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White Paper

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Table of Contents

1 Executive Summary ................................................................. 7
2 Introduction .................................................................................. 8
3 Problem definition ........................................................................... 9
  3.1 People affected ................................................................. 10
  3.2 Scenarios ............................................................................... 12
    3.2.1 Public Places: ................................................................. 12
    3.2.2 Private use: ................................................................. 13
    3.2.3 Sub-scenarios ............................................................... 13
    3.2.4 Specific Scenario/ Use Case ............................................. 14
4 WPA System ................................................................................. 16
  4.1 Basic Technology: ................................................................. 17
  4.2 Content Types Format and Filtering: .......................................... 18
    4.2.1 Content Types ............................................................. 18
    4.2.2 Content Classification .................................................... 20
    4.2.3 Content Format ............................................................ 21
      4.2.3.1 Protocol format ....................................................... 22
  4.3 Networks ................................................................................ 25
    4.3.1 IP Addressing ............................................................... 26
      4.3.1.1 Unicast ................................................................. 26
      4.3.1.2 Broadcast ............................................................ 26
      4.3.1.3 Multicast .............................................................. 26
      4.3.1.4 Mode for WPA ...................................................... 27
  4.4 Localization Systems ............................................................. 30
4.5 Services .......................................................................................................................... 32
  4.5.1 WPA Information services ................................................................. 32
  4.5.2 WPA streaming services ....................................................................... 32
4.6 User operation ........................................................................................................... 32
4.7 Architecture of the WPA system ........................................................................... 34
5 Standardization Bodies ............................................................................................ 38
6 User requirements ...................................................................................................... 39
  6.1 User requirements focus group discussion ................................................... 39
  6.2 User requirements elements ........................................................................... 41
    6.2.1 Terminal definition: ................................................................. 41
    6.2.2 Public Announcement Content ........................................... 42
    6.2.3 Operation preferences: ......................................................... 42
7 Stakeholders ............................................................................................................. 43
  7.1 User Associations .................................................................................... 43
  7.2 Public ............................................................................................................ 44
  7.3 Private ........................................................................................................... 44
8 Roadmap .................................................................................................................... 45
9 Ethical considerations ............................................................................................... 48
  9.1 Personal configuration information ....................................................... 48
  9.2 Personal history information ....................................................................... 48
10 Conclusions ............................................................................................................. 49
11 References ............................................................................................................... 50
12 Links ....................................................................................................................... 50
13 Abbreviations .......................................................................................................... 51
ANNEX I WPA DEMO ................................................................................................. 53
List of Figures

Figure 1  Example Scenario ................................................................. 15
Figure 2  Wireless Public Announcement System .............................. 16
Figure 3  Alert message Format ........................................................ 24
Figure 4  Multicast Network Architecture ....................................... 25
Figure 5  Public Announcement System Elements .............................. 34
Figure 6  Public Announcement Publication .................................... 35
Figure 7  Public Announcement User Localization ........................... 36
Figure 8  Public Announcement Filter ............................................. 37
Figure 9  Public Announcement Demo System ................................... 38
Figure 10 Wireless Public Announcement Demo System .................... 53
Figure 11 Server WPA Demo application ....................................... 55
Figure 12 Server WPA Demo application New Message window ....... 56
Figure 13 Register and Login Client WPA Demo application .......... 57
Figure 14 Client Message Screen .................................................... 58
Figure 15 Files Received screen ...................................................... 58
Figure 16 Configuration screen ....................................................... 59
Figure 17 Message presentation screen ......................................... 60
Figure 18 Message example screens ............................................. 61

List of Tables

Table 1 Announcement Types .......................................................... 20
Table 2 CAP Alert Message example ............................................ 23
Table 3 WPA Roadmap ................................................................. 47
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1 Executive Summary

This document describes the solutions proposed within the HearCom project for the deployment of a future Wireless Public Announcement Systems that takes into account the multitude of different user profiles in the community at large and with a special emphasis for people with a hearing problem.

The document analyzes the problem to be solved for the different scenarios and profiles and presents a review of the technologies available to assemble a solution.

The range of solutions as proposed by this white paper has a strong technological component and takes advantage of the state of the art of the IT technologies available in particular the IP based digital and mobile communication systems and an open protocol that defines a standard format message.

A demonstrator has been developed with the main functionalities some of them simulated to disseminate the concept and to allow user evaluation.

User needs have been analyzed by user focus groups and the results are presented together with the implications for the users of the solutions proposed.

The need to tailor the avalanche of available public information available at a given point to the needs of the real time user is presented and a filter solution is proposed based on the user profile, user preferences and physical location.

A roadmap for the possible deployment of these solutions in the current market is detailed including the standardization activities and the role of the key players.

The ethical issues concerning this type of service are reviewed with the aim to ensure the correct processing of personal data.
2 Introduction

Public Announcement systems such as at train stations, theatres and events are traditionally based on conveying audio voice messages to loudspeaker systems in a certain area. Understanding these messages may be difficult for persons having hearing problems, but also for many other persons when the system is inadequate due to the presence of competing background noise, poor environmental acoustics, poor system performance or other reasons.

For people using a hearing aid, a number of assistive systems have been deployed that permit accessibility to public auditory information and announcements by means of analog technology devices (for example, induction loops, FM links). Although helpful in many situations, these present systems have several known limitations such as limited range, limited availability, compromised sound quality, and interferences with and from other equipment. As a result, hearing aid manufacturers and organizations working on behalf of hearing aid users have for some years considered that a ‘replacement’ technology is required that will provide enhanced communication possibilities in our increasingly information-dependent society.

Alternatively, and additionally to auditory announcement systems, textual and image based announcement systems are increasingly used (for instance active information panels for departures, arrivals etc). Although effective for many people with hearing problems, such developments may introduce new barriers to others in society – for example, when vision is a problem. This implies that whatever ‘replacement’ solution is developed, it will need to be capable of multi-modal operation in order to be fully accessible. This could include sound, vision and tactile information.

In this paper, a wireless public announcement (WPA) system is proposed that delivers area-restricted announcement information to personal handheld devices such as smart-phones, PDAs and future personal communicators. By this route, the information can be delivered to the user in the most optimal and personal mode. This optimization will be driven by the user profile – a set of customizable and updatable user preferences stored in the handheld communicator that reflect the particular communication needs of the individual. Modes of delivery include audio, text and image, which can be optimized by, for example, amplification, magnification and brightness control. Additional processing is then through other assistive devices such as hearing aids, Braille displays, language translators and future services including speech recognition and others. Also, the WPA information can be stored and retrieved for later viewing, meaning that problems of distraction, attention and information overload can be more effectively managed.
The type of announcement that can be conveyed ranges from the simple text message, the displaying of images and icons and the reproduction of audio or video files and the connection to continuous flow of audio or video streams.

Essential to deployment of the WPA service is that existing mainstream technologies are used and that these technologies can easily migrate and upgrade to future technologies. Also it will be considered whether it would be possible to develop or use a compatible standard message format to transport the information. This standard could be based on the CAP 1.1 protocol as developed by the OASIS group, which subsequently became the basis for an ITU-T recommendation (X.1303).

The proposed PDA system will take advantage of the increased popularity of portable terminals and mobile devices for wireless communications, and of location systems based on the integration of different technologies including Bluetooth, RFID, WIFI, GPRS, UMTS.

Another favorable evolution is the increasing capability in mobile and communications technology through the availability of services now offered in voice and multimedia format. This opens the way to conveying public announcement information using images or video clips, which could be extremely valuable in overcoming certain disabilities (Icons or Sign Language).

3 Problem definition

Public announcements systems are often principally or entirely audio based; therefore the most immediately obvious problem lies with persons who have problems in hearing. However, even though this is perhaps the area of greatest challenge, when looking more deeply into the issues, a much wider range of issues becomes apparent. In fact, for each of a number of different user ability/disability profiles (detailed in the following sub sections) the problems differ but are frequently overlapping. So, provision of an accessible advanced announcement system requires a multiplicity of formats to ensure that the specific accessibility needs of these different user groups are adequately met.

It would be a mistake, however, to see the issues as confined to just clearly defined groups of ‘disabled’ people within society because almost anyone can be effectively disabled in certain circumstances – for instance, it you are in a foreign country and cannot speak the language. In other circumstances, even a person with severe impairment may not feel disabled, such as when a deaf or blind person is trying to fall asleep. We therefore need to view the areas below as only a guide to the nature of the issues that people might face – and the fluidity of the categories, and the facts that they are not mutually exclusive and that many people will fall into more than one category, needs to be borne well in mind.
Additionally non handicapped persons are often feeling more assured if a message is repeated in more modalities, multimodal information provision is often highly efficient.

One way in which able-bodied people can become temporarily ‘disabled’ (aside from the language issue already mentioned) is when confusion, panic and distraction take hold – which could easily happen during periods of stress when traveling etc. So, a task that may be simplicity itself when a person is sitting comfortably at home can become surprisingly challenging when the same person is under pressure.

3.1 People affected

- People with impaired hearing

Persons with impaired hearing are likely to find very significant access barriers with current audio based Public Announcement Systems – in fact even those with hearing that can be considered good are likely to experience problems as a result of poor acoustics and competing noise from babble, trains, clutter etc that are features of many public places. Hearing aids, which work at their best in favorable acoustic conditions, are often of very limited help in such circumstances and it is common for users to switch them off when they enter the acoustically ‘hostile’ environment of a railway terminus, say. For this reason, the delivery of important announcements in the form of sound only can be anticipated to disadvantage nearly all people with impaired hearing – perhaps 10 per cent of the population in Europe.

Paradoxically, the best way in which to help a great proportion of these people would be the provision of high quality sound, free from distortion and background noise. This is clearly difficult or practically impossible with present techniques as transmitted directly from the public address loudspeakers but a high quality sound feed via the handheld unit (and received through headphones or the user’s own hearing aids) is a standard mode for the wireless PA service. The combination of high quality appropriately amplified audio together with complementary textual messages could be expected to meet the needs of the great majority of persons with impaired hearing.

- People with impaired vision

Persons with impaired vision are likely to find fewer problems with audio communication but with the new emphasis on panels and images to convey public announcements, additional challenges are being introduced. This needs to be taken into account when designing systems.
particular, many people in this group will experience problems with long distance vision (minor cataract, severe astigmatism etc) meaning that while they are able to navigate their environment reasonably well, they cannot see distant screens, however large – even when mounted well above any intervening physical barriers. Such people could well find a handheld device helpful since they would need to rely on their (better) short distance vision and on good quality audio output..

At the other end of the vision impairment scale is the very much smaller number of people who employ some obvious form of assistance such as a ‘white stick’ or guide dog in order to navigate the environment. Although such people are unlikely to be able to benefit from screens at all – close or distant – they are, however, likely to receive personal attention and help at many venues precisely because their disability is so apparent.

The greatest problems for this impaired vision group are therefore likely to be faced by those with severe impairment, but for whom this is not sufficiently obvious to others around them. Not only are these people likely to have major difficulties with both text and moving images, but they are also physically vulnerable to the presence and movement of other people around them – so meeting the needs of such people will be challenging. Large font size is a requisite, but this is not enough if applied to the message content only, as any accompanying instructions (together with the controls on the handheld unit itself) need to be equally accessible.

- People with limited cognitive agility

A ‘limited cognition’ profile could include users with significant limitations in the use of technology. For such people, the system should be able to work in a basic configuration that provides users a minimum set of warranted functions that require little user interaction. Although persons with severely limited mental capacity will probably be unable to travel alone in safety in any case, those with higher degrees of functioning may be troubled by the sheer pace of events, rather than by the events themselves. This means that great care needs to be exercised in the formulation of the messages to ensure that they are easy to digest and act upon again here multimodal repetition can possibly be of great help.

- People with physical limitations

In addition to immediately obvious conditions such as reliance on crutches or a wheelchair, say, to get around, provision could be made for people encumbered by heavy luggage or who are in charge of small children. While people in this group might not have difficulties with accessing and digesting the messages themselves, they could face serious timeliness barriers. They could need more time to react to a given message, might need to react in a different way, or be unable to react at all. So the service provider should go beyond the bare provision of the message.
alone and take account of anticipated reactions by the recipients, since these could help determine how and when the message is transmitted.

There are also conditions such as curvature of the spine that may restrict a person’s movements, so that looking up a high-mounted screen becomes difficult or impossible. Clearly, a handheld provider of information could be of value to people in this group.

- Elderly people

The increasing numbers of older citizens in many European states means that this is an expanding group, which governments wish to see maintaining their ‘productivity’ and their independence within society. Agedness is not in itself, however, an impairment, nor does it specify any particular type of assistance that may be required. But it is likely that anyone adopting an ‘elderly’ profile will be likely to experience a combination of the previous impairments to a variable degree.

- People who face language barriers

The finally envisaged use of an accessible Public Announcement System is to cater for the needs of people facing language barriers (such as tourists and immigrants). Conveying basic and important messages (as a minimum) simultaneously in several languages is an increasingly important requirement for service providers. Providing textual information and high quality audio and storage for later retrieval and off-line understanding is therefore a basic requirement for this group.

### 3.2 Scenarios

Follows a list of scenarios where Announcement systems can be used.

**3.2.1 Public Places:**

- Transport environment: stations and terminals (train, bus, airport and sea ports).
- Transport environment: on board (bus, train, plane, boat)
- Audiences: (places of worship, conferences, public speeches)
- Education (schools, smaller rooms, interactive)
- Entertainment (cinemas, theatres, concerts)
- Markets, malls, busy shopping streets and fairs, closed and open air,
- Open air events: concerts, sport events, camping, etc
• Open Air Crowd Control (accident sites, demonstrations)
• Public buildings (education, hospitals etc)
• Museums and galleries

3.2.2 Private use:

Although this is not the focus of the solution as it is not a “Public environment”, it would be advantageous for the device to be usable in other (including domestic) contexts, and for the purpose of user familiarization with the system’s capabilities. This would require the possibility that the device could be kept always on, even at home, in order to be able to receive emergency calls, police and fire alarms and other messages. Alarms originated by a multiplicity of appliances, washing machine, gas or overflow detectors could also be explored. Private use can also improve the learning curve and memorization of the HMI operation.

Some particular examples of ‘private usage’ would be:

• Entertainment (radio, TV, music). Audio or video streams.
• Home appliances (Doorbell, signaling for medicine, cooking etc, fire alarms).
• Industrial/work environments (factories, offices, ...)

3.2.3 Sub-scenarios

Within each scenario, one or more of these sub scenarios may be valid:

• Static site information. The information available is typically static or is not changed very frequently – for example access to services provided by the Public Announcer Sponsor in a shopping mall. Or stable train time table information.

• Dynamic site information. This reflects information that is variable and need to be updated (i.e. Gate changes, operational changes,)

• Alarms, Warnings.

• Commercial (advertising related to location). This function can be extremely distracting and unwanted therefore the user should be able to filter it out.

• Other to be defined.
3.2.4 Specific Scenario/ Use Case

A typical example of the use of the system is provided below.

A person with hearing impairment has planned to go to a Museum. For that he will use public transport to travel there; specifically, he is planning to use the train.

First of all, the user should program the day elaborating a destination timetable and should prepare the WPA settings (filters) in his PCS Personal Communication System (a PDA). This activity can be performed at home connecting the PCS to a PC and with high speed internet access to Access Announcement Providers Web Pages (ie. Train or Museum information Web Pages).

At the train station, using the PCS/PDA connected via mobile or wireless to the Internet network and using the hearing aid, the user will receive audio, visual and vibration alerts of the PA. For example, if there is a change of train platform departure, the user will receive an alert with the new platform and the timetable. He should be able to review later in the PCS/PDA the audio or text messages received in order to have access to more details.

Once the user arrives at the museum, he will be able to receive different messages from the museum public announcement system. For example, the museum may send announcement messages about a tour offer for visitors with hearing loss. Not only will the users inside the museum receive the announcement messages, but also users in the vicinity of the building. In this way, the possible range of visitors may be increased. Museums often have souvenirs shops, where visitors can buy souvenirs of their visit – in this way the user could receive announcement messages about special discounts and offers within the shop museum.

The user could also receive Warning Alerts. For example, in the case of a fire occurring inside the train station or in the museum, the Common Alert Protocol (CAP) alert message originated at the Fire Brigade would be propagated automatically to all users around the train station or museum, advising them about the fire and the recommended actions to be taken.
Figure 1  Example Scenario
4 WPA System

The public announcement system proposed is just an example of a possible implementation of the ideas using mainstream technologies.

![Figure 2 Wireless Public Announcement System](image)

Figure 2 shows a block diagram of the Public Announcement System proposed. A hearing impaired user is equipped with hearing aids that communicate to the Personal Communication system (PCS) via a Wireless Body Area Network. The PCS is also used as a central communications hub connecting the user to the internet network.

The user when entering a Public Area like a Congress Hall or a Conference Room has access to the wireless messages conveyed via different wireless networks such as Bluetooth, Wi-Fi or Mobile.

Messages can be filtered based on the proximity of the user to the access points of the network (Bluetooth, Wi-Fi etc). An example of this could be public panels that relay the information based on a Bluetooth connection.
In the next sections a selected list of mature technologies is given on which this service can be based. All these technologies could be available in a compliant system. Service providers can select their chosen options taking into account required coverage and the target user terminal.

### 4.1 Basic Technology:

The WPA System should be developed based on IP Network technology.

The elements of the system should be selected taking advantage of the developments of mainstream technology in formats, protocols, wireless and mobile networks and terminals.

A wide range of mature mobile and wireless technologies are available to support the propagation of messages locally and at a longer range using the IP protocol.

- The system could be implemented by means of Mobile Phones, Smart Phones and PDA’s. These devices will have different communications capabilities to access to the WPA information services.

- The WPA platform integrates different IP based information systems such as WIFI and Bluetooth as used in indoor environments, and UMTS, GPRS and WIMAX etc. to distribute information in outdoors and open environments.

- An essential feature is the capability to filter WPA content based on the user position. A wide range of technologies are available to fix this position starting from GPS/Galileo and Mobile for the outside environment and beacons based on RFID, Zigbee or Bluetooth for the indoor environment. The filtering can be based at the terminal or at the WPA server.

- IP Networks can work in broadcast and/or multicast mode. This will depend on the network configuration, format information, device capabilities and the technology specification.

- XML is a well accepted standard concerning information format and this is proposed for the messages in a particular implementation proposed by the Common Alerting Protocol (CAP).

- Server based platforms are proposed for the distribution of information and for user registration and localization.
4.2 Content Types Format and Filtering:

4.2.1 Content Types

The objective is to reproduce and convey the original audio format from the Public Announcement. By extension other formats are possible:

- Text Format
- Audio information:

The starting format of the Public Announcement Messages is usually audio. This format is useful for a number of user profiles including elderly, visual impaired and hearing impaired. In this last case, the high quality audio stream could be fed to the user’s hearing aids as proposed by the HearCom Project.

- Multimedia information: this format can be included in the provision of the service to people with hearing and vision disabilities. In this mode all information must be exactly copied in audio and video.
- Streaming audio and video.

All these messages could include the possibility of exploring the announcement further by launching a dialogue between the user and the PA server by means of hypertext or equivalent. For example, if a fire alarm has been launched for the Railway Station, initially the user will see a simple Icon or text message associated with some alarm sound/vibration. The Announcement could be further explored by the user pressing a key to obtain more details. In this way, all profiles could access the information published by the Public Announcement System.

There should be a hierarchy in alarms e.g. important alarms, like a fire, should override everything and directly prompt to leave the area, e.g. showing the optimal exit.

Messages will have an expiration date and would be refreshed periodically so that new arrivals in the affected area, or users who did not receive the messages properly the first time, should be able to receive them again.

Once the announcement has been acknowledged by the user, the message will be stored in the live message store in the user’s device and no further announcement will be produced when the same message is refreshed by the server.

Messages that have passed their expiration life-time will be removed from the live message memory.
Announcements could be issued to notify the cancellation of an Announcement that will remove the message from the live message memory.
### 4.2.2 Content Classification

The message type is classified below by its occurrence (how frequent the message is generated), distribution, priority, the source of the message and examples.

<table>
<thead>
<tr>
<th>Type</th>
<th>Occurrence</th>
<th>Priority</th>
<th>Source</th>
<th>Examples</th>
</tr>
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<tbody>
<tr>
<td><strong>Urgent Service Announcement:</strong></td>
<td>Medium</td>
<td>Medium</td>
<td>Service Provider. Such as Airport, or Railway Office</td>
<td>Change of flight gate, delayed Departure, delayed arrivals.</td>
</tr>
<tr>
<td>Used for time related user service modifications</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Emergency support:</strong></td>
<td>Low</td>
<td>High</td>
<td>Public Authority: Police, Fire, Ambulance etc.</td>
<td>Fire alarm, Police warning, Accidents, Medical emergencies</td>
</tr>
<tr>
<td>Used for emergency situations.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Security Announcement:</strong></td>
<td>Medium</td>
<td>Low</td>
<td>Public Authority: Police, Fire</td>
<td>e.g. Security warnings, “do not leave your baggage unattended”)</td>
</tr>
<tr>
<td>Critical but not time related</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Commercial event</strong></td>
<td>High</td>
<td>Low</td>
<td>Commercial</td>
<td>(“ Sale at 15:00 “, “Free gifts at 16:00”)</td>
</tr>
<tr>
<td>Low priority announcement but time limited</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Point Of Interest Site information</strong></td>
<td>Medium</td>
<td>Low</td>
<td>Third parties.</td>
<td>Information Broadcast</td>
</tr>
<tr>
<td>No time limit</td>
<td></td>
<td></td>
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**Table 1 Announcement Types**
Urgent Service Announcement will provide information about last minute timetable or location changes – for example, departure/arrival delays or platform departures/arrival changes.

Emergency Support messages have the goal to inform the user – for example, in an airport to the occurrence of an accident, fire alarm etc… This service will support, but not replace, the normal emergency signaling service due to the best effort characteristics of the IP technology used. It will be used to complement the original emergency warning providing the user with more information and adapting this information to the user’s preferred characteristics.

Security announcement messages will provide information about security recommendations.

Commercial messages could be sent continuously by the server, with Specific Shop information events taking place in the vicinity of the user location.

Point of interest/ Site information will have the aim to inform the user of interesting sites in their vicinity: Shops, Police Stations or Pharmacies. This would be reported in a static way, which should require the user to navigate to access the content in which he is interested.

Both Commercial and Point of Interest information could be filtered out by the user not interested in these services.

4.2.3 Content Format

The system should include as many formats as it can support, trying to include everyone in the solution and increase the possibilities to extend the service.

The Public announcement messages should support the following types:

- Audio message.
- Text message.
- Images (picture, icon).
- Video message.
- Audio Stream
- Video Stream
• Combinations of the above types.

4.2.3.1 Protocol format

It is proposed to use as an envelope the formats specified in CAP (Common Alerting Protocol) an open and standard protocol used for exchanging public warnings. This standard has been approved by OASIS (Organization for the Advancement of Structured Information Standards) and published by ITU-R recommendation X.1303. This protocol unifies different emergency systems between different countries and organizations, and it is possible to adapt it to the WPA requirements, taking advantage of the standard defined and expanding the possible use area.

CAP Alert Message is based in XML and it is a very flexible format that allows including different fields and formats according to the requirements of the service. This format message is a simple scheme that provides an all-purpose format to exchange message over different networks. The main elements defined are the follow tags:

>alert>: this tag is the first, contains all the others than form the alert. Some basis tags are for example: source, status, unique identifier... It can be used alone with this tag inside, but it can contain more than one info tag.

>info>: this tags can contains significant amount of information about both categorical and textual descriptions. A lot of the info tags are used to describe multiple parameters and can also provide Multilanguage information.

>resource>: This tag provides optional references to additional information. Allows the inclusion of photos, maps, audio, video, links etc. in the warning message.

>area>: This segment is used to store the geographic area where the <info> segment containing it applies.
We can see in the example above, an example of a CAP alert message, it is a simple format that can be easily accessed by both machines and people.

The <alert> segment should include at least one <info> segment. Each <info> segment may include one or more <area> segments see following Figure.

```xml
<?xml version = "1.0" encoding = "UTF-8"?>
<alert xmlns = "http://www.incident.com/cap/1.0"
<identifier>430080713727</identifier>
<sender>hsas@dhs.gov</sender>
<sent>2003-04-02T14:39:01-05:00</sent>
<status>Actual</status>
<msgType>Alert</msgType>
<scope>Public</scope>
<info>
  <category>Security</category>
  <event>Homeland Security Advisory System Update</event>
  <urgency>Immediate</urgency>
  <severity>Severe</severity>
  <certainty>Likely</certainty>
  <senderName>U.S. Government, Department of Homeland Security</senderName>
  <headline>Homeland Security Sets Code ORANGE</headline>
  <description>The Department of Homeland Security has elevated the Homeland Security Advisory System threat level to ORANGE / High in response to intelligence which may indicate a heightened threat of terrorism.</description>
  <web>http://www.dhs.gov/dhspublic/display?theme=29</web>
  <param>HSAS=ORANGE</param>
  <resource>
    <resourceDesc>Image file (GIF)</resourceDesc>
    <url>http://www.dhs.gov/dhspublic/getAdvisoryImage</url>
  </resource>
  <area>
    <areaDesc>U.S. nationwide and interests worldwide</areaDesc>
  </area>
</info>
</alert>

Table 2  CAP Alert Message example
The XML structure allows multiple parameters to be logically attached to the message to allow its proper processing. The WPA System will adapt this standard to its requirements.

Other possible fields that would extend current OASIS standard:

- **Expiration**: The date when the message can be discarded
- **Audio and Video technical information**: Bit rate and Codec Information
- **Applicable area**: with coordinates or other references.
- **Specific profile dependent instructions**: For example escape routes for wheelchair users

CAP and its possible extensions would ensure that the alert messages can be sent through a variety of networks using the information stored on the message itself to identify its scope, target users, how to process it and what should be done with it.
4.3 Networks

The network being proposed to provide the Public Announcement Service is an IP network formed by the infrastructure of IP Communication Network elements already present in many public Places. Examples are: Mobile (GSM, 3G), Wi-Fi or Wi-Max.

The basic elements of this Network are shown in the following figure.

![Multicast Network Architecture](image)


**Figure 4 Multicast Network Architecture**

The information has to propagate from the Application Servers to the group of Users as efficiently as possible, jumping through a chain of Routers and Switches that are the basic elements of the Digital IP Network. Two elements are important when defining the Architecture: 1) network Addressing Mode and 2) Communication Protocols.
4.3.1 IP Addressing

4.3.1.1 Unicast

The most common IP Addressing method used by the IP applications is Unicast where messages are conveyed from the source to the destination on a one to one basis. This enables, if the appropriate protocol is used, the information to be resent if it was not received correctly the first time, thereby improving the performance of the system.

4.3.1.2 Broadcast

If the destination address refers to all nodes on the network, then the packet is a broadcast packet. Broadcast IP Addressing sends messages to the attention of the complete sub-network. All elements of the network have to process the broadcast information. This is rather wasteful in the case when not all the users in the network require the information, as is the case in the Public Announcement System when for example only some of the users of a Railway Station Wi-Fi Network might be subscribed to the Public Announcement System of the station.

4.3.1.3 Multicast

Multicast allows the sending of a single message to be processed by a limited number of previously registered destination elements that includes a selection of the total of the network elements. A multicast packet includes a group address. This packet will be delivered to all destinations registered with this group address.

Broadcast and Multicast for WPA

If a large group of wireless clients, needs to receive the same information, as in the case of the PA system, then broadcast and multicast have advantages. If unicast were used to send the information to each recipient individually, it would be required to send many separate information packages with basically the same information, resulting in high traffic load for the wireless network. With multicasting, only one package is necessary. Of course, this assumes that each client in the selected group address needs to receive the same package at the same time, which is the case for the Public Announcement System. When audio or video streams are involved, the case for using the multicast mode is very strong because it is only required to send the stream of information once, even if many destinations reside in the subnet.

The main difficulty of broadcast and multicast is that some of the information that the application is sending may not arrive at the destination correctly. As there is no individual reception feedback, the
application will not repeat the message to ensure reception. Applications should take this into account, and some information refreshing may be required to improve system performance.

Another difficulty is the case where some of the destination units perform power saving schemes and are asleep during multicast transmission. For Wireless systems, a scheme is used where the multicast messages are sent coordinated with a periodic beacon signal. This ensures that the clients are awake when all pending packages that are meanwhile buffered, are sent. This involves a delay in the transmission of these packages – a multiple of the beacon period. Some consideration has to be given to the fact that in order to increase the system throughput, short awakening periods have to be implemented – but this will reduce the battery life of the mobile device due to the increased activity. The Public Announcement Application designer should ensure that the performance of the system is within acceptable bounds by balancing these parameters.

4.3.1.4 Mode for WPA

The use of unicast, multicast or broadcast mode for the Wireless Public Announcement System is a network design decision.

The preferred solution would be unicast: every new user arriving in a particular area, a train station for example, will be identified. Messages will be specifically addressed to each individual user with the transmission power and transmission rate adapted to it, and with a feedback mechanism in place to ensure the repetition of the message if it not correctly received. The user will be unregistered as soon as they are out of reach. This solution requires that the server handling the service provides the registering mechanism.

The difficulty arises when many users share the same wireless infrastructure, as can be the case in a crowded station. In this case, sending a warning message will mean sending as many as there are users, with an extra allowance for the possibility of repetition. Depending on the type and size of the message, an audio announcement, for example, may result in long delays in the delivery of the message.

The alternative would be to broadcast the message. The message is sent in broadcast mode and there is no requirement for registration but no delivery guarantee. The message should be repeated periodically to ensure that new arrivals to the network receive it until it is no longer valid. The message has to be sent at the lowest rate and maximal transmission power to ensure reception. Multicast will be used, if supported by the network routers, when some of the traffic distribution areas do not need to receive the public announcement messages (no users of the service present). Multicasting will distribute the messages downstream in the network only to sectors affected by the service.
4.3.2 Protocols

The network that distributes messages in unicast, broadcast and multicasting mode requires to be configured to accept specific protocols.

The different elements of the network have to be configured (Servers Routers Switches and Clients) to register client participation in a group address. This will allow the system to dynamically reach the specific client with multicast packages in a typical network configuration based on a tree structure of routers and switches. These elements should be capable of connecting mobile clients to the application servers where the multicast messages are produced.

Additionally, the clients are mobile and changing in location from one network branch to another. Moreover, ad hoc networks can be established to allow the propagation of data when the coverage of one particular client is weak through other clients with good access.

The basic protocols proposed can be UDP/RTP (User Datagram Protocol/Real Time Transport Protocol) useful for transmitting voice and video streams without QoS (Quality of Signal) assurance. For this application it is proposed to use specific multicast protocols such as IGMP (Internet Group Management Protocol) that manage multicast group addresses in a streaming application context [7] and, in particular, the Wireless version WIGMP that takes into account the mobility of the clients.

- CAP protocol

There are different Announcement Systems based on a variety of networks, and format messages.

The CAP (Common Alerting Protocol) [8] originally conceived by an international working group for collecting and relaying hazard warnings provides an open standard format to convey digital messages for all types of notifications and alerts. The CAP format is compatible with existing techniques and also with emerging ones. CAP provides multiple advantages, among others:

- Supporting digital images, text, audio and video, streaming.
- multilingual and multi-audience messaging
- flexible geographic targeting (localization).
- compatible with digital encryption and signature capability.
• message update and cancellation features
• interoperability standard for use among warning systems and other emergency information systems.
• can be used by sensor systems.
• usable over multiple transmission systems.
• end to end authentication and validation of all messages.

This protocol provides numerous advantages related to interoperability between emergency systems around the world, independently of the network through which the alerting messages are sent. CAP Alerting Messages are based on XML language, which makes messages flexible enough to cover all the design WPA system requirements.

Although this protocol is designed to standardize message formats of the Alerting Systems around the world, this standard can be used as a basis to define Public Announcement System messages. In this way it is possible to join both alerting and public announcement messages in all environments, facilitating the installation of the infrastructure, the deployment of the system in public environments and promoting international interoperability.

This flexibility of the standard also allows the inclusion of multiple options in each message, for example:

• Different languages: in that way, designer messages could include alert/message in different languages. When the system is going to send the message to the users subscribed to the service it will do this based on the user profile. This will make it easier, for example, for a tourist to understand different alert and public announcement messages.

• Different formats: that means message design can include information as text, audio, multimedia, images, icons, streams... As a result of all these possibilities, it will able to provide the information to multiple profiles. For example, people with a vision disability could access the information when the system presents this in audio or multimedia format. Hearing disabled people, additionally to the use of hearing aids receiving good quality audio, can receive the information in text or multimedia format.

• Multiple technologies can be included through the information embedded in the messages and also in its transport.

• Multiple Transport Networks allow transporting the information around the world. This makes it easier to provide for the different
information services existing nowadays, both for emergency and public announcement information.

## 4.4 Localization Systems

Mobile users need to receive different announcements depending on their location. If they are at the train station they will usually have little use for messages relating to an airport for example. Distribution of public announcement messages could be performed if the device is accessing a global network based on the criteria of location using a specific filter that allows the user to receive only messages when they are located in the vicinity of a specific location or if the messages are received via a local network limiting the distribution to this network.

The user handheld device can find its own location using different technologies that may depend on where the user is, and on the localization infrastructure deployed within that scenario.

The localization resolution will depend on the supporting devices:

### Indoor Low resolution
- Mobile cells (GMS) 100-200m

### Indoor Medium resolution:
- Mobile cells (UMTS) 20-30 m
- Wi-Fi- WiMax 50-100m
- Other networks (Bluetooth) 10-50m

### Indoor High resolution
- Specific sensors (RFID, infrared, ....) 1-5 m

### Outdoor:
- GPS (high resolution) 10 m with higher resolution planned with Galileo in the future.

When the user is inside buildings or underground a combination of radio technologies (Wi-Fi, Mobile, Bluetooth or Zigbee beacons) can pinpoint the
user position in combination with a location service. A Location server receives the information available to the user – for example, which Bluetooth bases does the user see from his terminal and what signal strength is the user receiving. The corresponding calculation is performed at the server, and exact localization coordinates can be calculated for each user.

These coordinates will be taken into account by the different Public Announcement servers when distributing the current messages that correspond to this location.

Thereby, each user receives the Public Announcements Messages based on his location.
4.5 Services

This paragraph lists the services that could be provided using a WPA System.

4.5.1 WPA Information services

- **Basic service**
  - All PA audio information normally available from loudspeakers in a specific area and/or subarea. Presented as audio (on headset, hearing aids) and/or as text

- **Optional service**
  - All display information (as audio on headset or hearing aid; as adapted text on PDA)

- **Extended services**
  - Dynamic information (flight, destination,...) as set before
  - Specific service information (restaurants, toilets, booking-offices etc)
  - Specific commercial information (offers, shops,...)

4.5.2 WPA streaming services

The WPA service can be switched to a streaming mode when continuous operation is required as when listening to a long public speech or in the classroom:

- Audio streaming (e.g. at theatre, cinema, place of worship)
- Video streaming (entertainment, instruction).

4.6 User operation

As an example of the user operation of the service a list of indications is provided based on the experience of a Demo developed for HearCom. (see WPA Demo in Annex I)
Download application and installation: Application software can be downloaded from the Internet (at home, or when entering a service area) to the client device. If installed already it may be checked for updates. Once the user has the file loaded in the device opening the file will install the application.  [17]

Some of the operations that will be required from the point of view of the user are Registration, Login, Specifying the user configuration profile and preferences, Managing the Messages, Reading, Selecting Deleting Messages.

A specific implementation of the user operation can be seen in the Annex I.
4.7 Architecture of the WPA system.

Figure 5 Public Announcement System Elements

Figure 5 above shows the proposed Public Announcement System elements. The user can be connected through a variety of wireless networks to services that are resident in the servers.

Public Announcement Server where messages are stored and distributed.

The Location Server is used to calculate the best obtainable coordinates of users based on the information available to the user (using beacons, GPS, Access points and Cell signal intensity levels etc).
The information can be published by different organizations thereby extending the Public Announcement system to different uses: commercial, emergency, informative...

In the case of a train station, for example, Public Messages can be generated by the police, Fire and Rescue Services the Train Management Authorities and the Commercial department of shops around the station.

All these messages can be edited either locally or remotely and can be broadcasted to the persons located inside the station.
Public Announcement User Localization will be based on different technologies, depending on device and technologies available in the field. The different networks and beacons installed will detect the user and the localization server will calculate the specific coordinates based on this information and on other parameters such as signal power received and cell repeater detected. With this information, the localization server will be capable of filtering the information distributed by the Public Announcement Service Server and POI Server addressed to this user.
The Public Announcement User Location will filter the sending of messages to the user based on their location. Thereby, the user receives only messages of concern, based on where they are located (such as in a train station, including special offers from the shops around)...

User location is calculated in the Location Server from localization nodes information that form part of the infrastructure deployment in the public building. Depending on the node that detects the registered user, the system can estimate which messages will be of interest to a particular user.

This type of System should address the ethical issues associated with the availability of the user private information including location to external parties ensuring the privacy of this data as contemplated later in chapter 9.
Figure 9  Public Announcement Demo System

5 Standardization Bodies

Below are listed a number of organizations where the Wireless Public Announcement System Specs should be based.

Organization for the Advancement of Structured Information Standards (OASIS)

http://www.oasis-open.org/home/index.php

Internet Engineering Task Force (IETF)

http://www.ietf.org/

Internet Assigned Numbers Authority (IANA)

http://www.iana.org/
6 User requirements.

In the discussion of the User Requirements of a WPA, two points have been included: the view of the focus group and the system elements to be defined affecting the user point of view.

6.1 User requirements focus group discussion.

A number of people with hearing impairment reported, both informally and within a structured session (in which we ‘demonstrated’ the handheld reception of messages), difficulties arising from not hearing travel announcements. Here are some typical transport stories from the people we spoke to: [Quote #1]

“Some years ago, I took a plane home from London Heathrow to Glasgow knowing my wife would be there to meet me. The visibility was poor so I couldn’t see much from the window on the way. Part way through the flight there was some commotion, but then everyone settled down so I assumed there was no reason to worry. When we touched down it was misty and dark so I couldn’t see much, although it did feel a little strange. Then I saw the sign – ‘Welcome to Edinburgh’ it said. Apparently an announcement had been made that Glasgow airport was fog-bound and our flight was being diverted to Edinburgh – but of course I didn’t hear it, and my wife was still in Glasgow to meet me!”

[Quote#2]

“I have missed so many trains through not hearing announcements. Sometimes I have been on the wrong platform and sometimes I have not heard that the service is going to be late or has been cancelled. On one occasion, I discovered (too late) that the train would arrive at a different platform in five minutes time, but by the time I’d discovered this, the train was already there and I couldn’t run fast enough to catch it. It was not a nice experience and I had to wait another hour for the next rain, by which time I was late for my meeting. On another occasion I boarded the wrong train altogether and ended up in Arundel instead of London! I’ve always thought that each station should have a screen to show the announcement in text at the same time as it comes through the loudspeaker.”

[Quote#3]
“Visual information at railway stations is better than it used to be, and they’re often claim they have ‘real-time’ systems, but they don’t always give you the information you need when things go wrong – just when you most need it!”

Most users we consulted said that while they could see clear benefits in a wireless public announcement service, they would not consider it to be a replacement for fixed visual display screens, and were concerned that some service providers might see this as an excuse to cut back on present provisions. They felt this would apply especially to older and more vulnerable travellers (not represented in our frequent traveller group) who may be less likely to have, or to be able to use, such equipment.

There is a perception that some deaf and hard of hearing people believe that their hearing fellows are able to understand all the announcements that are made, whereas conventional hearing people will confirm that this is far from being the case. However, one person we spoke to said that he was aware that his wife who often accompanied him and who had good hearing was able to fully understand only around 50 per cent of audio announcements – although this was still a big improvement on his own position. Confirming what was said by other hard of hearing people we spoke to, he said that he was frequently aware that an announcement had been made, but could hardly ever make out the words – and that his hearing aids were almost useless in such situations. Although we were unable to trial direct injection of audio announcements into his hearing aids, he knew that this would be beneficial since he was able to use the telephone, where only voice information is present.

This same person confirmed the view reported previously that a regular mobile phone would be the most convenient product on which to receive textual messages, but that he would be prepared to use a dedicated system when traveling abroad, which he frequently did.

A number of practical points came up within our discussions. The PDA used in the focus group demonstration (HP iPAQ) had a sounder but no vibration alert. And although it was loud enough to be audible in a typical office environment (especially when hearing aids were being used), it was felt unlikely to be heard on, say, a busy railway station. Vibration is an effective mode of alerting from people with severe hearing loss, and the combination of sound and vibration is particularly welcome, but the unit has to be held or be worn close to the body for the vibration to be felt. It was thought that a device as large as a PDA was most likely to be carried in a bag, in which case neither the sounder nor the vibrotactile alert (assuming a model with this feature) would be capable of reliable alerting.

A more strongly articulated concern was that, within the context of the demonstration, different categories of message were being notified by an
identical ‘alerting’ tone. It was felt that there should be different tones (one for urgent notifications, one for ‘commercials’ and a third specifically for emergencies was a suggestion) for the basic message categories – and the idea of an emergency evacuation message, for example, being heralded by a catchy jingle seemed somewhat bizarre.

One telling outcome from this part of the work was the appreciation that while it is difficult for people to accurately gauge the potential value of such a service without the benefit of a real-life trial, the opportunity must not be lost of ensuring that any such services that might be introduced for the mass market (which seem likely to be driven by commercial considerations), are accessible to the widest possible range of users. So, while we detected only limited enthusiasm for ‘advertisements’ of any kind, people do appear willing to accept that these will be broadcast through such a system. However, they would definitely value the ability to select or deselect these categories in their ‘user profile’.

People expressed particular interest in being able to set up the system to show messages for specific services, such as a flight from a particular airport. At the same time, the weakness was pointed out of overly restricting the broadcast area of such messages. For example, if a particular service is not operating from a specific location, it could be very helpful to have this information before entering that location, thereby saving time (and perhaps lives in the case or emergency messages) and providing an opportunity to make alternative travel arrangements.

One point that became obvious from the forgoing discussions was the existence of a whole spectrum of potential services from simple rendering of loudspeaker-type announcements in their text equivalents, to a broadly based wireless public information service. It will therefore become vital at some future stage to define the limits of an envisaged service and to revisit the issue of users’ needs with a more tightly defined service plan.

Elements to be defined in the establishment of a WPA are.

6.2 User requirements elements.

It follows a list of the elements to be defined when implementing a WPA.

- Terminal definition:
- Public Announcement Content
- Operation Preferences

6.2.1 Terminal definition:
- Fixed and mobile terminals
• Linked to Hearing Aids

6.2.2 Public Announcement Content

• All relevant information (filtered)
• Only Emergencies.
• Video, Text, Audio, Images, Multimedia.
• Multimedia is planned as a function to available after a long term evolution of the Public Announcement Systems. Multimedia is a well supported content in IP Network is deemed useful for Hear Impaired and other impaired Users due to the capabilities of conveying images together with audio and interactive capabilities. This opens the way to include for example sign language Icons and other related solutions.

6.2.3 Operation preferences:

The system should be easy to operate ideally only an initial configuration should be sufficient to set it running in safe mode.

• Complexity: Self programmed using localization and profile. The system requires to establish Public Announcement Filters based on previous knowledge of:
  - Destination (Traveling by train to the Museum) route and time.
  - Objectives (Museum visit)
  - Accepted detours (Shopping, Pharmacy).

• Default safe configuration. To avoid tiresome system operations
• Self programmed via internet with basic inputs.
• Alternatively downloaded on arrival to the spot, BT/WIFI based.
7 Stakeholders.

The Public Announcement System can be part of the strategic actions of different stakeholders with a variety of objectives. Accessible warning and alert messages can be seen as the backbone of a Safety plan as part of a Health System in buildings, factories..., but also in malls, closed markets and public official buildings. Safety and Marketing strategy can be integrated including Wireless Public Announcement System in a multiplicity of scenarios. The extension of the WPA service from the original accessibility aim to a commercial role is appealing to potential investors.

Some examples of stakeholders are:

7.1 User Associations

User associations are an important stakeholder. Users are the most interested party in including Wireless Public Announcement System in their environments and also a good mean to disseminate the system between their friends and colleagues.

In Spain and European Union there is a wide variety of this kind of associations that could be interested in the WPA System. Some of them are:

CEAPAT\[14\]: Centro Estatal de Autonomía Personal y Ayudas Técnicas, the aim of this Spanish association depending on the Ministry of is to contribute to improve the quality of live of all citizens, with special focus on people with disabilities and elderly by means of integral accessibility, design for all and technical helps.

IMSERSO\[15\]: Instituto de Mayores y Servicios Sociales, Spanish legal entity of the Social Security System that manages complementary Services for elderly people and people in dependency situations.

Fundación ONCE\[16\]: Spanish private foundation, subsidiary of the Spanish Blind Organization (ONCE) whose aims are to execute social integration programs and assistance to people with disabilities.

RNID: Royal National Institute for Deaf People is a charity representing 9 million deaf and hard of hearing people in the UK. They offer a range of services for deaf and hard of hearing people, and provide information and support on all aspects of deafness, hearing loss and tinnitus.
CNSE [10]: Confederación Estatal de Personas Sordas, Spanish not profit entity that represent the interests of deaf people, acting as a coordinator of the movement of this collective in Spain.

EUD [13]: European Union of the Deaf, international not profit organization that represents deaf people in Europe, with the aim to promote, advance and protect the interests, needs and opportunities of the deaf people in the European Union.

### 7.2 Public

Public entities could be are a very important stakeholder of the WPA due to the statutory obligation to warrantee accessibility in all their buildings and services. WPA can eliminate important information barriers. In Spain the responsible entities are among others:

AENA [11]: Aeropuertos españoles y Navegación Aerea, is a public entity responsible for the development and management of Air Transport infrastructures (Airports) including the accessibility of the installations. Additionally promotes aeronautic culture and manages historical heritage of the Spanish airports. AENA develops numerous cultural activities: promotes investigations with annual prize awards, conferences, expositions and edition of books and magazines.

ADIF [12]: Administrador de Infraestructuras Ferroviarias, is a businesses public entity responsible for the development and management of Rail Transport infrastructures that depends on the Ministry of Public Works. Adif has a dynamic role in the rail sector, making the train the best way to travel and making easier the access to the infrastructure in equal conditions.

In the case of Museums, Zoos, Funfairs and similar establishments it would be possible also to provide information about the animals, attractions, pictures, sculptures etc based on the public announcement system, as well as providing simultaneously an alerting/emergency service. Also, the messages could include announcements about the different souvenirs that users could find in the establishment’s shops.

### 7.3 Private

Private spaces including big shopping centers, malls, cinemas and sport centers could as well take advantage of this double approach of the WPA System: Security and Commercial applications with full accessibility for everyone, independent of the user profile. For example in a mall, the service could publish offers, discounts, sales information etc, together with security warnings.
8 Roadmap

A Road Map of the WPAS implantation has been prepared and is reported in the HearCom document: Roadmaps for HearCom related products, systems or concepts [18] Table 3 is the roadmap table concerning WPA proposed by the HearCom Project.
# Roadmap Wireless Public Announcement system (WPA)

**Short description:** WPA is a wireless system for making announcements. The WPA system is location specific and is intended to complement conventional loudspeaker announcement systems (PA) that may be difficult or impossible to understand. The announcement information is delivered by broadcast messaging to personal terminals (mobile phones, PDA’s) in audio, text or multi-media formats. In the (long) future the WPA system may migrate into local information networks that may integrate retrieval services.

**Specific WPA components:** Application software for mobile terminals; Application software for service points (PA console).

**Supporting components:** Local wireless IP networks; Mobile terminals; Wireless links for hearing aids and headsets to deliver audio messages.

<table>
<thead>
<tr>
<th>Scope</th>
<th>Research</th>
<th>Development</th>
<th>Introduction</th>
<th>Operation</th>
<th>Future</th>
<th>Long Future</th>
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<tbody>
<tr>
<td><strong>End user / specific</strong></td>
<td>Problem to understand acoustic public announcements: Hearing and other impairments (vision, cognitive...)</td>
<td>Requirement analysis specification</td>
<td>Evaluation of specifications</td>
<td>Trial evaluations</td>
<td>Service evaluations</td>
<td>Migration into mainstream applications (local information network)</td>
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<tr>
<td><strong>End user / general</strong></td>
<td>Need for personal local specific information.</td>
<td>Requirement analysis</td>
<td></td>
<td>Trial evaluations</td>
<td>- Location specific info announcement - location specific information retrieval</td>
<td>Mainstream adoption</td>
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<tr>
<td><strong>Technologies</strong></td>
<td>- Network - Mobile terminals - Information delivery (audio, vision, tactile...)</td>
<td>- Local IP network technology o WiFi (hotspots) o Bluetooth o GSM/UMTS - Mobile information devices (mobiles,</td>
<td>- Prototype demo system - Client and server application software - No specific hardware development.</td>
<td>Manufacturing and marketing</td>
<td>Manufacturing and marketing</td>
<td>- Other IP networks - Low power - Popular mainstream</td>
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</table>
## Competing Technologies

<table>
<thead>
<tr>
<th>Competing Technologies</th>
<th>PDA’s,..) - Wireless hearing devices (aids, mobile headsets) - Wireless Body Area Networks - Power consumption</th>
<th>Increased availability of Internet</th>
<th>Integration of WPA services (not competing)</th>
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<th>?</th>
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## Interactions

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<th>Interactions</th>
<th>- Global Internet - SMS (mobile phones) - New message networks</th>
<th>- Limited potential of SMS (costs, network load)</th>
<th>- Deployment of WBAN to include headsets and hearing aids (WP8)</th>
<th>- Increased availability of IP networks. - WBAN for health and entertainment</th>
<th>- Adopt new IP technologies - Maintain audio PA</th>
<th>Integration into other information systems</th>
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</table>

## Markets

<table>
<thead>
<tr>
<th>Markets</th>
<th>- Transport stations (air, rail,...) - Shopping malls - Large public buildings (theatre, congress) - PA services</th>
<th>Market studies</th>
<th>Introduction studies</th>
<th>Market studies</th>
<th>Market evaluation studies</th>
</tr>
</thead>
</table>

## Market parties

<table>
<thead>
<tr>
<th>Market parties</th>
<th>- Network providers - Information providers - Commercial information providers - Terminal manufacturers - Application developers</th>
<th>Dissemination by publication, congress and workshops</th>
<th>- Dissemination - Partnering - Revenue models</th>
<th>- Promotion - Marketing</th>
<th>- Marketing - Exploitation</th>
<th>- Exploitation - Renewal studies</th>
</tr>
</thead>
</table>

**Table 3: WPA Roadmap**
9 Ethical considerations

This type of solution is affected by ethical issues mainly concerning the handling of personal profile information and the protection of personal communications.

In the case of a commercial application a seal of data privacy could be obtained for the complete system to make visible the commitment of the system to these issues in compliance with the EC Directive 95/46/EC [30].

Of course the exceptions of access by empowered public authorities subject to adequate legal safeguards are granted.

When performing test with expert users of different handicap profiles the personal data collected has been adequately protected.

9.1 Personal configuration information

The personal information incorporated in the system including the type of handicap profile and the access preferences has to be available only to the person concerned and should not be accessible to the outside world. This is achieved ensuring that this information is coded at the user terminal level and protected by user and password and is only transmitted to the server using secure communications.

At server level this information is not linked to the user by name or personal address and is only to a coded secured ID available only to qualified system managers that should be aware of the ethical issues. All database entries will be hash-coded to avoid external tampering.

9.2 Personal history information

The actual whereabouts of one person has to be maintained secret and not accessible to outside external elements. All the information corresponding to service accesses has to be equally protected so that no user history is accessible to unauthorized elements. Concerning data communications secure protocols and data encryption is used to ensure the safety of the data being transmitted.
10 Conclusions

A Wireless Public Announcement System is proposed based on already available mainstream radio digital technology.

The main objective has been the replacement of the competing solutions based on a magnetic loop or on FM message broadcasting.

This IP and digital Wireless based solution provides the flexibility necessary to render the service to a multiplicity of users of different interests and profiles with a variety of language and accessibility limitations. The service can be as well provided in a multiplicity of formats from text, audio, and video in a native multimedia environment.

A standard is proposed for the message format that will facilitate the propagation of the alert information through the different networks.

This solution is as well prepared to solve the ethical issues raised in this world of all accessible technologies where personal information should be safe and outside the reach of non-authorized persons.

A demonstrator has been implemented showing the main proposed functionalities and can be used as a developing tool to test some of the communications and HMI constraints.

A group of focus group users have been evaluating the solution and have issued recommendations and listed the difficulties and pitfalls that such a system should avoid.
11 References

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12 Links

13 Abbreviations

3G   See UMTS
ASR  Automatic Speech Recognition
BAN  Body Area Network
BT   Bluetooth
DSP  Digital Signal Processor
CAP  Common Alerting Protocol
CF   Compact Flash
CCXML Call Control eXtensible Markup Language
EDGE Enhanced Data rates for Global Evolution
GPRS General Packet Radio Service
GPP  General Purpose Processor
GPS  Global Position System
GSM  Global System for Mobile Communications
HA   Hearing Aid
HMI  Human Machine Interface
I/O  Input/Output
IVR  Interactive Voice Response
IP   Internet Protocol
LAN  Local Area Network
MFLOPS Million Floating Point Operations per Second
MIPS Millions Instruction Per Second
MMI  Man Machine Interface
MRF  Media Resource Function
OASIS Organization for the Advancement of Structured Information Standards
OS   Operating System
PAN  Personal Area Network
PCL  Personal Communication Link
PCS  Personal Communication System
PDA  Personal Digital Assistant
PHS  Personal Hearing System
POI  Point of Interest
POTS Plain Old Telephone System
RF   Radio Frequency
RIM  Research in Motion's
RTP  Real Time Transport Protocol
SD card Secure Digital card
SDIO Secure Digital card with IO interface
SV   Speaker Verification
TCP  Transmission Control Protocol
UDP  User Datagram Protocol
UMTS Universal Mobile Telephone Service
USB  Universal Serial Bus
W3C  World Wide Web Consortium
<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>WAN</td>
<td>Wide Area Network</td>
</tr>
<tr>
<td>WBAN</td>
<td>Wireless Body Area Network</td>
</tr>
<tr>
<td>WPA</td>
<td>Wireless Public Address</td>
</tr>
<tr>
<td>Wi-Fi</td>
<td>Wireless Fidelity, IEEE standard 802.11b</td>
</tr>
<tr>
<td>WIGMP</td>
<td>Wireless Internet Group Management Protocol</td>
</tr>
</tbody>
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ANNEX I WPA DEMO

A WPA (Wireless Public Announcement) Demo has been developed to present the possibilities of the Solution to interested parties and to perform a proof of concept test of the proposal in particular the communications and the HMI.

This demo is composed of a server and a client application.

The WPA Demo shows the basic possibilities of the future real system.

![Diagram of Wireless Public Announcement Demo System]

Figure 10  Wireless Public Announcement Demo System
The system has been conceived as a very flexible tool that allows the incorporation of new functionalities that can be added to the WPA System as a response to user feedback or to implement a customer request.

The demo uses a portable PC configured as Server and equipped with Wi-Fi connectivity.

Two users are shown in the figure both connected in an Ad-Hoc Wi-Fi network with the PC.

The current WPA Demo Server has the following functionalities:

- Select scenario
- User Position (simulated)
- Add user
- Add Message

The WPA server application Start screen is shown in the following figure. In this figure it is possible to see three different elements indicated in the figure by a red circle:
Figure 11 Server WPA Demo application

On the top of the figure under the section called Sites it is possible to select different scenarios. In the figure the scenario selected is an airport that corresponds with the Public Announcement Site 4. With this option a WPA System installed in an airport is being simulated.

On the bottom of the server application screen there is an Add User button. This button simulates the users being registered in the WPA demo application. The user will be added to the application registering the IP address of the device that will be used in the demonstration and activating the Add User button. At this moment the user IP address appears in the map of the WPA server application. The user position can be simulated. This is useful when the demo is taking place using mobile PDA’s not equipped with the required localization technology or in an indoor environment not covered by a Localization Service. It is possible to simulate the movement of the user by moving its representation in the demo server screen with the mouse. In this way the different functionalities of the WPA demo can be shown, for example the commercial or alarm messages that are been sent based on the user location.
On the right part of the figure an Add Message button is shown. Activating of this button is possible to add the messages that will be sent to the user from the server database. There are different types of messages: Information messages, Alerts messages, Commercial messages and News messages. For all these messages it is possible to include a text with the message title, a text explicative and attach files with audio, video or text content. Predetermined text can be useful for Alert messages defining the more common alerts. As an alternative customized text can be added manually.

![New Message](image)

**Figure 12** Server WPA Demo application New Message window

The Client WPA demo application provides the following functionalities:

- Register New User
- Login
- Message Received (Text or File)
- Configuration
- View Message

By starting the client WPA demo application the initial presentation is the login or register screen from which it is possible to log in as a new user of the system or from which access to the application is performed. To register in the system user should enter a User Name once and the Password twice for confirmation. In the case of an already registered user only User Name and Password have to be introduced. This is to warrant restricted access to both past exploration user history and user profile.
Both screens are shown in the following figure.

![Client WPA Demo application screens](image)

**Figure 13  Register and Login Client WPA Demo application**

The Client WPA Demo application has three flaps: messages, files and configuration. Messages screen will show the list of received messages with the type of message and the associate text. This allows the opening and closing of older messages for later reproduction.
Figure 14  Client Message Screen

Activating the Files flap the screen will show the different received files. The user can open previously received files at any time. The user can discard those files with the Delete File button.

Figure 15  Files Received screen
The Configuration flap allows the user to select what kind of messages he wants to receive: Information, News and/or Commercial. It is not possible to block the reception of Alert messages. Those messages will be received if the user is located in an area affected by them.

![Configuration screen](image)

**Figure 16 Configuration screen**

It is also possible to introduce a text label filter using this screen.

For example, if the user visiting an airport configures “Madrid” in the filter, the user will only receive messages which include “Madrid” in the text label.

All messages are filtered based on the user localization; it is not possible to receive airport information messages when the user is, for example, in the railway station unless specifically allowed. In particularly commercial messages will be received by proximity, only when the user has activated these messages and is in the vicinity of the shop.

When a user receives a new message, this message is stored in the client message screen and not reproduced immediately.

When a message is received an audio or vibration alarm will inform the user that new messages are available on the message repository.
Nevertheless if the message is an Alert message, the message will be opened immediately on the screen simultaneously with the audio or vibration alarm.

![Message presentation screen](image)

**Figure 17  Message presentation screen**

If the message is not an Alert message, to open it the user has to select it out of the server message list. In the case that the message has an attached file, the user should select the open button to open the file with the corresponding program depending on the type of content.

Messages can be as shown in the figure below of the type of a text file an icon, image or video sketch. The user can select as well an audio or video stream linked in the message itself.
Figure 18  Message example screens