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Television on a handheld receiver

- broadcasting with DVB-H

Digital Terrestrial Television Action Group

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Introduction

Over the last ten years digital technology has encouraged a rapid growth in the personal consumption of media. The advent of personal video recorders (PVRs), video-on-demand and the multiplication of programme offerings have enabled viewers to personalise the content that they want to watch. And with interactivity, viewers can directly express their preferences to broadcasters.

As part of this trend, and alongside the growth of mobile telephony, new technologies have been developed that enable viewers to watch streamed television-like services on their mobile telephone. The place of viewing is no longer limited to the television receiver at home, or in a vehicle, but is widened to allow personalised viewing of television by individuals wherever they are located.

The development of the Digital Video Broadcasting to a Handheld (DVB-H) standard makes it possible to deliver live broadcast television to a mobile handheld device. Building upon the strengths of the Digital Video Broadcasting - Terrestrial (DVB-T) standard in use in millions of homes, DVB-H recognises the trend towards the personal consumption of media.

Already, DVB-H has created much excitement. Articles in the media herald personal television on the move as a "killer application." But because DVB-H receivers can and often will combine the functionalities of a mobile phone and a television, the concept has also raised fears. Who will "own" the new service offering? Is DVB-H a broadcast service, a mobile phone service, or a mixture of the two? What are the potential business models that will allow service providers to cooperate to build new services and markets together seamlessly?

The purpose of this DigiTAG handbook is to provide an overview of broadcast television services to a handheld device using the DVB-H standard. Addressing the key commercial, technical and regulatory issues, this handbook seeks to inform members in the DVB-H value chain and regulatory domain about the new technology. So informed, they will be in a stronger, more enlightened position to define their strategy towards DVB-H, and help to grow the market for handheld television.

SECTION

1

Broadcasting to Handheld Devices

The deployment of digital terrestrial television services

National governments are beginning to prepare for an all-digital broadcast environment. As plans are made to end conventional analogue television services, broadcasters can exploit the capacity and flexibility offered by digital systems. For example, broadcasters can provide quality improvements, such as High-Definition television (HDTV), offer many more interactive features, and permit robust reception to receivers on the move in vehicles and portable handhelds.

Several digital terrestrial television standards exist. The Advanced Television System Committee (ATSC) standard provides HDTV services with fixed antenna reception although it does not allow for mobile or portable television reception. This standard is currently used in North America and South Korea. The Integrated Services Digital broadcasting (ISDB-T)

standard developed and adopted in Japan provides audio, video and multimedia services for the terrestrial television network including mobile reception and HDTV.

In Europe, the initial foray into digital broadcasting focused on the development of a standard to provide for portable and roof-top antenna reception. The Digital Video Broadcast standard for terrestrial television (DVB-T) has proven effective in meeting much more than its initial requirement. For example, DVB-T has been used to provide television services in public transportation, as is the case in Singapore and Taiwan, and recent receiver developments make its use possible in cars and in high speed trains. DVB-T has been adopted in Australia to provide HDTV, and in Europe and Asia to provide multi-channel standard definition television.

Television to a handheld receiver

The concept of providing television-like services on a handheld device has generated much enthusiasm. Already, mobile telecom operators are providing video streaming services using their UMTS networks, or third-generation networks. However, the main alternatives to providing live television services on a handheld device currently available are DMB, ISDB-T, MediaFLO and now DVB-H.

Digital Multimedia Broadcast (DMB) delivers mobile television services using the Eureka-147 Digital Audio Broadcast (DAB) standard with additional error-correction. T-DMB uses the terrestrial network in Band III and/or Band L while S-DMB uses the satellite network in Band L. While the first convergent mobile phone DMB products developed made use of satellite frequency, LG Electronics presented the first T-DMB receiver with a mobile phone in November 2004. S-DMB services were commercially launched in May 2005 and a commercial launch of T-DMB services is expected in 2006.

Integrated Services Digital Broadcasting (ISDB-T), developed by Japan as its digital terrestrial television standard, provides some modes which are suitable for broadcasting for handheld reception. As part of its original digital television strategy, the government has allocated 1/13th of the digital television transmission network for mobile broadcasting to portable and handheld devices. The services are expected to be launched in 2006.

MediaFLO is a proprietary system developed by Qualcomm to deliver broadcast services to handheld receivers using OFDM. Qualcomm intends to roll-out these services in the 700 MHz frequency band in the United States since it holds a license in this part of the spectrum.

DVB approach to handheld television: DVB-H

Building upon the portable and mobile capabilities of DVB-T, the DVB Project developed the Digital Video Broadcasting on Handhelds (DVB-H) standard for the delivery of audio and video content to mobile handheld devices. DVB-H overcomes two key limitations of the DVB-T standard when used for handheld devices - it lowers battery power consumption and improves robustness in the very difficult reception environments of indoor and outdoor portable use in devices with built-in antennas. DVB-H can be used alongside mobile telephone technology and thus benefit from access to a mobile telecom network and a broadcast network.

DVB-H Pilot Projects

Several pilot projects and commercial launches that provide live television broadcast services are currently underway or in development in many parts of the world.

Australia

In Sydney, Australia, a year-long DVB-H trial commenced in July 2005. While first measuring service coverage, the trial will be expanded to include a commercial component with approximately 1000 users. Partners include network operator Bridge Networks, mobile operator Telstra and Nokia.

North America

Network operator Crown Castle has deployed a DVB-H pilot using a 5 MHz channel of L-band spectrum in Pittsburgh, the United States. While DVB-H was developed as the handheld reception solution for DVB-T networks, the use of DVB-H in the United States demonstrates

that countries using the ATSC system for high-definition television to stationary receivers are interested in DVB-H to provide mobility to portable and handheld devices.

Europe
The Broadcast Mobile Convergence (bmco) project conducted the first live broadcast of DVB-H services on 4 May 2004 in Berlin, Germany. Comprised of Nokia, Philips, Universal Studios Networks Germany and Vodafone Pilotentwicklung, bmco tested DVB-H services within a public, digital terrestrial television network.

In the Netherlands, the first DVB-H trial, supported by Nokia and Nozema Services, took place during the IBC 2004 Exhibition. In July 2005, a second trial was launched in The Hague with several hundred "friendly" users. This trial includes the city centre as well as some major motorways and railway lines leading to The Hague so as to test the mobility of DVB-H. Trial partners include Digitenne, KPN, Nokia and Nozema Services.

In Helsinki, Finland, Finnish Mobile TV launched the first commercial pilot for DVB-H services from March to June 2005. As part of the pilot, 500 test users accessed television services on Nokia 7710 receivers. Project partners include Nokia for the technology, the main private and public television broadcasters for the content, the two main telecom operators and Digita, the main broadcast network operator for the network. In August 2005, a similar trial was held during the IAAF World Championships in Athletics.

In Berne, Switzerland, Swisscom launched a technical trial of DVB-H services in January 2005. A commercial trial is expected to begin in Autumn 2005.

In Cannes, France, network operator TDF led two DVB-H trials in early 2005. TDF demonstrated DVB-H services in February for the 3GSM Congress and in April for the MIP-TV conference. Nokia supplied the service system and receivers for these demos. More extensive trials are expected to begin in the region of Paris in Autumn 2005.

In Oxford, United Kingdom, a commercial pilot will supply 350 test users with Nokia DVB-H receivers with telephone functionalities. Project partners include Arqiva, O2, Nokia and Sony Semiconductors & Electronic Solutions.

In Spain, the government has approved DVB-H pilot projects that will take place in Barcelona and Madrid from September 2005 to February 2006. Approximately 500 users will access DVB-H services using a Nokia 7710 receiver. Partners include the network operator Abertis, Nokia and Telefonica Moviles.

In Denmark, a technical DVB-H trial is expected to be launched. Coordinated by the University of Denmark, partners include Nokia and Motorola for the DVB-H receivers, TDC for telephone services and public broadcaster DR for broadcast services.

SECTION

2

DVB-H value chain

Viewers
DVB-H enables viewers to watch television programmes on a handheld device. Such handheld televisions are likely to be considered personal items as the act of viewing increasingly becomes an individual, rather than a social, activity. Services can be accessed when viewers are "on the move" - in public transportation, waiting for an appointment or while at work. Hence, handheld viewing will extend the hours of television watching to parts of the day when viewers are not at home.

While it may be less likely that viewers will use their handheld television when they can benefit from a larger television, this may not always hold true. Viewers may be tempted to continue watching television on their handheld device should this provide access to different viewing experiences or extra functionality. Viewers may also choose to continue using their handheld television to individually interact or zap programmes services, while simultaneously watching a television programme with others on a larger television.

From a viewer's perspective, television services from a handheld device have an instant appeal and have generated much interest.

Broadcasters
With their experience in creating and aggregating content, broadcasters have a privileged role in delivering content for television services to a handheld device. In Japan, broadcasters have driven the launch of handheld television services.

However, broadcasters will need to define the level of their involvement in the DVB-H service offering. For example, will broadcasters manage the end-relationship with viewers or prefer to delegate this role to another party? And, if the second option is preferred, will broadcasters accept the packaging of their content in a third-party offer?

Broadcasters may not be alone in providing services. It is possible that other players, such as mobile phone operators, may by-pass broadcasters in the delivery of television services to a handheld device. At this stage, however, broadcasters are in a strong position since DVB-H is a new broadcast service offering that uses the broadcast spectrum to deliver broadcast services to a new type of television receiver.

Mobile telecom operators
Should mobile telecom operators be willing to integrate their mobile telephones with a DVB-H receiver, broadcasters may benefit from this partnership. Mobile telecom operators have access to a large customer database and a sophisticated payment system which can be used for customer billing. Because many consumers view mobile telephones as "trendy" devices and willingly change them every few years to benefit from new features or fashion, a service delivered via a combined TV/mobile phone may have a great potential for success. Mobile operators have already installed a dense networks of cellular transmitter sites which may be helpful to use for the roll-out of DVB-H services.

But incorporating a mobile phone into a DVB-H receiver means that mobile telecom operators will have a crucial role in the delivery of broadcast services. One can question whether mobile telecom operators will want to integrate a broadcast television receiver on their handheld telephones since this may lead to a reduction in the amount of telecommunication messages sent as consumers may be encouraged to become passive television viewers. However, there is a growing belief that broadcast programmes can be used to encourage viewers to consume telecom services such as tele-voting or visiting a dedicated website.

Broadcast Network Operators
Broadcast network operators have been among the key drivers in the development of the DVB-H standard. This is not surprising given the potential benefits to be derived from the use of their networks.

Broadcast network operators have access to network infrastructures that can support DVB-H. Many of the broadcast networks have been built to provide portable indoor coverage of DVB-T services, the same type of coverage required to support DVB-H services. This means that much of the infrastructure is already in place although some extra investment will be needed in order to allow for reception in more challenging locations. And unlike other network operators, broadcast network operators already use the high tower masts needed for the primary coverage of DVB-H services.

In addition, the broadcast network operator is well suited to serve as the intermediary between the various service providers. Given the limited spectrum resources available, it is likely that only one multiplex will be dedicated to DVB-H services when these services are initially launched. As a consequence, service providers will need to share the available capacity and may prefer to rely upon an independent operator to manage the network.

Manufacturers
Manufacturers of consumer devices and professional system components have actively supported the launch of DVB-H services. Some manufacturers have indicated that they can make DVB-H receivers available by 2006.

The DVB-H prototype chips currently measured have already reached a satisfactory performance level and are expected to be mass produced by late 2005. Because a DVB-H chip (tuner plus demodulator) will likely be priced at under 10 Euros in mass production, the extra cost for including DVB-H services in a multifunctional mobile phone will be marginal compared to the total cost of the terminal.

Enablers
Various groups have been working to promote DVB-H and other mobile technologies based upon the DVB-T standard.

bmco forum (pan European)
Originally set up to trial DVB-H services in Berlin, the bmco forum has expanded its scope and aims to contribute to the development of mobile broadcast technologies. www.bmco-berlin.com

The IPDC Forum (pan European)
Officially formed in January 2002, the IPDC Forum is an independent non-profit organization which aims to contribute to the development of multimedia services delivered via broadcasting networks. www.ipdc-forum.org

Finnish Mobile TV (Finland)
The Finnish Mobile TV has supported several DVB-H trials in Finland. It launched the first DVB-H commercial trial in March 2005. www.finnishmobiletv.com

Go Mobile (Germany)
The Deutsche TV Platform has set up a specialized working group to address the handheld and mobile broadcasting market.

Mobile Applications Group (United Kingdom)
The Mobile TV Applications Group, a working group of the Digital TV Group (DTG), examines mobile television services. They recently published the Handbook of Mobile TV Applications, a comprehensive survey of all mobile television applications. www.dtg.org.uk

Mobile TV Forum (France)
In November 2004, the French Minister of Industry launched the Mobile TV Forum with the support of 50 French companies from diverse industries, including broadcasters, mobile telecom operators, broadcast network operators and manufacturers. The group aims to work together to promote “television on-the-go”.

Research projects
DVB-H is supported by the European Commission through a number of European collaborative projects, including *Cismundus*, *Instinct*, *Daidalos*, *Enthrone* and *Wing TV*.

SECTION

3

Implications for broadcasters

New opportunities

The role of broadcasters is changing as a consequence of the move towards an all-digital broadcasting environment. With the arrival of new delivery methods for viewing audiovisual material, such as the Internet, personal video recorders (PVRs) and handheld devices, broadcasters can offer their audience access to programme services and archived material through any, and all, of these methods. Increasingly, broadcasters are choosing to become delivery-method agnostic and re-focusing their role on being content providers and aggregators.

Taking the BBC as an example, it has declared in its vision for the future *Building public value* that it 'will use the best of the new digital technologies to make its content more personal, more convenient and more relevant ... using the internet, mobile technology, broadband and interactivity, the BBC will be a pioneer and innovator, combining old and new media to offer a range of new services." The BBC's vision is clearly that mobile technology will have a significant place alongside internet, broadband and interactivity to provide new services.

Handheld television services enable broadcasters to reach their audience regardless of where viewers are located. Watching television will no longer be limited to the home, the conventional location for television consumption. Rather broadcasters can remain in contact with their audience throughout the day.

Depending on the time of day, broadcasters may find new audiences eager to consume television especially created to fit the moment and situation. Be it current topical material, programmes targeting viewers in movement, or a small screen simulcast version of the main programme services, broadcasters will be able to use handheld television to keep in touch with their audience, maintain service loyalty and inform, advertise and build up to the mainstream offering for the home television.

Television services integrated into a mobile telephone facilitate easy viewer interaction and enable sophisticated television programmes. While interactivity may be as simple as SMS voting in a first phase, it could later lead to the development of fully interactive programme formats which could, in turn, help generate revenue. Such services are key for telecom operators since they may otherwise risk losing revenue due to a reduction in normal call traffic when the user watches television.

Content

Not all existing television content is suitable for watching on a handheld device. Nevertheless live simulcasting of the existing linear TV-channels could be relatively simple to achieve, very attractive and easy to market. However, much handheld television consumption will be in snatched moments, or in idle times between other activities. As such, conventional schedules based on hour and half hour segments will not be well suited to these moments. Rather, the format of the content watched from a handheld television will likely consist of short and easy to understand sequences.

Live news, sports, weather, music and cartoons clips have emerged as the types of programmes preferred by viewers. The tie in with programmes watched later at home is an obvious benefit for broadcasters. But because new services can stimulate new viewing behaviour, it may be premature to draw conclusions. In fact only tangible experience will demonstrate what viewers will want to watch from a handheld television.

Screen-size

Handheld screen sizes will resemble those of mobile phones and personal digital assistants (PDAs). They are likely to vary from approximately 5 cm to 12 cm diagonal with a very sharp

pixel resolution. Early DVB-H tests of normal TV recoded to around 200kbit/s for display at CIF resolution (352 x 288) offered an enjoyable viewing experience and even permitted the reading of normally sized captions.

While the simplicity of such direct recoding is attractive, some types of traditional television programmes risk losing out in usability. This is the case with sports such as football and ice-hockey. However, with minor editorial intervention, broadcasters can select a window within the normal broadcast image to capture the part for display on the handheld terminal screen. By this means, the action in a football match follows the ball, the players in contact with the ball and the goal mouth. By cropping unnecessary details such as the grass, spectators and other players, broadcasters can zoom in on the action, all of which is extracted from the conventional television picture.

Cyclical presentations
As a low-cost alternative, broadcasters can re-purpose material for a repeated cyclical presentation. Appropriate material can be edited to the desired length and suitably-sized title and closing elements added. The material is then loaded into a carousel for repeated transmission. Some broadcasters have already begun building experience in the use of cyclical carousel presentation of material over enhanced broadcasting channels.

Interactivity
DVB-H television services can benefit from an interaction channel. Although interactivity has not yet been fully exploited for traditional television market, it may be facilitated through the adoption of DVB-H services since a personal device may be more conducive to such activity rather than a shared television set. Interactivity can be used to allow viewer voting, much like the phone call and SMS voting during such programmes as Pop Idol, or even allow viewers to participate in game shows alongside the televised contestants using, for example, built-in digital cameras.

Local guide services can provide viewers with information on a city or region, such as weather forecasts, film trailers and a teletext guide. With an interactive channel, viewers can request specific information. However, because of a standard middleware interface is currently lacking, some futher development is necessary before viewers are able to trigger interactive services directly from the broadcast system.

Current content on UMTS telecom networks
Although it is difficult to compare the service offering available from the UMTS networks while at the early stages of their roll-out, it is useful to understand some of the content currently available. Types of content which have had popularity with users include football video downloads, footage from reality television programmes and comedy clips

In one example, Vodafone in Germany provided its users with access to a complete feature film, *Was Sie schon immer über Singles wissen wollten*, the day before RTL broadcast the film on television. In the United States, Fox has recently made a one minute “mobisodes” of its hit television show *24* available for the Verizon mobile networks. A scaled down version of the show is also available.

Early information from the mobile phone market suggests that users are more likely to pay UMTS call charges for entertainment rather than for information. However, broadcasters can benefit from their well-known and respected reputation and use this to leverage their information services.

Content such as news bulletins, news alerts (video version of SMS news alert), sports highlights, weather forecasts and financial information are likely to have lasting appeal. But with very little practical experience of handheld terminal consumption patterns to draw upon it is still early to speculate as to what viewers using such devices will ultimately find compelling to watch.

SECTION

4

DVB-H business models

The market for handheld television services

Viewers have indicated their interest in watching television from a handheld device. A number of studies conducted throughout Europe confirm this. In one of these, the IPDC Forum commissioned a market study of the United Kingdom, Finland and Sweden in September 2003. The study showed that between 40-60% of mobile phone users are interested in receiving TV on their mobile phone and willing to pay up to 10 Euros per month for the service.

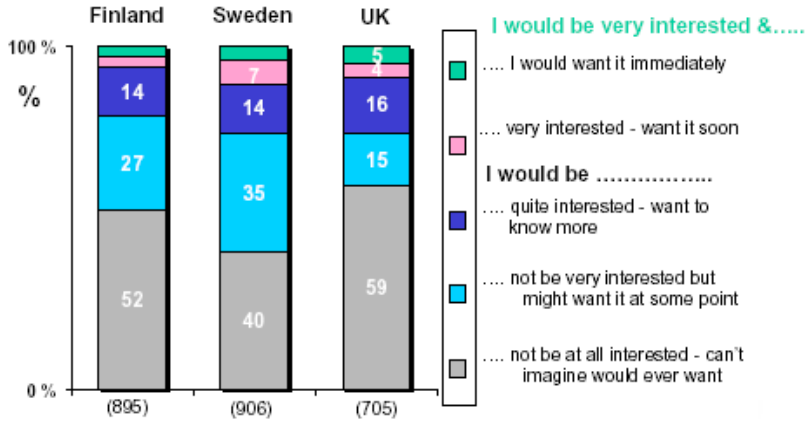


Figure 1: from IPDC Forum / HPI Research

The results of a study by the bmco project showed that 77.8% of respondents felt that having television on their mobile telephone was a good or excellent idea. These studies suggest that the market for television on a handheld will be quite large. The target audience numbers are even larger when considering that viewers are counted in individuals and not in households, as with traditional television viewing.

Broadcaster business incentives

While several incentives for service providers exist, they will depend on the players involved and the business model adopted.

New markets

Television on a handheld receiver will trigger different viewing habits when compared to traditional television. Viewers will be able to watch television outside of the traditional peak-hours, most likely in short slots of time. Thus, broadcasters will be better able to reach their evening peak time viewing audience at other times of the day

Revenue from subscription fees

Viewer payment for access to handheld television services can be handled either via a monthly subscription fee or a charge for each use like a pay-as-you-go formula. Market studies have shown that viewers prefer a subscription fee. In the bmco study, viewers indicated a willingness to pay between 8-12 Euros per month to access 6-8 different television programme channels.

With a subscription service, income will be generated based on the total number of subscribers. Considering that Vodafone currently has over 150 million customers worldwide, the potential subscribers base is quite large. In the United States alone, it is estimated that users will spend $30 billion annually on mobile television services.

Increased advertising revenue
Advertising budgets are increasingly being spent on advertisements in new media, such as the Internet. This means that advertising funds are being diverted from traditional media. DVB-H services provide a new advertisement opportunity in an appealing new media format. While providing advertisers with a new forum to market their goods and services it also enables broadcasters to increase their advertisement revenue.

With a return channel, advertising can be tailored for its intended audience. Advertisers will be able to locate the user, better understand user behaviour and benefit from viewer interaction. With user identification, personalised advertisement and micro-segmentation also becomes possible. Not only will this be advantageous for advertisers, but also permit broadcasters to receive higher tariffs for air-time.

Possible business models
In the case of providing DVB-H services, the following issues will need to be addressed:

- What kinds of services are offered to consumers?
- Who manages the end-relationship with consumers and who can market the service offering?
- What billing mechanism - if any - will be used to provide income? What other sources of income are applicable (i.e. public license fee, advertisement)?
- Who has access to the necessary DVB-H resources (i.e. spectrum, networks, etc)?
- Who can develop and deliver appealing content?
- What are the investment capabilities of each organisation?
- What synergies are possible within existing business activities?

The issue of managing consumer relationships is fundamental. Both broadcasters and telecom operators have long and successful relationships with their respective viewers and customers, but may have initial difficulties in finding a business model where they must cooperate. DVB-H services could be offered as a “stand-alone” service, with no associated telecommunication possibilities, but this would require a new ‘horizontal’ receiver market be established.

Alternatively, mobile telecom operators could take the leading role by aggregating the content, encrypting the programmes, offering the service and maintaining the networks, and marketing television as an extra feature of their handsets.
Telecom operators must recognize the proven capability of broadcasters to define attractive service bouquets that meet the demands of the viewing audience. Based on long experience, broadcasters have been able to successfully combine a variety of content into appealing packages. Viewers value and trust broadcaster brands. Bringing these powerful brands to a new platform provides a strong advantage.

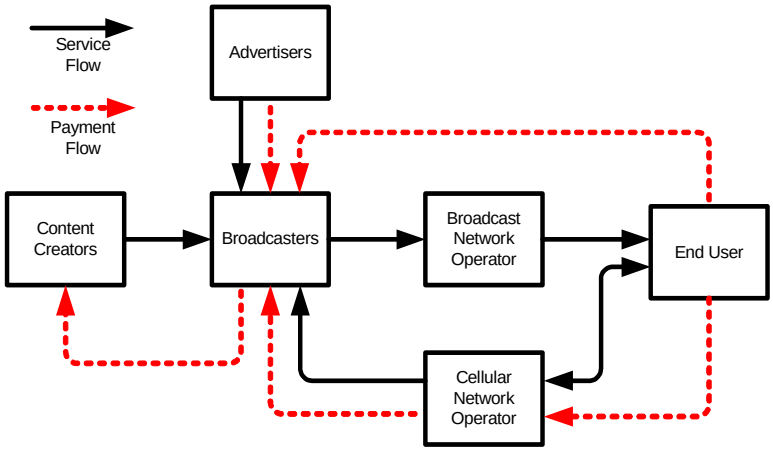
Broadcasters, on the other hand, must recognize that telecom operators have developed a large existing customer base which they may easily convert to mobile television using their impressive marketing skills. A pattern of subsidising user terminals against future subscription income is well established. Without the mobile telecom operators, it may be difficult to attain high user penetration of DVB-H-enabled receivers.

The next few paragraphs describe a variety of possible business models. The business models presented are neither all-inclusive nor exhaustive but can be used as examples.

The most simple model of a horizontal market for a handheld incorporating only a DVB-H receiver is not included since this would only develop some time from now when handheld receivers become available at gadget prices.

Model 1: Broadcaster-led approach with mobile telecom operator

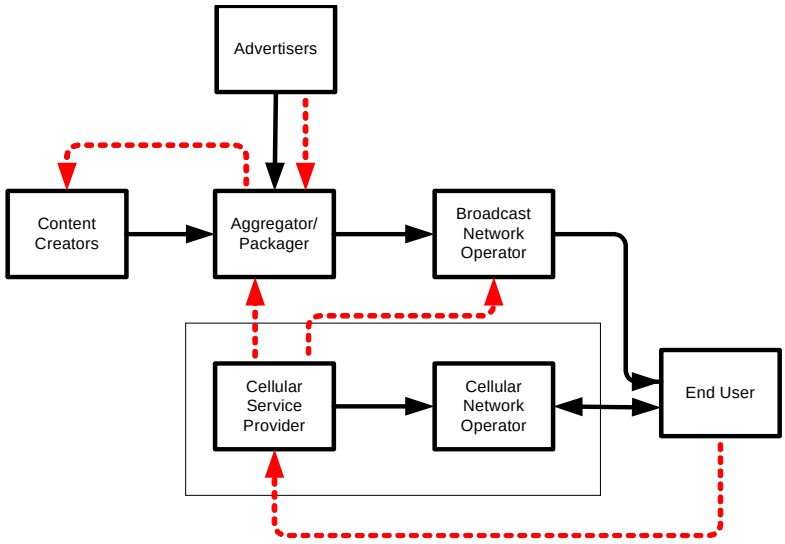
In this model, broadcasters manage the end-relationship with the consumer. The broadcaster receives payments for the use of the service, from consumers from the license fee, or subscription, or through payments made via the telecoms network operator. A variation on this could be broadcast funding from advertising revenue. As this is not an integrated service proposal, consumers may need to pay more than one service provider to obtain the different services. Fully interactive services are a possibility and a separate billing procedure will be necessary for consumers to pay mobile telecom operators for the use of such services.



The involvement of the mobile telecom operator may be limited except for linked telecom services. Given the expected initial high cost of DVB-H receivers, market penetration may be low if no receiver subsidies are offered.

Model 2: Mobile telecom operator-led approach with broadcaster

In this model, mobile telecom operators manage the end-relationship with consumers and are responsible for service provisions, marketing and customer care. In addition, mobile telecom operators will need to purchase spectrum and content from broadcasters and other content providers. Consumers have access to an integrated service proposition which means that a complete package will be offered by one service provider.

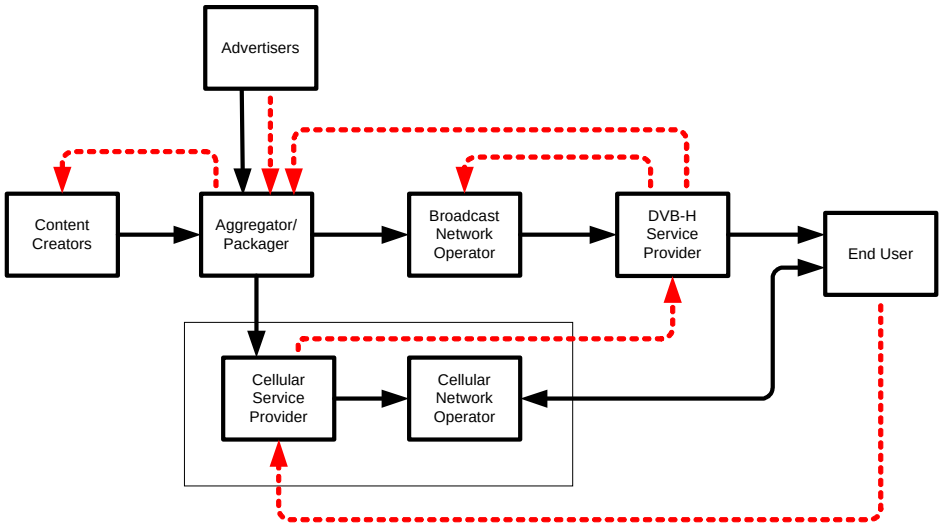


As a variation, mobile telecom operators could directly handle advertisements. While mobile telecom operators would be responsible for general marketing, it could be possible for broadcasters to market individual television programmes. For programmes that generate

revenue, for example using tele-voting, broadcasters would be responsible for marketing the programme while the mobile telecom operator would be responsible for the billing. Revenue would be shared.

Model 3: Independent DVB-H service provider approach

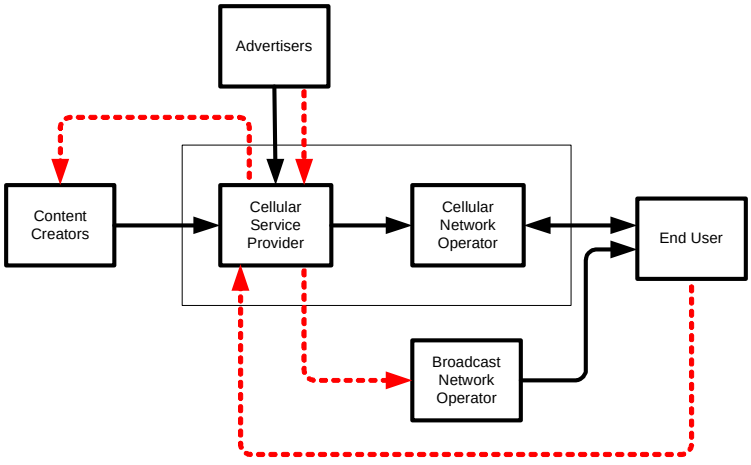
In this model, the mobile telecom operator manages the end-relationship with consumers and is responsible for service provisions, marketing and customer care. A dedicated DVB-H service provider acts as a facilitator for mobile operators in the aggregation of content and the use of the spectrum. Consumers have access to an integrated service proposition which means that a complete package will be offered by one service provider.



Variations in this model would include the handling of advertisements directly by the DVB-H service provider.

Model 4: Mobile telecom operator-led approach

In this model, the mobile telecom operator is responsible for all aspects of the value chain, from the content creator to the consumer. Broadcasters, or broadcast network operators, provide simply the DVB-H transport capacity. Consumers have access to an integrated service proposition which means that a complete package will be offered by the one service provider. Such a model gives telecom operators a dominant role, with very little involvement from the broadcasting side.



SECTION

5

Technical aspects of DVB-H

Principles of the DVB-H system
Building upon the principles of the DVB-T standard, the DVB-H standard adds functional elements necessary for the requirements of the mobile handheld reception environment.

Both DVB-H and DVB-T use the same physical layer and DVB-H can be backwards compatible with DVB-T. Like DVB-T, DVB-H can carry the same MPEG-2 transport stream and use the same transmitter and OFDM modulators for its signal. Up to 50 television programmes targeted for handheld devices can be transmitted in a single multiplex or the capacity of a multiplex can be shared between DVB-T and DVB-H.

However, given the requirements for each system, DVB-H provides additional support for mobile handheld reception. This includes battery saving through time-slicing and increased general robustness and improved error resilience compared to DVB-T using MPE-FEC. In addition, DVB-H broadcasts sound, picture and other data using Internet Protocol (IP).

Time-Slicing
As with any handheld device, battery life is critically important. Users prefer operating for the whole day or, preferably, several days without needing to recharge their device. In order to reduce the amount of power consumed by a handheld device, DVB-H uses time-slicing.

Time-slicing means that the data representing a particular service is delivered to the handheld device in bursts at given intervals of time. Video and audio data (1-2 Mbits), generally representing between 1-5 seconds of the content arrives in the single burst. When the receiver is not receiving the wanted burst of data, the tuner contained in the handheld device is “inactive” and therefore using less power. The user, however, does not notice the period of receiver activity or inactivity since the data bursts are stored in the receiver memory and played out continuously. Time-slicing could allow for up to a 95% reduction in power consumption compared to conventional and continuously operating DVB-T tuners. Of course, power is consumed continually by other parts of the receiver notably the video and audio decoders and the display.

Note that while the receiver is “inactive” for periods of time, the broadcasting transmitter remains active at all times, sending a series of time-slice bursts for each service in sequence. In addition time-sliced and non time-sliced services can be placed in the same multiplex.

MPE-FEC(Multi-Protocol Encapsulation/Forward Error Correction)
Because handheld devices have small antennas that require reception from many different locations, they necessitate a robust transmission system with solid error protection.

To better match the handheld environment, DVB-H offers improved transmission robustness through the use of an additional level of forward error correction (FEC) at the Multi Protocol Encapsulation (MPE) layer. The use of MPE-FEC is optional.

IPDC (Internet Protocol DataCasting)
With IP Datacast, content is delivered in the form of data packets using the same distribution technique as used for delivering digital content on the Internet. The use of Internet Protocol to carry its data, in so-called IP packets, allows DVB-H to rely upon standard components and protocols for content manipulation, storage and transmission.

In addition to video and audio stream broadcasting, IP Datacast over DVB-H system can be used also for file delivery.

Overview of the system
One approach to constructing a total end-to-end DVB-H system making use of a mobile telecoms network for the subscription billing is shown below.

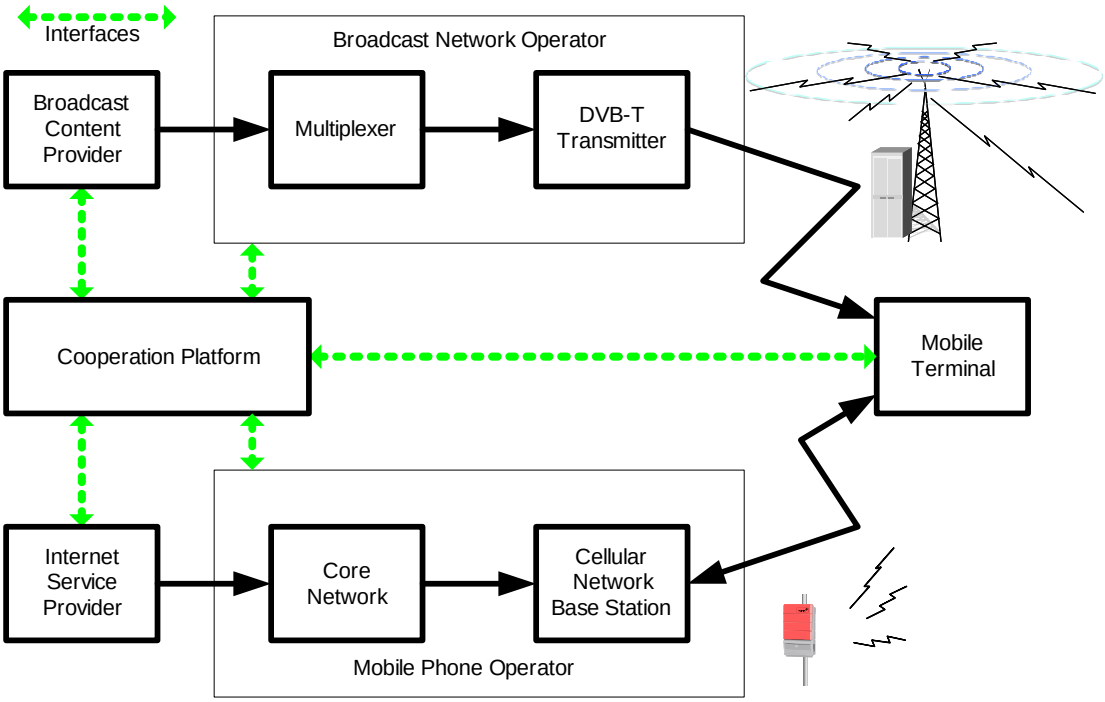


Figure 2: System architecture for collaboration between mobile and broadcast operators

Optional characteristics
Broadcast services can be delivered by DVB-H without the need for an interaction channel, or in the configuration shown, an interaction channel can easily be provided by the use of a cellular network such as the GSM network. Methods of providing payment for services can be built upon a proprietary encryption and payment solution or in conjunction with the telecoms network's inherent service statistics collection and billing functions. The DVB Project has been elaborating these options in the Convergent Mobile and Broadcast Services (CMBS) group.

Network architecture
While the DVB-T network is intended primarily for roof top antenna reception, a DVB-H network will be designed for portable reception available even inside buildings. Hence it will need a much higher signal power density. In order to reach the higher power density needed for mobile coverage levels, several network architectures can be used depending on available frequencies, allowed maximum transmitter powers and antenna heights. The following network scenarios are possible:

- Existing DVB-T network with indoor coverage and DVB-H within the same multiplex,
- DVB-T and DVB-H using hierarchical transmission in the same radio frequency channel with DVB-H on the high-priority stream, or
- A DVB-H only network (which can then make use the optional 4K mode if needed).

DVB-H can use both Single Frequency Networks (SFN) and Multiple Frequency Networks (MFN) topologies.

One main transmitter and several repeaters
The simplest network architecture is one that uses a main transmitter with several repeater transmitters to boost the signal level at the edges of the cell. These repeaters may be necessary when it is not possible to have a high tower for the main transmitter or to fill-in shadows in the reception pattern.

A repeater is a special high gain antenna amplifier that takes the input signal via a receiving antenna, amplifies it and connects the signal to a transmitter antenna. This kind of network topology (essentially circular in shape) may not be very practical and experience shows that several transmitters may be required, each extended by some repeaters, to encompass the entire coverage area required.

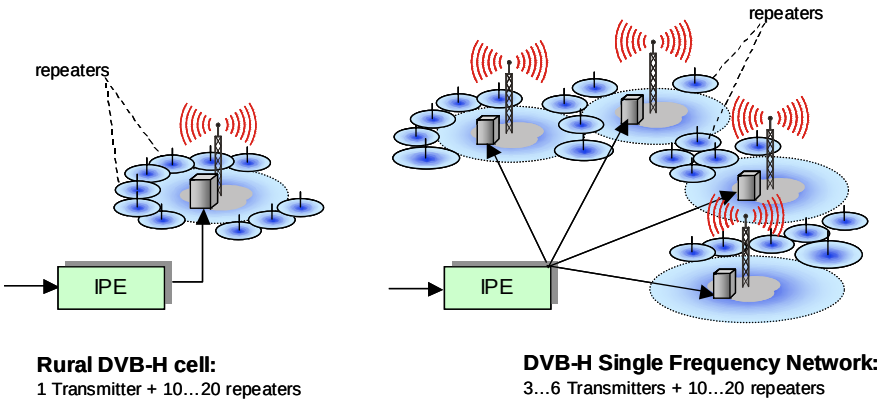


Figure 3: Possible network topology solutions for DVB-H

Single Frequency Network (SFN)
An efficient network for DVB-H reception can be built by using several transmitters on the same frequency. A large area of up to 60 kilometres can be covered without needing high transmitter towers. The identical signals are transmitted from several sites and the system behaviour is similar to that of a distributed transmitter. The DVB-H main transmitters must be accurately synchronized, most easily with time signals received from GPS satellites. Repeaters can be used to improve coverage on critical areas where indoor or car reception performance has been found to be insufficient. This kind of network structure is sometimes known as a Dense SFN network.

Nation-wide coverage
When nationwide coverage is required, over distances of hundreds of kilometres, several radio frequency channels will be needed. The availability of channels differs very much from one country to another. In theory, three channels should be sufficient to provide continuous coverage with any area. However, practical network planning shows that 5-6 channels are actually needed. By using different channels in neighbouring areas gives the possibility also to run local content in each area. This may be important with DVB-H where local content is expected to have an important role.

Finalization of the DVB-H standard
The physical layer of the DVB-H standard has been approved by the European Telecommunication Standards Institute (ETSI) since December 2004. As a next stage, the IP Datacasting systems level in being finalized by the DVB Project before submission to ETSI.

Some DVB-H receivers may be embedded within a mobile telephone receivers. However, not all devices, such as in-car receivers and pocket receivers, will have an interaction channel. Therefore, the access control mechanism specified by DVB cannot solely rely on a return path. In some cases it may be necessary to encrypt the services, so that operators can charge

users for the access and consumption of handheld television services. To enable end-to-end systems, the encryption could be implemented on IP and allow only authenticated users to access, receive and consume the service.

The DVB CBMS (Convergence of Broadcasting and Mobile Services) working group is responsible for specifying the video and audio formats, the Electronic Service Guide, and content protection aspects of the DVB-H standard.

Two approaches are currently under consideration for Service Provision and Protection (SPP) broadly emanating from the broadcast and mobile areas respectively.

- The use of a common standard scrambling method at the content level (e.g. ISMAcryp) combined with a Digital Rights Management system, either using a proprietary or open standard, and,
- The use of open encryption standards (i.e. IPsec) and a single Digital Rights Management solution based on an open standard (i.e. OMA DRM 2.0).

The DVB Project may decide in favour of one of these two alternatives, or may decide to specify both for use in different environments and for specific applications.

SECTION

6

Regulatory issues - The need for spectrum

Broadcast frequency spectrum is administered by national radiocommunications agencies in alignment with international agreements at the International Telecommunications Union (ITU). The ITU is presently part way through the process of developing a new frequency plan for Europe, Africa and the Middle East for the all-digital future.

The planning rules used to determine the share of spectrum allocated to each country are based on the characteristics of DVB-T as a reference and apply three possible reception scenarios: fixed roof-top antennas, outdoor portable reception and indoor portable reception. National administrations have submitted their service requirements for the initial planning studies carried out in 2005. The planning process should be completed in the final session of the Regional Radiocommunications Conference (RRC-06) in the summer of 2006. The expectation is that it will be very difficult, if not impossible, to meet all of the national requirements for DVB-T services in the RRC-06 plan.

DVB-H has not been taken into consideration given that it was not standardised until after the start of the RRC process. Clearly since DVB-H is based on the DVB-T physical layer, it should be possible to introduce DVB-H services into the frequency bands where DVB-T allocations are given. However the topology of DVB-H network and the signal strengths required for handheld terminals are different from DVB-T, therefore proposing such services will require adhering to the obligations of the RRC-06 plan for protection of other services. Any spectrum assigned to a DVB-H network will reduce the spectrum available for DVB-T networks and national regulators will need to decide which operators are given access to the spectrum.

Currently, the most pragmatic approach in a situation where a national administration anticipates a possible wish for a DVB-H network would be for it to submit service requirements for indoor portable reception of DVB-T as the nearest match to the signal conditions required for DVB-

H services. However, the IPDC Forum and other groups are undertaking activities in order to improve the situation in the context of the RRC.

The preference for exclusively DVB-H multiplexes

Mobile handheld receivers have much smaller antennas than those used for fixed or portable television. In addition, mobile handheld receivers must be able to receive a signal from a variety of different locations and sometimes at high-speeds, for example in trains or in cars. These factors need to be compensated by making existing networks more dense and selecting more robust modulation parameters. Therefore, the co-existence of DVB-T and DVB-H services in a single channel, although technically possible, is unlikely to be ideal.

Using an entire channel for DVB-H services provides the added benefit of making it possible to offer 30, 40 or 50 services simultaneously, which is likely to garner much more user interest than if only a few programme services are available. Freeing the network planners from the constraints and complexities of trying to simultaneously serve a coverage area with DVB-T may permit more creative use of spectrum in places where people use handheld devices.

The preference for Band IV in UHF

The designers of the DVB-H system have stated their preference for spectrum in the broadcast Band IV between 470MHz and 650MHz. This is prime spectrum real estate for any wireless radio services, close to the optimal, since it is low enough in frequency to offer long distance propagation characteristics and high enough to avoid the worst effects of man-made noise interference. For those designing a receiver product which includes mobile telephone capabilities, this frequency range minimizes potential interference at the receiver between the DVB-H reception and the GSM/UMTS transmissions.

The antenna size available in a handheld receiver ideally suits a higher frequency use. In the United States trials are underway in the L Band (1.5GHz). However, in Europe, the L Band is assigned to broadcast use for S-DAB and T-DAB radio and the planning channel bandwidth of 1.7MHz means that it is not possible to make direct use of the DVB-H standard. In addition, the cost of a transmitter network for 1.5GHz would be much more expensive than at UHF.

The alternative television broadcast frequency in Band III (VHF) with technologies currently available at minimum cost would imply the use of telescopic antennas. In addition, international planning coordination would make the use of DVB-H in this band prior to analogue television switch-off extremely difficult, if not impossible.

Overall, there is a clear preference for DVB-H in the UHF band, preferably Band IV

Recommended steps

At present

In a context of evolving technologies, it is best that necessary resources are made available to enable the implementation of DVB-H pilots throughout Europe. Based upon the knowledge gained during the technical and commercial trials, Europe will be in a strong position to roll-out DVB-H wherever the necessary spectrum becomes available.

In the short-term

It is likely that the initial developments of broadcast services to handhelds in a worldwide context will take place prior to analogue switch-off. Therefore, to ensure that Europe is well positioned to respond to this challenge, it is imperative that resources are made available to develop these services. In order to benefit from economies of scale, these services will need to be offered on a national or pan-European level, in which large segments of a population can be covered.

There is a strong need for European coordination in order to create conditions for a European market for the equipment manufacturers, especially at the user level (mobile phone, PDA, in-car receiver, etc) in a situation where availability of spectrum in the UHF band varies significantly from one country to the other.

In the medium-term
Beyond the first phase, additional spectrum will be needed to allow for the further development of these services. It may be possible to leverage spectrum released through the digital dividend, in countries where such a dividend exists.

Conclusions

Traditional broadcasting is undergoing a process of change as a consequence of the move towards an all-digital broadcasting environment. New technology, such as streaming technology and personal video recorders (PVRs) can complement traditional broadcasting. New players are entering the market. More programmes, competition and new distribution platforms means that the television viewing experience will change. For television providers, the arrival of IPTV and the enhanced offering of cable and satellite providers has increased the competition. However the terrestrial platform benefits from a unique competitive advantage - that of wireless mobility.

New technologies, such as UMTS, are enabling mobile telecom operators to provide television-like services to their subscribers and enter the television broadcast market. Already, this has led to nascent cooperation between broadcasters and mobile operators. However, because UMTS networks cannot provide television-like services to a large population at a reasonable cost, these services will likely become available via a broadcast network.

In order to retain a role in the provision of television services to handheld devices, broadcasters will need to stake their claim quickly or risk the involvement of new players in the market. Because the ideal spectrum for DVB-H services is assigned to broadcasting, using a DVB-H network enables broadcasters to retain a leading role and leverage their strengths in the provision of content. But broadcasting television services to a handheld using the DVB-H standard will require compromises among the players.

The technology to provide handheld television services exists. Consumer demand for such services is expected to grow, and it may be possible to commercially launch such services as early as 2006. However, key regulatory and business issues will need to be resolved. Broadcasters and other members of the value chain should use this time to consider how handheld television services such as DVB-H may be integrated into their strategy.

Appendix

The below definitions provide further information on some of the more technical terms referenced in the document.

4K mode is a functionality available with the DVB-H standard in addition to the 2K and 8K modes offered by the DVB-T standard. Operators can therefore choose between 2K, 4K and 8K to suit the particular network size and configuration. The use of the 4K mode increases mobility by a factor of two when compared to the 8K mode. In addition, the maximum SFN size is doubled when compared to the 2K mode. However, the 4K mode cannot be used in combination with an existing DVB-T network.

Advanced Television System Committee (ATSC) is a standards organization based in the United States to promote the establishment of technical standards for all aspects of advanced television systems. The digital terrestrial television standard developed by ATSC specifies 8-VSB transmission for HDTV. www.atsc.org

Convergent Mobile and Broadcast Services (CMBS) is a sub-group of the Technical Module of the DVB Project formed in March 2001. It is tasked with developing technical specifications and guidelines for applications and services that utilise 'co-operation' between broadcast and mobile telecommunications platforms. In 2004, a set of detailed technical requirements were generated for an "IPDC in DVB-H" system. These requirements are the basis of the fundamental specification work for IPDC systems.

Digital Multimedia Broadcast (DMB) delivers mobile television services using the Eureka-147 Digital Audio Broadcast (DAB) standard with additional error-correction. T-DMB (terrestrial) uses the terrestrial network in Band III and/or Band L while S-DMB (satellite) uses the satellite network in Band L.

Digital Video Broadcasting standard for terrestrial television (DVB-T) is a transmission specification for digital terrestrial television developed by the DVB Project.

The **DVB Project** is an industry-led consortium of over 260 broadcasters, manufacturers, network operators, software developers, regulatory bodies and others in over 35 countries committed to designing global standards for the global delivery of digital television and data services. www.dvb.org

Eureka 147 is a standard for digital audio broadcasting.

European Telecommunication Standards Institute (ETSI) is an independent, non-profit organization responsible for the standardization of telecommunications, broadcasting and related areas, such as intelligent transportation and medical electronics, within Europe.

High-Definition television (HDTV) is a display format used for digital television transmissions. HDTV provides a high quality display with a vertical resolution display from 720p to 1080i.

Integrated Services Digital Broadcasting for terrestrial television (ISDB-T) is a national transmission standard for digital terrestrial television broadcasting developed in Japan. It provides broadcasting modes for high-definition television and handheld television reception. It specifies OFDM transmission with digital modulation schemes (QPSK, DQPSK, 16QAM and 64QAM).

International Telecommunications Union (ITU) is an international organization, part of the United Nations system, where governments and the private sector coordinate global telecom

networks and services. It is responsible for standardization, coordination and development of international telecommunications including radio regulation for the use of transmission spectrum, as well as the harmonization of national policies.

L-band is a part of the electromagnetic spectrum. It is used by some communications satellites and digital audio broadcasting.

MediaFLO is a proprietary system developed by Qualcomm to deliver broadcast services to handheld receivers using OFDM. Qualcomm intends to roll-out these services in the 700 MHz spectrum in the United States where it holds a license.

Middleware is software that interfaces between the upper applications layer and thelower physical layer of a system.

MPEG-2 is the video and audio compression standard used by DVDs and to provide many present-day digital television services.

Orthogonal Frequency Division Multiplexing (OFDM) is a digital transmission technique which places data on hundreds or thousands of carriers simultaneously.

Personal digital assistants (PDAs) are handheld devices that combine computing, Internet and telephone features. PDAs are also called palmtops, hand-held computers and pocket computers.

Personal video recorders (PVRs) uses a computer hard disk to store information in digital format. They have all of the same functionality of VCRs (recording, playback, fast forwarding, rewinding, pausing) plus the ability to instantly jump to any part of the program without having to rewind or fast forward the data stream. They also permit simultaneous recordings and replay with time shift.

Regional Radiocommunications Conference (04/06) is an ITU conference convened to address the technical basis for the planning of the digital radio and television terrestrial broadcasting service in the frequency bands 174-230 MHz and 470-862 MHz for parts of Region 1 (Europe and Africa) and Region 3 (Asia and Australasia). The first session of the conference took place in May 2004 with the second session planned for June 2006 in Geneva.

Simulcasting is the dual transmission of the digital terrestrial television signal and the analogue terrestrial television signal.

Teletext offers a range of text-based information viewed on television sets with the appropriate decoder. The information is included as data inside analogue broadcasts and usually includes news, weather and television schedules. Subtitle information is also transmitted in the teletext signal.

Universal Mobile Telecommunications System (UMTS) provides voice, video and multimedia data at a speed of up to 2 megabits per second for reception in mobile conditions. Unlike broadcast networks which can deliver wideband point to multipoint transmissions to mobile devices for an unlimited number of simultaneous users, however, UMTS networks are designed for point-to-point transmission. UMTS is often known as third-generation, or 3G, mobile technology.

Further resources

For further information on DVB-H, the below listed resources are available:

DVB World 2004 Conference Proceedings (available for purchase)
Dublin, March 2004
http://www.iab.ch/pages/orderproceedings.htm

Michael Kornfeld and Ulrich Reimers: **DVB-H — the emerging standard for mobile data communication**
EBU Technical Review, No. 301, January 2005
http://www.ebu.ch/en/technical/trev/trev_301-dvb-h.pdf

IPDC Forum Digital Terrestrial Broadcasting for Handheld Devices Workshop Presentations
Brussels, February 2005

IPDC Forum Broadcast Media in Mobile Workshop Presentations
London, April 2004
http://www.ipdc-forum.org/resources/resources.html

EN 302 304 v1.1.1: **Digital Video Broadcasting (DVB); Transmission System for Handheld Terminals (DVB-H)**
ETSI, November 2004
http://webapp.etsi.org/exchangefolder/en_302304v010101p.pdf

DTG: **Mobile TV Applications Handbook** (available for purchase)
http://www.dtg.org.uk/publications/mobile_book.html

DigiTAG

www.digitag.org