be able to test the activation and transmission method by using AML in October 2016.

The potential implementation and integration issues related to the E-GNSS SUPL server, the handset's E-GNSS SUPL client, and the handset Galileo ready chipset are depicted in the introduction of section 2.3 of this document.

2.3.3 Italia

Concerning the transmission method, and the reception of the HELP112 location information at the PSAP level, AREU would be able to modify their centralized location server (used for the 112 App Where ARE U) in order to receive the HELP112 location SMS and make the location information available to the PSAP. However, in Italia, it is not possible to send SMS to 112. The handset software will therefore have to be configured to send the HELP112 location SMS to the full MSISDN of the centralized location server.

The potential implementation and integration issues related to the E-GNSS SUPL server, the handset's E-GNSS SUPL client, and the handset Galileo ready chipset are depicted in the introduction of section 2.3 of this document.

2.3.4 Austria

The Austrian pilot is in the same case as the UK and Lithuanian pilots. It will be able to test the activation and transmission method by using AML.

Besides, this pilot site underlines the fact that not only 112 calls should be able to trigger the HELP112 software inside the handset, but depending on the nation there are additional short emergency numbers (by national laws) which should also trigger the Help112 software. In Austria, in addition to the numbers 122 (Fire), 133 (Police), 144 (Ambulance) which end up directly in the nearest responsible communication center, there is a feature which enables dialling 999 (British emergency number or 911 (US emergency number) on mobile handsets and connects them to 112. So dialling all of these emergency short numbers (national traditional “old” numbers and 112 or 999 or 911) should trigger the Help112 Software. This type of implementation has to be discussed with HELP112 developers (OS providers/Handset manufacturers) to determine whether or not all of these emergency numbers could be integrated to the handset’s HELP112 software.
The potential implementation and integration issues related to the E-GNSS SUPL server, the handset’s E-GNSS SUPL client, and the handset Galileo ready chipset are depicted in the introduction of section 2.3 of this document.
3. ARCHITECTURE 2: HANDSET BASED HYBRID POSITIONING METHOD + AUTOMATED ACTIVATION + SMS TRANSMISSION ROAMING ENABLED

3.1 ARCHITECTURE OVERVIEW AND I/F

In this architecture, the location of the caller is estimated by using the handset's own capabilities, the activation process is entirely automated, and the location information (HELP112 location MSD) is transmitted to the most appropriate PSAP in an emergency location SMS. The architecture used to transmit the HELP112 location SMS additionally handles international roaming and makes use of one or several HELP112 location servers according to the architecture selected. The two foreseen roaming enabled transmission methods are described hereafter.

This architecture is available for every mobile phones that have location capabilities. The location methods used will therefore rely on the capabilities of the handset, the user’s settings, and the environment of the caller. In the description hereafter, we will consider an Android smartphone able to estimate a location using location capabilities up to A-GNSS. By considering this type of handset, we are able to cover all the location methods that might be available at the handset level (from Cell-Id to hybrid location method using Cell-Id+WiFi+A-GNSS) without discarding phones with limited location capabilities. In the trial phase of HELP112, the various handset based location methods could be tested by modifying the user’s settings of the handset while making use of several handsets with different location capabilities.

According to the user’s settings, the location methods available at the handset level are the following:

- GNSS standalone if the handset location service is set to use device sensors only or if the data connectivity is not available at the time of the emergency call.
- WiFi and Cell-Id if the handset location service is set to “battery saving” mode.
- A-GNSS using network capabilities if the handset location service is set to “high accuracy” (Mainly A-GPS).

There are two methods foreseen to handle international roaming while sending the HELP112 location MSD in an SMS. These two solutions are described in D3.1.

In the first solution (Architecture 2-A), the handset questions a regularly updated local database (on the handset itself) to get the full MSISDN of the most appropriate PSAP in the visited country.
based on the MCC and MNC. This full MSISDN is used by the home country SMSC to route the HELP112 location SMS to the appropriate HELP112 location server in the visited country. All mobile networks involved should agree on zero rate for such emergency location SMS for end users.

The chart below shows the components involved in Architecture 2-A and the interfaces between them:

![Architecture 2-A components description](image)

In the second solution (Architecture 2-B), all HELP112 location servers in Europe are linked together. The home country HELP112 location server receives the HELP112 location SMS, and then based on the MCC and MNC contained in the HELP112 location MSD, it forwards the location data to the visited country HELP112 location server.

The chart below shows the components involved in Architecture 2-B and the interfaces between them:
The different components are defined hereafter. To depict the current level of implementation of each component, the following color coding is used: Exists and no modification is needed, Exist and need to be modified, Does not exist.

- **HELP112 mobile handset’s software:**

  The HELP112 mobile handset’s software is triggered by a 112 emergency call or SMS, and then initiates the location process using the location services of the handset. Once a location estimate using GNSS is calculated or after a configured timeout, this software formats the HELP112 location SMS containing the HELP112 location MSD and initiates the HELP112 location SMS transfer.

  In architecture 2-A, the HELP112 location software makes a request to a handset’s local database in order to get the full MSISDN of the most appropriate PSAP.

- **GNSS chipset:**

  If it is mandatory to use Galileo and EGNOS in the location estimated by the handset’s GNSS chipset, this chipset has to be modified to use Galileo and EGNOS signals in the location estimate. Such a chipset does not exist yet, but the first chipset of this type is foreseen to be available before the end of year 2016.

- **Handset’s local database (Architecture 2-A):**
This handset’s local database is mandatory in Architecture 2-A. It is used by the handset’s HELP112 software to get the full MSISDN of the most appropriate PSAP. In order to do that, the MCC and MNC provided by the serving network are used as a key. This database will have to be updated on a regular basis.

- **Home country SMSC:**

  The SMSC (Short Message Service Center) is a network element in the mobile network. Its function is to store, forward, convert and deliver Short Message Service (SMS) messages. The caller’s home network SMSC receives the HELP112 location SMS sent from a mobile phone using SM-AL (Short Message – Application Layer) protocol. This SMSC is responsible for recognizing the HELP112 location SMS.

  In Architecture 2-A, the home network SMSC is able, based on visited PSAP full MSISDN, to either forward the HELP112 location SMS to the home country SMS Gateway using SMPP (Short Message Peer to Peer) protocol if the full MSISDN of the PSAP is attributed to a home country network, or forward the HELP112 location SMS to the appropriate visited network SMSC using SMPP protocol if the full MSISDN of the PSAP is attributed to a visited country network. In the second case, the visited network SMSC then forwards the HELP112 location SMS to the visited country SMS Gateway using SMPP protocol. The visited country SMSC has to be programmed to send emergency location SMS via an SMS gateway to the HELP112 location server that handles emergency location SMS.

  In Architecture 2-B, the home network SMSC forwards the HELP112 location SMS to the home country SMS Gateway using SMPP protocol. It has to be programmed to send emergency location SMS via an SMS gateway to a HELP112 location server that handles emergency location SMS.

- **SMS Gateway:**

  The SMS gateway is making the interface between the network (SMSC) and the emergency services (HELP112 location server). The protocol used to forwards the HELP112 location SMS to the HELP112 location server is HTTPS.

- **HELP112 location server:**

  The HELP112 location server is used to store the location information of the caller transmitted into the HELP112 location SMS, and make it reachable from the PSAP. It could also be used to compare the location information from the handset (location SMS) with the location information obtained from the mobile network (providing by GMLC) for the MSISDN of the emergency caller, before making it available to the PSAP. This comparison allows to remove invalid WiFi/GNSS location estimates.
In addition, in architecture 2-B, the home HELP112 location server is able to make a request to a local database, in order to find the address of the visited country HELP112 location server the caller is currently related to, based on MCC and MNC extracted from the HELP112 location MSD. If the home country HELP112 location server is not the current serving location server for the caller, the home country location server then forwards the HELP112 location MSD to the visited country HELP112 location server using an HTTPS message.

- **Location server’s local database (Architecture 2-B):**

This database is mandatory in Architecture 2-B. It is used by the HELP112 location server to get the address of the visited country HELP112 location server if needed. In order to do that, the MCC and MNC extracted from the HELP112 location MSD are used as a key. This database will have to be updated on a regular basis.

- **PSAP CAD system:**

The PSAP CAD (Computer Assisted Dispatch) system retrieves the location information from the HELP112 location server in normal way, without any additional task for the call taker. In countries where no location server exists yet, it is recommended to pull the location information from the HELP112 location server using HTTPS.

Hereafter are depicted the steps of an E112 emergency call using this architecture:

- A person in distress calls 112 or sends a 112 SMS (where this facility exists e.g. for deaf people) using his mobile handset.

- Call session:
  - The call is routed to the most appropriate PSAP as it is done for existing 112 emergency calls. The voice call is not impacted by this E112 architecture.

- Get location:
  - The HELP112 software is triggered by the call to 112.
  - If necessary, the HELP112 software switch ON the location services of the handset.
All the available location methods are used to estimate the location of the caller (with regards to the handset’s "User Settings" and capabilities).

If previously switched ON, the HELP112 software switches OFF the location services of the handset.

- Send location HELP112 location MSD

Once the estimate of the caller location has been made using GNSS or after the HELP112 configured timeout, the HELP112 MSD is formatted in an SMS as described in section 5.2.2 of WP3 deliverable D3.1. The AML SMS in Annex A is a good example of location SMS containing the HELP112 location MSD.

### Solution A

- The HELP112 software makes a query to the handset’s local database to determine the full MSISDN of the most appropriate PSAP in the visited country based on the MCC and MNC.

- The HELP112 location SMS is routed to the home network SMSC of the caller.

- The HELP112 location SMS is sent using the full MSISDN of the visited country HELP112 PSAP.

- The home network SMSC forwards the HELP112 location SMS to the visited network SMSC based on the full MSISDN of the visited country PSAP using SMPP protocol. The visited network SMSC has to be programmed to send emergency location SMS via an SMS gateway to a location server that handles emergency location SMS.

### Solution B

- The HELP112 location SMS is routed to the home network SMSC of the caller.

- To be routed to the corresponding home country location server, the SMS is identified by an SMS number such as 112, or a dedicated full length MSISDN of the PSAP (PSAP of home country).

- The SMSC forwards the HELP112 location SMS to the HELP112 location server in the home country of the caller through an SMS gateway.

- The SMS gateway could be provided by an SMS aggregator which takes SMPP (Short Message Peer to Peer) output from the SMSC’s of all mobile networks.
o The SMS gateway could be provided by an SMS aggregator which takes SMPP (Short Message Peer to Peer) output from the SMSC’s of all mobile networks.

o The SMS gateway then sends an HTTPS message containing the HELP112 location MSD to the home country HELP112 location server.

o The SMS gateway then sends an HTTPS message containing the HELP112 location MSD to the HELP112 location server in the visited country.

o The home country location server extracts the HELP112 location MSD and based on the MCC and MNC, it does forward the HELP112 location MSD to the appropriate HELP112 location server in the visited country using HTTPS protocol.

o The access to HELP112 location information from the PSAP that handled the voice call depends on how PSAP obtains location in country concerned (Pull or Push).

o The PSAP then validates the handset based location by comparing it to the location provided by mobile network’s GMLC if such capability exists at the PSAP level.
The diagram hereafter illustrates the **Solution A** algorithm described above:

![Diagram of Solution A](image)

**Figure 5 - Architecture 2-A: HELP112 automated activation + SMS transmission international roaming enabled diagram (A)**
The diagram hereafter illustrates the **Solution B** algorithm described above:

![Diagram](image)

**Figure 6 - Architecture 2-B: HELP112 automated activation + SMS transmission international roaming enabled diagram (B)**
3.2 RECOMMENDATIONS TO ARCHITECTURE STAKEHOLDERS

3.2.1 Handset manufacturers/OS providers

The recommendations which potentially could be addressed to handset manufacturers/OS providers are listed in the following table:
### HELP112 software implementation

- OS providers or handsets manufacturers have to develop a HELP112 software which can be triggered by 112 emergency call or 112 SMS.
- The HELP112 location SMS shall only be sent in HELP112 ready countries based on MCC/MNC.
- HELP112 activation process and timeout shall follow the requirements defined for AML in *ETSI TR 103 393*[^1] and shall make use of the handset’s location services.
- OS providers or handsets manufacturers shall define battery power level threshold for each type of location method available and for simultaneously allowing a 5 minutes voice call.
- OS providers or handsets manufacturers shall ensure that HELP112 location SMS is a silent SMS (Class-Zero SMS). It cannot be seen by the caller, does not incur any charges, and it is not stored on the handset.
- **In solution A:**
  - OS providers/Handset manufacturers shall provide a database of European PSAPs MSISDN that HELP112 software can access using MCC and MNC as a key. This database shall be regularly updated in accordance with Public authorities/PSAP.

### Location estimate

- Based on the user’s settings all location methods available shall be used to compute the location of the caller as quickly, precisely, and accurately as possible (Cell-Id, WiFi, GNSS, A-GNSS).
- If mandatory, handset manufacturers/OS providers shall contact GNSS chipsets providers so that they develop E-GNSS chipsets (Galileo and EGNOS)

<table>
<thead>
<tr>
<th>Table 7 - Architecture 2 - Recommendations to handset manufacturers/OS providers</th>
</tr>
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<tbody>
<tr>
<td><strong>Item</strong></td>
</tr>
<tr>
<td>---</td>
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<tr>
<td>HELP112 software implementation</td>
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#### 3.2.2 Mobile Network Operator

The recommendations which potentially could be addressed to MNOs are listed in the following table:

[^1]: *ETSI TR 103 393, Advanced Mobile Location for emergency calls, Apr 2016*
### Help112 routing
- MNOs shall ensure that Help112 location SMS is priority.
- MNOs shall carry Help112 location SMS free of charge for end users (Class-Zero SMS). MNOs involved in each country (home and visited) are concerned.
- MNOs shall agree with network equipment providers that the SMS can be sent during the emergency call (change this switch parameter if needed).
- **In solution A:**
  - In case the full MSISDN to which the location SMS is sent to, is not related to the same country than the SMSC that receives the location SMS, MNOs shall ensure that this home SMSC will forward the location SMS to the visited SMSC that corresponds to the MSISDN.
  - In case the full MSISDN is related to the same country than the SMSC that receives the location SMS, MNOs shall ensure that the location SMS is routed to the SMS Gateway.

### Help112 implementation
- MNOs would have to contact handset manufacturers/OS providers so that they deploy this Help112 implementation.

### Test
- MNOs will have to test this Help112 implementation with handset manufacturers/OS providers that have developed handset’s Help112 software and PSAPs.

#### Table 8 - Architecture 2 - Recommendations to Mobile Network Operators

### 3.2.3 Public authority/PSAP

The recommendations which potentially could be addressed to the Public authority/PSAP are listed in the following table:
### 3.2.4 Regulatory authorities

The recommendations which could be addressed to Regulatory authorities are listed in the following table:

<table>
<thead>
<tr>
<th>Item</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>HELP112 implementation</td>
<td>• If this solution is the chosen one, regulatory authorities would have to make sure that PSAPs are merging to this solution.</td>
</tr>
<tr>
<td>HELP112 location estimate</td>
<td>• Regulatory authorities shall encourage the development and use of E-GNSS chipsets for smartphones.</td>
</tr>
</tbody>
</table>

#### Table 10 - Architecture 2 - Recommendation to Regulatory authorities

### 3.3 IMPLEMENTATION ROADMAP IN PILOT SITES

#### 3.3.1 UK

For Architecture 2-A (use of PSAP’s MSISDN database added to the handset), should either the Handset Manufacturer (i.e. Sony or Samsung) or an OS provider (i.e Google/Android) implements the HELP112 software to the handset, BT would likely be able to test this architecture during the trial phase of HELP112.

It is worth noting that both Google/Android and Sony have separately indicated that it was straightforward process to build it into the handset software. Actually, BT is already working on the development of this solution in order to be able to test it in the timeframe of HELP112 project.
For Architecture 2-B, (Home HELP112 location server forwards the HELP112 location MSD to the Visited HELP112 location server), BT will review its feasibility in April –June 2016 period in order to evaluate whether it will be in position to implement this architecture during HELP112 project timeframe. BT underlines that the implementation of this architecture was not in its original contribution plan to HELP112. Until BT completes the feasibility, it is not confirmed whether BT will take part in testing this architecture during the trial phase.

### 3.3.2 Lithuania

Lithuania is expected to implement AML (implementation of the SMS transmission method) in October 2016. 112ERC is currently studying the possibility to reserve a long number for their location server. The possibility to test this architecture in the Lithuanian pilot will then relies on the implementation of the HELP112 software to the handset by either the Handset Manufacturer (i.e. Sony or Samsung) or an OS provider (i.e Google/Android).

### 3.3.3 Italia

AREU would be able to modify its centralized location server (used for the 112 App Where ARE U) in order to receive the HELP112 location SMS and make the location information available to the PSAP. Should either the Handset Manufacturer or an OS provider implements the HELP112 software to the handset, AREU would likely be able to test the architecture 2-A during the trial phase of HELP112. Besides, due to the impossibility to send SMS to 112 in Italia, the full MSISDN of the PSAP should be used to send the HELP112 location SMS, even if Italia is the home country of the caller.

### 3.3.4 Austria

For Notruf, it is not foreseen to implement an architecture with SMS transmission that handles international roaming during the HELP112 project timeframe.
4. ARCHITECTURE 3: HANDSET BASED HYBRID POSITIONING METHOD + AUTOMATED ACTIVATION + SMS TRANSMISSION + ENHANCED NETWORK POSITIONING METHOD AS SAFETY NET

4.1 ARCHITECTURE OVERVIEW AND I/F

In this architecture, the location of the caller is initially estimated by using the available handset’s location services, the activation process is entirely automated, and the location information (HELP112 location MSD) is transmitted to the most appropriate PSAP in an emergency location SMS.

According to the user’s settings, the location methods that might be available at the handset level are the following:

- GNSS standalone if the handset location service is set to use device sensors only or if the data connectivity is not available at the time of the emergency call.
- WiFi and Cell-Id if the handset location service is set to “battery saving” mode.
- A-GNSS using network capabilities if the handset location service is set to “high accuracy” (Mainly A-GPS).

In addition to the location estimated by the handset capabilities, in this architecture, a User Plane Network based location method based on the Radio Measurement Report (RMR) is used. The necessary pieces of information contained in the RMR are sent to a Location Calculator that uses them to estimate the location of the caller. That would for instance allow to compute an accurate estimate of the caller’s location even when no location or only a simple Cell-Id location has been estimated by the handset before the sending of the location SMS, hence acting as a Safety net.

The RMR is always available since it is automatically sent by the handset to the network while in dedicated mode (when a voice call is ongoing) every 480ms for the purposes of managing the allocated radio resources by the network. It is also available for SIMless caller.

The RMR contains the Time Advance (TA) value from the Serving Cell in addition to the Received Signal Strengths from both the Serving Cell and the neighbouring cells (up to 6 neighbours).

These information are sent with the HELP112 location SMS in one or several SMS depending on the number of cells the handset is seeing. The handset can report up to 6 neighbouring cells for each network as per 3GPP standards. And for each cell, up to 10 bytes are needed to transmit the necessary data. Therefore it is needed to cater for up to 70 bytes. If it is needed to support

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8 HELP112 Deliverable D3.1, Description of the Scenarios Document, Section 5.2.1
9 HELP112 Deliverable D3.1, Description of the Scenarios Document, Section 4.1.1.3
gathering data from multiple networks (theory to be verified) this of course expands linearly. The RMR data could be transmitted in hexadecimal pairs along with the HELP112 location MSD.

The Location Calculator that is used to estimate the caller’s location based on the RMR data is a node that can either be a physically separate component, or can be incorporated into the HELP112 location server.HELP112 consortium would recommend a standalone component and centralised deployment. The main or sole contribution from the mobile network operators would be to provide the cell tower data.

The Location Calculator would require periodic updates of the cell towers data, which would include: GPS coordinates of each cell in the network, the orientation and power of its antennas, basic cell identification codes and frequencies, from each of the networks. The cell towers data are gathered into a database at the Location Calculator level that the latter can access and use to compute the location based on the Radio Measurement Report data provided in HELP112 SMSs.

With regards to the type of network used by the caller, and the content of the Radio Measurement Report, the location methods available at the Location Calculator level are the following (all these methods are described in HELP112 deliverable D3.1 section 4.1.1):

- Cell-Id - 2G/3G/4G.
- Cell-Id + Timing Advance - 2G/4G.
- Cell-Id + Round Trip Time - 3G.
- Cell-Id + Time Advance and Received Signal (CITARX) - 2G.
- Cell ID with Path loss and Related Measurements (RF Pattern Matching) – 2G/3G/4G.
- Observed Time Difference Of Arrival (O-TDOA) – 3G/4G.

This architecture is available for any mobile phones irrespective of its location capabilities. At the handset level, the location methods used will therefore rely on the capabilities of the handset, the user’s settings, and the environment of the caller. In the description hereafter, we will consider an Android smartphone able to estimate a location using location capabilities up to A-GNSS. By considering this type of handset, we are able to cover all the location methods that might be available at the handset level (from Cell-Id to hybrid location method using Cell-Id+WiFi+A-GNSS) without discarding the phones with limited location capabilities. In the trial phase of HELP112, the various handset based location methods could be tested by modifying the user’s settings of the handset while making use of several handsets with different location capabilities. On the other hand, if the caller is using a phone that has no location capabilities, his location could still be estimated by the Location Calculator using the Radio Measurement Report data.

The activation and transmission process are both following the HELP112 automated activation process and the transmission of HELP112 location MSD using SMS described in HELP112
deliverable D3.1 (Description of the scenarios). These methods of activation and transmission derive from Advance Mobile Location process standardised by ETSI in *ETSI TR 103 393*.

The chart below shows the components involved in Architecture 3 and the interfaces between them:

![Architecture 3 components description](image)

**Figure 7 - Architecture 3 components description**

The different components are defined hereafter. To depict the current level of implementation of each component, the following color coding is used: **Exists and no modification is needed**, **Exist and need to be modified**, **Does not exist**.

- **HELP112 mobile handset’s software:**

The HELP112 mobile handset’s software is triggered by a 112 emergency call or SMS, and then initiates the location process using the location services of the handset. Once a location estimate using GNSS is calculated or after a configured timeout, this software formats the HELP112 location MSD into a location SMS and initiates the HELP112 location SMS transfer.

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10 *ETSI TR 103 393, Advanced Mobile Location for emergency calls, latest version*
In addition to formatting the HELP112 location MSD, the HELP112 handset’s software is in charge to use the necessary pieces of information from the RMR and put them into the location SMS space left (in addition to the HELP112 location MSD), and additional SMSs if needed.

For each neighbouring cell measured the needed information is both the Identifier, and the Received Signal Strength in decibels. Time Advance is also reported for the Serving cell.

Depending on the type of network, the Identifier can be:

- **Cell General Identity (CGI in 2G network)** which is composed of:
  - MCC: Mobile Country Code
  - MNC: Mobile Network Code
  - LAC: Location Area Code
  - CI: Cell Id

- **Service Area Identity (SAI in 3G network)** which is composed of:
  - MCC: Mobile Country Code
  - MNC: Mobile Network Code
  - LAC: Location Area Code
  - SAC: Service Area Code

- **And for LTE network:**
  - MCC: Mobile Country Code
  - MNC: Mobile Network Code
  - LTE id

It is worth noting that the Radio Measurement Report does report:

- The complete CGI for the Serving Cell, while only a couple of parameters for the neighboring cells (BSIC-BCCH). BSIC stands for Base Station Identity Code and BCCH stands for Broadcast Control Channel and their combination could be used to identify the neighbor cell, hence deducing the whole set of parameters making the CGI.
- The received signal level for the Serving cell and the reported neighbors (up to 6 neighbouring cells).
- Time Advance for the Serving cell.

Each of these attributes are integers, along with the Received Signal Strength (RSS). Since we consider here a transmission method using SMS, these data could be transmitted in hexadecimal pairs in order to maintain the human readable HELP112 location MSD foreseen in this document. However, in the future, a binary representation of both the HELP112 location MSD and the RMR data could be foreseen. Considering the size of the HELP112 location MSD, it would be possible to send a full set of data for the serving network within 2 SMS messages. Each SMS has to be identified by an HELP112 identifier in order to be routed to the appropriate HELP112 location server.

- **GNSS chipset:**
If it is mandatory to use Galileo and EGNOS in the location estimated by the handset’s GNSS chipset, this chipset has to be modified to use Galileo and EGNOS signals in the location estimate. Such a chipset does not exist yet, but the first chipset of this type is foreseen to be available by the end of year 2016.

- **Network SMSC:**

The SMSC (Short Message Service Center) is a network element in the mobile network. Its function is to store, forward, convert and deliver Short Message Service (SMS) messages. The caller’s home network SMSC receives the HELP112 SMSs sent from a mobile phone using SM-AL (Short Message – Application Layer) protocol. This SMSC is responsible for recognizing the HELP112 location SMSs, and forwards them to the corresponding SMS Gateway using SMPP (Short Message Peer to Peer) protocol. It has to be programmed to send emergency location SMS via an SMS gateway to an HELP112 location server that handles emergency location SMS.

- **SMS Gateway:**

The SMS gateway is making the interface between the network (SMSC) and the emergency services (HELP112 location server). The protocol used to forwards the HELP112 location SMS to the HELP112 location server is HTTPS.

- **HELP112 location server:**

The HELP112 location server is used to store the location information of the caller transmitted into the HELP112 location SMSs, and make it reachable from the PSAP. It could also be used to compare the location information from the handset (location SMS) with the location information obtained from the mobile network (provided by the GMLC) for the MSISDN of the emergency caller, before making it available to the PSAP. This comparison allows to remove invalid WiFi/GNSS location estimates.

In addition, in this architecture, the HELP112 location server is connected to a Location Calculator that is used to calculate the location of the caller based on the RMR data embedded in the location SMSs along with the HELP112 location MSD.

The interface between the HELP112 location server and the Location Calculator uses the standard MLP protocols (Mobile Location Protocol) which are XML over HTTP. These protocols are extended for our purposes. The MLP standard\(^\text{11}\) is defined by OMA (Open Mobile Alliance).

The emergency location request interface (**eme_lir** - emergency location immediate request) is used as the basic message that transmit the RMR data from the HELP112 location server to the

\(^{11}\) **OMA-TS-MLP-V3_2-20110719-A, Mobile Location Protocol, Version 3.2, 19 Jul 2011**
Location Calculator. MLP already incorporates a mechanism to define extensions to the specification, and that will be used to define the HELP112 data which will contain all of the cell measurement data and optionally a reference location if one is provided in the HELP112 location MSD (This will allow for the generation of location fingerprints to improve location accuracy in subsequent requests (sub 50m in cities)). The Description Type Document (DTD) for these data is defined in Annex B of the current document.

- **Location Calculator:**

The Location Calculator is a piece of software which is connected to the HELP112 location server. It is able to calculate the location of the caller, based on the data transmitted by the HELP112 location server into the eme_lir MLP message. The Location Calculator will take this input and return a standard eme_lia (emergency location immediate answer) which will contain the calculated shape. For this purpose, the Location Calculator also makes requests to a local database of Cell towers data needed to compute the location of the caller.

- **Cell towers database:**

This Cell towers database consists in one csv file per radio network (2G or 3G) for each Mobile Network Operator. These files are comma-separated text files provided by each MNO in order to update the database from possible Radio Network changes and modifications. The name and format of these CSV files are strictly specified in order to be understood and used by the Location Calculator. For instance, by considering an implementation of the Location calculator from the Consortium member, Creativity Software, the names and formats of the CSV files shall strictly follow the specifications described in Creativity Software's document named "Radio Network Data File" Version 1.3.

For 2G networks, the parameters needed in the CSV files are the following (each parameter is described in Annex C of the current document):

- CID
- SiteName
- CellName
- Longitude
- Latitude:
  - AntennaType
  - MaxCellRadius
  - AntennaGain
  - BSNominalPower
  - BSPowerBCCH
  - TAlimit
  - AntennaSpec
  - HeightAGL
  - DownTilt
For 3G networks, the parameters needed in the CSV file are the following (each parameter is described in Annex B of the current document):

- Azimuth
- HorizBeamWidth
- LAC
- NCC
- BCC
- BCCH

This database is used by the Location Calculator to estimate the location of the caller based on the RMR data.

- **PSAP CAD system:**

The PSAP CAD (Computer Assisted Dispatch) system retrieves the location information from the HELP112 location server in normal way, without any additional task for the call taker. In countries where no location server exists yet, it is recommended to pull the location information from the HELP112 location server using HTTPS.

Hereafter are depicted the steps of an E112 emergency call using this architecture:

- A person in distress calls 112 or send a 112 SMS (where this facility exists e.g. for deaf people) using his mobile handset.
• Call session:
  
  o The call is routed to the most appropriate PSAP as it is done for existing 112 emergency calls. The voice call is not impacted by this E112 architecture.

• Get location and RMR data at the handset level:
  
  o The HELP112 software is triggered by the call to 112.

  o If necessary, the HELP112 software switch on the location services of the handset.

  o All the available location methods are used to estimate the location of the caller (with regards to the handset’s "User Settings” and capabilities).

  o The HELP112 software gets the Identifier, RSS, and TA for the serving cell and RSS and BSIC-BCCH for the neighbours from the RMR.

  o If previously switched ON, the HELP112 software switches OFF the location services of the handset.

• Send HELP112 location MSD and RMR data
  
  o Once the estimate of the caller location has been made using GNSS and the RMR data have been collected, or after HELP112 configured timeout, the HELP112 MSD and the RMR data are formatted in one or several location SMSs. The AML SMS in Annex A is a good example of location SMS containing the HELP112 location MSD and could be extended to contain the RMR data.

  o The location SMSs are routed to the home network SMSC of the caller. The SMSC forwards the HELP112 location SMSs to the HELP112 location server through an SMS gateway.

  o To be routed to the corresponding location server, the SMSs are identified by an SMS number such as 112, or a dedicated full length MSISDN of the PSAP.

  o The SMS gateway could be provided by an SMS aggregator which takes SMPP (Short Message Peer to Peer) output from the SMSC’s of all mobile networks.
The SMS gateway then sends an HTTPS message containing the HELP112 location MSD and RMR data to the HELP112 location server.

- Get location from Location Calculator
  - The HELP112 location server makes an eme_lir request containing the RMR data and the location provided by the handset in the HELP112 location MSD if available.
  - The Location Calculator Makes a request to the Cell tower database to retrieve the Cell towers information related to the RMR data.
  - The Location Calculator computes the location of the caller based on the RMR data and the Cell tower data.
  - The Location Calculator makes an eme_lia response to the HELP112 location server containing the calculated shape.
  - If the handset based location estimate was available in the eme_lir message, the Location Calculator uses it to generate location fingerprints to improve location accuracy in subsequent requests.

- Display location on PSAP operator CAD
  - The access to HELP112 location information from the PSAP depends on how PSAP obtains location in country concerned (Pull or Push).
  - The PSAP first retrieves the location estimated by the handset capabilities (HELP112 location MSD) and then validates this location estimate by comparing it to the location provided by mobile network’s GMLC if such capacity exists at the PSAP level.
  - If case of no location or a simple cell-id location is returned in the HELP112 location MSD, or if a GNSS or WiFi location has been invalidated by the PSAP, the PSAP retrieves the location estimated by the Location Calculator.
  - If the PSAP has not the capability to compare the handset’s based location with the location provided by the mobile network’s GMLC, then the location calculated by the Location Calculator is used for this purpose.
The diagram hereafter illustrates the algorithm above:

Figure 8 - Architecture 3: HELP112 automated activation + SMS transmission + Location Calculator (Safety Net)
4.2 **Recommendations to architecture stakeholders**

### 4.2.1 Handset manufacturers/OS providers

The recommendations which potentially could be addressed to the handset manufacturers/OS providers are listed in the following table:

<table>
<thead>
<tr>
<th>Item</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>HELP112 software</td>
<td>• OS providers or handsets manufacturers have to develop a HELP112 software which can be triggered by 112 emergency call or 112 SMS</td>
</tr>
<tr>
<td>implementation</td>
<td>• HELP112 software shall interact with the location services of the handset to get and format the location of the caller.</td>
</tr>
<tr>
<td></td>
<td>• HELP112 software shall format and send the RMR data necessary to compute caller’s location at the Location Calculator level.</td>
</tr>
<tr>
<td></td>
<td>• The HELP112 location SMSs shall only be sent in HELP112 ready countries based on MCC/MNC.</td>
</tr>
<tr>
<td></td>
<td>• HELP112 activation process and timeout shall follow the requirements defined for AML in <em>ETSI TR 103 393</em>.</td>
</tr>
<tr>
<td></td>
<td>• OS providers or handsets manufacturers shall define battery power level threshold for each type of location method available and for simultaneously allowing a 5 minutes voice call.</td>
</tr>
<tr>
<td></td>
<td>• OS providers or handsets manufacturers shall ensure that HELP112 location SMS is a silent SMS (Class-Zero SMS), i.e. it cannot be seen by the caller, does not incur any charges, and it is not stored on the handset.</td>
</tr>
</tbody>
</table>

| Location estimate         | • Based on the user’s settings all location methods available shall be used to compute the location of the caller as quickly, precisely, and accurately as possible (Cell-Id, WiFi, GNSS, A-GNSS). |
|                           | • If mandatory, handset manufacturers/OS providers shall contact GNSS chipsets providers so that they develop E-GNSS chipsets (Galileo and EGNOS). |

Table 11 - Architecture 3 - Recommendations to handset manufacturers/OS providers

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12 *ETSI TR 103 393, Advanced Mobile Location for emergency calls, Apr 2016*
4.2.2 Mobile Network Operator

The recommendations which potentially could be addressed to the MNOs are listed in the following table:

<table>
<thead>
<tr>
<th>Item</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>HELP112 routing</td>
<td>• In the case of an emergency call, MNOs shall ensure that they are able to handle emergency call and route the call and HELP112 location SMSs to the appropriate PSAP (Same PSAP for call and location SMS).&lt;br&gt;• MNOs shall ensure that HELP112 location SMSs is priority.&lt;br&gt;• MNOs shall carry HELP112 location SMSs free of charge for end users.&lt;br&gt;• MNOs shall agree with network equipment providers that the SMSs can be sent during the emergency call (change this switch parameter if needed).</td>
</tr>
<tr>
<td>Cell tower data files</td>
<td>• MNOs shall provide regular updates of their Cell tower data files to Cell tower database managers on a regular basis and on ad-hoc basis. The defined format of Cell tower data files has to be followed.</td>
</tr>
<tr>
<td>HELP112 implementation</td>
<td>• MNOs would have to contact handset manufacturers/OS providers so that they deploy this HELP112 implementation.</td>
</tr>
<tr>
<td>Test</td>
<td>• MNOs will have to test this HELP112 implementation with handset manufacturers/OS providers that have developed handset’s HELP112 software, Location Calculator providers, and PSAPs.</td>
</tr>
</tbody>
</table>

Table 12 - Architecture 3 - Recommendations to Mobile Network Operators

4.2.3 Public authority/PSAP

The recommendations which could be addressed to the Public authority/PSAP are listed in the following table:
Item | Recommendation
--- | ---
HELP112 implementation | • PSAP shall ensure that they are able to receive the HELP112 location SMSs (regular and Data SMSs) by providing an HELP112 location server, extract HELP112 location MSD and RMR data from location SMSs, and then display the information on the call taker’s GIS.
• PSAPs shall ensure that each HELP112 location server has access to a Location Calculator.
• PSAP shall ensure the handset based location estimate and the Location Calculator location estimate can be distinctly retrieved from the HELP112 location server.
• PSAPs would have to ask MNOs to contact handset manufacturers/OS providers so that they deploy this HELP112 implementation software.
• PSAPs shall decide guidance/process for call takers for:
  o Comparing Cell-Id location (if available), and HELP112 handset based location data.
  o Comparing Location Calculator location estimate and handset based location estimate.
  o Using Location Calculator location estimate in case of no handset based location estimate or Cell-Id handset based location.

Table 13 - Architecture 3 - Recommendations to Public authority/PSAP

4.2.4 Location Calculator Provider

The recommendations which could be addressed to the Location Calculator providers are listed in the following table:
HELP112 location estimate

• Location Calculator providers shall contact MNOs so that they provide and regularly share updates of their networks’ Cell tower data files.

<table>
<thead>
<tr>
<th>Item</th>
<th>Recommendation</th>
</tr>
</thead>
</table>
| HELP112 implementation | • Location Calculator providers, in accordance with PSAPs shall set up the MLP interfaces between each HELP112 location server and its related Location Calculator.  
• Location Calculator providers shall provide, for each Location Calculator, an accessible Cell tower database for the purpose of estimating the location of the caller based on the RMR data.  
• The location calculator will have to validate and import these Cell tower data files to be able to provide a location calculation for any network in a country. |
| HELP112 location estimate | • Location Calculator providers shall contact MNOs so that they provide and regularly share updates of their networks’ Cell tower data files. |

Table 14 - Architecture 3 - Recommendation to Location Calculator providers

4.2.5 Regulatory authorities

The recommendations which could be addressed to the Regulatory authorities are listed in the following table:

<table>
<thead>
<tr>
<th>Item</th>
<th>Recommendation</th>
</tr>
</thead>
</table>
| HELP112 implementation | • The format of the Cell tower data files has to be agreed between regulatory authorities, MNOs, and Location Calculator providers.  
• If this solution is the chosen one, regulatory authorities would have to make sure that PSAPs are merging to this solution. |
| HELP112 location estimate | • Regulatory authorities shall encourage the development and use of E-GNSS chipsets for smartphones. |

Table 15 - Architecture 3 - Recommendation to the Regulatory authorities

4.3 IMPLEMENTATION ROADMAP IN PILOT SITES

After several discussions with OS providers and handset manufacturers, it seems difficult to put in place this type of HELP112 handset software (with the sending of RMR data) in the timeframe of the project. Nevertheless, the door is not closed and Google/Android is actually interested in studying this solution in the near future, should HELP112 pilots managed to demonstrate of the additional value of the Location Calculator.

For this architecture, HELP112 pilot phase would therefore focus on the comparison between the Location Calculator solution and the Handset based positioning methods, and particularly the
accuracy, precision, and availability of the Location Calculator solution when no GNSS solution is available at the handset level. Testing the Location Calculator solution would be possible through offline testing, without any need to connect to the mobile operators. Creativity Software has already shared the process document for the offline test.

4.3.1 UK
For the pilot in UK, work is in progress between the different stakeholders in order to be able to test parts of this architecture during the trial phase of HELP112:
- Handset based location methods and SMS transmission method could be tested using AML.
- Location Calculator performances could be tested using Creativity Software solution in collaboration with one or several local MNOs providing the Cell tower data files.

4.3.2 Lithuania
As for the UK pilot, work is in progress to be able on one hand to test the handset based location methods and the SMS transmission method by using AML, and on the other hand to test offline the Location Calculator performances by using Creativity Software solution in collaboration with one or several local MNOs (e.g.: Tele2) providing the Cell tower data files.

4.3.3 Italia
Italia already has its own system to retrieve the location of the caller based on the serving cell-Id. This mechanism works as followed and is regulated by law: the PSAP contacts the related Ministry of Interior service, which then asks the corresponding MNO for the location of the caller; the Ministry of Interior then gives this location to the PSAP that initiated the request. There is therefore currently no direct link between Italian PSAPs and Italian MNOs to get the location of an emergency caller based on the serving cell-Id.
After discussions with AREU, it seems currently difficult for MNOs to bypass the ministry of interior by providing and updating a cell tower database directly to the PSAP in order to use and test the Location Calculator. Hence, this architecture will probably not be tested in this pilot. Nevertheless, discussion could start between PSAPs, MNOs, and the Ministry of Interior, in order to find a way to provide the cell tower database to the PSAPs and use the Location Calculator solution.

4.3.4 Austria
For the moment, this pilot site has currently no agreement with any MNO to provide the cell tower database required to test the Location Calculator performances. It will probably be difficult to put in place such agreement during the timeframe of HELP112, and therefore Austria is unlikely to test this architecture during the trial phase of HELP112.
5. ARCHITECTURE 4: HANDSET BASED HYBRID POSITIONING METHOD + AUTOMATED ACTIVATION + DATA CHANNEL TRANSMISSION

5.1 ARCHITECTURE OVERVIEW AND I/F

In the case where the handset’s data connection is available and sufficiently reliable (3G or 4G network) to be used at the time of the emergency call, it could be practical to use the data channel to transmit the location data to the PSAP. In this architecture, the location of the caller is estimated by using the handset’s own means, the activation process is entirely automated, and the location information (HELP112 location MSD\textsuperscript{13}) is transmitted to the most appropriate PSAP in an HTTPS message over the data channel.

This architecture is usable with every mobile phones that have location capabilities. The location methods used will therefore rely on the capabilities of the handset, the user’s settings, and the environment of the caller. In the description hereafter, we will consider an android smartphone able to estimate a location using location capabilities up to A-GNSS. By considering this type of handset, we are able to cover all the location methods that might be available at the handset level (from Cell-Id to hybrid location method using Cell-Id+WiFi+A-GNSS) without discard phones with limited location capabilities. In the trial phase of HELP112, the several handset based location methods could be tested by modifying the user’s settings of the handset and making use of several handsets with different location capabilities.

According to the user’s settings, the location methods available at the handset level are the following:

- GNSS standalone if the handset location service is set to use device sensors only or if the data connectivity is not available at the time of the emergency call.
- WiFi and Cell-Id if the handset location service is set to “battery saving” mode.
- A-GNSS using network capabilities if the handset location service is set to “high accuracy” (Mainly A-GPS).

There are two methods foreseen to send the HELP112 location MSD by using the data channel. The choice of one approach or another relies on the implementation of emergency services in the country concerned (National or Regional). These two solutions are described in D3.1\textsuperscript{14}. In both architectures the HELP112 location MSD is pushed to an HELP 112 location server using an HTTPS message, using XML within the HTTPS message.

\textsuperscript{13} HELP112 Deliverable D3.1, Description of the Scenarios Document, Section 5.2.1

\textsuperscript{14} HELP112 Deliverable D3.1, Description of the Scenarios Document, Section 5.2.3
In the National approach (Architecture 4-A), PSAPs operate at the national level or there are HELP112 national location servers that regional PSAPs can all access. In this case, the caller’s handset’s makes requests to a regularly updated database in order to get the URL of a national HELP112 location server to which sends the HELP112 location MSD using the MCC and MNC provided by the network as a key. And then the PSAP can pull the location data from the national HELP112 location server. This solution would therefore easily handle roaming.

The chart below shows the components involved in Architecture 4-B and the interfaces between them:

In the Regional approach (Architecture 4-B), PSAPs operate at the regional level and the location data should be maintained in the regional jurisdiction. In this case, the handset makes a request to a local database to get the URL of the most appropriate National HELP112 location server based on the MCC and MNC provided by the network. This URL is then used by the handset’s HELP112 software to push the HELP112 location data to the related HELP112 National location server using HTTPS. Once the National HELP112 location server receives the HELP112 location data pushed by the handset’s HELP112 software, it could then extract the location information and use it to map the HELP112 location data to the most appropriate HELP112 Regional proxy server using a HTTPS data push. Then the regional PSAP could pull the location data from the proxy server, for instance using the caller’s handset MSISDN as a key.

The chart below shows the components involved in Architecture 4-B and the interfaces between them:
The different components are defined hereafter. To depict the current level of implementation of each component, the following color coding is used: **Exists and no modification is needed**, **Exist and need to be modified**, **Does not exist**.

- **HELP112 mobile handset’s software:**

The HELP112 mobile handset’s software is triggered by a 112 emergency call or SMS, and then initiates the location process using the location services of the handset. Once a location estimate using GNSS is calculated or after a configured timeout, this software formats the HELP112 location MSD in XML format and initiates the transfer of this data encapsulated in an HTTPS message.

In both architectures (4-A and 4-B), the HELP112 location software makes a request to a handset’s local database in order to get the URL of the most appropriate HELP112 National location server based on MCC and MNC provided by the network.

- **GNSS chipset:**

If it is mandatory to use Galileo and EGNOS in the location estimated by the handset’s GNSS chipset, this chipset has to be modified to use Galileo and EGNOS signals in the location estimate. Such a chipset does not exist yet, but the first chipset of this type is foreseen to be available by the end of year 2016.
• **Handset’s local database:**

This handset’s local database is used by the handset’s HELP112 software to get the URL of the most appropriate HELP112 National Location server. In order to do that, the MCC and MNC provided by the serving network are used as a key. This database will have to be updated on a regular basis.

• **HELP112 National location server:**

The HELP112 National location server is used to store the location information of the caller transmitted into the HELP112 location HTTPS message, and make it reachable from the PSAP. It could also be used to compare the location information from the handset (HELP112 location MSD) with the location information obtained from the mobile network (providing by GMLC) for the MSISDN of the emergency caller, before making it available to the PSAP. This comparison allows to remove invalid WiFi/GNSS location estimates.

In addition, in architecture 4-B, the HELP112 National location server is able to make a request to a local database, in order to find the URL of the most appropriate HELP112 proxy server the caller is currently related to, based on the location extracted from the HELP112 location MSD. In the Regional approach this HELP112 National location server then forwards the HELP112 location MSD to the corresponding HELP112 proxy server using an HTTPS message.

• **HELP112 National location server’s local database (Architecture 4-B):**

This database is mandatory in Architecture 4-B. It is used by the HELP112 National location server to get the URL of the most appropriate HELP112 Regional proxy server. In order to do that, the location extracted from the HELP112 location MSD is used as a key. This database will have to be updated on a regular basis.

• **HELP112 Regional proxy server (Architecture 4-B):**

In countries where architecture 4-B is implemented, the HELP112 Regional proxy server receives HTTPS message containing the HELP112 location MSD from the HELP112 National location server. As per the HELP112 National location server, HELP112 Regional proxy could also be used to compare the location information from the handset (HELP112 location MSD) with the location information obtained from the mobile network (providing by GMLC) for the MSISDN of the emergency caller, before making it available to the PSAP. This comparison allows to remove invalid WiFi/GNSS location estimates.

• **PSAP CAD system:**
The PSAP CAD (Computer Assisted Dispatch) system retrieves the location information from the HELP112 location server in normal way, without any additional task for the call taker. In countries where no location server exists yet, it is recommended to pull the location information from the HELP112 location server using HTTPS.

Hereafter are depicted the steps of an E112 emergency call using this architecture:

- A person in distress calls 112 or send a 112 SMS (where this facility exists e.g. for deaf people) using his mobile handset.

- Call session:
  - The call is routed to the most appropriate PSAP as it is done for existing 112 emergency calls. The voice call is not impacted by this E112 architecture.

- Get location:
  - The HELP112 software is triggered by the call to 112.
  - If necessary, the HELP112 software switch on the location services of the handset.
  - All the available location methods are used to estimate the location of the caller (with regards to the handset’s “User Settings” and capabilities).
  - If previously switched on, the HELP112 software switches off the location services of the handset.

- Send location HELP112 location MSD
  - Once the estimate of the caller location has been made using GNSS or after HELP112 configured timeout, the HELP112 MSD is formatted in XML format into an HTTPS message as described in section 5.2.3 of WP3 deliverable D3.1.
  - The HELP112 software makes a request to the handset’s local database to determine the URL of the most appropriate HELP112 National location server based on the MCC and MNC.
- The HTTPS message containing the HELP112 location MSD is pushed to the National HELP112 location server using the URL got from the local database.

- **In Architecture 4-B (Regional approach):**
  
  - The HELP112 National location server extracts the location information and makes requests to a local database to get the URL of the most appropriate HELP112 Regional proxy server based on the location of the caller.
  
  - The HELP112 National location server forwards the HELP112 location HTTPS message (HTTPS data push) to the HELP112 Regional proxy server using the URL got from the local database.

- The access to HELP112 location information from the PSAP that handled the voice call depends on how PSAP obtains location in country concerned (Pull or Push). In countries where the National approach is implemented, the PSAP will get the location information from this National server. In countries where the Regional approach is implemented, the PSAP will get the location information from the Regional proxy it is related to.

- The PSAP then validates the handset based location by comparing it to the location provided by mobile network’s GMLC if such capacity exists at the PSAP level.
The diagram hereafter illustrates the algorithm above:

Figure 11 - Architecture 4: HELP112 automated activation + Data channel transmission
5.2 RECOMMENDATIONS TO ARCHITECTURE STAKEHOLDERS

5.2.1 Handset manufacturers/OS providers

The recommendations which could be addressed to the handset manufacturers/OS providers are listed in the following table:

<table>
<thead>
<tr>
<th>Item</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HELP112 software implementation</strong></td>
<td>• OS providers or handsets manufacturers have to develop a HELP112 software which can be triggered by 112 emergency call or 112 SMS.</td>
</tr>
<tr>
<td></td>
<td>• The XML HELP112 location MSD shall only be sent in HELP112 ready countries based on MCC/MNC.</td>
</tr>
<tr>
<td></td>
<td>• HELP112 activation process and timeout shall follow the requirements defined for AML in <em>ETSI TR 103 393</em> and shall make use of the handset’s location services.</td>
</tr>
<tr>
<td></td>
<td>• OS providers or handsets manufacturers shall define battery power level threshold for each type of location method available and for simultaneously allowing a 5 minutes voice call.</td>
</tr>
<tr>
<td></td>
<td>• OS providers or handsets manufacturers shall ensure that the XML HELP112 location MSD cannot be seen by the caller during or after the call and is not stored on the handset.</td>
</tr>
<tr>
<td></td>
<td>• OS providers/Handset manufacturers shall provide a database of European HELP112 National location servers URLs that HELP112 software can access using MCC and MNC as a key. This database shall be regularly updated in accordance with Public authorities/PSAP.</td>
</tr>
<tr>
<td><strong>Location estimate</strong></td>
<td>• Based on the user’s settings all location methods available shall be used to compute the location of the caller as quickly, precisely, and accurately as possible (Cell-Id, WiFi, GNSS, A-GNSS).</td>
</tr>
<tr>
<td></td>
<td>• If mandatory, handset manufacturers/OS providers shall contact GNSS chipsets providers so that they develop E-GNSS chipsets (Galileo and EGNOS)</td>
</tr>
</tbody>
</table>

Table 16 - Architecture 4 - Recommendations to handset manufacturers/OS providers

---

15 *ETSI TR 103 393, Advanced Mobile Location for emergency calls, Apr 2016*
5.2.2 Mobile Network Operator

The recommendations which could be addressed to the MNOs are listed in the following table:

<table>
<thead>
<tr>
<th>Item</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>HELP112 routing</td>
<td>• MNOs shall ensure with network equipment providers that the HTTPS message can be sent during the emergency call.</td>
</tr>
<tr>
<td></td>
<td>• MNOs shall ensure that the location data is routed to the HELP112 National location server corresponding to the destination URL.</td>
</tr>
<tr>
<td>HELP112 implementation</td>
<td>• MNOs would have to contact handset manufacturers/OS providers so that they deploy this HELP112 implementation.</td>
</tr>
<tr>
<td></td>
<td>• MNOs would have to agree with network equipment providers that the data channel can be used during the emergency call.</td>
</tr>
<tr>
<td>Test</td>
<td>• MNOs will have to test this HELP112 implementation with handset manufacturers/OS providers that have developed handset’s HELP112 software and PSAPs.</td>
</tr>
</tbody>
</table>

Table 17 - Architecture 4 - Recommendations to Mobile Network Operators

5.2.3 Public authority/PSAP

The recommendations which could be addressed to the Public authority/PSAP are listed in the following table:
**HELP112 implementation**

- PSAPs of a given country shall provide a National HELP112 location server.
- In country where PSAPs operate at Regional level (Regional approach):
  - PSAPs shall provide HELP112 Regional proxy server in each region with a specific regional jurisdiction for location data.
  - PSAPs shall ensure that the HELP112 National location server is linked to all the country's HELP112 Regional proxy servers.
  - PSAPs shall ensure that the HELP112 National location server is able to extract the location information from the HTTPS message and to use it as a key to get the URL of the most appropriate HELP112 Regional proxy server.
  - PSAPs shall provide, at the HELP112 National location server level, a database of country HELP112 Regional proxy servers URLs that the HELP112 National location server can access using the location of the caller as a key. PSAPs shall regularly update this database.
- PSAPs shall ensure that they are able to extract HELP112 location data from XML HELP112 location data, and then display the information on the call taker’s GIS.
- PSAPs would have to ask MNOs to contact handset manufacturers/OS providers so that they deploy this HELP112 implementation software.
- PSAPs shall decide guidance/process for call takers for comparing Cell-Id location (if available), and HELP112 location data.

---

**Table 18 - Architecture 4 - Recommendations to Public authority/PSAP**

### 5.2.4 Regulation authorities

The recommendations which could be addressed to the Regulatory authorities are presented in the following table:

<table>
<thead>
<tr>
<th>Item</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>HELP112 implementation</td>
<td>- If this solution is the chosen one, regulatory authorities would have to make sure that PSAPs are merging to this solution.</td>
</tr>
<tr>
<td>HELP112 location estimate</td>
<td>- Regulatory authorities shall encourage the development and use of E-GNSS chipsets for smartphones.</td>
</tr>
</tbody>
</table>

---

**Table 19 - Architecture 4 - Recommendation to Regulatory authorities**
5.3 Implementation Roadmap in Pilot Sites

5.3.1 UK

In UK, PSAPs operate at the National level, so that is the National approach that could be implemented. BT is planning to work on the National approach architecture ready for testing within HELP112 timescales. The first step of the work to be done is to determine whether this will be Google (Android OS), Sony or Samsung that will provide modified handsets with the HELP112 software and the local database for this architecture, and to agree an XML/HTTPS protocol to transmit the HELP112 location MSD.

5.3.2 Lithuania

112ERC is currently focusing on implementing a solution that uses SMS transmission to convey the location data. They should be able to test this type of architecture using SMS in October 2016. Therefore, should 112ERC implement an architecture using the data channel, it would not be during the timeframe of HELP112.

5.3.3 Italia

Italia already has a location server able to receive location data from Where ARE U 112 App using the data channel. AREU confirms that it is straightforward to modify the Where ARE U location server so that it could receive HELP112 location data sent via the data channel. This type of implementation matches the “National approach” architecture.

It has to be determined whether it will be an OS provider (e.g.: Google/Android) or a handset manufacturer (e.g.: Sony, Samsung) that will provide modified handsets with the HELP112 software and the local database for this architecture. The provider of the HELP112 software will have to agree with AREU on an XML/HTTPS protocol to transmit the HELP112 location data to the Where ARE U location server.

5.3.4 Austria

Should this architecture be tested in the Austrian pilot, it would be as a fall-back solution to SMS transmission.
6. ARCHITECTURE 5: HANDSET BASED HYBRID POSITIONING METHOD + AUTOMATED ACTIVATION + IMS SIP TRANSMISSION

6.1 ARCHITECTURE OVERVIEW AND I/F

This architecture is based on an IMS emergency call used to transmit the HELP112 location MSD to the PSAP. The IP Multimedia Subsystem (IMS) is a core network framework for delivering IP multimedia services. It originates in 3GPP Release 5, finalised in 2002 and is based on IETF protocols such as SIP and SDP that are very mature (RFC 3261 and RFC 4566 and additional updates). It uses VoIP (on UMTS-PS or LTE network) to transmit the location data to the most appropriate PSAP.

Standardisation groups as part of ETSI are working to create standards to support emergency call handling and location information transmitted by IP based communications, in LTE networks (ETSI TS 123.167, ETSI TS 124.229). The “Best Current Practice for Communications Services in Support of Emergency Calling” document (RFC 6881) describes the best current practice about how access networks, SIP user agents, proxy servers, and PSAP support IMS emergency calling. RFC 6443 (“Framework for Emergency Calling Using Internet Multimedia”) is designed to complement RFC 6881 in section headings, numbering, and content. First and foremost, the emergency call is managed by the mobile phone, the network and the PSAP following these standards and RFCs.

In this architecture, the mobile handset determines its precise location by its own means depending on the user’s settings:

- GNSS standalone if the handset location service is set to use device sensors only.
- WiFi and Cell-Id if the handset location service is set to “battery saving” mode
- A-GNSS using network capabilities if the handset location service is set to “high accuracy” (Mainly A-GPS)

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16 HELP112 Deliverable D3.1, Description of the Scenarios Document, Section 5.2.1
17 ETSI TS 123.167, Universal Mobile Telecommunications System (UMTS); LTE; IP Multimedia Subsystem (IMS) emergency sessions, latest version
18 ETSI TS 124.229, Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); LTE; Internet Protocol (IP) multimedia call control protocol based on Session Initiation Protocol (SIP) and Session Description Protocol (SDP); Stage 3, latest version
19 Internet Engineering Task Force (IETF), RFC6881, Best Current Practice for Communications Services in Support of Emergency Calling, Mar 2013
20 Internet Engineering Task Force (IETF), RFC6443, Framework for Emergency Calling Using Internet Multimedia, Dec 2011
The activation and transmission process is the HELP112 automated activation process and the transmission of HELP112 location MSD using SIP/IMS described in HELP112 deliverable D3.1 (Description of the scenarios). The activation method derives from Advance Mobile Location process standardised by ETSI in *ETSI TR 103 393*.

The chart below shows the components involved in this architecture and the interfaces between them:

![Architecture components description](image)

**Figure 12 - Architecture 5 components description**

The different components are defined hereafter. To depict the current level of implementation of each component, the following color coding is used: **Exists and no modification is needed**, **Exist and need to be modified**, **Does not exist**.

- **HELP112 mobile handset’s software**

The HELP112 mobile handset’s is triggered by a 112 emergency call or SMS, and then initiates the location process using the location services of the handset. Once a location estimate using GNSS is calculated or after a configured timeout, this software formats the HELP112 SIP re-INVITE.
message containing the HELP112 location MSD and then initiates the SIP re-INVITE message transfer.

- **Handset’s VoIP API**

This architecture needs a native SIP/IMS client available on the handset. This client is used to initiate the IMS call, and then the HELP112 software uses it to send the SIP re-INVITE message containing the HELP112 location MSD. Having such a client embedded into smartphones is not a common practice, but it should become more typical when VoLTE will be the common solution for mobile voice call.

- **Emergency-Call Session Control Function (E-CSCF)**

Emergency Call Session Control Function (E-CSCF) is the root node of the emergency IMS architecture, which cares primarily about signaling. The E-CSCF, using location data from multiple sources, and routes the call to the local Public Safety Access Point (PSAP). It interfaces with the Location Information Server (LIS) using HTTP Enabled Location Delivery protocol (HELD: RFC 5985\(^{22}\) and RFC 5986\(^{23}\)) to get the coarse location of the handset, and with the Location-to-Service Translation server (LoST: RFC 5222\(^{24}\)) to get the most appropriate PSAP Uniform Resource Identifier (URI: RFC 3986\(^{25}\)) based on the coarse location of the handset. Such a CSCF needs to be implemented in all IMS networks.

- **Location Information Server (LIS)**

The Location Information Server, or LIS is an IMS network node originally defined in the National Emergency Number Association network architecture that addresses the intermediate solution for providing e911 service for users of VoIP telephony. The LIS is the node that determines the location of the VoIP terminal. In mobile network, the location of the device is given as the position of the serving cell with a region of uncertainty. The location information is retrieved from the LIS using the HELD protocol.

- **Location-to-Service Translation (LoST)**

\(^{22}\) Internet Engineering Task Force (IETF), RFC 5985, HTTP-Enabled Location Delivery (HELD), Sep 2010
\(^{23}\) Internet Engineering Task Force (IETF), RFC 5986, Discovering the Local Location Information Server (LIS), Sep 2010
\(^{24}\) Internet Engineering Task Force (IETF), RFC 5222, LoST: A Location-to-Service Translation Protocol, Aug 2008
\(^{25}\) Internet Engineering Task Force (IETF), RFC 3986, Uniform Resource Identifier (URI): Generic Syntax, Jan 2005
The Location-to-Service Translation (LoST) server is an entity of the IMS network used by the E-CSCF to get the most appropriate PSAP URI (SIP address) based on the coarse location retrieved from the LIS and the specific emergency Uniform Resource Name (URN: RFC 2141) for HELP112 call: "urn:service:sos:help112". The protocol used between the E-CSCF and the LoST server is the LoST protocol (RFC 5222).

- **GNSS chipset:**

If it is mandatory to use Galileo and EGNOS in the location estimated by the handset’s GNSS chipset, this chipset has to be modified to use Galileo and EGNOS signals in the location estimate. Such a chipset does not exist yet, but the first chipset of this type is foreseen to be available by the end of year 2016.

- **PSAP VoIP API**

In this architecture, PSAPs are able to handle IMS emergency call from mobile network. PSAPs in Europe are not currently SIP-ready but since networks will move towards full IP networks, PSAP are going to use this technology in the next decade.

- **PSAP CAD system**

The PSAP Computer Assisted Dispatch (CAD) system needs to be modified in order to extract HELP112 location MSD from the SIP re-INVITE message and display the location information on the call taker screen.

Hereafter are the steps of such an emergency call:

- A person in distress calls 112 using his mobile handset and VoIP (LTE or UMTS-PS network).

- **Call session initiation:**
  
  - The mobile handset sends a SIP-INVITE message to the Emergency Call Session Control Function (E-CSCF) of the IMS network to initiate the call with the PSAP.
The E-CSCF gets the caller’s coarse location by interrogating the Location Information Server (LIS) using HELD protocol. The LIS returns the location either “by value”, i.e. encoded in PIDF-LO (RFC 4119²⁶ and RFC 5491²⁷) or in geodetic XML location format or in civic XML location format (RFC 3863²⁸), or “by reference”, i.e the LIS generates a URI and an application dereferences this URI to obtain a physical location value.

The E-CSCF makes a query containing the caller’s location to the Location-to-Service Translation (LoST) server using the emergency service Uniform Resource Name (URN: RFC 2141): "urn:service:sos". The LoST server returns the most appropriate PSAP URI. This URI will be used to route the call to the appropriate PSAP.

The E-CSCF routes the call and initiates SIP session to PSAP URI - passing coarse location and location URI in the SIP INVITE message.

- Get location:
  - The HELP112 software is triggered by the call to 112.
  - If necessary, the HELP112 software switch on the location services of the handset.
  - All the available location methods are used to estimate the location of the caller (with regards to the handset’s “User Settings” and capabilities).
  - If previously switched on, the HELP112 software switches off the location services of the handset.

- Send location data to the PSAP:
  - The location data set is sent by the User Agent (UA) of the mobile handset in a SIP re-INVITE message (using a specific HELP112 URN) after a configured timeout (by default 20 seconds) or as soon as a location estimate based on GNSS has been obtained.

²⁶ Internet Engineering Task Force (IETF), RFC 4119, A Presence-based GEOPRIV Location Object Format, Dec 2005
²⁷ Internet Engineering Task Force (IETF), RFC 5491, GEOPRIV Presence Information Data Format Location Object (PIDF-LO) Usage Clarification, Considerations, and Recommendations, Mar 2009
²⁸ Internet Engineering Task Force (IETF), RFC 3863, Presence Information Data Format (PIDF), August 2004
computed. The location MSD defined for HELP112 is described in HELP112 Deliverable D3.1 ("Description of the Scenarios Document", Section 5.2.1). The SIP re-INVITE message shall at least include the information of the HELP112 MSD. To format the SIP re-INVITE and potentially add more information than in the HELP112 MSD, rules defined in IETF document "Additional Data Related to an Emergency Call" shall be followed. The existed URI could be used or a specific URI for the HELP112 location data could be standardized.

- In order to route the SIP re-INVITE message to the right PSAP, the same URI than the one determined by the LoST thanks to the coarse location is used.

- The UA of the PSAP which has handled the voice call receives the SIP re-INVITE message. It detects the specific HELP112 URN and extracts the location data from the header and body of the SIP re-INVITE message. And finally the location is displayed on the call-taker CAD.

The diagram hereafter illustrates the algorithm above:

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Figure 13 - Architecture 5: HELP112 automated activation + IMS emergency call diagram
6.2 Recommendation to Architecture Stakeholders

6.2.1 Handset manufacturers/OS providers

The recommendations which could be addressed to the handset manufacturers/OS providers are listed in the following table:

<table>
<thead>
<tr>
<th>Item</th>
<th>Recommendation</th>
</tr>
</thead>
</table>
| IMS emergency call               | • The handset of the caller shall be able to make calls using the IMS network. In order to use IMS emergency call, handset manufacturers or OS providers shall ensure that:  
  o The mobile phone is able to detect the IMS emergency call.  
  o The terminal can perform a special registration solely for the purpose of making emergency calls. It provides the user with an emergency Public User Identity and an associated TEL-URL. |
| IMS HELP112 software implementation | • OS providers or handsets manufacturers have to develop a HELP112 software which can be triggered by IMS emergency call, and can interact with the SIP UA of the handset to format the SIP re-INVITE message containing the HELP112 MSD.  
  • The HELP112 SIP re-INVITE message shall only be sent in HELP112 IMS ready countries based on MCC/MNC.  
  • HELP112 activation process and timeout shall follow the requirements defined for AML in ETSI TR 103 393, as long as no standardisation exists for HELP112 IMS. |
| Location estimate                | • The handset’s location services activated by the HELP112 software shall be able to compute a location estimate based on GNSS, WiFi, and Cell-Id, and to make use of GNSS assistance data if available, in order to provide a location of the caller as quickly, precisely, and accurately as possible.  
  • If mandatory, handset manufacturers/OS providers shall contact GNSS chipsets providers so that they develop E-GNSS chipsets (Galileo and EGNOS). |

Table 20 - Architecture 5 - Recommendations to handset manufacturers/OS providers

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30 ETSI TR 103 393, Advanced Mobile Location for emergency calls, Apr 2016
6.2.2 IMS network provider

An IMS architecture is composed of many mutually connected elements:

- **CSCF (Call Session Control Function)** – This is the root node of the IMS architecture, which cares primarily about signaling. Four types of CSCF can be distinguished: Proxy-CSCF, interrogating-CSCF, Serving-CSCF and Emergency-CSCF.

- **HSS (Home Subscriber Server)** – This element is similar to the home location register HLR (Home Location Register) in GSM technology. It contains all the necessary information about users.

- **AS-SIP (Session Initiation Protocol Application Server), OSA-SCS (Open Service Access Service Capability Server) and IM-SSF (IP Multimedia Service Switching Function)** – these are application servers allow the addition of multimedia services in IMS.

- **MRFC/P (Media Resource Function Controller/Processor)** – This element is located in the home network. MRFC acts as a SIP user agent. The main function of this element is to provide support for multimedia conferencing.

- **SLF (Subscriber Location Function)** – This element is used only in case there are more than one HSS and is used to assign the correct HSS to the user.

- **MGCF (Media Gateway Controller Function)** – This component is necessary to connect the IMS network with the public telephone network PSTN (Public Switching Telephone Network).

- **MGW (Media Gateway)** – The final element for bearer channel from circuit-switched networks and media streams from IP networks. Its main functions are conversion, transcoding and signaling.

- **BGCF (Breakout Gateway Control Function)** – The main function of this element is to act as a SIP proxy processing requests for routing from an S-CSCF in case the session cannot be routed using DNS or ENUM/DNS.

- **CF (Charging Function)** – Charging function is an important element of the IMS architecture and an integral function of IMS customer care functionality. Charging for services is divided into two ways: online (is intended for users who pay the bills periodically) and offline charging (which a customer must prepay).

The recommendations which could be addressed to the IMS network providers are listed in the following table:
In the case of an emergency call, the IMS network provider shall ensure that it is able to handle emergency call and route the call and its signaling part (SIP) to the appropriate PSAP. That includes the supplying of specific components for IMS emergency call such as E-CSCF.

- MNOs shall provide a coverage of IMS networks as wide as possible to make this type of emergency call available almost everywhere in Europe.

- MNOs would have to contact handset manufacturers/OS providers so that they deploy IMS HELP112.

- IMS network providers shall also ensure that the HELP112 SIP re-INVITE message is sent to the PSAP that handled the call.
- MNOs shall ensure that the HELP112 SIP INVITE message can be sent during the ongoing emergency call.

- MNOs will have to test HELP112 IMS emergency call with handset manufacturers/OS providers that have developed handset’s HELP112 software, and SIP ready PSAPs.

**6.2.3 Public authority/PSAP**

The recommendations which could be addressed to the Public authority/PSAP are listed in the following table:

<table>
<thead>
<tr>
<th>Item</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMS emergency call</td>
<td>- PSAPs have to be SIP ready in order to handle IMS emergency calls.</td>
</tr>
</tbody>
</table>
| IMS HELP112 implementation  | - PSAP shall ensure that they are able to receive the HELP112 SIP re-INVITE message, extract HELP112 location data from SIP re-INVITE message header and body, and then display the information on the call taker’s GIS.  
- PSAPs would have to contact MNOs so that they deploy IMS network that can manage emergency calls. They would also have to ask MNOs to contact handset manufacturers/OS providers so that they deploy IMS HELP112. |

**6.2.4 Regulatory authorities**

The recommendations which could be addressed to the Regulatory authorities are listed in the following table:
### Table 23 - Architecture 5 - Recommendations to regulatory authorities

<table>
<thead>
<tr>
<th>Item</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMS HELP112 standardisation</td>
<td>- The IMS HELP112 has to be standardised, especially the way the HELP112 SIP re-INVITE message is formatted (new HELP112 URI or use of existing URI, ...) and which location data shall appear in this message in addition to the current location data put in the HELP112 MSD.</td>
</tr>
<tr>
<td>IMS HELP112 implementation</td>
<td>- If this solution is the chosen one, regulatory authorities would have to make sure that PSAPs are merging to a standardised IMS HELP112 solution.</td>
</tr>
</tbody>
</table>

### 6.3 IMPLEMENTATION ROADMAP IN PILOT SITES

Since the implementation of this architecture requires a full IMS/SIP network which is currently unavailable in all of the four pilots, and moreover requires to deeply modify the way the PSAP receives both voice call and location data, this architecture is out of the scope each PSAP is expected to do during the pilot. It will therefore not be possible to test this architecture during the timeframe of HELP112. However, pilots are opened to discuss about this solution for future implementation when all PSAPs are IMS ready.
7. ARCHITECTURE 6: HANDSET BASED HYBRID POSITIONING METHOD + AUTOMATED ACTIVATION + INBAND MODEM TRANSMISSION

7.1 ARCHITECTURE OVERVIEW AND I/F

In this architecture, the location of the caller is estimated by using the handset’s own means, the activation process is entirely automated, and the transmission of the location information (HELP112 location MSD31) to the PSAP is based on the in-band modem technology from eCall.

This architecture is usable with every mobile phones that have location capabilities. The location methods used will therefore rely on the capabilities of the handset, the user’s settings, and the environment of the caller. In the description hereafter, we will consider an android smartphone able to estimate a location using location capabilities up to A-GNSS. By considering this type of handset, we are able to cover all the location methods that might be available at the handset level (from Cell-Id to hybrid location method using Cell-Id+WiFi+A-GNSS) without discard phones with limited location capabilities.

According to the user’s settings, the location solutions available are the following:

- GNSS standalone if the handset location service is set to use device sensors only or if the data connectivity is not available at the time of the emergency call.
- WiFi and Cell-Id if the handset location service is set to “battery saving” mode.
- A-GNSS if the handset location service is set to “high accuracy” (Mainly A-GPS).

The activation process is the HELP112 automated activation process described in HELP112 deliverable D3.1 (Description of the scenarios). This method of activation derive from Advance Mobile Location process standardised by ETSI in ETSI TR 103 39332.

The transmission of HELP112 location MSD is derived from eCall and is based on a modem pair (consisting of transmitters and receivers at handset and PSAP level) that operates full-duplex and allows reliable transmission of HELP112 MSD from mobile phone to PSAP via the voice channel of the emergency call through cellular network. This eCall method initiated from a mobile phone rather than from a vehicle is called Personal eCall. Personal eCall has been discussed in CEN TC 278 and in ETSI TC MSG but no standardization has yet been done. We will describe here the case where a specific eCall flag exists for Personal eCall. This type of eCall flag has not been yet standardised by 3GPP. Personal eCall is described in more details in HELP112 documents D1.2 and D3.1. This technology is using the voice channel to transmit the HELP112 location MSD to the

---

31 HELP112 Deliverable D3.1, Description of the Scenarios Document, Section 5.2.1
32 ETSI TR 103 393, Advanced Mobile Location for emergency calls, latest version
PSAP, what therefore enables the system to use the E112 routing protocols deployed in existing networks. It will also only allow an HELP112 location MSD up to 140 bytes due to the specific eCall sequence to send the location data using the in-band modem. This sequence is described in **3GPP TS 26 267 Release 13 Section 5.1.5.**

The chart below shows the components involved in this architecture and the interfaces between them:

![Architecture 6 components description](image)

**Figure 14 - Architecture 6 components description**

The different components are defined hereafter. To depict the current level of implementation of each component, the following color coding is used: **Exists and no modification is needed**, **Exist and need to be modified**, **Does not exist**.

- **Communication module**

  The communication module of the handset shall be modified in order to add the Personal eCall flag when a 112 emergency call is initiated. This flag will be used by the network to route the call and the HELP112 location MSD to the appropriate Personal eCall ready PSAP.

- **HELP112 mobile handset’s software**

  The HELP112 mobile handset’s software is triggered by a 112 emergency call or SMS, and then initiates the location process using the location services of the handset. Once a location estimate
using GNSS is calculated or after a configured timeout, this software formats the HELP112 location MSD and then pass it to the handset’s in-band modem for modulation and transmission.

- **GNSS chipset:**

If it is mandatory to use Galileo and EGNOS in the location estimated by the handset’s GNSS chipset, this chipset has to be modified to use Galileo and EGNOS signals in the location estimate. Such a chipset does not exist yet, but the first chipset of this type is foreseen to be available by the end of year 2016.

- **Handset’s in-band modem**

This architecture needs an in-band modem at the handset level. This modem modulates the HELP112 location MSD as described in 3GPP TS 26 267 Release 13. In this architecture, this is the mobile phone that initiates the computation of the location MSD and the transmission after the HELP112 configured timeout (~20 seconds) or as soon as a location has been estimated using GNSS. The in-band modem then push the data as soon as they are modulated (The modem shall therefore uses the additional signal format for push mode described in 3GPP TS 26 267 Release 13 Section 5.1.9). The specific eCall flag for Personal eCall is used to identify the transmitted data and allow the mobile network to route the data to the most appropriate PSAP and the PSAP to handle the data correctly. Such an eCall flag for Personal eCall has not been standardized yet. As described in 3GPP TS 26 267 Release 13, the Cellular Text telephone Modem (CTM) that exists in mobile handset was developed in 3GPP for transmitting text data for text telephony. It was evaluated as a potential solution for eCall in-band modem in the technical report (3GPP TR 26.967) and found not able to meet eCall requirements.

- **Mobile network**

Mobile Network equipment will have to be modified by Mobile Network Operators (MNO) in order to identify that the 112 voice call is a Personal eCall from the eCall flag inserted by the handset’s communication module. The MNO handles the eCall like any other 112 call and routes the call to the most appropriate PSAP. The PSAP operator will receive both the voice call and the MSD.

- **PSAP’s in-band modem**

PSAP could reuse their in-band modem implemented for eCall (following the standard 3GPP TS 26 267 Release 13) to receive and demodulate the Personal eCall message. This in-band modem would have to be upgraded in order to handle Personal eCall, which means recognizing the specific eCall flag for Personal eCall.
• **PSAP CAD system**

The PSAP Computer Assisted Dispatch (CAD) system needs to be modified in order to extract HELP112 location MSD from the Personal eCall message and display the location information on the call taker screen.

Hereafter are the steps of such an emergency call:

• A person in distress calls 112 using his mobile handset and VoIP (LTE or UMTS-PS network).

• Call session initiation:
  - The handset’s communication module initiates the E112 call with the Personal eCall flag.
  - The call is routed to the most appropriate Personal eCall ready PSAP by the mobile network using the Personal eCall flag.

• Get location:
  - The HELP112 software is triggered by the call to 112.
  - If necessary, the HELP112 software switch on the location services of the handset.
  - All the available location methods are used to estimate the location of the caller (with regards to the handset’s “User Settings” and capabilities).
  - If previously switched on, the HELP112 software switches off the location services of the handset.

• Send location data to the PSAP:
  - Once the estimate of the caller location has been made using GNSS or after HELP112 configured timeout, the HELP112 software computes the HELP112 location MSD and pass it to the handset’s in-band modem. The size of the HELP112 location MSD shall not exceed 140 bytes.
The handset’s in-band modem (that could be an API that is compliant with eCall in-band modem specifications – 3GPP TS 26 267 Release 13) modulates the HELP112 location MSD and sends it through the voice channel using the Personal eCall flag. During the sending of the HELP112 location MSD, the voice call is muted at both handset and PSAP sides for at least 4 seconds (but potentially 20 seconds).

- The HELP112 location MSD is routed to the most appropriate Personal eCall ready PSAP (same PSAP that handles the voice call) by the mobile network using the Personal eCall flag.

- The PSAP’s in-band modem receives the HELP112 location MSD and handles it based on the Personal eCall flag. The in-band modem demodulates the incoming data symbols.

- The voice call is unmuted at both caller and PSAP operator sides.

- The location data is then provided to the PSAP operator and displayed on its CAD.

The diagram hereafter illustrates the algorithm above:
Figure 15 - Architecture 6: HELP112 automated activation + in-band modem transmission
### 7.2 RECOMMENDATIONS TO ARCHITECTURE STAKEHOLDERS

#### 7.2.1 Handset manufacturers/OS providers

The recommendations which could be addressed to the handset manufacturers/OS providers are listed in the following table:

<table>
<thead>
<tr>
<th>Item</th>
<th>Recommendation</th>
</tr>
</thead>
</table>
| HELP112 software implementation | - OS providers or handsets manufacturers have to develop a HELP112 software which can be triggered by 112 emergency call or 112 SMS.  
- HELP112 activation process and timeout shall follow the requirements defined for AML in ETSI TR 103 393 and shall make use of the handset’s location services.  
- OS providers or handsets manufacturers shall define battery power level threshold for each type of location method available and for simultaneously allowing a 5 minutes voice call.  
- OS providers or handsets manufacturers shall ensure that the HELP112 location MSD cannot be seen by the caller during or after the call and is not stored on the handset.  
- OS providers or handset manufacturers shall provide mobile phones with in-band modem that follow eCall standards.  
- OS providers or handset manufacturers shall ensure that for Personal eCall enabled mobile phone, dialling or sending SMS to 112 triggers the adding of Personal eCall flag in order to allow the mobile network to route the call and the HELP112 location MSD to the right PSAP. |
| Location estimate | - Based on the user’s settings all location methods available shall be used to compute the location of the caller as quickly, precisely, and accurately as possible (Cell-Id, WiFi, GNSS, A-GNSS).  
- If mandatory, handset manufacturers/OS providers shall contact GNSS chipsets providers so that they develop E-GNSS chipsets (Galileo and EGNOS) |

Table 24 - Architecture 6 - Recommendations to handset manufacturers/OS providers

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33 ETSI TR 103 393, Advanced Mobile Location for emergency calls, Apr 2016
7.2.2 Mobile Network Operator

The recommendations which could be addressed to the MNOs are listed in the following table:

<table>
<thead>
<tr>
<th>Item</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>HELP112 routing</td>
<td>• MNOs shall agree with network equipment providers that the Personal eCall voice call and HELP112 MSD is routed to the appropriate PSAP based on the Personal eCall flag.</td>
</tr>
<tr>
<td>HELP112 implementation</td>
<td>• MNOs would have to contact handset manufacturers/OS providers so that they deploy this HELP112 implementation.</td>
</tr>
<tr>
<td>Test</td>
<td>• MNOs will have to test this HELP112 implementation with handset manufacturers/OS providers that have developed handset’s HELP112 software and in-band modem, and PSAPs.</td>
</tr>
</tbody>
</table>

Table 25 - Architecture 6 - Recommendations to Mobile Network Operators

7.2.3 Public authority/PSAP

The recommendations which could be addressed to the Public authority/PSAP are listed in the following table:

<table>
<thead>
<tr>
<th>Item</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>HELP112 implementation</td>
<td>• PSAPs shall ensure that, in addition to be eCall ready, they are able to handle Personal eCall, and display the HELP112 location data on the PSAP operator CAD.</td>
</tr>
<tr>
<td></td>
<td>• PSAPs would have to ask MNOs to contact handset manufacturers/OS providers so that they deploy this HELP112 solution based on Personal eCall.</td>
</tr>
<tr>
<td></td>
<td>• PSAPs shall decide guidance for call takers for comparing Cell-Id location (if available), and HELP112 location data.</td>
</tr>
</tbody>
</table>

Table 26 - Architecture 6 - Recommendations to Public authority/PSAP

7.2.4 Regulatory authorities

The recommendations which could be addressed to the Regulatory authorities are listed in the following table:
### 7.3 Implementation Roadmap in Pilot Sites

#### 7.3.1 UK

In UK, British Telecom has no selected eCall PSAPs able to process eCall MSD and therefore no PSAP able to handle Personal eCall as well. eCall is not likely to be piloted until late 2017. As a consequence, UK would not be able to participate in this architecture in HELP112 trial phase.

#### 7.3.2 Lithuania

112 ERC already has a Pan-European eCall infrastructure at PSAP end, and would be ready to implement a new Personal eCall flag if exists. Nevertheless, it is not in the roadmap of any OS provider or handset manufacturer to implement such a HELP 112 software and in-band modem in the handset itself. Besides, the new flag for Personal eCall is not yet defined, and should be routed differently from other eCalls by MNOs. It seems difficult to test this type of architecture during the timeframe of HELP112 project.

#### 7.3.3 Italia

It could be possible at AREU PSAP level to test such an architecture during the timeframe of HELP112, should PSAP and MNOs implement Personal eCall flag. Nevertheless, it is not in the roadmap of any OS provider or handset manufacturer to implement such a HELP 112 software and in-band modem in the handset itself. Besides, the new flag for Personal eCall is not yet defined, and should be routed differently from other eCalls by MNOs. It seems difficult to test this type of architecture during the timeframe of HELP112 project.
7.3.4 Austria

Notruf PSAPs have currently no connection to eCall, and therefore Notruf will not be able to test this architecture in the timeframe of HELP112.
## ANNEX A: AML LOCATION MESSAGE — SMS FORMAT

Unless explicitly stated in the description data, values should not include white space or zero padded values. Data should be passed using the ASCII\(^{34}\) standard character set only.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Attribute Name</th>
<th>Attribute Size (chars)</th>
<th>Attribute Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A&quot;ML</td>
<td>4 3 8</td>
<td>The header must appear at the beginning of the SMS message as it’s used to differentiate AML messages from other 112 related SMS messages. The header must be in upper case and have a double quotes character (&quot;') in the character 2 position. The attribute value will indicate the interface version number. <strong>This is version 2 of the interface and servers should be able to recognise at least the current and previous version numbers.</strong> No left padding with zeros is required. An example of the Header would be A&quot;ML=2;lt=...</td>
</tr>
</tbody>
</table>

---

\(^{34}\) American Standard Code for Information Exchange II
<table>
<thead>
<tr>
<th>Attribute</th>
<th>Attribute Name</th>
<th>Attribute Size (chars)</th>
<th>Attribute Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Name</td>
<td>Value (Max)</td>
</tr>
<tr>
<td>Latitude</td>
<td>lt</td>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td>Longitude</td>
<td>lg</td>
<td>2</td>
<td>10</td>
</tr>
</tbody>
</table>

The WGS84 latitude and longitude of the centre of the location area given in decimal degrees up to 5 decimal places giving resolution to 1.1 metres.

The format of the attribute value will be `<sign><decimal degrees>` where:

- `<sign>` This can either be a + or -. For latitude values in the UK the sign will always be positive. For longitude a '-' indicates a location to the west of the meridian and a '+' indicates a position to the east of the meridian. If no sign is present then a '+' will be assumed as default.

- `<degrees>` This is a numeric value representing the latitude or longitude in terms of decimal degrees relative to the equator or meridian. This field consists of numeric and a single decimal point character (.)

Latitude values fall in the range of +/-90 degrees (2 digits before the decimal point). Character, whereas Longitudes fall in the range +/-180 degrees (3 digits), therefore Latitude is one character less than Longitude.

**Note:** Some standard location API’s will return co-ordinates formatted to the European Standard for floating point numbers (a comma is used instead of a decimal point) if the handset language is not set to UK English. AML has been adapted to cater for this format but as a principle Software Developers should check the format and convert the co-ordinates to the format specified in this document if required.

Examples of the latitude and longitude are given below.

AML=2;lt=+55.74317;lg=-4.26881;rd=...

If it is not possible to determine a location the SMS should still be sent without the positioning method attribute set to N (pm=N) and latitude and longitude attributes should not be included.
<table>
<thead>
<tr>
<th>Attribute</th>
<th>Attribute Name</th>
<th>Attribute Size (chars)</th>
<th>Attribute Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radius</td>
<td>rd</td>
<td>2 5 8</td>
<td>The radius of the location area in metres. This field is all numeric. An example of a radius attribute is given below ...881;rd=50;al=... If it is not possible to determine a location the SMS should still be sent with the positioning method set to N (pm=N) and the radius attribute should not be included. In the unlikely event that the radius value length exceeds 5 characters (&gt;99999 metres) then positioning method set to N (pm=N) but the latitude, longitude and radius attribute should not be included.</td>
</tr>
<tr>
<td>Altitude</td>
<td>al</td>
<td>2 4 7</td>
<td>The altitude in metres of the handset relative to mean sea level. An example of an altitude attribute is shown below ...=50;al=22;fl=... If altitude cannot be determined or if the position method attribute is set to N (pm=N) then the altitude attribute should not be present in the AML message.</td>
</tr>
<tr>
<td>Floor Number</td>
<td>fl</td>
<td>2 3 6</td>
<td>The floor number within the building. Floor numbering differs between countries so for the avoidance of doubt floor number should be that which appears on the lift button in the building: ...220;fl=3;top=... If floor number cannot be determined or if the position method attribute is set to N (pm=N) then the floor number attribute should not be included.</td>
</tr>
</tbody>
</table>
### Attribute Description

**Name**

**Value** (Max)

**Total incl '='**

**Time of Positioning (TOP)**

<table>
<thead>
<tr>
<th>Attribute Name</th>
<th>Value</th>
<th>Attribute Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>top</td>
<td>3</td>
<td>14</td>
</tr>
</tbody>
</table>

The date and time that the handset determined its location. The Time of Positioning is specified in GMT (UTC).

This must be the time that location was determined (i.e. at this time the phone was at this location), no other time/date should be used. The field format is YYYYMMDDhhmmss

Where:

- **YYYY** is the year.
- **MM** is the month in the range 01 to 12.
- **DD** is the month in the range 01 to 31
- **hh** is the hour in the range 00 to 23
- **mm** is the minute in the range 00 to 59
- **ss** is the second in the range 00 to 59.

An example of a Time of Position attribute is shown below:

```
...al=220;top=20130717175329;ci=...
```

When the handset is unable to determine its location the TOP should be the date and time that the location process was deemed to have failed.
<table>
<thead>
<tr>
<th>Attribute</th>
<th>Attribute Name</th>
<th>Attribute Size (chars)</th>
<th>Attribute Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Name</td>
<td>Value (Max)</td>
</tr>
<tr>
<td>Cell ID</td>
<td>ci</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>Positioning Method</td>
<td>pm</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>International mobile subscriber identity</td>
<td>si</td>
<td>2</td>
<td>15</td>
</tr>
<tr>
<td>International mobile equipment identity</td>
<td>ei</td>
<td>2</td>
<td>16</td>
</tr>
<tr>
<td>Attribute</td>
<td>Attribute Name</td>
<td>Size (chars)</td>
<td>Attribute Description</td>
</tr>
<tr>
<td>--------------</td>
<td>----------------</td>
<td>--------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td></td>
<td>Name</td>
<td>Value (Max)</td>
<td>Total incl ‘=’</td>
</tr>
<tr>
<td>MCC</td>
<td>mcc</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Mobile Country Code, used to determine the network country that the emergency call was made on. If it is not possible to determine the country code this attribute should not appear in the AML message.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MNC</td>
<td>mnc</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Mobile Network Code, of the mobile network used to make the emergency call.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Message Length</td>
<td>ml</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>The length of the entire SMS message including the header and the length attribute. The message length value should be all numeric. An example of the message length message would be:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Example: ....;mcc=234;mnc=30;ml=124
Annex B: DTD for MLP RMR data

```xml
<!ELEMENT help112 (referencelocation?,measurement+)>
<!ELEMENT referencelocation (time,locationmethod?,lev_conf?,shape)>
<!ELEMENT time (#PCDATA)>
<!ATTLIST time utc_off CDATA "0000">
<!ELEMENT locationmethod (GPS|WIFI|CELL)>
<!ELEMENT lev_conf (#PCDATA)>
<!ELEMENT measurement (time,servingcell,adjacentcell?)>
<!ELEMENT servingcell (cellmeasurement)>
<!ELEMENT adjacentcell (cellmeasurement+)>
<!ELEMENT cellmeasurement ((cgi|sai|lte_cell),ta?,rxlevel)>
<!ELEMENT cgi (mcc,mnc,lac,cellid)>
<!ELEMENT sai (mcc,mnc,lac,sac)>
<!ELEMENT lte_cell (mcc,mnc,lte_ci)>
<!ELEMENT time (#PCDATA)>
<!ELEMENT mcc (#PCDATA)>
<!ELEMENT mnc (#PCDATA)>
<!ELEMENT lac (#PCDATA)>
<!ELEMENT cellid (#PCDATA)>
<!ELEMENT sac (#PCDATA)>
<!ELEMENT lte_ci (#PCDATA)>

An example set of XML is as follows

<help112>
```
<referencelocation>
  <time utc_off="+0100">2016043011550000</time>
  <locationmethod>GPS</locationmethod>
  <confidence></confidence>
  <shape>
    <CircularArea>
      <coord><X>0.45673</X><Y>54.053</Y></coord>
      <radius>34</radius>
    </CircularArea>
  </shape>
</referencelocation>

<measurement>
  <time utc_off="+0100">2016043011550000</time>
  <servingcell>
    <cellmeasurement>
      <cgi>
        <mcc>54</mcc>
        <mnc>01</mnc>
        <lac>64</lac>
        <cellid>55535</cellid>
      </cgi>
      <ta>0</ta>
      <rxlevel>23</rxlevel>
    </cellmeasurement>
  </servingcell>
  <adjacentcell>
    <cellmeasurement>
    </cellmeasurement>
  </adjacentcell>
</measurement>
<cgi>
  <mcc>54</mcc>
  <mnc>01</mnc>
  <lac>64</lac>
  <cellid>55534</cellid>
</cgi>

<rxlevel>35</rxlevel>
<cellmeasurement>
</cellmeasurement>

<cgi>
  <mcc>54</mcc>
  <mnc>01</mnc>
  <lac>64</lac>
  <cellid>55544</cellid>
</cgi>

<rxlevel>27</rxlevel>
<cellmeasurement>
</cellmeasurement>

<cgi>
  <mcc>51</mcc>
  <mnc>01</mnc>
  <lac>64</lac>
  <cellid>3466</cellid>
</cgi>

<rxlevel>27</rxlevel>
<cellmeasurement>
</cellmeasurement>
## Annex C: Specifications of the network database parameters.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Format</th>
<th>Value Range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CID</td>
<td>Integer</td>
<td>[0, 65535]</td>
<td>Identifying the cell within a Location Area (LA), as defined in [1] for GSM and in [2] for UMTS.</td>
</tr>
<tr>
<td>SiteName</td>
<td>Alpha numeric</td>
<td>A–Z, 0–9 and %#+[ ] [1, 256] characters</td>
<td>Name of the site. Non case sensitive.</td>
</tr>
<tr>
<td>CellName</td>
<td>Alpha numeric</td>
<td>A–Z, 0–9 and %#+[] [1, 127] characters</td>
<td>Name of the cell. Non case sensitive.</td>
</tr>
<tr>
<td>Longitude</td>
<td>Float</td>
<td>[-180.0, 180.0]</td>
<td>Degrees east of prime meridian; western longitudes are negative.</td>
</tr>
<tr>
<td>Latitude</td>
<td>Float</td>
<td>[-90.0, 90.0]</td>
<td>Degrees above equator; southern latitudes are negative.</td>
</tr>
<tr>
<td>AntennaType</td>
<td>Alpha numeric</td>
<td>PICO, MICRO, OMNI, MACRO, REPEAT</td>
<td>Classifies the cell according to the area covered. Non case sensitive.</td>
</tr>
<tr>
<td>MaxCellRadius</td>
<td>Integer</td>
<td>[1, 120000]</td>
<td>Maximum radius for cell signal coverage in meters. A general algorithm is used for an estimation of the maximum cell-radius if not specified.</td>
</tr>
<tr>
<td>AntennaGain</td>
<td>Float</td>
<td>[-12800, -12799]</td>
<td>Gain range of the antenna. Expressed in dBi.</td>
</tr>
</tbody>
</table>
| BSNominalPower| Float       | [0, 80]           | Base Station Nominal Power. The power level present to the antenna, including allowances for cable and combiner losses but not
<table>
<thead>
<tr>
<th>Antenna Parameter</th>
<th>Data Type</th>
<th>Range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BSPowerBCCH</td>
<td>Float</td>
<td>[0, 63]</td>
<td>BS output power in dBm, for BCCH RF channel number.</td>
</tr>
<tr>
<td>TAlimit</td>
<td>Integer</td>
<td>[0-64]</td>
<td>Maximum TA value.</td>
</tr>
<tr>
<td>AntennaSpec</td>
<td>Alpha numeric</td>
<td>A–Z, 0–9 and %#+[]</td>
<td>Antenna model number.</td>
</tr>
<tr>
<td>HeightAGL</td>
<td>Float</td>
<td>[0,1000]</td>
<td>Height of the antenna above ground level. Measured in metres.</td>
</tr>
<tr>
<td>DownTilt</td>
<td>Float</td>
<td>[-90, -90]</td>
<td>Antenna tilt, combined mechanical and electrical. Expressed in degrees relative to the horizontal plane centred at the antenna output. Values below the plane are positive.</td>
</tr>
<tr>
<td>Azimuth</td>
<td>Float</td>
<td>[0, 360[</td>
<td>The pointing angle of the base station TX antenna expressed in degrees, clockwise from North. For antenna_type OMNI Azimuth must be 0.</td>
</tr>
<tr>
<td>HorizBeamWidth</td>
<td>Float</td>
<td>[0, 360]</td>
<td>Beamwidth of the antenna measured from boresight to 3dB point and given in degrees. For example, for a three-sectored site the TX antennas could have beamwidths of 65 degrees. NULL or 0 values are replaced by the default value 60. For antenna_type OMNI HorizBeamWidth must be 360.</td>
</tr>
<tr>
<td>LAC</td>
<td>Integer</td>
<td>[1, 65535]</td>
<td>Identifier of the Location Area within the PLMN as defined in [1] for GSM and [2] for UMTS.</td>
</tr>
<tr>
<td></td>
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</tr>
<tr>
<td>NCC</td>
<td>Integer</td>
<td>[0 , 7]</td>
<td>National Color Code (NCC) as defined in [1] for GSM.</td>
</tr>
<tr>
<td>BCC</td>
<td>Integer</td>
<td>[0 , 7]</td>
<td>Base Station Color Code (BCC) as defined in [1] for GSM. Identifier of the Base Station (BS) to distinguish cells transmitting on the same frequency.</td>
</tr>
<tr>
<td>BCCH</td>
<td>Integer</td>
<td>For GSM 800 [128 , 251] For GSM 900 [0 ,124],[975,1023] For GSM 1800 [512 , 885] For GSM 1900 [512 , 810]</td>
<td>Absolute Radio Frequency Channel Number (ARFCN) for Broadcast Control Channel (BCCH) as defined in [1] for GSM.</td>
</tr>
<tr>
<td>PSC</td>
<td>Integer</td>
<td>[0 , 511]</td>
<td>The downlink primary scrambling code as defined in [2] for 3G.</td>
</tr>
<tr>
<td>UARFCN</td>
<td>Integer</td>
<td>For UMTS 900 [2925 , 3099] For UMTS 2100 [10550 , 10849]</td>
<td>UMTS channel number assigned to CPICH as defined in [2] for 3G.</td>
</tr>
<tr>
<td>RNCid</td>
<td>Integer</td>
<td>For UMTS [0-40905]</td>
<td>Identifier of RNC [3]</td>
</tr>
</tbody>
</table>
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