

Mobile hybrid networks for tourist service provision in small Destination Management Organizations

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Abstract

The combination of broadcasting networks with the emerging Digital Video Broadcasting – Handheld (DVB-H) standard and broadband cellular communication networks, produces a hybrid network with interesting potential for mobile multimedia tourist applications. This hybrid network allow tourists to access tourist multimedia contents while on the destination, combining several telecommunication networks in order to provide innovative added-value services. This paper presents the design, implementation and evaluation in a small destination of a hybrid network composed of point-to-multipoint technologies for the provision of general information about the destination (Points of Interest, agenda, food and beverage, accommodation) that are the same for all tourists; and point-to-point technologies for a point-to-point interaction to access personalized added-value services (ticket purchasing, personalized contents).

Keywords: hybrid network, tourist services; authoring tool; validation; small destination.

1 Introduction

Many mobile applications and Location-Based Services (LBS) have been implemented for cellular technologies such as GSM, GPRS or UMTS. However, if many people at the same time and place interact with those applications with high data rate requirements (i.e. video streaming), even 3G networks like UMTS face several limitations. This is where the standard for high bandwidth point-to-multipoint communication Digital Video Broadcasting (DVB) comes into play. DVB is designed to transmit high volume data (mainly video) which will be used simultaneously by a large number of users. Moreover, DVB-Handheld (DVB-H) enables broadcasting digital television as well as data to mobile devices. As next generation devices may be equipped with a cellular network, it is likely to combine both networks to achieve an effective hybrid network. In such a way, new types of multimedia applications for mobile users may be created.

This paper presents the design, development and validation of a hybrid technological platform that allows accessing tourist multimedia contents while on the destination, combining several telecommunication networks in order to provide innovative added-

value tourist services. Therefore, two technologies have been combined: DVB-H technologies for the provision of general information about the destination (Points of Interest, agenda, food and beverage, accommodation) that are the same for all tourists; and UMTS, GPRS or HSDPA/HSUPA technologies for a point-to-point interaction to access personalized added-value services (ticket purchasing, personalized contents).

This paper is organized as follows. Section 2 describes briefly the state of the art in mobile television and hybrid networks, as well as examples of existing applications. The methodology implemented for the development of the hybrid network, the authoring tool implemented and the mobile services developed are described in Section 3. Section 4 describes briefly the validation scenario and the results of the evaluation campaign. Finally, conclusion and further work are summarized in Section 5.

2 State of the art

2.1 Mobile broadcasting

Broadcast networks are point-to-multipoint networks (like common television), which deliver data simultaneously to a large number of users. Recently, digital video broadcast (DVB) has evolved as a standard for broadcasting digital television as well as data services (DVB Project, 1996). As a standard for high bandwidth point-to-multipoint communication, DVB-T is designed to transmit high volume data, to be used simultaneously by a large number of users (Reimers, 2001). A DVB-T network is built up by a number of cells, each cell covering an area of up to 50 km in radius.

DVB-H (Digital Video Broadcasting-Handheld) is the latest European standard for the transmission of broadcast content to handheld terminal devices, developed by the international Digital Video Broadcasting Project and published in 2005 by ETSI (DVB Project, 2004). It is based on the European DVB-T standard for digital terrestrial television but tailored to the special requirements of the pocket-size class of receivers. Using broadcasting networks while being mobile is especially challenging, as power capacity, storage space, and processing power of the end devices are rather limited. In addition, mobile devices might not be continuously online due to limited network coverage or power supply. Thus, DVB-H optimizations for mobile reception include Time-slicing, Multi-Protocol Encapsulation, and an additional 4K transmission mode.

The data to be broadcasted is organized in carousels, which repeat their content periodically so that users can watch programs or retrieve data on a regular basis. The content of the carousel can be changed on the run partly or totally. Round times are still a question to be answered depending on the type of data. While specific data like news should be available frequently, others such as weather forecasts might be interesting only for a short time.

2.2 Existing hybrid systems

Although DVB-H supports multiple media and data channels, it remains a unidirectional transmission path. Thus, it enables only purely local interactivity where viewers interact with e.g. Electronic Service Guide (ESG) information or applications downloaded to the terminal via IP Datacast. More advanced interactivity concepts (quizzing, side-information browsing and ticket purchase) require a bi-directional return-channel over a unicast network for the exchange of personalized content and information.

The combination of such powerful point-to-multipoint broadcast to reach mobile devices with a supplementary point-to-point interactive communication network forms a hybrid network (Heuck, 2004). Several projects have worked in the field of hybrid platforms for advanced interactive service applications.

Hartl *et al.* (2005) describe the setup of a hybrid mobile-broadcast network in Berlin, using DVB-H as the broadcast system and the existing GSM/SPRS network as the interaction channel. Three types of services were implemented in the pilot trial: streaming of TV-like content to mobile devices; interactive TV providing voice call-in, SMS or mobile web access as the return channel; and service and content download independently from transmission time with different options for the return channel.

The “night scene live” prototype (Balzner *et al.*, 2005) demonstrated the potential and special features of the hybrid network in the domain of mobile entertainment. To aid revellers in their decision on where to go, videos from parties are broadcasted to party-revellers, attracting them to current events and helping them to stay informed about what is going on where. Videos and additional information for each event, such as who is performing, the music style and happy hours can be selected in a web portal.

Moreover, Klinkenberg and Steckel (2006) introduced an approach to modularize interactive services in broadcast-only and respectively hybrid networks. Their work focuses on Java applications delivered via DVB-H and the IP Datacast framework on top.

Regarding European projects, the LIVE project (Bürger *et al.*, 2007) aims at the development of semantic-based and user/content-aware systems to pioneer intelligent self-describing interactive TV content. The project relies on an intelligent media framework to match the content with personal user preferences. The concept even envisages letting audience feedback influence the live editorial workflows in real-time.

Finally, the Amuse project has developed a platform to present the scenario and requirements enhancing live sports coverage via interactive mobile TV (Schatz, Wagner and Berger, 2007). The context of an alpine skiing event provides a typical

sports event situation which demands real-time reception of information about the current status of the race, the start-order, ranking and the “did-not-finish” list.

As a conclusion, it is clear that hybrid networks could have an enormous impact on destination promotion and Location-Based services while in the destination. However, most of the existing applications are more related to entertainment and sports. Thus, Destination Management Organizations (DMO) should deeply analyze the possibilities in order to integrate these innovative approaches in their technological roadmaps. In this paper we present an example of the design, implementation and evaluation of a hybrid network, describing the required step for a functional DVB-H implementation focused on the tourism domain.

3 Description of the prototype

3.1 Architecture

Fig. 1 shows the basic communication networks and required architectural components of a hybrid network. The unicast path is based on UMTS/HSDPA network, analogous to common real-world hybrid trial deployments. Standard-compliant DVB-H broadcast equipment is used for IP encapsulation, multiplexing and transmission.

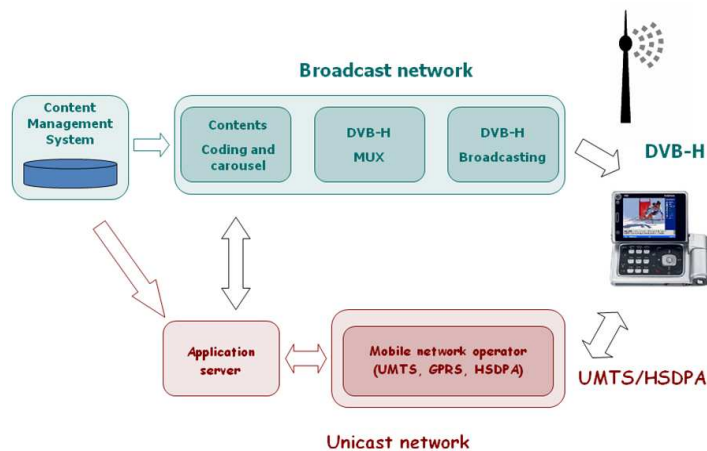


Fig. 1. Architecture of the proposed hybrid network.

Content and information are exchanged via both the broadcast and unicast paths (Fig. 2). Multimedia content are provisioned via similar programmable tools and can be modified in real-time. Unicast is primarily used for one-way (e.g. promotional videos) and two-way interactivity including personalized content exchange, ticket reservation and additional on-demand (video) content.

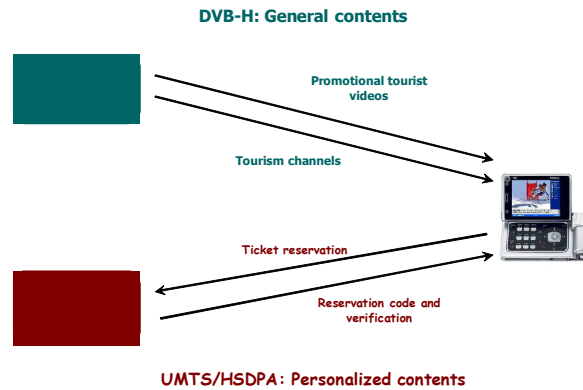


Fig. 2. Examples of tourist contents in a hybrid approach.

3.2 Design of the DVB-H network

A methodological approach has been designed and implemented for the design of DVB-H networks in tourist destinations. Generally speaking, the objective of coverage planning for these networks is to provide sufficient signal quality over the destination with minimal network cost, while keeping the potential interference under a specified level. Practically, this means that given a tourist destination and the operation frequency, a candidate set of sites in which a transmitter or a gap-filler will be place should be determined at each destination.

First of all, the site with the wider coverage has to be determined. In order to broadcast multimedia contents using the DVB-H standard, a radio network that preferably uses a UHF channel of the radio spectrum is required. As this spectrum is regulated, it is compulsory to find a free channel with broadcasting permission in order to offer the service.

In order to determine the geographical coverage of the DVB-H network, several parameters have to be fixed, such as the description of the network with information about the transmitters and the coverage area; the geographical coordinates of each transmitter (latitude and longitude); the characteristics of the radiant system in each transmitter; the average power of the transmitters or the maximum equivalent radiant isotropic power.

All this information is processed using a special GIS software to dynamically simulate a gain map to define the optimal position of the transmitters and the size of the DVB-H cells for each destination. A gain map is defined as a map of gain values for a fixed cell radius, at the same resolution and size as the scenario map. This map is calculated for each point of the destination area. Once the position and size of the DVB-H cells have been determined, the antenna height and transmission power have to be estimated.

The software includes a propagation model which estimates the signal level received in each location of the destination, taking into account the propagation losses suffered by the signal due to different propagation mechanisms such as reflection, refraction or scattering. Its dynamic simulation allows evaluating the overall QoS perceived by tourists for a given information as a function of the transmission configuration.

3.3 Authoring tools for generating carousels

As it has been mentioned before, the Electronic Service Guide (ESG) includes information about the services available. Tourists can select the services and items they are interested in and find stored items on the terminal. Thus, this project has implemented an authoring tool for non-technical users to seamlessly automate the creation of the ESG, and therefore, to update the carousel of multimedia contents that will be broadcasted. The tool is based on the XMLTV standard, which is used for the programming of the ESG, and has been implemented in Java to develop user-friendly interfaces.

No previous knowledge about XML or DVB-H is required to work with the tool. People at the DMO have to determine the starting time of the emission of the promotion contents, define the channels and programs, and combine them using the interface. It is also possible to load and modify existing ESGs created with the tool. Fig. 3 displays the graphical interface of the authoring tool. There are several tabs on the top part, each of them representing each of the channels that compose the ESG. Each tab displays the corresponding information for each channel, with five main sections.

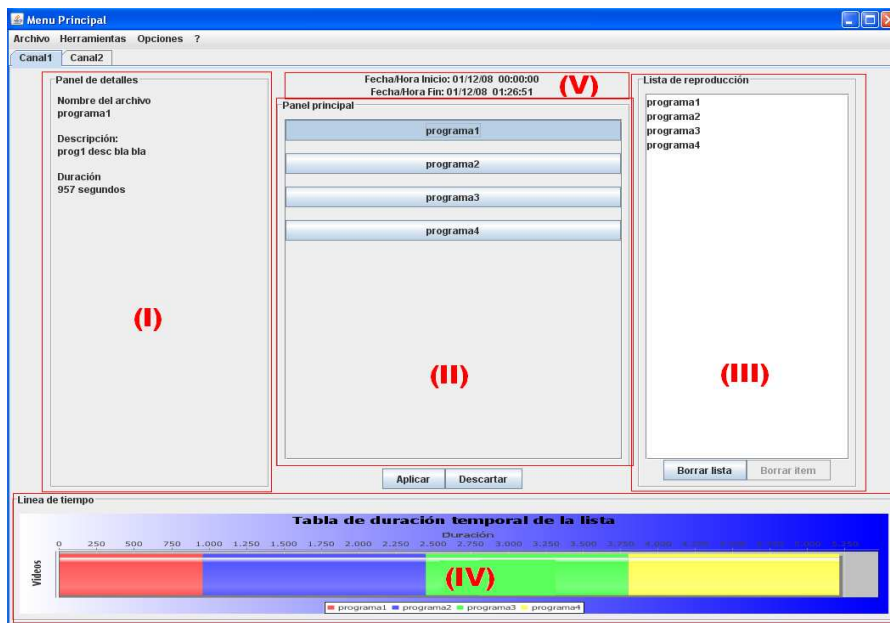


Fig. 3. Main GUI of the authoring tool.

The panel with the details of the program (I) displays the basic information (name, description and duration) of the selected program in panel II or III. Panel II lists all the created programs for the ESG, including all the details. This panel is common and identical for all the channels. The emission list (III) shows the programs in the same order as they will be broadcasted. This list can be edited to add, modify or delete programs as well as to change the emission order. Timetable (IV) represents graphically the emission list, so that the user has a visual image of the duration of each of the selected programs. Finally, panel V displays the time and day of beginning and end of the carousel.

Once the carousel has been generated, the authoring tool creates the corresponding ESG. Moreover, the videos and applications included in the carousel are transmitted to the DVB-H equipments in order to be broadcasted.

3.4 Definition of the mobile services

DVB-H allows the transmission of applications and services related to the video content that is being broadcasted, which can be freely accessed by tourists from their mobile devices. Furthermore, the proposed hybrid communication network offers new opportunities for mobile services. Bandwidth-intensive non-personalized contents (i.e. good quality videos) can be linked to specific applications related to the content. These applications should contain profile information to recommend contents and tourists activities that could be of interests for different tourist profiles.

However, due to current technical limitations, the DVB-H hardware is not accessible from custom mobile applications. The JSR-272, Mobile Broadcast Service API for Handheld Terminals defines an optional package in the Java ME environment for interactive broadcast services for mobile terminals. The API is designed to provide full control of a broadcast service implementation on a device. However, as no manufacturer has implemented this API yet, mobile DVB-H applications have to make use of the embedded DVB-H player, delegating the access to the broadcast content and application in the player. Although this should not be a serious limitation, the DVB-H player provided by the hardware manufacturers does not correctly receive the broadcasted data.

In order to overcome this problem, the implemented approach attaches links to the broadcast videos. The DVB-H player is able to recognize this type of content and notify users that additional contents and services are available. Tourists can follow these links to open a mobile application from their browser, communicating with the web server through the point-to-point network. A mobile tourist portal has been implemented (<http://oinati.batura.mobi/>) in five different languages related to the main tourist profiles of the destination (Spanish, Basque, Catalan, French and English) (Fig. 4). Although it is based on the existing destination portal, contents have been reformatted due to the limitations of mobile devices.

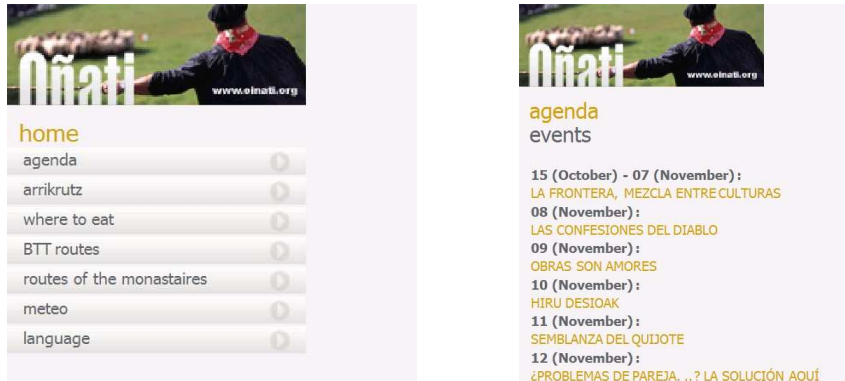


Fig. 4. (a) Main menu of the mobile application; **(b)** Agenda.

Available multimedia contents and applications are related to the daily cultural agenda, information about top resources of the destination (the caves of Arrikruz, the University), restaurants, trekking and cultural routes, and weather forecast. In order to simplify the navigation through the application, the DMO has to redefine the message and the contents provided. One of the main services implemented is the reservation of tickets for the caves.

4 Validation

4.1 Description of the evaluation campaign

The prototype has been validated in the municipality of Oñate. Oñate is located at the heart of the Basque Country (Spain), a small destination in a valley surrounded on all sides by verdant mountains, except to the south. Moreover, it is considered as one of the most relevant historical place in the province of Gipuzkoa, being a popular tourist destination (around 20.000 visitors during 2009). One of the main attractions are the caves of Arrikruz, with nearly 3.500 visitors between July and August 2010.

First, the design of the DVB-H network has been conducted in close collaboration with the regional and local broadcasters. After calculating the most convenient location for the transmitter (in this case, one transmitter has been enough) and receiving the required legal authorizations to use a free channel to broadcast, the final step has been the deployment of the DVB-H hardware equipment. The DVB-H platform from SIDA has been selected, as it offers an overall solution known as POLARPLUS. This transmitter and the required antennas have been installed in the emission centre of Belar, reaching a good coverage level of Oñate.

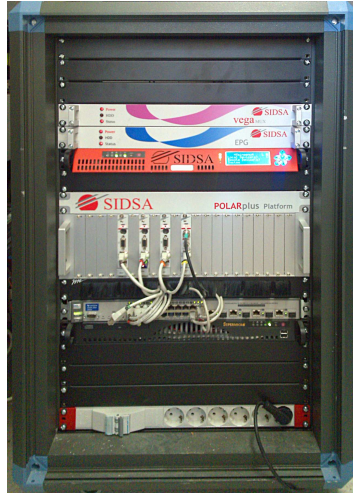


Fig. 5. DVB-H hardware.

Regarding the multimedia contents, two main sources of contents have been used for the evaluation campaign. On the one hand, seven broadcast videos have been recorded and produced by the DMO (Fig. 6), each of them oriented to different profiles of tourists (nature, culture, traditions.) All the videos have been recorded in both Spanish and Basque, and have an average duration of ten minutes. On the other hand, contents from the local television were also broadcasted, so that visitors could also feel and know the daily life of the citizens. The contents have been organized in carousels so that they are repeated periodically. These contents can be easily modified by the destination using the authoring tool.



Fig. 6. Frame of a broadcasted video.

Tourists were able to access general tourist information about the destination (non-personalised) using DVB-H technologies. If the tourist is interested in getting more information about any of the presented Points of Interest (such as purchasing tickets for the caves), the mobile device connects to a point-to-point network (UMTS, GPRS or HSDPA/HSUPA) in order to provide personalized information to the user.

Four Nokia N96 devices suitable for DVB-H standard have been available for loan at the DMO. Tourists were invited to try the prototype when visiting the tourist office (Fig. 8).

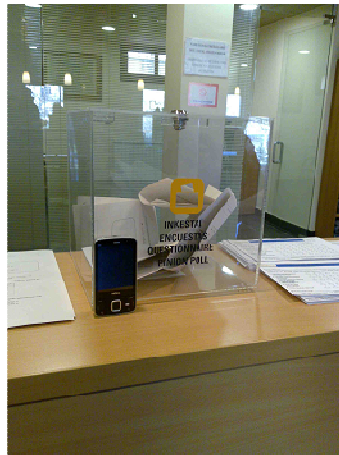


Fig. 7. Stand inside the tourist office to hold the questionnaires.

Questionnaires have been designed and implemented by the DMO in close collaboration with the technological providers. The following aspects have been collected: profile of the visitor (data about their range of age, gender, origin, education and familiarity with new technologies); easiness of use of the mobile device (size of the screen, the size of the device or the use of the keyboard); features of the multimedia contents (quality of the contents (both video and audio), the perceived quality of the broadcasted content and the duration of the videos); and willingness to pay and overall satisfaction.

4.2 Results of the evaluation

18 people (eight male and ten female) mainly between 15 and 45 year old (although there were two people over 60), took part in the evaluation campaign. Nearly one quarter of the users were frequent Internet users and more than one third were familiar to the use of laptops.

The first set of questions was devoted to analyze the usability of the mobile device. Most of the users were satisfied with its size and weight, although 25% of them thought it was too big. Anyhow, all of them agreed on the usability of the keyboard to interact with the device. Another critical aspect is the size of the screen which was

acceptable for two thirds of the users. Finally, the answers about the easiness of use of the device have shown that two thirds of them were able to interact with the platform without further explanations. It was also quite easy to select the multimedia contents from the carousel.

Users were also asked about the perceived quality of the multimedia contents available about the tourist resources of Oñate. Only 12.5% of the users were not very satisfied with the perceived quality. The answers were much more disperse when querying about the duration of the videos, so it was not possible to gain a clear conclusion. Technical limitations about the reception of the DVB-H signal were also queried. The main problems arise in very narrow streets in the Old Town in Oñate and indoor. This problem can be solved with a radio license allowing transmitting signal with more power. Regarding the perceived value of watching tourist videos, more than half of the users considered that videos had a very high or high utility. Only ten percent of users considered that tourist videos had low or very low value. The perceived value of watching regular TV channels on the mobile phone was not so high; less than a quarter of the users considered that it had a very high or high utility, a third of them an appropriate utility, and nearly half of them low or very low utility.

Although many other questions were asked about the perceived utility of the services available, the questionnaire provided very useful information about the willingness to pay for the offered services. Most of the users would pay for broadcasting services related to tourist contents, but they would not pay for watching general mobile television. Finally, and although weather forecasts have always been seen as a crucial mobile tourist service, only 12% of the users would only pay for those contents.

5 Conclusions and future work

In this paper, we have presented a hybrid technological tourist platform based on point-to-point and point-to-multipoint networks. DVB-H is the European standard for the transmission of broadcast content to handheld terminal devices. In the hybrid approach, the DVB-H network is used to deliver non-personalized tourist content (multimedia and data) of general interest to mobile devices. Tourists can consume this content and make use of the point-to-point network to access personalised content of their interest. The methodology to design and implement a hybrid network for tourist purposes has been presented and validated in a small tourist destination.

Although results from the evaluation campaign have been very positive and encourage further work on the real implementation of hybrid networks in tourist destinations, different factors may affect the success of such networks. Regarding the costs of the required infrastructure, it is obvious that a big investment in infrastructure is required for wide coverage areas. Moreover, the future of DVB-H is not clear. Although there are a lot of big players involved (content providers, telecommunication operators, broadcasters) and there are some successful examples in Asian countries, in Europe no one has dared to face the required investment. Thus,

the DVB-H coverage has been mainly limited to testbed scenarios or very restricted areas.

However, the potential of hybrid networks in the tourism sector cannot be denied. As a future work, the use of the transport protocols defined in DVB-H applied on Wifi based multicast networks should be analyzed. This type of hybrid networks requires a minimal inversion and present engaging open research topics.

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