EENA Operations Document

Public Warning

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1 Executive Summary

For the delivery of public warning, there appears to be no single solution that fits all of the requirements for the timely notification of an emergency incident or situation. Therefore, a Public Warning System (PWS) ought to be a blend of the best attributes of all of the existing technologies, adapted to the particular demands of the country or territory in question.

This document presents an investigation of the various technologies that are available for public warning, and enables comparison between the various technologies in use today and of those being considered, through initiatives in many countries, for deployment in next generation PWS.

This document also identifies standards involved in the delivery of PWS, such as the developmental ISO 22322 - societal security and emergency management[1], and ETSI TS 102 182[2], which reinforces the message that none of the technologies fulfils all requirements. The document also provides examples of PWS implementations in diverse countries, identifies several next generation PWS technologies, such as Hbb TV, and discusses the Universal Service Directive[3] call for a pan-European 'reverse 112 system'.

2 Acronyms

3GPP	Third Generation Partnership Programme
ATIS	Alliance for Telecommunications Industry Solutions
CAP	Common Alerting Protocol
CB	Cell Broadcast
CMAS	Commercial Mobile Alert System (now called WEA)
eMBMS	Evolved Multimedia Broadcast/Multicast Service
EPC	Evolved Packet Core
ETSI	European Telecommunication Standards Institute
EU	European Union
GSM	Global System for Mobile Telephony (2G)
HAM	amateur radio
Hbb TV	Hybrid broadcast broadband TV
HLR	Home Location Register
IMS	IP Multimedia Subsystem
IP	Internet Protocol
IPAWS	Integrated Public Alert and Warning System
ISO	International Standards Organization
ITU	International Telecommunications Union
LTE	Long Term Evolution (4G)
MMS	Multimedia Messaging System
MoWaS	Modular Warning System
PSTN	Public Switched Telephone Network
PWS	Public Warning System
RDS	Radio Data System
RSS	Really Simple Syndication
SMS	Short Messaging Service
UMTS	Universal Mobile Telecommunications System (3G)
URL	Universal Resource Locator
USSD	Unstructured Supplementary Service Data
VLR	Visitor Location Register
WEA	Wireless Emergency Alert

[1] ISO 22322: http://www.iso.org/iso/catalogue_detail.htm?csnumber=53335
[2] ETSI TS 102 182: http://www.etsi.org/deliver/etsi_ts/102100_102199/102182/
[3] Universal Service Directive: http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32002L0022

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3 Introduction

Public Warning Systems are needed to protect the lives of people in case of major emergency by warning the public of impending disasters. Tornados, tsunamis, hurricanes, floods, natural volcanic, and releases of deadly gas are examples of dangerous situations where PWS can save lives. Chemical plants, hydroelectric plants in dams and nuclear facilities are required to have the ability to notify the surrounding population of an industrial accident.

There is no doubt that effective early warning systems have substantially reduced deaths and injuries from severe weather events.[4] Early warnings of flooding risks have been shown to be effective in reducing flood-related deaths (Malilay et al. 1997). For example, there is a difference between the 1992-1994 flooding along the Rhine and the Meuse rivers and the 1995 flooding along the same rivers (Estrela et al. 2001). The two floods had similar characteristics; both were caused by persistent heavy precipitation. Ten people lost their lives and over 900 million US$ in damages occurred during the first event, while the economic cost was reduced by almost a half, no lives were lost during the 1995 flood due to awareness and behavioural changes.

In the last 70 years sirens have been the most widely used PWS, together with radio broadcast. For public warning there is no single solution that fits all requirements to reach all citizens in case of an emergency. Therefore, multiple technologies need to be considered. This document investigates the various technologies that are available for public warning.

The 2011 amendment of section 22a of the Universal Service Directive[5] calls on the Commission to present a report on the establishment of a "reverse 112 system", i.e. an EU-wide, universal, multilingual, accessible, simplified and efficient interconnected system for warning and alerting citizens in case of imminent or developing natural and/or man-made major emergencies and disasters of any type, considers that such a system should be implemented without hindering privacy and in combination with appropriate information and training campaigns for citizens.

Furthermore, section 22b calls on the Commission, in close cooperation with Member States, to assess and consider, as soon as possible, appropriate actions to extend the notion of the Universal Service to include the creation and maintenance of a pan-European, multilingual, accessible to all and efficient "reverse 112" i.e. an early warning system for citizens using telecommunications in case of imminent or developing major emergencies and disasters throughout the EU.

4 Event alert notification cycle time

Public warning is the capability to bring to the immediate attention of all people who might be directly impacted following the onset, or predicted onset, of an emergency so that they can take action to mitigate the impact of this incident.

The time it takes to communicate critical information in an emergency can mean the difference between safety and catastrophe. The ability to accurately deliver the right information, to the right audience, at the right time is crucial to any emergency planning effort.

The time passed between an event occurrence and the reception of the warning message by the citizen is the "event alert notification time".

The "event alert notification time" will depend on the nature of the threats that each country or region faces as shown in figure 1. This could be anything from an earthquake to several less time critical incidents.

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[4] Costs and Benefits of early Warning Systems (David Rogers and Vladimir Tsirkunov, 2010): http://www.preventionweb.net/english/hyogo/gar/2011/en/home/index.html

[5] 2011 amendment of the Universal Service Directive: http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex:32009L0136

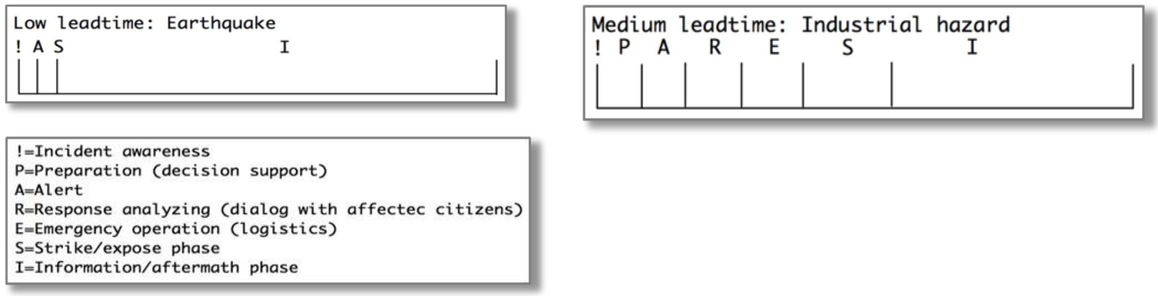
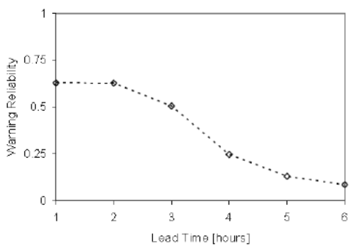
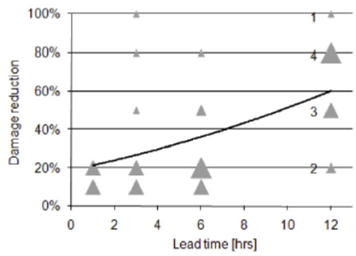


Figure 1: Event notification lead time

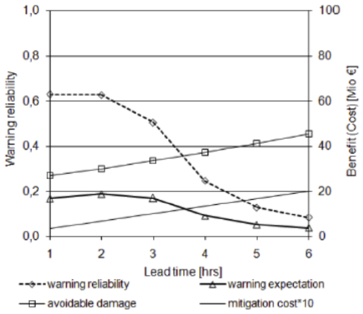
Good examples can be found in the "Costs and benefits of early warning systems" report (Rogers and Tsirkunov 2010) [6] about the relationship between the reliability of public warning, the lead time, and as a consequence, the cost-benefit of early warning systems (see the diagrams in figure 2).



Warning Reliability as a function of the lead time



Damage reduction as a function of lead time



Warning expectation as an indicator of optimal alert in the Besos basin

Figure 2: Costs and benefits of early warning systems

6 Costs and Benefits of early Warning Systems (David Rogers and Vladimir Tsirkunov, 2010): http://www.preventionweb.net/english/hyogo/gar/2011/en/home/index.html

5 Means of Public Warning

Requirements for communications from authorities and organizations to individuals, groups or the general public during emergencies have been published by ETSI in ETSI TS 102 182[7]. These requirements include the main means of PWS messages distribution:

- Mobile phones (Cell broadcast, Short Message Service - SMS, Multimedia Messaging System - MMS, Unstructured Supplementary Service Data - USSD, Instant Messages Service - IMS, Email, Push IP to Smartphones)
- Fixed phones
- Pagers
- TV, radio
- Sirens
- Billboards
- Internet (web, email, PC notification, social media)

Current generation PWS consists mostly of sirens and alerting over radio and TV. Modern sirens have the capability to generate sounds with different tones, but that is not used everywhere, since citizens may not remember the meaning of the different tones.

The use of radio and TV are components in the mix of PWS technologies, but radio and TV are only capable of reaching citizens when they are listening or viewing.

6 Public Warning Systems based on telephony

As described in ETSI TS 102 182, none of the technologies fulfils all requirements; however some technologies for mobile phones and fixed line phones will be considered in the present document.

6.1 Cell Broadcast description

Cell Broadcast (CB) is a technology that has a similar user experience to SMS: text messages are displayed on the screen of the mobile device. However, the technology that is used to send the message to the mobile phone differs between the two services. Whereas SMS is a point-to-point service, CB is a point-to-multipoint service: a broadcast service.

With CB it is possible to send a text message

- to a large number of subscribers,
- including visitors from other countries,
- in near real-time,
- with location specific information,
- in their desired language,
- even when the network is congested.

Since CB is broadcast, it takes a single message to reach potentially all subscribers and roamers on the network, who have enabled the CB service on their mobile device, without the need to know the numbers of their mobile devices. To send a CB message to reach all subscribers (potentially millions) takes between seconds and a couple of minutes.

The message can be broadcasted in a single radio cell, in a group of cells or in the entire network, which makes the service location specific. Messages can be broadcasted in various languages and on the mobile phone only the message in the desired language will be displayed.

A big advantage compared to other technologies for PWS use is that in GSM a dedicated broadcast channel is always available, so CB messages can be broadcasted even when the voice and signalling channels are congested, which is bound to happen in cases of an emergency. In UMTS and LTE the CB technology has the highest priority over any other service for allocation of a channel.

CB is defined in 3GPP TS 23.041[8] for GSM, UMTS and LTE. CB includes the Earthquake and Tsunami Warning System (ETWS) which is in use in Japan and can deliver a notification within 4 seconds.

[7] ETSI TS 102 182: http://www.etsi.org/deliver/etsi_ts/102100_102199/102182/

[8] 3GPP TS 23.041: http://www.3gpp.org/DynaReport/23041.htm

Specific use of CB for PWS in Europe is specified in ETSI TS 102 900[9] and this service is called EU-Alert. In the US the Commercial Mobile Alert Service (CMAS) via CB is specified in ATIS 0700006[10]: CMAS in GSM and UMTS and in ATIS 0700010: CMAS in EPC.

EU-Alert and CMAS compatible mobile devices appeared on the market from 2011 onwards with a dedicated ring tone and vibration alert to distinguish warning messages from regular (CB and SMS) messages.

There is a label used in the US to mark all phones capable of receiving alerts according to CMAS requirements:

6.2 SMS based system description

The use of SMS has long been criticized for use in critical situations due to congestion in the network. However the capacity in the networks has been largely increased in recent years and used in the correct way SMS can be a solid, reliable and efficient way to reach citizens in a matter of urgency.

One of the most obvious advantages of using SMS is that it works on any handset that can receive traditional SMS. No handset changes are required.

On the other hand, traditional SMS is neither location based nor, due to network issues, suitable for alert purposes and cannot be prioritized. There are solutions today that enable the location-based capability besides utilizing the network in a more efficient way, while still delivering the message to the handset as traditional SMS.

These solutions mainly consist of two different components:

- Geo-targeting provides the localization capability, using probing technology to retrieve and store location updates from all users, including visitors, within the network. Geo-targeting may also make use of existing probes or other ways of retrieving location updates from the mobile phones. Components, not affecting existing mobile infrastructure, need to be installed in the operator's environment. It is quite common for mobile operators to install this kind of equipment due to the very fast growing commercial possibilities within location based services.

- An advanced SMSC provides optimized use and protection of the mobile network. This is a specially designed SMSC, designed for alert purposes only, ensuring fast, efficient and secure message distribution with reduced network load.

The components are not standardized in ETSI or 3GPP.

Key capabilities of such a solution:

- Localizing of handsets and information about the handsets within the risk area
- Efficient message distribution (avoiding routing process)
- Avoiding load of HLR (reducing risk of congestion)
- Barring capability, protecting the mobile network during emergency situations
- Optimizing air traffic
- Designed to support packet switched network like 3G and LTE (not only 2G)
- Avoiding congestion
- Ease of implementation; does not affect the end user (no need for handset configuration)
- Will also reach visitors from other countries (as long as they can receive SMS)
- The ability to respond to alerts indicating, for example, that one is in need of help

Citizen's privacy is protected by the Privacy and Electronic Communications (EC Directive) Regulations 2003[11]. Legislation in some countries doesn't exempt location based SMS from this regulation. Examples are Germany, Sweden[12], where legislation needs to be changed before 1 January 2016, and the UK[13] which will work to ensure that appropriate safeguards are in place.

[9] ETSI TS 102 900: http://webapp.etsi.org/workprogram/Report_WorkItem.asp?WKI_ID=38226

[10] ATIS standards can be purchased from for example Amazon

[11] EC Directive on Privacy and Electronic Communications: http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1435656905864&uri=URISERV:l24216a

[12] http://www.riksdagen.se/sv/Dokument-Lagar/Utredningar/Statens-offentliga-utredningar/Viktigt-meddelande-till-allman_H2B392/?html=true

6.3 App based system description

Location based SMS and Cell Broadcast solutions require the mobile operator to deliver components of the PWS solution. App (mobile application) based solutions bypass this involvement; the mobile operator merely acts as the ordinary bit-pipe.

Mass alerting via apps is often a feature of a 112-app (see EENA apps document[14]). When citizens install a 112-app on their mobile phone, they implicitly agree to provide information about their location to the app service provider. This allows the app provider to send location based alert messages to the app.

Apps only work in the area where the app service is operated, since the app service provider will have established an agreement with a regional PSAP and never a national or international agreement, since the interfaces and the data format for this service have not been standardized.

It should be considered, that potential cybersecurity issues (denial of service attacks) might impact system responsiveness under some circumstances, since availability of the system depends on public resources.

6.4 Systems for fixed telephones

There are some challenges related to use of the fixed network for Geographic alert. Geographic alerting via the fixed phone network is different to traditional telephony and must be handled with care. Automatic scaling and the ability to detect and protect the public telephone infrastructure from overload and congestion are crucial.

The figure below is a simplified illustration of a typical structure of the PSTN (Public Switched Telephone Network), showing the difference between normal call flow and alert call flow.

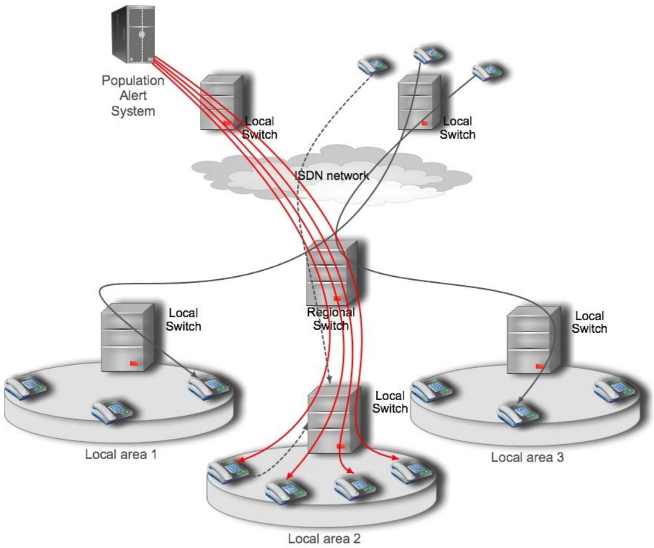


Figure 3: Structure of typical PSTN

The switches are scaled according to the population density they are dedicated to cover. A normal infrastructure has large switches located on a regional level to distribute traffic to a number of local switches. Local switches cover a specific local area. The local switches are scaled according to the number of people they cover.
If the number of telephone lines used simultaneously from the geographical alert system exceeds the number of available lines within the local telephone switch, an overload occurs. The consequences may be serious even when used for non-critical situations. Overload will not only slow the dissemination of alert messages, it will also cause problems with the outbound traffic from the area, such as for instance emergency calls.

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[13] http://goo.gl/u6LDLj
[14] EENA apps document: http://www.eena.org/uploads/gallery/files/operations_documents/2014_02_25_112smartphoneapps.pdf

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7 Public Warning Systems based on TV

There are 2 different possibilities to disseminate information over TV.

- Insertion in broadcast signal

In this case the emergency notification platform is connected to a gateway located after the signal output from the relevant TV station adding a "super title" slide to the existing TV signal.

- Insertion into set-top boxes

With digital video broadcast (more precisely multi-cast) the information is sent by the alert platform to the network service provider and from there to all the set-top-boxes in the specific area of the target area.

8 Sirens

Sirens are an effective warning system for outdoor use especially in areas with special warning needs such as dams, chemical plants, harbours, etc. Another advantage is that the system, if it is built in the right way, is able to work at least 4 – 5 days without external electric power. However costs for investments, maintenance and surveillance are rather high.

Furthermore, sirens can be used in a scalable way (from one siren to the whole area/country). Electronic sirens are also able to make spoken announcements. Sirens that only have one tone can only relay one message (i.e. go inside and close doors and windows) which may be the right message in all cases.

9 The use of social networks for Public Warning

Recent events have highlighted the value of social media for citizens. As peer-to-peer communication to foster self-help capabilities, increase individual situational awareness or to help establish emerging response groups with volunteers. From a communications perspective, social media are a 'multi-directional, interactive communication tool' (Woodcock[15]). At its core 'social networking […] is a sociological phenomenon that brings people with shared connections into mutually acceptable constructs' (Crowe[16]).

Increasingly, emergency services have incorporated social media in their communication plans and actively disseminate alerts and warnings via existing accounts on major social networking platform like Twitter or Facebook. In this regard warning systems shall consider social media in their concepts as additional means to reach-out to specific citizen groups. In the context of alerts and warnings one can position such a process as "push" model, although it is argued, that social media itself provide 2-way communication to enable interactivity between the users. Thus, rumour management, the shaping of warning messages according to needs of specific citizen groups are inherently available. It is worth to be noted, that several studies about citizen perception reveal that information from official sources is trusted most – even in social media.
Furthermore, social media provide dedicated alert services to their users. 'Twitter Alert'[17], to name one of them, is high-priority tweets from select public agencies and public safety organizations, sent to subscribers as mobile notifications only during crisis situations. Aside from being delivered to a phone, Twitter Alerts are also highlighted on the home screen timeline. In Europe predominantly UK and Spanish emergency services utilize Twitter Alerts in their warning schemes.

Two of the roles of VOST (Virtual Operations Support Groups) teams are to support official originators in fighting hoaxes and dissemination of official messages. Some have signed collaboration agreements with Emergency Services:

- In Spain, an agreement exists between VOST Euskadi with the organisation in charge of 112 in the Basque Government;
- In France, agreements exist between VISOV and a few regional Fire & Rescue Services (SDIS30, SDIS83) and Civil Protection & Crisis Management organisations (COS-EST, CRICR Med, EMIZ Sud)

Social networks are not designed for emergency situations, but they can provide important force multipliers if used wisely.

'Social Networking' is very important and its importance will grow. But its dependency on underlying technologies which are not designed for the acute phase of an emergency may make it vulnerable. Gateways should include such services, but as one part of a 'blended approach' to public warning.

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[15] Woodcock, J. (2009) Leveraging social media to engage the public in homeland security; available online at: http://www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA509065; accessed 25 April, 2012
[16] Crowe, A. (2012) Disasters 2.0: The Application of Social Media Systems for Modern Emergency Management, CRC Press
[17] (https://about.twitter.com/de/products/alerts

10 Public Warning Systems by interconnecting voluntary HAM Service

While this option was forgotten for some countries it should be still considered. There are communities of skilled radio amateurs in each country, which can organize emergency communication, which will last longer than public telephony and data services under some circumstances. This was clearly shown during the last earthquake disaster in Nepal (2015).

11 Next Generation PWS

11.1 PWS with rich media

The PWS as specified in 3GPP has focused on delivering text-based warning notifications of limited content to the public at a large scale. Experience with the current PWS has resulted in some public safety alerting agencies having difficulties in trying to include all the essential information needed to inform the public within the limited size of the current PWS Warning Notification. Some of this essential information includes maps with public safety mark-up, images of missing persons, live news video broadcasts, evacuation information, latest safety briefings, weather warnings, emergency shelter locations and assembly points, etc.

3GPP has studied delivering more extensive multimedia warning notification content than is currently supported in PWS and investigating both the broadcasting of more extensive multimedia content for a PWS and the mechanisms by which users would be able to receive and view this multimedia content[18].

Use of rich media will also allow people with disabilities access to PWS. Deaf people could be warned with video that shows a person or an avatar speaking in sign-language, and blind people could listen to an audio stream.

11.2 PWS on Hbb TV

Hybrid Broadcast Broadband TV or "HbbTV", is a major new pan-European initiative aimed at harmonising the broadcast and broadband delivery of entertainment to the end consumer through connected TVs and set-top boxes and is specified in ETSI TS 102 796[19].

Insertion of warning messages into the Hbb TV data stream has been investigated by the EU funded project Alert4all. A description of this capability has been described in the project deliverable "Communication system for dissemination of alert messages: architecture and design document"[20] ().

11.3 Emergency messages over satellite

An ETSI Specialist Task Force (STF473) has defined the MAMES protocol for Multiple Alert Messages Encapsulation over Satellite, which can carry for example Common Alerting Protocol (CAP) messages efficiently over a Galileo/EGNOS satellite link. The STF has delivered a Technical Report with MAMES Deployment Guidelines in ETSI TR 103 338[21] and a Technical Specification in ETSI TS 103 337[22] for the MAMES protocol.

Due to their inherent broadcast capability, satellite-based networks are ideally suited for distributing alert information, especially to large areas or to regions with a poor (or a possibly compromised) terrestrial communications infrastructure.

[18] 3GPP TR 22.815: http://www.3gpp.org/DynaReport/22815.htm
[19] ETSI TS 102 796: http://webapp.etsi.org/workprogram/Report_WorkItem.asp?WKI_ID=39272
[20] http://www.alert4all.eu/images/deliverables_public/A4A_D3.6.DLR.v1.0.F.pdf
[21] http://webapp.etsi.org/WorkProgram/Report_WorkItem.asp?WKI_ID=28593
[22] ETSI TS 103 337: http://webapp.etsi.org/WorkProgram/Report_WorkItem.asp?WKI_ID=41310

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12 Use of multiple technologies

In theory, the secret of success ought to be to blend the best attributes of all of the existing distribution methods. Each method has its own strengths and weaknesses, but blending them ensures that the weakness of each system is covered by the strength of another.

The problem is that the emergency manager may be faced with a complex mix of different technologies which makes it difficult to determine which technologies are best suited for any specific emergency situation.

Furthermore, to avoid confusion, all delivery mechanisms must tell the same tale, and must keep in step so that users do not become more confused the more versions of a given message they see. See also CAP, below.

There are products that convert the proposed message to the format needed for each technology, and signal it to the right network operations centre for the technology concerned. This may be an SMS gateway, a Cell Broadcast Centre, a pre-arranged maps portal, phone bank, television station, or siren control system. It removes the technical detail of how things are done from the list of things with which the emergency manager has to deal.

In ISO an International Standard – ISO 22322 Societal security and emergency management – has been published[23]. This standard provides principles and generic guidelines for developing, managing and implementing PWS, before, during and after incidents.

This International Standard is applicable to all organisations involved in preparation and issuing public warning on international, national, regional or local levels.

13 Common Alerting Protocol – CAP

The Common Alerting Protocol (CAP) is a general format for exchanging all-hazard emergency alerts and public warnings over all kinds of networks. CAP allows a consistent warning message to be disseminated simultaneously over many different warning systems, thus increasing warning effectiveness while simplifying the warning task. And CAP provides a template for effective warning messages based on best practices identified in academic research and real-world experience.

CAP may also be used as an integration between several components in a PWS such as sensors (or other Key Integrator Systems) being able to automatically trigger alerts based on threshold values. This leads to easy integration if both Key Indicators and outgoing warning channels are CAP enabled.

Common Alert Protocol (CAP) is an open standard promulgated by OASIS[24].

The ITU has adopted v1.2 of the CAP protocol and published this as an ITU recommendation in X.1303bis[25].

Since CAP is a template, the actual interface standard on the use of various CAP parameters needs to be specified in a detailed specification. An example of such a specification is the CAP IPAWS Profile[26]. This specification is used in CMAS.

CAP is somewhat US centric and therefore Canada has published its CAP-CP (Canadian Profile)[27] variant and Australia is developing a CAP-AU-STD[28] variant which could also be useable in other Asia-Pacific regions.

A European example of CAP usage is the adoption of the "CAP Profile Fire"[29] by the Italian National Fire Brigade in 2011.

[23] ISO 22322: http://www.iso.org/iso/catalogue_detail.htm?csnumber=53335
[24] http://docs.oasis-open.org/emergency/cap/v1.2/CAP-v1.2-os.html
[25] http://www.itu.int/rec/T-REC-X.1303bis/en
[26] http://docs.oasis-open.org/emergency/cap/v1.2/ipaws-profile/v1.0/cs01/cap-v1.2-ipaws-profile-cs01.html
[27] http://capan.ca/index.php/en/cap-cp
[28] https://www.govshare.gov.au/item-details/?rid=57
[29] http://www.vigilfuoco.it/aspx/ReturnDocument.aspx?IdDocumento=4857

14 Operational aspects

14.1 Testing Public Warning Systems

PWS are (hopefully) rarely used "in anger". They therefore spend most of their time "in maintenance".

Obviously, the system needs to work when needed. The obvious way to ensure that is to set off practice alerts. The issue then is that the public would become used to the alert tones to the point of becoming desensitised to them.

Testing if the mobile operator's infrastructure works can be done without actually sending messages to the general public, or in the case of SMS, by sending messages only to specific test devices.

On the other hand, there is also a need to constantly demonstrate the system in operation so that citizens can recognise it, and can be reassured that it will work, and how it will manifest itself, when needed.

'Public Reassurance' demonstrations may be scheduled on a regular basis, for example on an annual disaster preparedness day (such as the anniversary of a notable disaster), or at the beginning of the season of maximum natural hazard, or on a monthly basis. The test message should have a clear indication that a test is under way. In many countries the tests are advertised in the media to attract awareness.

Some examples:

Sweden:
Sweden tests the siren system at 1500 hours every third month at the first Monday in the month. Though it is a national test they have a public announcement in the national radio. The test has two purposes;

- To get the public aware of the siren system and
- That the public knows that it works in proper order and to train the operators of the system.

Government can also get feedback from the public if something is wrong with system or if something went wrong in the test.
The same day at 1900 hours they also test the Radio Data System (RDS) – this works not only as an indoor warning system, it works with all radios which have RDS features. When Sweden goes for EU-Alert they will probably test the system in the same manner. This is important for generating public trust in the system as well as getting people aware that the system works
Sirens can often do multiple tones, but people tend to forget the meaning of the different tones.

Czech Republic:
The Czech Republic for example, formerly used about six different tones, but now they use only one because people forgot the meaning of the more obscure tones.

The Netherlands:
The Netherlands has a monthly siren test at noon on the first Monday of the month. Also, this is advertised in the media each month, so Dutch people know that it is a test.

Lithuania:
Lithuania has a monthly test of a national LT-Alert CB system at noon on the first Saturday of the month. The test has several purposes:

- To get public awareness of the existing CB system;
- Allow the public to check proper settings of emergency messages reception on mobile handsets;
- Periodic check of the availability of the cellular infrastructure.

Germany:
Germany tests the functionality of MoWaS on a regular basis. Frequency and duration is up to the local governments. For instance, in Bavaria, sirens are tested twice a year. In conjunction with the provisioning of the new warning app NINA[30], dedicated tests in several parts of the countries had been conducted in Nordrhein-Westfalen of the fire services Düsseldorf and Gütersloh early 2015.

[30] http://www.bbk.bund.de/DE/NINA/Warn-App_NINA.html

14.2 Procedures

There are often national and regional laws on the responsibility of issuing warning messages to the general public. Many of these are based on jurisdiction and boundaries which are territory based. For example, a police chief of one city has no authority at all in another city.

In all cases detailed records should be kept for all ongoing and completed notifications:

- Decision taking procedure
- Role of the PSAPs
- Use cases: successful cases where PWS has been used
- Formal Emergency Plans, agreed between all stakeholders

15 Examples of implementations and use of PWS

This section contains descriptions of implementations in various countries.

15.1 Norway

In 2003 the Directorate for Civil Protection and Emergency Planning launched the first large scale test towards fixed phones – with good results. Since then solutions covering fixed phones have not been used in large scale, but on several occasions each year in local areas.

In 2007 the first location based alert system for mobile phones was tested in an area where a tsunami due to a mountain slide in a fjord was a major threat. In this case, several municipalities together with the Norwegian Water Resources and Energy Directorate, and regional authorities joined forces to build a system based on electronic sirens and a simultaneous warning-message delivered as an SMS message on mobile phones.

The SMS part of the system is based on location-based SMS.

Public warning by mobile phones has been considered by national authorities in Norway, latterly in a report to the Ministry of Justice in November 2011 and is described as a possible future resource together with the sirens that already exist, without taking any decision on what technology for dissemination of warning messages to mobile phones eventually will be preferred. However, the technology to distribute text-messages to mobile telephones has been used by local municipalities several times when smaller crisis have occurred, such as polluted air and water.

15.2 The Netherlands

NL-Alert, based on Cell Broadcast technology as specified in ETSI TS 102 900[31] went live in 2012 and has been used tens of times per year since, mostly for fire related emergencies.

The Dutch government provides NL-Alert for legacy devices for which Cell Broadcast reception needs to be configured by the owner (see http://www.nl-alert.nl for how-to configure your device) and also for CMAS/WEA compatible devices. Devices that are sold in operator shops are pre-configured. The NL-Alert/CMAS service is available on Android, Windows OS and Apple's iOS devices.

Since December 2014 NL-Alert in mobile networks has been mandated under Dutch Telecom law. Support for NL-Alert in LTE networks shall be implemented before end of 2015.

The Dutch Ministry of Safety and Justice has decided to discontinue the use of sirens by 2017 or later and replace them by NL-Alert.

Additional information:
http://www.eena.org/ressource/static/files/paul-nl-alert-presentation-eena-2013-vdef-paul-kubben.pdf

15.3 Sweden

Warnings and information via radio and television are complemented by the system for outdoor warnings. Outdoor warnings can be given in practically all built-up areas with more than 1,000 inhabitants and in areas surrounding nuclear power stations. The system consists of around 4,500 sirens. In the event of danger, the "Important Public Announcement" (IPA) siren sounds, followed by information via radio or television. The equipment in the outdoor warning system is owned by the state, while the municipalities are the users and also responsible for operation and maintenance.

The system has gradually been modernized and is now computer and radio-based, which makes it possible to activate only the sirens that are needed at the time in question. The system can also be used for sending spoken messages from sirens that are adapted for this. Reserve power is available to guarantee outdoor warnings also during power cuts.

[31] ETSI TS 102 900: http://webapp.etsi.org/workprogram/Report_WorkItem.asp?WKI_ID=38226

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In the inner preparedness zones around nuclear power stations, the inhabitants shall also be given warning indoors, as well as outdoor warning. This is done over the RDS system, and households are provided with special radio receivers intended for warnings.

Since 2002, the RDS receiver does not just warn about nuclear accidents, but is also activated during other serious accidents, such as accidents with hazardous substances. When an accident occurs, the display turns red and shows the text “IMPORTANT ANNOUNCEMENT”, at the same time as sounding a piercing alarm signal. After this, the receiver switches automatically to Sveriges Radio P4 at high volume and gives information about the accident. The receiver will sound the alarm even if it is turned off. At an alarm, the clock stops, to make it possible to see when the alarm sounded. The receiver returns to the standard setting at the press of any button.

The common response to these accidents is to go indoors, close doors, windows and ventilation, and to listen to Sveriges Radio.

Sweden is implementing a location based SMS warning system which should become operational in 2016. Privacy legislation currently prevents going live. Until then, text messages are sent only to registered devices.

15.4 Spain

In Spain, the General Directorate for Civil Protection (Ministry of the Interior) and the Regions are responsible for implementation of public warning measures.

In the case of the regions, public warning measures vary widely from one region to another, from with siren-based warning, to mass messages being sent to fixed lines, faxes, SMS or email.

The General Directorate of Civil Protection is in charge of all regulation concerning critical infrastructures, such as dams or nuclear plants, although at the moment each type has a specific national regulation to comply with (there is no single regulation that applies to all critical infrastructures).

For instance, the regulation concerning dams defines the minimum set of warning measures to be put in place; although it does not specifically indicate how often tests and user training exercises need to be carried out. The types of warning systems typically include:

- Acoustic warning based on sirens (Pneumatic/ Electronic) with specific signalling (i.e. French warning signal at a frequency of 200 Hz) to issue signals to the flooding area. Figure 4 shows the connectivity between the sirens (green lines) and the colour-coded representation of the signal power (from – 107 dBm to -67 dBm).
- Simultaneous and automatic telephony based alert for subscribers in the flooding area, with information and detailed instructions provided using IVR systems.
- Alerting through media, and using the radio network, to provide instructions to be followed.

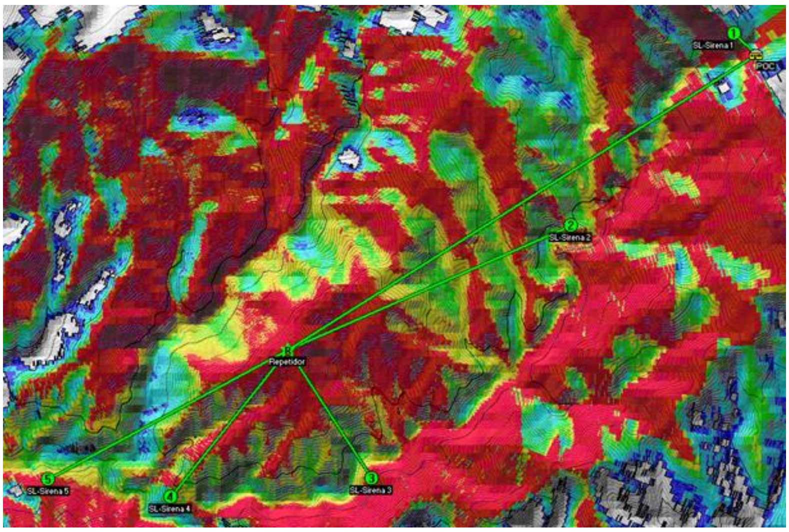

Figure 4: Coverage area of a siren system for a flooding

15.5 Germany

Federal and state governments agreed to use the radio as a major warning means for large-scale emergencies, disasters and in case of civil protection. With the proliferation of smart phones and other media, this basic warning mechanism has been extended. Since 2013 Germany has deployed a so-called Modular warning system (MoWaS)[32] which utilizes the government-owned satellite-based warning system (SatWaS). The use of SatWaS as a transmission medium makes the system less susceptible to power outages and loss of terrestrial transmission paths, as is often the case, especially in disaster areas. MoWaS is thus a stage of SatWaS where existing alerting and warning messages disseminated via press and media are complemented by additional communication channels and alerting authorities. MoWaS consists of three major building areas: Initiation, transmission path and devices

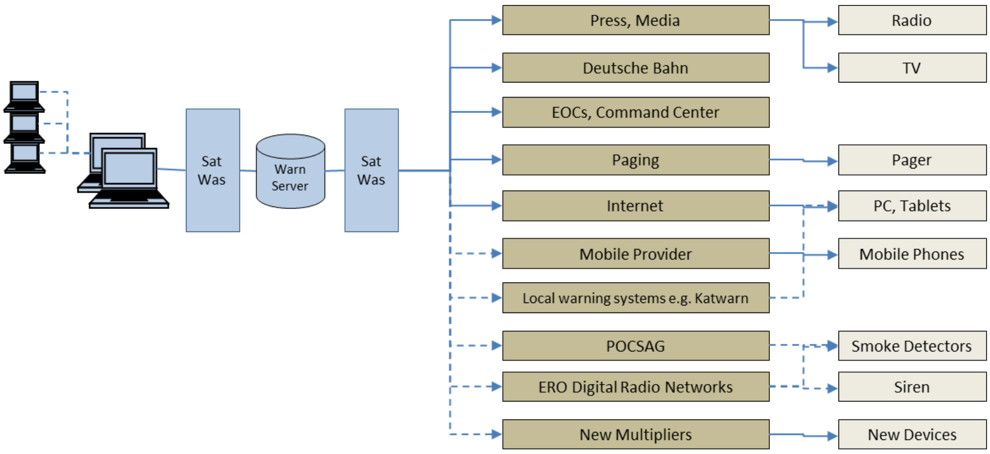

Figure 5: MoWaS architecture (translated & adapted)

The initiation area includes the sender/receiver systems in the EOCs and command centers on the federal and state level. The transmission path covers all components from the initiation to the alert authorities/ multipliers and the management of the devices, respectively. The device area all devices are considered which are available to the end user – the citizens.

Additionally, the Federal Office for Civil Protection and Disaster Assistance (BBK) an app called NINA Notfall-Informations- und Nachrichten-App)[33].

NINA is integrated in MoWaS thus enabling alert authorities to disseminate information to citizens via their mobile phones. With the built-in push-function citizens are continually informed about the hazards and threats. Besides, event-related behavior hints and general emergency tips from experts improve self-help capabilities in case of of potential hazards.

NINA also offers basic information and advice in the field of emergency civil protection. The warning relates App NINA data mainly from the so-called modular warning system (MoWaS) which has already been used in 2013 by the federal government and all provinces for warnings of civil defense and disaster protection. In addition, the app also contains current information from the German Weather Service (DWD), as well as current water levels of the Waterways and Shipping Administration of the Federal Government (WSV). NINA is therefore another important channel for warning the population in Germany.

Additionally KATWARN[34] is available to citizens.

32 http://www.bbk.bund.de/DE/AufgabenundAusstattung/Krisenmanagement/WarnungderBevoelkerung/Warnmittel/MoWaS/MoWaS_node.html

33 http://www.bbk.bund.de/DE/NINA/Warn-App_NINA_Einstieg.html

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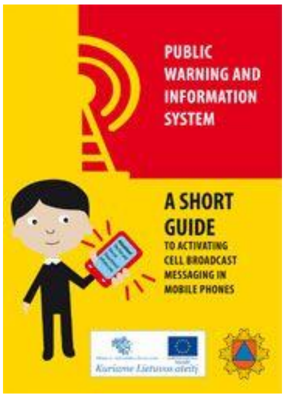
KATWARN is a nationwide uniform warning service for mobile phones. When disasters such as major fires, bomb finds or hurricanes send the responsible disaster response authorities, fire service control centers or the German Weather Service on KATWARN warning information directly and spatially related to the mobile phones of the affected citizens. KATWARN is a free of charge service which was developed by Fraunhofer FOKUS on behalf of public insurance companies and has been in operation since 2010. With KATWARN behavioral information can be received in addition to sirens, loudspeaker announcements or messages on the radio. KATWARN tells you not only that there is a dangerous situation, but also HOW you should behave. Also the deaf and hard-of-hearing community is supported. The key functions are:

- Official warnings for the current location (Guardian Angel)
- Official warnings for seven freely chosen places (e.g. Kita, office, apartment)
- Overview of warnings in the adjacent area
- Forward or share alerts e.g. Twitter
- Individual alert test function on your own smartphone

The app is available for iOS, Android and Windows Phone. Alternatively KATWARN messages can be received by SMS/ email after registration.

15.6 Lithuania

Lithuania deployed a multilingual geographically targeted PWS based on cell broadcast technology in 2012 to complement the siren system. Emergency alert broadcasts can be initiated from municipal authorities for local – small scale – emergencies and from national level for country wide emergencies. Information about the system, the history of messages and a how-to on configuring mobile phones can be found here: http://gpis.vpgt.lt/go.php/lit/English (see also figure below). Wireless Emergency Alert Capable devices (according to CMAS) are fully interoperable to receive emergency broadcasts from Lithuanian PWS. Lithuania has also implemented a pilot Emergency App system to complement reception of emergency IP push notifications for personal communication devices (smartphones, tablets).



[34] www.katwarn.de

15.7 Czech Republic

To ensure the public warning and needed information transfer the Unified System of Warning and Information (USWI) is developed and operated in the Czech Republic. The USWI consists of information centres (nationwide, regional and so-called the level of other operators), a data network, radio networks and warning, information and measuring terminal devices. The tasks of the USWI are not only to trigger a warning signal and deliver emergency information to public, but subsequently also giving information to the public about the character of the danger and regime is provisioned in an affected territory.
The USWI is guaranteed and operated by the General Directorate of Fire Rescue Service of the Czech Republic (GD FRS), which establishes the requirements for individual elements of the USWI. GD FRS ensures, operates and tests the USWI infrastructure, which provides an ability to spread radio signal and organize functional tests of the terminal devices. GD FRS sets out the principles of area coverage of the terminal devices of the USWI on the territory of the Czech Republic.
The USWI infrastructure consists of:

- selective radio signalling system (SRSS), which provides a remote operation of the USWI terminal devices,
- the terminal devices, which ensure the public warning and information transfer.

The USWI terminal devices are rotary sirens, electronic sirens and local information systems (municipal radio networks connected into the USWI).
The SSRS is closed one-way digital system, which transmits activation orders to the terminal devices (sirens, pagers), and is not able to get a feedback whether the terminal devices carried out expected operations and what is their operational status. More sophisticated two-way Monitoring System of Terminal Devices (MSTD) is being developed nowadays. The MSTD extends the current system and will be able to collect, transfer, process, archive and display information from the warning and measuring terminal devices (e.g. dangerous-material detectors). The Operational Programme Environment of the EU structural and investment fund usually finance the modernization and development of the USWI.
For Public Warning only one "Common Warning" signal is used, a fluctuated tone with a duration of 140 seconds. The warning signal of the electronic sirens and municipal radio networks can be followed by a short audio text specifying the danger (floods, chemical accident, nuclear accident, etc.). The warning signal is followed by an emergency audio message for the public, which gives information what happened, where it happened, what is a potential danger and advice to protect lives, animals and properties. TV and radio broadcasting, municipal radio networks and mobile warning devices (mobile sirens etc.) can be also used for the public warning and information about the emergency. The USWI is tested every month in the whole country, each first Wednesday at 12 am. The possibility of mobile phone warning with SMS usage by the operators network is being tested nowadays. The system is expected to deliver SMS message directly into a selected area and the system would warn the deaf and mute persons too.
The PWS is a part of emergency plans, mainly regional emergency plans, external emergency plans of nuclear power plants and external emergency plans of the potential danger providers set by the Act on major accident prevention.

15.8 Japan

Earthquakes are a common occurrence in Japan.

Japan has an advanced infrastructure of seismic sensors in the ocean around Japan that detects earthquakes and which generates messages that are broadcast to the citizens via the 'Area Mail' service. Area Mail is based on the Cell Broadcast bearer service. The 3GPP specified "Earthquake and Tsunami Warning System" (ETWS) has used both 'Area Mail' and additional Paging Channel bearers since 2007.

The ETWS detects the initial slight tremor of an earthquake, the Primary Wave and sends a warning message that an earthquake (Secondary Wave) is about to happen to the mobile devices in the affected area.

ETWS can deliver the first notification to mobile devices within four seconds. This Primary Notification contains minimum information, such as "Earthquake" or "Tsunami". The mobile device will display a pre-set message.

The Secondary Notification uses the 'Area Mail' service (which is similar to the Cell Broadcast bearer service). This bearer contains more detailed information in text.

15.9 Israel

Israel is in the grip of multi-fold challenges that threaten the population's safety and security on a constant basis. Besides being in the firing line of missile and rocket threats, additional challenges are imposed based on the fact that Israel is located on the Syrian-African Break of the respective tectonic plates.

The Israeli Home Front Command and the National Emergency Management Authority "NEMA" have deployed an emergency alert and notification system based on new media age technologies. The Israeli standard has set a requirement where citizens can be reached within less than 20 seconds (on UMTS 3G networks) so that the entire Israeli population can be informed in time, reach protecting shelters and take respective measures. Figure 6 shows how much time citizens have to reach protective space depending on the distance to where the threat comes from. Recent measures show that the system’s lead time is 7-8 seconds until the message arrives on the recipients’ handsets.

Figure 6: Time to reach protected space

Only cell broadcast technology can provide the core foundation for Israel’s national alert and notification system. The cell broadcast based solution is now being expanded by existing means such as TV, radio, sirens and Internet. All of which is going to be operated from one central platform.

Different sensors and sensor fusion engines are also connected to the system allowing additional input that is sent automatically (in case of an earthquake or Tsunami) or via human interface. The protocol used for the communication is CAP v1.2[35]

The system allows not only information flow from the municipalities to the population, but allows also using the same platform for interactive information exchange where the citizens can send help requests and information to the authorities over the same central platform by using a dedicated Smartphone application with “Panic” button. The messages from the citizens contain a default help message, created text or even a photo taken at the incident’s location.

This constellation provides the next evolutionary step where the given alert and notification system is fully integrated into the 112 eco system.

Additional information:
http://www.eena.org/ressource/static/files/noam-multi-channel-early-warning-brief.pdf

[35] http://docs.oasis-open.org/emergency/cap/v1.2/CAP-v1.2-os.html

15.10 Chile

In February 2010, Chile suffered from one of the worst earthquakes in its history. The event was even more tragic as the country was hit also by a devastating tsunami right after the earthquake. Although the information was known and the US Pacific Tsunami Warning Center had delivered all necessary information in time, this precious information had not reached the public. Chile didn't have an adequate emergency alert and notification system to alert the target population in time. This has led to it suffering more casualties due to the Tsunami than through the earthquake itself.

Following the President's order the Chilean Sub Secretary of Telecommunications (Subtel) issued on January 14th 2011, an official tender for deployment of Chile's next generation emergency alert and notification system.

The system's first phase based on cell broadcast technology was handed over to operations in October 2011. It is now being expanded by further capabilities such as notification over TV, radio and Internet, including push notifications to Smartphones that do not support the cell broadcast technology. The system in Chile was the first system of its kind in the Americas, advancing also the US American CMAS (WEA) project.

The system utilizes standard protocols based on OASIS CAP v1.2 (Common Alert Protocol)[36].

15.11 Taiwan

The National Communications Commission of Taiwan auctioned spectrum licenses for LTE services in October 2013 and providing PWS via cell broadcast was a mandatory component of that license. CBCs are being deployed, but the interface specification for the interface between the government's aggregator system and the CBCs at the mobile operators has not been finalized yet (April 2015).

15.12 Korea

The Korean Public Alerting System is a standardized 3GPP system based on cell broadcast (3GPP TS 23.041[37]) and is provided over the LTE network since 2012.

15.13 Other initiatives

Other countries are investigating how to proceed with PWS. For example France and Greece have issued an RFP for a PWS based on cell broadcast. Belgium and the UK are doing pilots based on SMS and possibly also cell broadcast in a later stage.

Canada is developing standards, with the support of ATIS, for a CMAS-like PWS based on cell broadcast.

[36] http://docs.oasis-open.org/emergency/cap/v1.2/CAP-v1.2-os.html

[37] 3GPP TS 23.041: http://www.3gpp.org/DynaReport/23041.htm

16 Recommendations

As explained in chapter 8, a PWS should consist of a mixture of technologies that works best in a country. Most countries already have a warning system and the examples described in chapter 11 show that adding a technology in the mobile network can be and has been done and is being considered in many countries today. The rationale behind this is that only recently the case that many citizens have a mobile phone which they carry with them most of the day. These citizens can be reached on their mobile phone most of the time.

Therefore the recommendations in the present document, as follows, are primarily focused on mobile networks technologies, which reflect the 2011 amendment of the Universal Service Directive.

Stakeholders	Actions
European Authorities	Take appropriate actions to include the creation and maintenance of a pan-European, multilingual, accessible to all and efficient «reverse 112», as per 2011 amendment of the Universal Service Directive. EU-Alert, as specified in 3GPP TS 23 041, provides a standardized pan-European solution. Promote rich media alert and deployment of eMBMS for PWS accessible to people with disabilities. More support for unified requirement for Wireless Emergency Alert on telephone handsets should be provided by European Authorities in order to make this feature is available out-of-the-box for citizens and interoperable when roaming within EU.
National Government	Implement "reverse 112" to cover local, regional and national emergencies.
National / Regional Authorities	Create a clear Public Warning procedure with a clear description of responsibilities
Emergency services	Define formal emergency plans including Next Generation PWS channels
National telecommunication regulator Network operators	To cooperate with National Government to facilitate the implementation of "reverse 112"
Mobile network operators	Deploy eMBMS
Mobile handset vendors	Cooperate with operators and authorities to deploy rich media alerting.
European standards authorities	Co-operate with peers in other regions to facilitate interoperability and roaming.

17 EENA Requirements

Requirements	
Definition of event alert notification cycle time for potential risks	Defined
Multilingual Public Warning System	Compulsory
Multi-technology Public Warning System	Compulsory

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