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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, to directly express 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.

DVB-H has created much excitement. However, because DVB-H receivers typically combine the functionalities of a mobile phone and a television, it has also raised fears. Who "own" the DVB-H 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 community 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 and 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. A hybrid version of this standard has been adopted in Brazil.

In Europe, the initial foray into digital broadcasting focused on the development of a standard to provide for portable and roof-top antenna reception. However, the Digital Video Broadcast standard for terrestrial television (DVB-T) surpassed the expectations of the initial requirement. It has been used to provide television services in public transportation, as is the case in Singapore and Taiwan, HDTV services in Australia, and multi-channel standard definition television in Europe and Asia.

Television to a handheld receiver

The concept of providing television-like services on a handheld device has generated much enthusiasm. Following this trend, mobile telecom operators provide 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 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. Korea commercially launched S.DMB services and T-DMB services in 2005. In June 2006, Mobiles Fernsehen Deutschland (MFD) launched T-DMB services in Germany.

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 one mobile television service, 1seg, to portable and handheld devices. The service was launched in Japan in 2006. A satellite version of this service is also available.

MediaFLO is a system developed by Qualcomm to deliver broadcast services to handheld receivers using OFDM. Qualcomm has built the network in the United States using the 700 MHz frequency band while the telecom operators Verizon and AT&T/Cingular have made the services available to their customers.

DVB approach to handheld television: DVB-H and DVB-SH

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.

The DVB Project has also developed a second standard, Digital Video Broadcasting Satellite Services to Handhelds (DVB-SH), for the delivery of video, audio and data services to handheld devices.

DVB-SH is a hybrid system that uses frequencies below 3GHz, generally S-band frequencies, to provide large-scale coverage using satellite while terrestrial gap fillers augment coverage in areas where satellite coverage is not possible. The DVB Project approved the DVB-SH system specification in February 2007 and a formal standardisation review by ETSI is currently underway.

DVB-H Market Status

Around the world, countries have been exploring the use of DVB-H services. In 7 countries in Europe, Asia and Africa, DVB-H services have been launched while a further 8 countries are preparing to launch services in 2008. Many other countries have undertaken extensive commercial and technical trials.

In Europe, it is clear that DVB-H will be the standard of choice for mobile television services as it has already been adopted by a majority of countries. The decision to formally mandate the DVB-H standard by the European Commission may prove to be unnecessary.

Launched services
In June 2006, 3Italia became the first mobile operator to launch DVB-H services. It offers viewers 12 television programme services with a coverage of over 60% of the Italian population. Services can be purchased as part of a bundled offering with voice services or separately on a pay-per-view basis. According to 3Italia, mobile television subscriptions are fast approaching 10% of all subscribers.

In September 2006, Telecom Italia Mobile (TIM) launched DVB-H services while Vodafone Italia launched its DVB-H services in December 2006.

In late 2006, DVB-H services were launched in Finland, Albania and Vietnam. In Finland, the network operator Digita rolled out a DVB-H network to 25% of the population and will increase coverage to 40% of the population by the end of 2007 following analogue switch-off. In Albania, DVB-H services are available to 65% of the population while in Vietnam services are available in the cities of Hanoi and Ho Chi Minh.

In 2007, DVB-H services were launched in India, Nigeria and the Philippines.

Expected launches in 2008
In Europe, many countries have taken concrete actions to allow for the launch of DVB-H services in 2008. Regulators in Austria, France and Germany have invited candidates to tender for DVB-H licenses while in Switzerland, a DVB-H license has been allocated to Swisscom Broadcasting. In these countries, DVB-H services are expected to be launched by the middle of 2008. In the case of Switzerland and Austria, regulators would like services to be available in time for the UEFA EURO 2008 Football Championship.

In Belgium and Spain, the government has already set-aside the necessary frequencies to accommodate DVB-H services. One multiplex has been reserved in Spain and the government is currently in the process of drafting the necessary legislation to allow for the launch of DVB-H services.

The Netherlands and Malaysia have also announced that DVB-H services will be launched in 2008.

Commercial and technical trials
Extensive commercial and technical trials have taken place in over 40 countries around the world. Many countries have undertaken multiple trials or extended existing technical trials into commercial trials.

Commercial trials have been used to gauge viewer interest in DVB-H services. In all published results, viewers have expressed high interest in receiving mobile television 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. During commercial DVB-H trials, it was found that many of the viewing sessions took place while users were at home. Viewers may be tempted to continue watching television on their handheld device to access different viewing experiences or individually interact with programmes services.

From a viewer’s perspective, television services from a handheld device have an instant appeal and generate 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 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.

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. Already, a wide range of DVB-H system components and receivers are available on the market.

Because a DVB-H chip (tuner plus demodulator) is available from several vendors at less than 10 Euros in mass production, the extra cost for including DVB-H services in a multifunctional mobile phone is marginal compared to the total cost of the terminal. It can be expected that manufacturers will increasingly include DVB-H tuners in their mobile devices.

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.

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. 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.

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
In various commercial DVB-H pilots conducted across Europe, viewers have indicated their interest in watching television from a handheld device. In commercial DVB-H trials conducted in the United Kingdom, Switzerland and Spain, the interest in subscribing to mobile television services varies between 35% and 75%, as demonstrated in the chart on the next page.

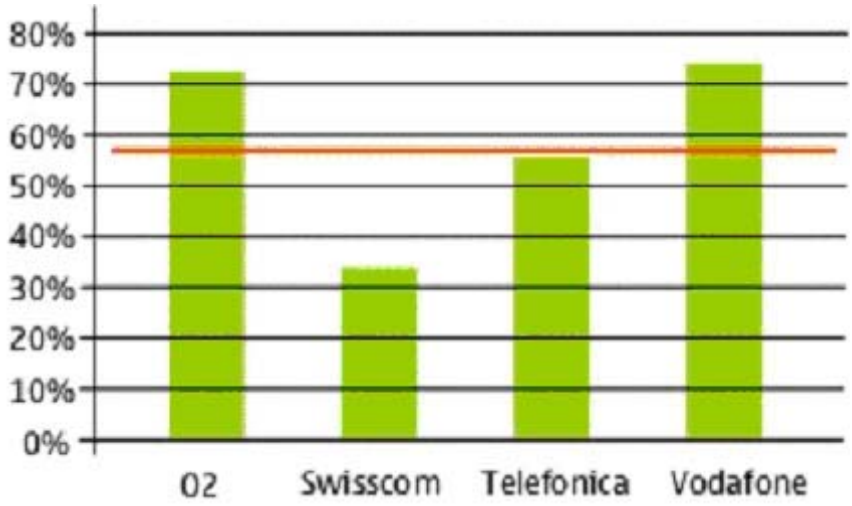


Figure 1: willingness to subscribe to mobile television services

With a high interest in mobile television services, 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 and broadcasters will be better able to reach their evening peak time viewing audience at other times of the day. Results from commercial DVB-H pilots show that viewers spend a considerable amount of time watching mobile television services, with each viewing session lasting between 16-35 minutes. Peak viewing times occur three times during the day - in the morning, midday and in the evening.

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. Both options have been made available to viewers in Italy. Data collected from several pilots in different countries indicate a willingness to pay between 5-12 Euros per month for the service offering.

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 diverted from traditional media and instead spent on advertisements in new media, such as the Internet. 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.

Advertising in mobile television can be based on commercial breaks or overlay banners on the screen. Also, an electronic service guide can be used for advertising purposes.

With a return channel, advertising can be tailored for a specific 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 become a possibility. 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.

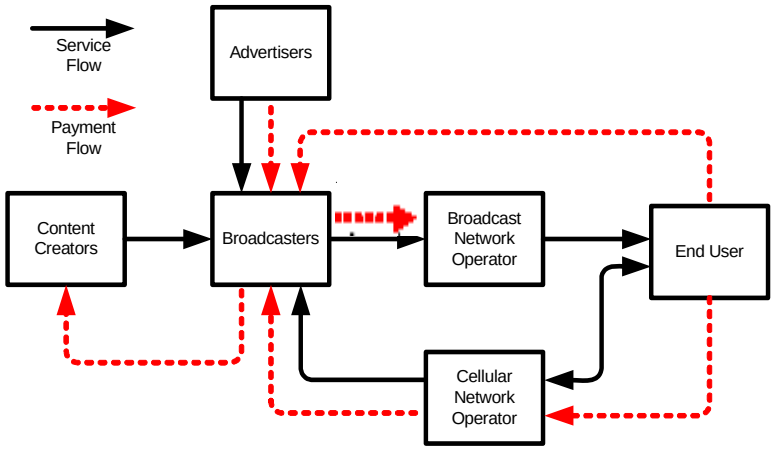
Broadcasters, on the other hand, must recognize that telecom operators have developed a large existing customer base which they may easily convert to mobile television using their impressive marketing skills. A pattern of subsidising user terminals against future subscription income is well established. 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

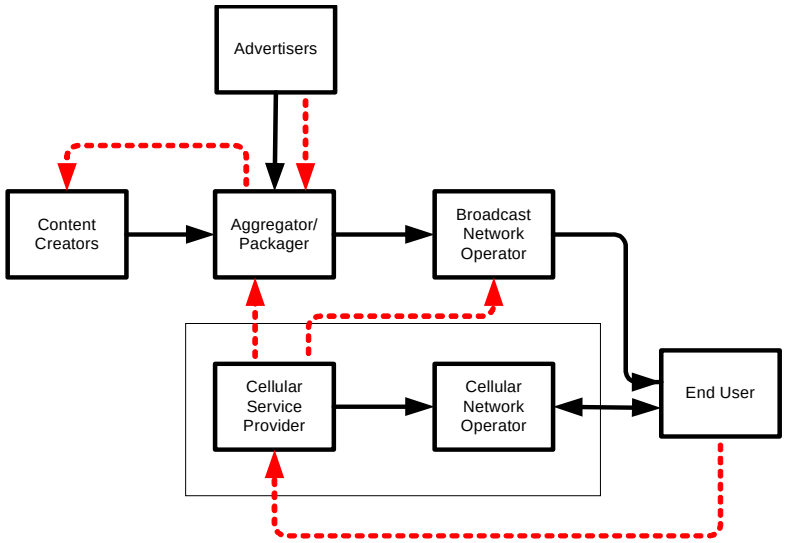
In this model, broadcasters manage the end-relationship with the consumer. The broadcaster receives payments for the use of the service, from consumers from the license fee, or subscription, or through payments made via the telecoms network operator. A variation on this could be broadcast funding from 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.

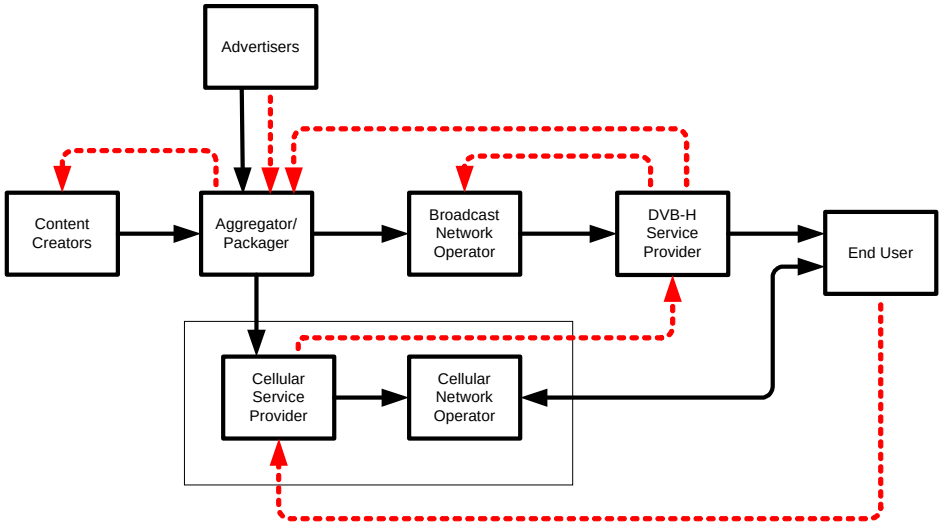


As a variation, mobile telecom operators could directly handle advertisements. While mobile telecom operators would be responsible for general marketing, it could be possible for

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

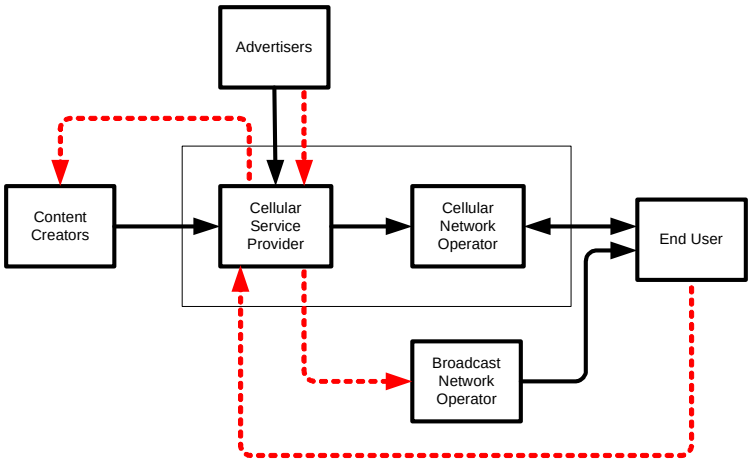
In this model, the mobile telecom operator manages the end-relationship with consumers and is responsible for service provisions, marketing and customer care. A dedicated DVB-H service provider acts as a facilitator for mobile operators in the aggregation of content and the use of the spectrum. Consumers 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.

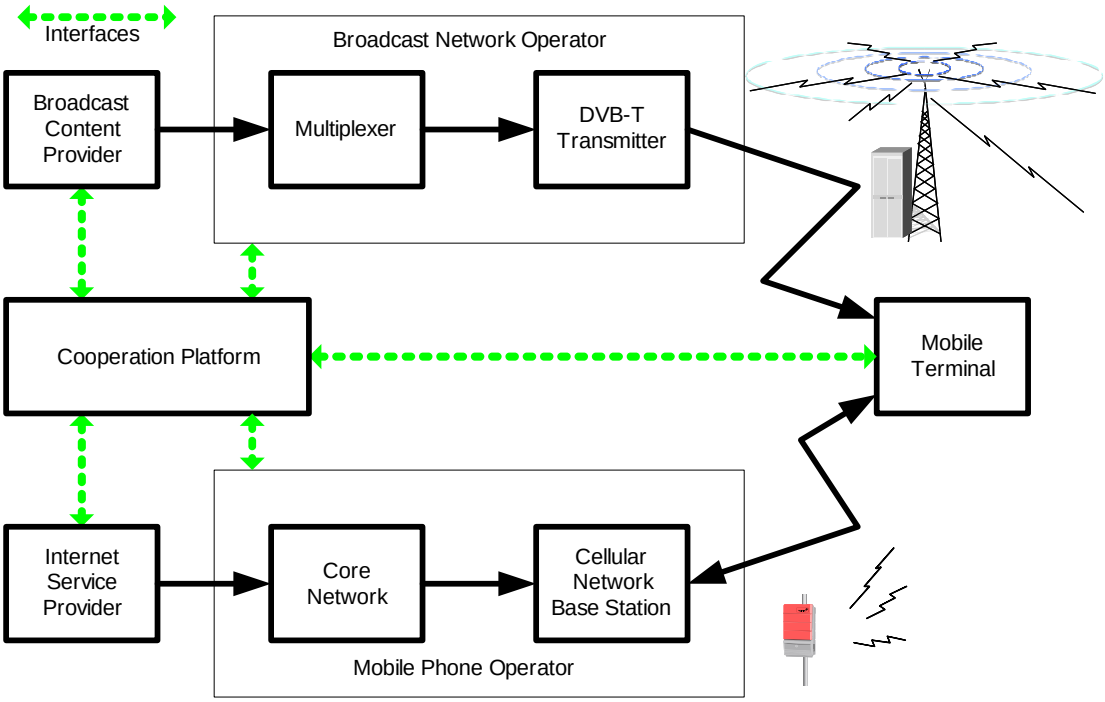


Figure 2: System architecture for collaboration between mobile and broadcast operators

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.

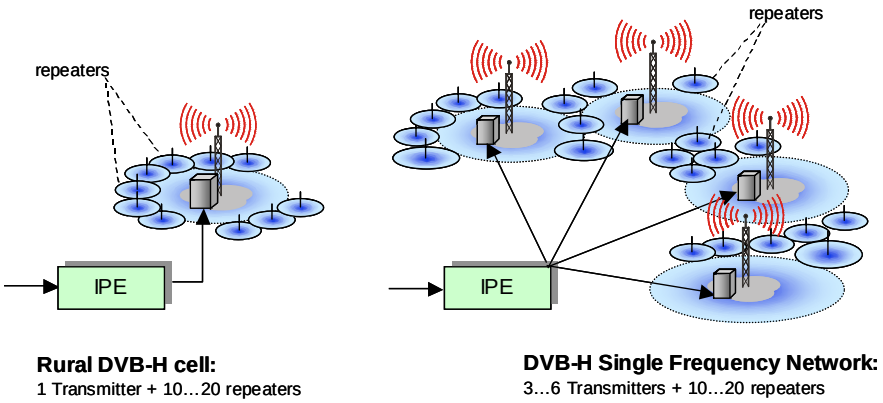


Figure 3: Possible network topology solutions for DVB-H

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.

Portable indoor coverage
Commercial DVB-H pilots have shown that viewers are watching their mobile television services indoors, making it essential that services allow for portable indoor coverage. However, allowing for portable indoor coverage can be quite onerous.

It is for this reason that the DVB Project is currently working on the development of a small gap filler that viewers can install to improve indoor coverage in an area of approximately 100 square meters. The device is connected to a roof-top antenna, generally through in-house

cabling system, and provides an on-channel repeat of a single DVB-H multiplex. This work is expected to be completed in early 2008.

Elements 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.

Most of the DVB-H receivers are embedded within a mobile telephone receivers. However, some of the devices, such as in-car receivers and pocket receivers, will not have an interaction channel. Therefore, the access control mechanism which was specified by DVB could not 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 is implemented on IP and allow only authenticated users to access, receive and consume the service.

The DVB Project has put together a set of specifications for IP Datacasting (DVB-IPDC) to help define such components as the Electronic Service Guide (ESG), Content Delivery Protocols (CDP), Service Purchase and Protection (SPP), and the Programme Specific Information / Service Information (PSI/SI). SPP, which defines the encryption mechanism used, provides two distinct profiles - the Open Security Framework profile and 18Crypt profile.

While used for the DVB-H standard, DVB-IPDC can also be used for other DVB standards such as satellite service for handhelds (DVB-SH).

Alongside these developments by the DVB Project, mobile telecom operators have developed OMA-BCAST which secures content based on two profiles - the DRM Profile and the Smartcard Profile. The DRM Profile is nearly identical to the DVB IPDC's18Crypt while the Smartcard Profile makes use of the SIM card in mobile telephone devices.

SECTION

6

Regulatory issues - The need for spectrum

Broadcast frequency spectrum is administered by national communications regulators in accordance with international agreements decided at the International Telecommunications Union (ITU). In June 2006, national administrations representing 118 countries in Europe, Africa and parts of Asia agreed to an new frequency plan for an all-digital future.

The new frequency plan, Geneva 2006 Agreement (GE-06), establishes the transmission of DVB-T and T-DAB services in frequency Band III (174-230 MHz) and DVB-T services in frequency Bands IV/V (470-862 MHz). Generally, countries have been allocated 3 T-DAB and 1 DVB-T "coverage layers" in the Band III and 7-8 DVB-T layers in Bands IV/V.

Because DVB-H had not yet been standardised at the time when planning for GE-06 began, its spectrum requirements could not be taken into consideration as part of the plan. However, because DVB-H is based on the DVB-T physical layer, it is possible to introduce DVB-H services into the frequency bands where DVB-T allocations are given so long as such services adhere to the obligations of GE-06 for protection of other services.

GE-06 provides national administrations with much flexibility. Modifications to GE-06 are possible so long as neighbouring countries affected by such a modification give their consent. Under certain conditions, it is possible to operate services on a non-interference and non-protection basis.

Flexibility is further enhanced by the allocation of frequencies as allotments rather than assignments. While requirements submitted as assignments are based on the location of individual transmission sites, allotments allow national administrations to provide information on the type of network for the area and its boundary. The implementation of an allotment results in its conversion into one or more assignments with the same level of required protection and potential interference as the allotment.

The flexibility allowed by the GE-06 Agreement makes it possible for national administrations to launch DVB-H services within the existing parameters of the frequency plan.

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 tens of ervices 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 have taken place 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

Pilots for DVB-H services have been arranged throughout Europe. Based upon the knowledge gained during the technical and commercial trials, Europe has started to roll-out DVB-H services wherever the necessary spectrum has become available. In addition, several countries in Asia have also decided to adopt DVB-H for mobile television.

In the short-term
Pressure to start mobile television services to handheld devices prior to analogue switch-off is strong in many countries. 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 still 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 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 and new distribution platforms means that the television viewing experience is undergoing 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 between the different members of the service value chain.

In the summer of 2006, Italy became the first country in the world to launch commercial DVB-H television services. Mobile operators, network operators and broadcasters have worked together to allow for the successful launch of such services. Building upon this success, it can be expected that further DVB-H launches will take place in the near future.

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

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 270 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.

Geneva 2006 Agreement is an international frequency plan for digital terrestrial radio (T-DAB) and television (DVB-T) broadcasting services 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).

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 system developed by Qualcomm to deliver broadcast services to handheld receivers using OFDM. Qualcomm is currently rolling out the network for these services in the United States.

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.

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.

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