DTT Technology for Rural Communities Alerting

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ABSTRACT

The transition from analog to digital television broadcasting has opened the way to a number of new services, enabled by the advanced potentialities offered by interactive applications. Considering the wide diffusion of TV receivers among people living both in towns and rural areas, and how many people, either old or young, educated or not, are familiar with the TV box, it is reasonable to exploit such a capillary and widespread technology to reach immediately and directly almost the total population in a certain area. Among the possible applications, emergency and alert information dissemination can play a vital role in improving the communities response and reaction to natural or man made disasters. Focusing on this topic, this paper proposes an alert dissemination service exploiting an MHP interactive application developed ad hoc for DVB-T broadcasting, to force the direct delivery of emergency information to TV users.

Keywords

Digital Terrestrial Television, emergency, dissemination, MHP, interactive application.

INTRODUCTION

Natural or man made disasters occurrence dramatically emphasizes the need of an efficient dissemination infrastructure, to rapidly alert people about imminent dangers, and the actions to undertake in response to them. Consequently, the research of a proper service to rapidly disseminate alerts and information to a scattered audience, especially to people living far from towns and, in general, in rural areas, is of great interest.

Thanks to its huge diffusion, TV broadcasting represents a good candidate to reach people almost everywhere; TV receivers are practically in every house, but also in pubs, restaurants and hotels. Moreover, the recent introduction of Digital Terrestrial Television (DTT), and its fast spreading (ITU, 2006), open the way to new services. Several experimental interactive applications have been proposed and partly tested up to now; among them, T-learning (Gambi et al, 2006; López-Nores et al, 2005), T-health (Fernàndez, 2007), T-tourism and participation. They all share the common goal of improving inclusion and participation of those users not enough skilled to access more complex technologies, or excluded because of geographical or logistic reasons. Moreover, the integration of Digital Video Broadcasting-Handheld (DVB-H) receivers into mobile phones, at least in Europe, and a DVB-T/H convergence expected in the next few years, will make interactive applications run on both platforms, with a few adjustments. DTT combines the appeal and mass audience of traditional TV with interactive contents, somehow similar to those currently available on the Web. The key role is played by the Multimedia Home Platform (MHP) standard (ETSI, 2003). MHP applications (Xlets) enrich the video content by adding animations or text based materials (hypertext); further, they support enhanced interactivity through the Set Top Box (STB) return channel interface.

In this paper we present a low complexity and cost effective service, for the dissemination of emergency information to rural communities, based on an integrated DVB-T/emergency network, and a properly designed Xlet. As a flexible solution, at a first level it can provide hyper-textual information; then it can be easily extended to deliver richer contents, by interfacing a videoconference (VC) equipment. The service herein described mainly addresses

residential users, but the growing development of the DVB-H platform will allow reception also to mobile users. In the proposed framework, DTT acts as the primary technological platform for A/V content distribution; alerts dissemination is "forced" by means of the MHP advanced features. A VC system enables quick and effective A/V contents production and transmission, essential in supporting Civil Protection organizations and public authorities during emergency situations, to communicate specific instructions and guidelines to citizens and rural communities.

SYSTEM LAYOUT

Thanks to the almost uniform TV broadcasting coverage, disaster alerts and emergency information can be delivered either to people living in towns and scattered over wide rural areas. Exploiting the MHP advanced features, enriched contents can be provided, that during emergency conditions may superimpose to the normal reception of TV programs, to immediately alert people watching TV, by forcing the transmitted content to change without any action required. This feature is innovative, if compared to classical and more common DTT applications, since, in this specific service, the receiver acts on the basis of the system commands, and not under the user control. MHP allows either the network operator to control when an application should start and stop (telling the receiver whether it should execute automatically), and to manage a dynamic and real time behaviour of the contents shown.

As a case study for a real implementation of the proposed service, we consider the territory of the Regione Marche (in Italy), where an emergency radio network, named MarcheWay (Web, 2007), is already present, to connect Civil Protection bases located in different sites. In Figure 1, a system view of the proposed architecture is depicted: in the Civil Protection network the points represent the sources of alert and emergency announcements, that are issued and transmitted to the Civil Protection Operational Centre (CPOC). Once collected in the CPOC, the announcements may be processed according with their priority, importance, and the level of risk they relate to.

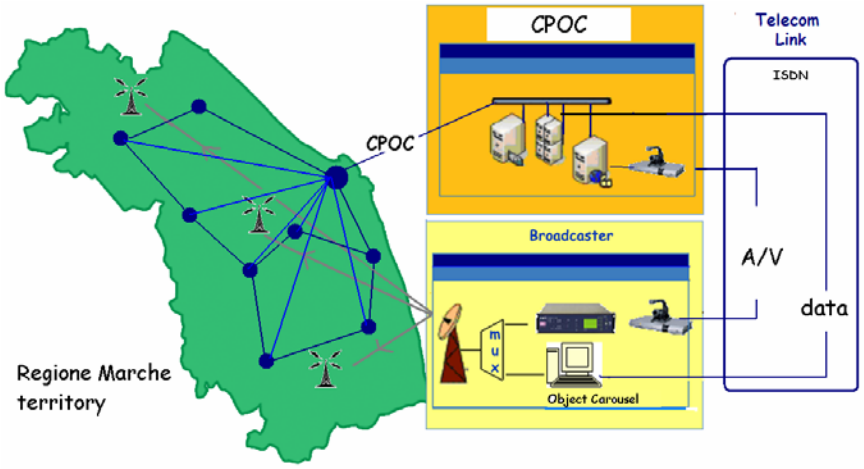


Figure 1. The proposed telecom infrastructure

An ISDN link interfaces the existing radio network with the DTT infrastructure, to transfer A/V signals and data originating from the CPOC. Through DTT, the alerts are disseminated over the whole regional territory. A/V contents, eventually produced "on-the-fly" during emergency conditions by operators in the CPOC, are handled by a VC installation; a suited Object Carousel (OC) generator collects the data from the CPOC through a network interface, and re-injects them on a DTT service.

Three different alert classes may be defined:

1) no-immediate risk: textual form

2) immediate risk: graphical/textual form only

3) strong immediate risk: CPOC operator presence, graphical/textual additional material.

Messages of class 1 are delivered without any priority: their content is managed by the MHP receiver, and displayed when browsing the Xlet. Messages of classes 2 and 3, related to a higher level of risk, autonomously modify the reception of TV programs, and through the Xlet perform a live content update of specific news and information, requiring no action by the user. In this sense, MHP applications can be used to force TV viewers to get informed about impeding dangers.

Alerts in graphical form are properly formatted as JPEG files; the A/V presence of rescue operators is obtained through the VC system, that allows an immediate and real time presence during high emergency situations. In Figure 1, an ISDN link connecting the CPOC to a broadcaster site, to transfer A/V signals, is shown: it ensures a constant bit rate flow, whilst more modern xDSL services only guarantee best effort throughputs. For the purposes of the proposed system, commercial VC terminals may be used, with a sufficient image quality and limited bandwidth requirements, over a single ISDN link. In the broadcasting station, a second VC terminal is located: the received A/V signals, in H.263 or H.264 compressed format, are decoded into analog format, given in input to an MPEG2 encoder, and converted again into a DVB compliant Transport Stream (TS). The multiplexer mixes different A/V streams and adds the interactive content output by the OC generator.

The OC stream contains the required tables (according with (ETSI, 2004)), in addition to a Digital Storage Media – Control and Command (DSM-CC) (ISO, 1996) file system, consisting of a whole local folder where one or more Xlets are stored, together with the JPEG and text files representing the emergency information issued by the CPOC, FTP transferred with the Xlet. The Xlet can be associated to one or more A/V services, by merging the Program Map Tables (PMTs) of the A/V encoder and the OC generator, and obtaining a table containing the A/V Program IDs (PIDs), the Application Information Table (AIT) PID, and the DSM-CC PID. The contents shown on each user's remote screen are automatically updated, every time the CPOC operators change the JPEG or text alerts, without requiring a channel switch, or any other action by the user. This is possible thanks to specific functions jointly implemented by the OC generator and the MHP application.

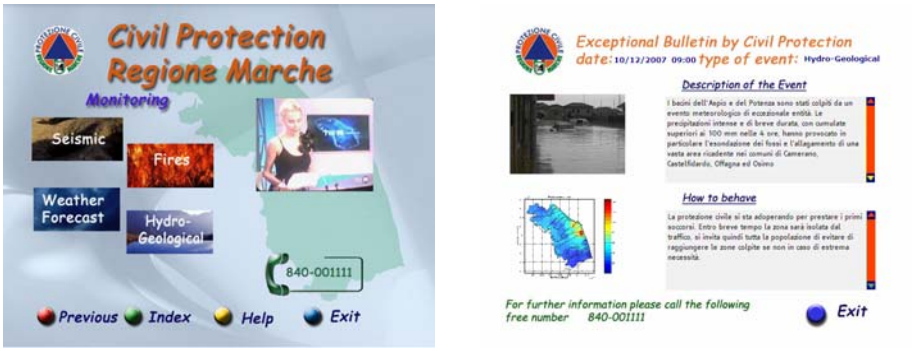
MHP: MULTIMEDIA HOME PLATFORM AND THE TRUE-XLET

MHP is fundamental in implementing the specific features of the service presented in this paper, besides enabling the reception and execution of interactive applications on a STB.

MHP has chosen DSM-CC OC as the file-based data broadcast protocol: Xlet Java classes and resource files are structured as a file system, inserted in a cyclic structure, and injected into the main stream. Any resource in the file system can be selected to be updated or changed during time; this way, JPEGs and texts delivering emergency and alert messages can be updated, and automatically shown on the user's TV screen.

At a conceptual level, an Xlet can be assimilated to a set of "pages", graphical environments that can be browsed by means of the standard colored keys on the remote control (RC). Xlets must implement proper methods and interfaces (Morris, Smith-Chaigneau, 2005) to comply with the MHP specification, and be correctly executed by MHP STBs. An interactive, MHP compliant application, named TRUE-Xlet (Television for RUral Emergency) in the following, has been developed in the framework of the presented system, to provide real time alert dissemination over DVB-T.

In a reference scenario, the user is watching his favourite TV program. If an emergency event occurs, for example, of category 1, the TRUE-Xlet is transmitted by one or more TV broadcasters located in the interested areas, and executed by the receiving STB, without the need of any action by the viewer. The TV program is not interrupted by the TRUE-Xlet: as shown in Figure 2 a), the original A/V signal is scaled and moved right on the screen. A new graphical content is also shown, with a number of different topics that can be browsed by the viewer through focusable buttons. In case of a category 2 emergency event, as shown in Figure 2 b), the, the video signal is temporarily hidden, and other information is provided, about the organization issuing the alert message (Civil Protection), the type of risk the message refers to (texts and JPEGs), an emergency phone number to call, and how to exit the Xlet, as shown in Figure 2 b).



a) b)

Figure 2. a) The TRUE-Xlet GUI, b) Risk event description

Finally, Figure 3 shows the Xlet interface when class 3 alerts are transmitted. In these cases, besides JPEGs and text elements, the A/V signal captured at the CPOC premise is also shown.

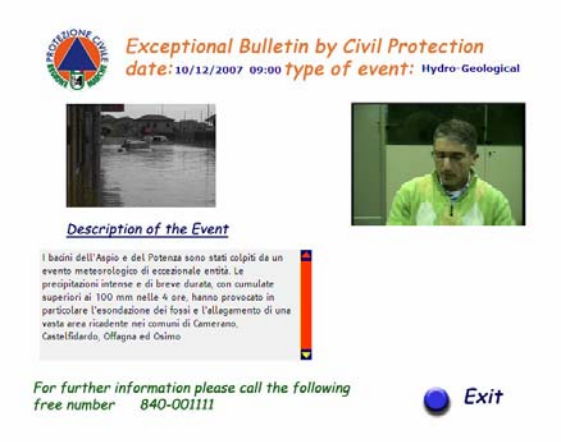


Figure 3. Class 3 alert description

Aiming at delivering the alerts without any action required by the users, the TRUE-Xlet is configured to auto-start: when broadcast and downloaded by a STB tuned on the proper service, it is automatically executed, without interrupting the TV program. The auto-start status is signalled in the AIT associated with the service the STB is currently showing. If killed by the user (by pressing the Blue button on the RC), the Xlet will not restart automatically, but the user may start it again on his own will.

The graphical interface shown in Figure 3, and, in general, any of the Xlet pages, is composed by textual and pictorial elements. To provide a real-time updating of the information delivered to remote viewers, even when they are passively watching TV, it is necessary to act at server side, and to configure the monitored resources in the Xlet as DSM-CC objects. To check the timeliness of a file, each object in the OC has a version number and can be updated as the carousel is being broadcast.

From the server side, any time the CPOC operators change a monitored resource, a script rebuild “on the fly” the transport stream in order to broadcast the updated content. This is accomplished in a way that is similar to the original generation, but with the version number parameters of AIT and DSM-CC changed and updated accordingly.

The following code extract shows a part of the AIT: the version number is set as a parameter, and updated every time one of the file system elements changes:

```
#define ait section

ait = application_information_section(application_type =
DVB_J_application_type, common_descriptor_loop = [],application_loop =
[application1,…])

…

ait.set(version_number = int(Params['vernum']),section_number = 0,
last_section_number = 0)

…
```

On the client side the TRUE-Xlet is able to "listen to" DSM-CC objects updating, to acquire their new versions, as follows:

```
try {

cf1 = new DSMCCObject("flood_picture.jpg");

cf1.addObjectChangeEventListener(this);

cf1.setRetrievalMode(DSMCCObject.FROM_STREAM_ONLY);

cf1.asynchronousLoad(this);}

catch (Exception e) { … }
```

OCs support the notion of version number for the module transporting a given file. A *DSMCCObject* can be registered not only for asynchronous loading events, but also for change events. The *ObjectChangeEvent* carries the current version number, and also the *DSMCCObject* that has changed. A *DSMCCObject* state can be monitored using the *ObjectChangeEventListener* interface. Listeners of this interface will be notified by the STB, that triggers an event whenever the monitored version number changes. The DSM-CC object (a JPEG file, in this example) retrieval mode is set to *from_stream_only*: the STB is in any case forced to download the JPEG file from the stream currently on air, so that the displayed image is always the last and updated one. The picture may be also resized, to make it suited to a TV screen visualization.

Asynchronous data access is performed by the method *asynchronousLoad()* on the *DSMCCObject*. The method call is non-blocking, i.e. the application continues execution while the *DSMCCObject* is loaded. When loading is complete, listeners implementing the *AsynchronousLoadingEventListener* interface are properly notified.

CONCLUSION

This paper presents an innovative service, exploiting the joint adoption of videoconference and DVB-T technologies, together with the MHP capabilities, to quickly disseminate emergency alerts to rural users. The service requires a proper configuration of the transmitting system and the MHP application, to ensure alerts visualization, in a way that is independent from the specific TV program viewers are tuned on. This service is currently under test on the local DTT infrastructure of the Regione Marche.

REFERENCES

[1] ITU International Telecommunication Union, RCC-06 WG, "Status of DVB-T Implementation in Europe", April 2006, available at: http://www.ero.dk/

[2] Gambi, E., Spinsante, S., Baldi, M., Righi, G., Ronzino, G. (2006) A system level integration for Remote Learning Services Based on DVB-T Platform, *Proceedings of IASTED International Conference on Internet and Multimedia Systems and Applications EuroIMSA 2006*, Innsbruck, Austria.

[3] López-Nores, M., Pazos-Arias, J., et al (2005) Bringing Standard into T-learning, *Proceedings of EuroITV 2005, 3rd European Conference on Interactive Television, User-Centred ITV Systems*, Aalborg University, Denmark.
[4] Fernàndez Ubiergo, G. (2007) Interactive Television Services for Telemedicine (T-HEALTH), *Proceedings of CATAI2007 – Telemedicine Standardization – XV Winter Course*, Tenerife Canary Islands, Spain.
[5] ETSI TS 102 812 – Digital Video Broadcasting (DVB) – Multimedia Home Platform (MHP) Specification 1.1.1, June 2003.
[6] Web site: www.rete.marche.it, December 2007.
[7] ETSI EN 300 744 v1.5.1 – Digital Video Broadcasting (DVB) - Framing structure, channel coding and modulation for digital terrestrial television, November 2004.
[8] ISO/IEC Digital Storage Media Command and Control (DSM-CC) ISO/IEC 13818-6 International Standard, July 1996.
[9] Morris, S., Smith-Chaigneau, A. (2005) Interactive TV Standards: a guide to MHP, OCAP and JavaTV, Focal Press.