



TECHNICAL REPORT

Emergency Communications (EMTEL); Advanced Mobile Location for emergency calls

PREVIEW
iTech STANBANK
(standards.iteh.ai)
Full standard: <https://standards.iteh.ai/catalog/standards/sist/b4-d071b8-e361-435e-8ea4-bff0fd6b6f71/etsi-tr-103-393-v1.1-2016-03>

ReferenceDTR/EMTEL-00035

Keywordsemergency, location

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Foreword

This Technical Report (TR) has been produced by ETSI Special Committee Emergency Communications (EMTEL).

Modal verbs terminology

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Introduction

One of the biggest challenges facing the Emergency Services is determining the location of mobile callers. Cell based location has been available to the Emergency Services for more than 10 years. While cell data can help with verbal establishment of a caller's location, a more precise location will allow an even quicker emergency response.

Ambulance Service measurements show that, on average, 30 seconds per call can be saved if a precise location is automatically provided, and several minutes can be saved where callers are unable to verbally describe their location due to stress, injury, language or simple unfamiliarity with an area. In the UK alone it is estimated that each year there are about 36 000 cases where the Emergency Services have to spend a significant amount of time searching for a caller because a location could not be verbally provided.

Advanced Mobile Location (AML) allows use of native smart phone technology to pass (Assisted) GNSS or WiFi based location data to Emergency Service PSAPs. These technologies can provide a location precision as good as 5 metres outdoors (and averaging to within circular areas of ~25 m radius for indoor locations), a significant improvement on existing cell coverage provided by mobile networks, which average (across the UK) circular areas of about 1,75 km radius.

The present document builds on the Advanced Mobile Location initiative that has been piloted in the UK and shown to improve the precision and accuracy of a caller's location information for emergency calls from mobile handsets.

1 Scope

The scope of the present document is to:

- Consider how AML can be used with different PSAP, and Location Delivery to PSAP, arrangements that exist in Europe.
- Consider how AML can be extended to cover the case of handsets that roam.
- Optimize the content of a location message to be of most use to the emergency services.
- Provide a reference on AML for administrations, mobile networks and handset manufacturers.

The present document focusses on circuit switched emergency voice calls and location transport via SMS, but provides an outlook to other technologies suitable the future.

A review of how AML has been implemented in the UK is contained in Annex C.

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non specific. For specific references, only the cited version applies. For non-specific references, the latest version of the reference document (including any amendments) applies.

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The following referenced documents are necessary for the application of the present document.

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The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

- [i.1] IETF RFC 6881: "Best Current Practice for Communications Services in Support of Emergency Calling".
- [i.2] ETSI TS 123 167: "Universal Mobile Telecommunications System (UMTS); LTE; IP Multimedia Subsystem (IMS) emergency sessions (3GPP TS 23.167)".
- [i.3] ETSI TS 124 229: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); LTE; IP multimedia call control protocol based on Session Initiation Protocol (SIP) and Session Description Protocol (SDP); Stage 3 (3GPP TS 24.229)".

3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

AML	Advanced Mobile Location
BT	British Telecommunications
GMLC	Gateway Mobile Location Centre
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
HTTPS	Hypertext Transfer Protocol Secure
IMEI	International Mobile Equipment Identifier
IMS	Internet protocol Multimedia Subsystem
IMSI	International Mobile Station Identity
LSS	Limited Service State
MAC	Media Access Control
MCC	Mobile Country Code
ML	Message Length
MNC	Mobile Network Code
MSISDN	Mobile Station International Subscriber Directory Number
NTP	Network Time Protocol
PSAP	Public Safety Answering Point
SIM	Subscriber Identity Module
SIP	Session Initiation Protocol
SMPP	Short Message Peer to Peer
SMSC	Short Message Service Centre
SSID	Service Set Identification
TS12	Teleservice 12
UTC	Coordinated Universal Time (literally Universal Temps Coordonné)
WGS84	World Geodetic System 1984
XML	Extensible Markup Language

4 General Description

4.1 Overview

AML functionality is triggered by a TS12 emergency call (which is unaffected), and is designed to supplement the basic network location feed wherever possible, i.e. with some acknowledgement of limitations in GNSS or WiFi availability for the handset and the time required to acquire location using GNSS.

Location information established by the handset, using its built-in GNSS and WiFi connectivity, together with user plane assistance data from a handset-selected service where available, is transported (e.g. through use of SMS) to the emergency service PSAPs.

Handset locations obtained through the AML functionality are compared to the location provided by mobile network GMLCs (currently using basic cell coverage information), using an algorithm that analyses factors such as time of positioning and the separation of the two locations. This is to validate any handset location information provided, to ensure it is consistent with the network location.

It is important that AML does not interfere with the voice call so both the handset and mobile network should be configured to be able to simultaneously support a standard 3GPP™ mobile emergency voice call, location determination using GNSS/WiFi capabilities and SMS transmission of the location over the 3GPP mobile network.

5 Location transport

5.1 Use of SMS in a single country where a PSAP obtains mobile location from a centralized location server

When the location is determined by the device it can be sent using a simple SMS message.

SMS offers the widest possible geographic coverage, especially in remote areas, is reliable to a fixed destination and is robust - if a voice emergency call can be made an SMS is also possible. SMS is a store and forward service and therefore instantaneous delivery is not guaranteed. However, in a current AML implementation, SMS from a mobile to a fixed location offers reliable performance.

SMS emergency location messages should not be charged to end users.

NOTE: Zero rate billing is already applied by mobile networks to SMSs to 112 in some countries.

An SMS message is initially routed to the home network's SMSC. SMSCs should be programmed to send an emergency location SMS (identified by an SMS number such as 112, or a dedicated full length MSISDN of the PSAP) via an SMS gateway to a server operated by, or on behalf of, the PSAP that is running an AML location processing application (the AML Server). The AML Server compares the information from the handset with location information from the mobile network for the MSISDN of the emergency caller, before making it available to the PSAP's existing location server. An example of this currently used in the UK is shown in clause C.1.

Resilience of the servers and the interconnecting links should meet national targets.

5.2 Use of SMS when roaming

If an end user from country A roams to another European country (country B), and makes a 112 call, then the 112 voice call is routed to a local PSAP in visited country B, but the SMS is returned to the SMSC in country A for routing.

If 112 was used as destination for the emergency location SMS, the SMSC in country A would simply direct it to the AML Server in country A where it cannot currently be used (no path to AML Server in visited country B).

The visited country in which the mobile handset is operating can be determined by the handset using the Mobile Country Code (MCC) component of the current serving cell ID. The mobile handset also has information about the Mobile Network being used (e.g. for charging information) and the cell information.

One option is for the mobile handset to then look-up an SMS number (in a regularly updated handset database) to which to route the emergency location SMS specific to the visited country - as long as this is a full length MSISDN the home country SMSC should then be able to route it to the visited country's location processing server (i.e. the AML Server in country B). Charging arrangements between mobile networks should be agreed to zero rate such SMS messages for end users.

Which server can be selected to be the visited country's location processing server will be dependent on the current infrastructure within that country - in some cases it could be a server within the PSAP that already receives the GMLC network location information from mobile networks, which will need to be upgraded to receive the content of the AML SMS.

A second option is that if it is not possible to use a full length MSISDN for each country, then where the AML Server in country A does have links to other countries across Europe, the Mobile Country Code and Mobile Network Code should be used to forward the AML information from the AML Server in the home country (country A) to the PSAP's AML Server/location processing server in the visited country.

5.3 Using a data push across the mobile network

Data push across a mobile network is an alternative option to using SMS transport that may also be adopted if the data connectivity is considered to be sufficiently widespread and reliable to use instead. It relies on end users having a data subscription and for data to be enabled in the handset. There is also a limitation in that roaming users are likely to disable use of data to avoid roaming charges. This method currently has the disadvantage that data cannot be zero rated.

The visited country in which the mobile handset is currently operating can be determined using the Mobile Country Code (MCC) component of the current serving cell ID. This is sufficient for the handset [in a regularly updated handset database] to identify the URL for a national location processing server to which data may be pushed using an HTTPS message, using the same data elements as in the SMS message, probably using XML within the HTTPS message.

In some countries a national server approach is sufficient, as PSAPs operate at the national level (as in Stage 1 PSAP in the UK), or there are national location processing servers which regional PSAPs can all access. In other countries with regional PSAPs it poses additional challenges.

There are differing approaches to solving this challenge depending on whether the data is pushed to the PSAP or pulled by the PSAP, and what are the existing emergency location server arrangements (regional or national servers). Options are that:

- All PSAPs, regional or otherwise, *pull* from a national emergency location server.
- Establish a hierarchy of proxy-servers that reside inside each PSAP region. If the location data should be maintained within the regional jurisdiction of the PSAP, then the national server should be able to identify the correct regional proxy server to push the data to, and then subsequently push it. Requests can then be made by the regional PSAP (probably using the originating device's telephone number/MSISDN as a key) to pull location from the regional proxy-server. (If the regional proxy-server has not had location pushed to it from the national server it may subsequently request information from a national server.)

6 Handset Considerations

6.1 Overview

This clause focusses on using SMS as transport for the emergency location information due to current limitations of other methods discussed in clause 5.

6.2 Process Automation

The software should be integrated with all existing emergency call mechanisms available on the handset including manual selection of 112 digits (or any national emergency numbers such as 999 in the UK), or use of an Emergency Call button.

The use of AML software should be dependent on the Mobile Country Code and Mobile Network Code identified by the handset, to help allow a managed rollout of AML.

In an emergency, callers are often stressed or panicking so it is important that the AML functionality and transmission of the SMS message is automatically triggered without any manual intervention by the user.

The use of AML software should be invisible to the user so as not to confuse them when they are trying to get help.

No record of the SMS message should be available to the user either during or after the emergency call.

The SMS message should be sent to the destination number [which may be a Country specific number] irrespective of the method used to initiate the emergency call.

If a country supports SMS emergency contact to PSAPs (for example for deaf users), then an emergency SMS should also be supported with AML functionality and generate an emergency location SMS.

6.3 Battery Life

The trigger for an emergency response will still be the voice call received by the PSAP, so it is important to check there is sufficient battery life for a short (5 minute) voice call before switching on any location devices likely to consume appreciable battery life. Equally should any location devices already be switched on when an emergency call is made, and likely to jeopardize a short voice call, they should be switched off.

Handset developers need to use two pieces of information to protect the voice emergency call:

- The minimum battery capacity required to support a short (5 minute) voice call.
- The battery consumption used by location devices as part of the AML process.

These values will vary between handset models and, over time, will change as technology evolves and improves. There are therefore no recommended values in the present document: handset, battery and chipset manufacturers will be best placed to know accurate values.

If current battery charge is a barrier to using some location methods then a cell based method, which does not involve high drain devices, should be used. PSAPs will normally already receive a cell based location directly from the Mobile Networks, however cell data from handsets can sometimes return a smaller area so should still be provided as explained in clause 6.4.

6.4 Positioning Methods

GNSS offers the most accurate location information in most cases but is slower than other methods. At the other end of the spectrum cell based location is quick but typically returns a large location area.

The general rule is that PSAPs need the best data as long as it does not take too long to determine. To do this it is recommended to use a configurable, 'send what is available now' timeout (T_1). T_1 should be changeable with an 'over air' update. At this time it is recommended to use a T_1 timeout period of 20 seconds.

As soon as the emergency call is initiated the handset, subject to battery check, should switch the following on (if not already switched on):

- GNSS.
- WiFi.

When an emergency call is made, the handset should immediately attempt to determine location via all methods in parallel so as not to delay transmission of location. If it is possible to distinguish them, cached (stale) or existing locations should not be used.

NOTE: WiFi location is obtained by the handset interrogating a server (e.g. based on SSIDs or MAC address).

If a new GNSS location becomes available before T_1 seconds then that data should be sent to the PSAP without waiting for the timeout.

If after T_1 seconds no GNSS data is available but a WiFi based location is available then that data should be sent to the PSAP.

If no WiFi based location is available then cell ID based location data should be sent to the PSAP.

If GNSS or WiFi were switched on by the AML functionality when the emergency call was initiated then they should be switched off as soon as they are no longer needed.

If it has not been possible to get a location from any method then an SMS should be sent to the PSAP indicating that all positioning methods have failed.

The following timeline shows the process.

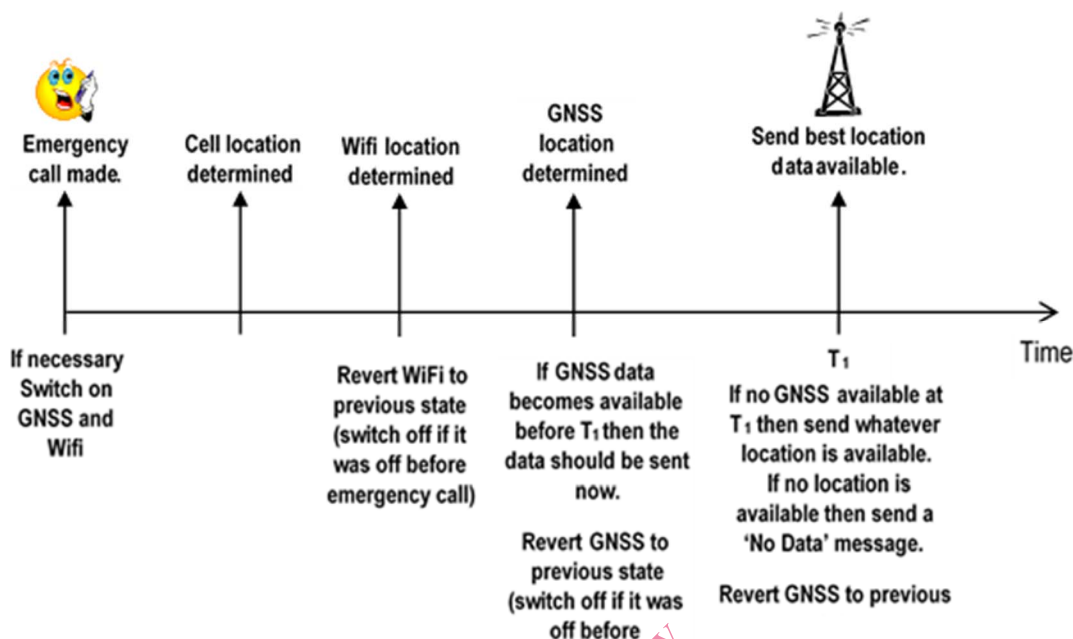


Figure 1: Timeline

After the emergency call

On completion of the emergency call (voice and AML location search) the state of all devices should be returned to their original state as prior to the emergency call being initiated.

It is noted that some 'WiFi to location' services require that multiple WiFi MAC addresses be supplied. This is helpful as it can help to eliminate situations where an incorrect location is given because a WiFi router has been moved and its location has not been updated on the service's location server. Similarly multiple cell identifiers can be used by the handset to interrogate a server to generate a smaller location circle by identifying the overlap area for various coloured cells (see red circle formed from overlap below).

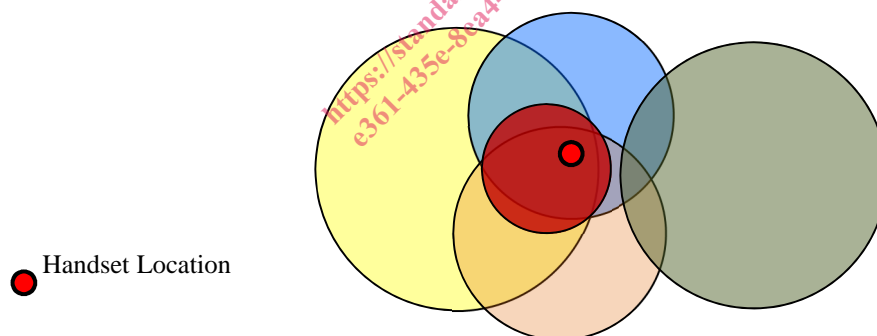


Figure 2: Handset location with multiple location sources

6.5 Limited Service State

If an emergency call is made when a handset cannot successfully register to an available network (Limited Service State (LSS)) then the voice call is routed to a PSAP.

In such cases the AML location process should still function and an SMS message be created. If it is not possible to send the SMS due to the LSS state (SMS does not work in LSS) then the message should be stored on the handset and transmission retried every 30 seconds. If after 30 minutes the handset has not been able to transmit the SMS message (which would only be possible after the LSS emergency call ended and caller had re-registered on home network) then no further attempt should be made and the SMS should be discarded.