Understanding DVB-T2

Key technical, business, & regulatory implications

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Introduction

The DVB-T standard is the most successful digital terrestrial television standards in the world. First published in 1995, it has been adopted by more than half of all countries in the world. Since the publication of the DVB-T standard, however, research in transmission technology has continued, and new options for modulating and error-protecting broadcast steams have been developed. Simultaneously, the demand for broadcasting frequency spectrum has increased as has the pressure to release broadcast spectrum for non-broadcast applications, making it is ever more necessary to maximise spectrum efficiency.

In response, the DVB Project has developed the second-generation digital terrestrial television (DVB-T2) standard. The specification, first published by the DVB Project in June 2008, has been standardised by European Telecommunication Standardisations Institute (ETSI) since September 2009. Implementation and product development using this new standard has already begun.

The possibility to increase the capacity in a digital terrestrial television (DTT) multiplex is one of the key benefits of the DVB-T2 standard. In comparison with the current digital terrestrial television standard, DVB-T, the second-generation standard, DVB-T2, provides a minimum increase in capacity of at least 30% in equivalent reception conditions using existing receiving antennas. Some preliminary testing, however, suggests that the increase in capacity obtained in practice may be closer to 50%. This can make possible the launch of new broadcast services that make intensive use of frequency capacity.

However, the implementation of a new digital terrestrial television (DTT) standard will have a profound impact upon the broadcast industry. The cost of developing, distributing, and implementing new equipment will need to be borne by manufacturers, network operators, and viewers. Business issues related to financing the launch of services the DVB-T2 standard need to be explored. The demand for services using DVB-T2 will likely vary depending on the demands of the market as will the approach for launching such services. Broadcasters will also need to consider possible business cases and how current revenue streams can be maintained and/or augmented.

Two excellent documents, the DVB-T2 specification (ETSI EN302755) and the Implementation Guidelines (DVB Bluebook A133), are available with the details of the technology. However, this handbook seeks to provide a wider understanding of the DVB-T2 standard to encompass issues beyond the technology. It addresses the key technical, business, and regulatory issues that must be taken into consideration by the broadcast industry when contemplating a launch of services using the DVB-T2 standard.

Section
1

The need for a new terrestrial television standard

The terrestrial television platform remains one of the most important television delivery platforms in Europe. It is currently one of the most widespread broadcast transmission systems and provides viewers with nearly universal access to both free-to-air and pay television services.

The conversion of the terrestrial platform from analogue to digital technology has enabled increased competition in the television market. In many European markets, viewers have been able to access many new services, including greater television programme choice, enhanced quality, and interactivity. The launch of pay services on the DTT platform has allowed viewers to benefit from such services as pay-per-view events, near video-on-demand, and basic pay bouquets. The unique features of the DTT platform allow viewers to benefit from regional and local services as well as portable and mobile reception.

Viewers have demonstrated strong confidence in the DTT platform given the high penetration of services. Currently, the DTT platform is the fastest growing digital platform in Europe and in some countries the number of viewers relying on the terrestrial television platform for their primary television services has increased significantly since the launch of digital services. Given the demand of viewers to access television services on the terrestrial television platform, broadcasters will want to maximize the DTT services available.

Limited frequency availability

The terrestrial television platform has traditionally used frequencies in Bands III (174-230 MHz) and IV/V (470-862 MHz) for the provision of broadcast television services. The frequency spectrum in Bands III and IV/V are particularly advantageous for certain types of services since they provide a good balance between coverage area for a certain transmitter power, including some lower power applications, and separation distance between transmitters.

These frequencies have traditionally been reserved exclusively for broadcasters. However, the demand for access to these frequency bands has been strong from other service providers including telecom operators and technology firms.

The propagation characteristics of the frequencies in Bands IV/V are proving to be particularly appealing to telecom operators for the provision of mobile broadband services which they believe will include 75% of all Internet subscribers by 2013. Because it can be expensive to provide broadband service through a fixed telephone line in rural areas, telecom operators have called for the launch of mobile broadband services in these areas as a way to reduce the digital divide existing in parts of Europe. Currently, several national administrations in Europe have decided to allocate 72 MHz in Band V, in the frequency range from 790–862 MHz, for the provision of mobile telecom (IMT) services.

Other applications can also make use of the frequencies in Bands IV/V. Leading information technology firms such as Microsoft and Intel have called for the use of wireless broadband services and other such applications in the so-called “white spaces” where frequencies at a given location and at a given time are available for use. In the United States, the Federal Communications Commission (FCC) has given its approval for the use of white spaces by unlicensed devices in the frequencies

reserved for broadcast services. However, the approval of such devices has not yet begun.

Other applications, such as WiMAX which provides wireless broadband access based in a local area, could also benefit from the frequencies in Bands IV/V. However, this would require frequency allocation from national administrations as well as changes to the ITU's Radio Regulations.

In Europe, the frequencies in Bands IV/V have been used for the provision of services ancillary to broadcasting (SAB/SAP), which includes such equipment as wireless microphones, and used extensively in the production of audiovisual content as well as in theatre, music and sporting events. These frequencies are also, in some cases, reserved for emergency communication services, also known as public protection and disaster relief (PPDR).

Digital switchover

The move from analogue to digital television on the terrestrial platform has enabled countries to release broadcast frequencies for new services. The number of frequency channels available as well as the date of their availability will vary between countries. In Europe, the European Commission has recommended that its Member-States complete the process by 2012. While this deadline will be achieved by some, it may not be possible for all Member-States. Further information on the status of analogue switch-off in Europe can be found in Annex 1.

At the forefront of digital switchover, broadcasters in many countries have made use of frequencies available in Bands IV/V for the launch of DTT services. Viewers have been able to access new television programme services as an incentive to convert from analogue to digital technology. In many cases, it has been necessary to switch-off existing analogue terrestrial television services in order to provide sufficient capacity for the launch of nationwide DTT services or to extend the coverage of DTT services to ensure universal coverage.

The debate on how best to re-allocate frequencies in Bands IV/V that had previously been used for analogue broadcast services has been fierce in Europe given the demands of broadcasters, telecom operators, and other (potential) users.

DVB-T2 for terrestrial broadcasting

To meet with the demands of television viewers, broadcasters must be prepared to launch new services on the DTT platform. Depending on the needs of a given market, such services as video-on-demand, HDTV, and mobile television must be made available to ensure the appeal and competitiveness of the DTT platform. In addition, broadcasters will want to retain sufficient flexibility to ensure that the DTT platform can evolve and provide new services as they become available. However, the provision of any additional services will require the allocation of additional frequencies in Bands IV/V for broadcast services.

The development of the DVB-T2 specification demonstrates the broadcast industry's confidence in the terrestrial television platform. Constrained by limited frequency capacity, the terrestrial television platform needed a new, more efficient, transmission system to meet the demands of the future and to allow for the launch of new services. The DVB Project responded in June 2008 with the publication of the DVB-T2 specification.

Section
2

Technical overview of DVB-T2

As a first step in developing the DVB-T2 specification, the DVB Project developed the key commercial requirements for the proposed specification. These commercial requirements placed some limitations on the technology that could be used but also ensured that the new specification could meet with the needs of the existing broadcast market.

Among the 21 commercial requirements approved by the DVB Project, it was necessary that the new specification could make use of existing domestic receiving antennas and transmitter infrastructure, provide a minimum of 30% capacity increase compared with the DVB-T standard in similar reception conditions, and meet with the interference levels and spectrum mask requirements of the Geneva 2006 Agreement. The specification is also designed to target fixed rooftop antennas.

Based on these commercial requirements, the DVB Project established a group to develop the technical features of the proposed specification.

Key technical features

Building on the success of DVB-T, the DVB-T2 specification incorporates the latest developments in modulation and error-protection to increase the bit-rate capacity and improve signal robustness. To achieve these improvements, detailed changes have been made to the physical layer features, to the network configuration, and to optimize performance to match the propagation characteristics of the frequency channel.

The DVB-T2 commercial requirements called for capacity increase of 30% compared with DVB-T in equivalent reception conditions. However, current field testing suggests that the capacity gain may be closer to 65%. However, it is not until widespread experience is gained with DVB-T2 in all application circumstances that the full extent of its beneficial gain will be known.

Physical layer features

Like the DVB-T standard, the DVB-T2 specification uses OFDM (Orthogonal Frequency Division Multiplex) modulation. The availability of a large number of modes allows for the same level of flexibility to suit the specific area of application as with the DVB-T standard. However, the addition of the 256 QAM mode in the DVB-T2 specification allows for the ability to increase the number of bits carried per data cell and benefit from improved FEC (forward error correction) which gives a major capacity boost.

Like the DVB-S2 standard, the DVB-T2 specification makes use of LDPC (Low-density parity-check) codes in combination with BCH (Bose-Chaudhuri-Hocquengham) to protect against high noise levels and interference. In comparison, the DVB-T standard, which makes use of convolutional coding and Reed-Solomon, two further code rates have been added.

As with the DVB-T standard, the DVB-T2 specification makes use of scattered pilot patterns for use by receivers to compensate for changes in channels as a result of time and frequency. The DVB-T2 specification has the additional flexibility provided by the choice of eight scattered pilot patterns that can be selected based upon the FFT size and Guard Interval fraction adopted to maximize the data payload.

The DVB-T2 specification offers a choice of various robustness and protection levels for each service separately within a transport stream carried by a signal in a given channel. This allows each service to have a unique modulation mode depending on the required signal robustness through the use of Physical Layer Pipes (PLP).

Network configuration

The DVB-T2 specification allows for the possibility of maximizing the performance in single frequency network applications. Compared with the DVB-T standard, new carrier modes have been added to improve the performance of SFNs and increase the symbol period.

This increase in the symbol period, in turn, allows for a reduction in the proportional size of the guard interval while still handling multipath reflections. An additional Alamouti coding mode is also available in option for simple SFNs where a receiver can benefit from signals simultaneously received from more than one transmitter. Using these features, it has been estimated that the use of a SFNs could allow for a potential capacity gain of up to 67% compared with a DVB-T mode of similar robustness.

Compared with the DVB-T standard, the DVB-T2 specification allows for a reduction in the peak to average power used in the transmitter station. The peak amplifier power rating can be reduced by 25% which can significantly reduce the total amount of power that must be made available for the functionality of high power transmission stations. This is achieved through the use of tone reservation and ACE (active constellation extension) techniques.

The DVB-T2 specification defines a single profile which incorporates time-slicing but not time-frequency-slicing (TFS). Features which would allow a possible future implementation of TFS (for receivers with two tuners/front-ends) can be found in annex E (ETSI EN302755). TFS might in future make it possible for a large multiplex of signals to be spread across several linked frequencies and thus benefit from a potentially significant gain in capacity as a result of statistical multiplexing and a gain in network planning as a result of increased frequency diversity. Preliminary analysis within DVB suggests that TFS may allow a capacity gain of approximately 20% and a network planning gain of 3-4 dBs.

Comparison of available modes in DVB-T and DVB-T2

	DVB-T	**DVB-T2**
FEC	Convolutional Coding + Reed Solomon 1/2, 2/3, 3/4, 5/6, 7/8	LPDC + BCH 1/2, **3/5**, 2/3, 3/4, **4/5**, 5/6
Modes	QPSK, 16QAM, 64QAM	QPSK, 16QAM, 64QAM, **256QAM**
Guard Interval	1/4, 1/8, 1/16, 1/32	1/4, **19/256**, 1/8, **19/128**, 1/16, 1/32, **1/128**
FFT size	2k, 8k	**1k**, 2k, **4k**, 8k, **16k**, **32k**
Scattered Pilots	8% of total	**1%**, **2%**, **4%**, 8% of total
Continual Pilots	2.6% of total	**0.35%** of total

Source: DVB Project

Optimised performance to match frequency channel propagation characteristics

The DVB-T2 specification provides for improved signal robustness against external influences such as the impact cause by geography, weather, and buildings. This is

achieved through the use of the rotated constellations technique and time and frequency interleaving.

Rotated constellations provide significantly improved robustness against loss of data cells by ensuring that loss of information from one channel component can be recovered in another channel component. This is achieved by mapping data on normal QAM (x,y axis) which is then rotated in the "I-Q" plane so that each axis on its own (u1, u2) carries sufficient information. The *I* and *Q* components are sent at different times using different cells to ensure information recovery if necessary.

Time interleaving provides further signal robustness against disturbances such as impulsive noise over a given period of time and disturbances over a limited frequency span.

Expected spectrum efficiency gain

The exact capacity gain that can be achieved using the DVB-T2 specification in comparison with the DVB-T standard is not yet fully known. Commercial requirements called for a capacity gain of 30% in comparison with DVB-T in equivalent reception conditions. However, the current transmission mode selected by the United Kingdom shows that the capacity is as much as 66%.

Example of MFN mode in the United Kingdom

	Current UK DVB-T mode	**Selected UK DVB-T2 mode**
Modulation	64 QAM	256 QAM
FFT size	2k	32k
Guard Interval	1/32	1/128
FEC	2/3CC + RS	2/3 LDPC + BCH
Carrier mode	Standard	Extended
Capacity	**24.1 Mbit/s**	**40.2 Mbit/s**

Source: OFCOM

The use of national SFN can allow for greater spectrum efficiency. However, national SFNs limit the ability for broadcasters to provide regional and local services. The full extent of the beneficial capacity gain of DVB-T standard will not be known until further experience is acquired.

Status (pilots, announced launches)

Currently, the United Kingdom and Finland have announced plans to launch HDTV services on the terrestrial platform using the DVB-T2 specification. DVB-T2 trials are either underway or have been completed in Finland, Germany, Italy, Spain, Sweden, and the United Kingdom.

In the United Kingdom, the communications regulator OFCOM has decided to allocate one of its six DTT multiplexes (Multiplex B) in the UHF frequency band for the provision of HD services using the DVB-T2 specification in combination with MPEG-4 AVC compression technology. It has allocated 4 HD television programme service slots to broadcasters with services on the current analogue terrestrial television platform (BBC, ITV, Channel 4/S4C, and Five).

The release of Multiplex B is possible due to the increased capacity available in the other DTT multiplexes after the completion of analogue switch-off. The SD services in Multiplex B will be transferred to the other multiplexes so that no SD programme services will need to be sacrificed. As a result, the launch of HD services using DVB-T2 will correspond with the calendar for analogue switch-off. As a given

region switches off its analogue terrestrial television services, HD services are set to launch.

The transmitter at Winter Hill, providing services to viewers in Manchester and Liverpool, will be the first to launch HD services on 2 December 2009. In regions where analogue switch-off is not to take place until a later date (i.e. 2012), HD services will likely launch with restricted population coverage using temporary frequency allocations. It is expected that by June 2010, up to 50% of the population will be able to access HD services.

In Finland, the mobile telecom operator DNA Oy has been allocated a license to operate two DVB-T2 multiplexes using frequencies in the VHF frequency band. While the network architecture is not yet known, two options are currently being evaluated. It is possible that DNA Oy could either operate the DVB-T2 network using a series of smaller transmitters located at its mobile telephone masts or, alternatively, DNA Oy could adopt a traditional broadcast network using transmission sites with high masts and high power to target rooftop antennas. The second option is the expected implementation of the DVB-T2 specification as had been envisaged by the DVB Project in its development of the standard.

The two DVB-T2 multiplexes will use the MPEG-4 AVC compression format and make between 8-10 HD television programme services available to viewers. The launch of services is expected in 2010 with a coverage of 60% of the population to be reached by the end of 2011.

Section
3

Key DVB-T2 market players

The broadcast industry will need to work together to ensure a successful deployment of services using the DVB-T2 standard. The more efficient use of the spectrum compared with current usage can provide benefit to all members of the broadcast industry. However, the costs of deploying such services will also need to be shared.

Broadcasters

The implementation of the DVB-T2 standard can provide broadcasters with the opportunity to either deliver existing services using less frequency capacity or to deliver more services using their existing frequency capacity.

In delivering existing services using less frequency capacity, broadcasters could make savings as the cost of their transmissions will be reduced. However, this is only possible once all viewers have converted to DVB-T2. Such a conversion will take time, especially in the absence of an appealing new service offering to provide the necessary impetus for an equipment upgrade.

In delivering more services using existing frequency capacity, broadcasters can choose to provide new high-definition television services or increase the choice in standard definition services available. The cost of transmission should not vary significantly since the frequency capacity used remains the same.

However, the broadcasters will need to bear the cost of providing new services and content. In some cases, this content may already be available on other television delivery platforms such as cable and satellite. Commercial broadcasters may be able to benefit from new means for generating revenue while public service broadcasters may benefit from the opportunity to make all of their content, including HDTV, available on the DTT platform. However in launching new services, broadcasters will need to co-ordinate their communications and marketing effort to ensure that viewers understand the new offering.

The launch of services using DVB-T2 will likely require the simultaneous transmission of both DVB-T and DVB-T2 standards for a significant period of time in those countries where digital switchover has been completed. The cost of this dual transmission will need to be borne by broadcasters.

Broadcast network operators

In order to allow for the launch of DVB-T2, broadcast network operators will need to roll out a DVB-T2 transmission network. However, the cost of the network roll out is reduced significantly since broadcast network operators can use their existing transmitter infrastructure including sites, transmitters, masts, and antennas. In a multi-frequency network, existing transmitting equipment, such as distribution circuits, network terminal equipment, transmitter input equipment, filters, and, most likely, combiner systems. It will only be necessary to acquire a DVB-T2 modulator to replace the DVB-T unit. At gap-filler sites, the re-transmitter will need to be adapted for DVB-T2.

Because DVB-T2 targets fixed roof top and portable antennas, as does DVB-T in most countries, it is unlikely that new transmission sites will be necessary. Given that planning parameters do not need to change between DVB-T and DVB-T2, it can be assumed that coverage areas will remain the same unless the broadcaster wishes a change.

Costs will increase should a broadcast network operator build a new network for DVB-T2. In this case, the DVB-T2 coverage area and roll-out strategy will need to be defined, and new equipment acquired. Depending on the length of the procurement procedure and the roll-out of the network, the process can take time. As is the case with the deployment of a DVB-T network, existing masts and sites can be used and it can be expected that the roll-out of a new DVB-T2 network will be approximately similar to the roll-out of a new DVB-T network.

Broadcast network operators will be able to generate revenue through the use of their transmission network. As more DTT networks are rolled out, broadcast network operators will be able to increase their revenue, assuming no surplus in broadcast capacity.

Manufacturers

Manufacturers of consumer devices and professional system components need to make new equipment available for DVB-T2. The timeline for the launch of services using DVB-T2 will depend on the speed at which manufacturers can begin to mass produce the necessary equipment.

Through the sale of consumer devices, manufacturers provide the direct link between the viewer and the service offering. It is for this reason that manufacturers will want to ensure that consumers clearly understand the offering available on the DVB-T2 platform and how this offering can be differentiated from other available services. A logo can serve as an important tool to help consumers better understand service offerings and equipment capabilities.

In terms of product availabilities, it is possible that the first DVB-T2 consumer devices will be available at the end of 2009 to correspond with the first launch of services using the DVB-T2 standard in the United Kingdom. However, the availability of devices in mass volume is expected in early 2010 to coincide with the FIFA 2010 Football Championship which is expected to serve as a key stimulus for the public in the uptake of HD services. At this time, it is expected that major manufacturers will make integrated television sets (iDTVs) available with DVB-T2 capabilities. However, the market for DVB-T2 set-top boxes should also be significant given the existing penetration of HD-ready displays in homes.

Manufacturers will need to ensure that their DVB-T2 devices comply with the receiver specifications determined by national administrations and/or industry groups. However, to be able to benefit from economies of scale, manufacturers will encourage countries to adopt common receiver specifications. This will help to reduce the need to produce different DVB-T2 receivers for each market which can result in an increase in the cost of the receiver.

Viewers

The success of a DVB-T2 service launch will depend on viewer demand for the service. Should demand be high and many receivers sold, national administrations may consider launching further services using the DVB-T2 specification.

However, viewers may resent the need to purchase new television receiving equipment. Depending on the services launched on the DVB-T2 platform, they may not clearly understand the new service offering nor what equipment is necessary to receive the new service. In the case of a launch of HDTV services, viewers will need a DVB-T2 receiver as well as an HD display which could create some confusion. In addition, the resentment may be exacerbated should viewers have only recently upgraded their television equipment as part of digital switchover.

In cases where a new frequency channel is used to launch DVB-T2, it may be necessary for viewers to change or upgrade their aerials. This can be an additional, and unexpected, cost. Should DVB-T2 be launched on a network that previously provided DVB-T, it will be necessary for all viewers to rescan their DTT receivers. From experience in the United Kingdom, DTT receiver rescanning can be difficult for some viewers, especially the elderly.

Section
4

DVB-T2 business issues

While the technical characteristics of the DVB-T2 specification unquestionably bring benefits in comparison with existing terrestrial television standards, the commercial launch of services will require a well-conceived business strategy that brings together the needs of the full broadcast industry. For a successful deployment, service operators will need to consider the needs of the market, and specifically the size of the market and the type of services that the different market segments will want to access.

Similar to the DVB-T standard, the DVB-T2 specification provides operators with significant flexibility to launch new digital television services on the terrestrial platform. The new services that could be offered on the DTT platform will be based the development of new technologies in combination with the demands of the market and could, for example, include HDTV, SDTV, 3D TV, video-on-demand, etc.

Because of the capacity improvements compared with the DVB-T standard, operators can consider offering either more standard-definition services or to launch bit-rate demanding services such as high-definition services. For example, assuming that a capacity of nearly 40 Mbit/s is possible in a given DVB-T2 multiplex, it could be possible to provide between 4-6 high-definition services or between 15-20 standard-definition services. In either scenario, it will result in lower transmission costs for each service.

The DVB-T2 specification has been designed for reception by existing fixed, roof-top antennas although reception by portable antennas may be possible in some cases. However, the standard has not been specifically designed for the provision of mobile television services.

The demand for the DVB-T2 standard

The increased capacity available with DVB-T2 specification provides the DTT platform with the ability to evolve its service offering and retain its competitiveness with other television delivery platforms.

The use of the DVB-T2 standard will provide many countries with sufficient capacity to launch new services on the DTT platform. At this stage, countries that have announced plans to adopt the DVB-T2 standard will use the capacity improvements to launch HDTV services on the DTT platform while other countries have indicated a similar intention. The opportunity to provide for a full-scale HD/DTT platform, with a significant number of HD services, may best be achieved using the DVB-T2 standard. However, it should be noted that some countries, such as France and Italy, have sourced sufficient spectrum capacity to launch HD services using the DVB-T standard in combination with MPEG-4 AVC compression technology.

While the demand for new services on the terrestrial platform can be expected to be highest in those markets where a large number of viewers rely on the terrestrial television platform for their primary television, countries where fewer viewers rely on the terrestrial television platform can also benefit from a strong DTT platform. Depending on the business model adopted, an attractive free-to-air or pay-DTT service offering can be made available.

Free-to-air services

The launch of free-to-air services has helped to drive penetration of the DTT platform. Viewers have been willing to purchase new equipment to access new services, especially in countries where the offer of free-to-air digital services has been significantly higher compared with the offer on the analogue platform. It can be expected that any new offer of free and appealing services to television viewers will help drive further DTT penetration.

In countries where a high number of free-to-air services are already available, it may not be feasible for the market to support further new services through advertisement. Rather it may be more feasible to transition existing services from standard-definition towards high-definition. As HD services increasingly become the television viewing "norm" it may no longer be possible for viewers to accept the standard-definition quality on large, flat panel displays. However, the free-to-air offer must be sufficiently large to encourage viewers to invest in new television equipment.

Pay-DTT services

The use of the DVB-T2 specification can provide pay-DTT operators with the opportunity to provide new services to their subscribers. In order to compete effectively with other pay television platforms, the DTT platform will need to have sufficient capacity to provide new services, whether more thematic channels or high-definition television.

Pay-DTT services have proven to be particularly successful in small markets where viewers generally access their television services from a variety of different television delivery platforms. The launch of pay-DTT services has been an effective means for increasing DTT penetration while also increasing the competitiveness of the pay television landscape. In the Netherlands, with a significant reliance on the cable platform, the pay-DTT platform has proven successful in increasing the penetration of terrestrial platform through its competitively priced subscription fees.

Launching services using DVB-T2 will allow pay-DTT platform operators to significantly increase their capacity to offer new services while also retaining sufficient flexibility for further service launches. In general, the reduction of transmission costs will likely create additional business opportunities for pay-DTT services. In some countries, it may be most feasible to offer new services using the DVB-T2 standard on a pay-DTT platform.

Broadcaster's business case

Retaining the competitiveness of the DTT platform in comparison with other television delivery platforms will be essential for broadcasters. They will need to ensure that the DTT platform offers similar services as are available on other television platforms whether in terms of quality and/or quantity. It is only by doing so that the DTT platform will maintain its economic viability.

The ability to generating revenue will also be an important factor in determining whether new services, either free-to-air or pay, are launched on the DTT platform. While the DTT platform will need to provide new services in order to continue to compete with other television platforms, it can only do so on condition of having sufficient financial capacity.

In the launch of free-to-air DVB-T services, commercial broadcasters have relied upon revenue from advertisement. It is now questionable, especially given the current economic situation, whether additional revenue can be generated through advertisement. However, the DTT platform will need to remain competitive and

draw large numbers of viewers in order to retain its current advertising revenue stream.

The offer of pay services may be a means of bringing innovation to the DTT platform. By relying upon subscription services to generate revenue, operators can use investments to launch new services. They also maintain strong relationships with their subscribers which could facilitate the introduction of DVB-T2 receivers. In some countries, the DVB-T2 specification could offer the opportunity to further develop pay-DTT services.

Approaches to launching DVB-T2

The status of digital switchover varies across Europe. Some countries have completed the process while others have not yet launched DTT services. In either of these two scenarios, the launch of DVB-T2 is feasible. However, such a launch is much more difficult in countries that are currently in the process of completing the roll-out of their DTT platform.

Markets having completed digital switchover

Markets having completed analogue switch-off are in a strong position to launch DVB-T2. Frequencies are likely to be available to launch new services and viewers should be sufficiently confident with existing DTT services to be receptive to new service launches on the DTT platform.

In these countries, it is anticipated that a long simulcast period between DVB-T and DVB-T2 services will take place. It is likely that the services using DVB-T2 will be viewed as an enhancement to the existing DVB-T platform rather than as a replacement.

Greenfield markets

Markets that have not yet launched any DTT services could choose to launch their DTT platforms directly with the DVB-T2 specification and thus bypass the use of the DVB-T standard. This would eliminate the need for a further transition period, between DVB-T2 and DVB-T, while also benefiting from the capacity gain available with DVB-T2. A scenario with the simulcast of DVB-T2 and analogue services could be envisaged.

In Europe, however, such a scenario is unlikely. National administrations are currently under pressure from the European Commission to complete their digital switchover by 2012 and will be unable to do so should they choose to adopt the DVB-T2 specification. Although DVB-T2 receivers will initially be available in the market in early 2010, it is likely that their cost will be high making their widespread penetration difficult to achieve. By the time the cost of receivers drops as a result of the anticipated increased demand, the Commission's deadline for digital switchover would have passed.

The shift from analogue to digital service using DVB-T2 and leapfrogging DVB-T may be more plausible in countries outside of Europe should many years be available before the completion of digital switchover is necessary.

Markets undertaking digital switchover

In most of Europe, countries are currently in the process of completing digital switchover. DTT services have been launched using the DVB-T standard yet analogue services have not been switched off completely. In general, both DVB-T and analogue services are simultaneously available.

It will be difficult to launch DVB-T2 in these countries since any available frequencies will be used either for DTT or analogue services. Furthermore, the broadcast industry is likely to be concentrating on ensuring that viewers are prepared for analogue switch-off. As a result they will want to limit potential viewer confusion by keeping to reasonable limits the number of messages communicated to viewers.

Strategies for marketing DVB-T2

Viewers will need to be enticed to purchase new equipment in order to receive services using the DVB-T2 specification. Such an incentive will require access to new services. As with the launch of the DVB-T platform, it is important for viewers to clearly understand the new services that they can access from the DVB-T2 platform.

The DTT platform has been most successful in markets that have offered viewers a significant improvement between the analogue and DVB-T platforms. For the success of DVB-T2, it will be important for viewers to clearly understand the new service offering and how it differs from the existing offering. In some countries, the new service offering may be HDTV while in other it may be the offer of new thematic channels.

Pay operators can play a key role in the marketing of the new services. With an existing subscriber base and well developed marketing tools, they are well positioned to know how to package and market a compelling service offering.

It will also be important to limit viewer confusion. Already, viewers are confronted with a wide array of broadcast industry logos, whether industry approved or unique to specific manufacturers, including those for HD displays and receivers as well as national DTT logos. To limit viewer confusion, it will be important for viewers to clearly understand the benefits available with DVB-T2 services and what they need to do in order to access such services.

Broadcasters and platform operators will need to work closely with manufacturers and retailers to ensure that viewers understand what new services will be available in a given area, when, and what they will need to do to receive these services.

Possible migration from DVB-T towards DVB-T2?

The development of the DVB-T2 specification has largely been a result of the broadcast industry's need to launch new services on the DTT platform yet facing the constraint of limited frequency capacity. For many countries, DVB-T2 offers the unique opportunity to launch bit-rate intensive services, namely HDTV, on the DTT platform.

However, for some, the DVB-T2 specification has been viewed as a potential replacement for the existing DVB-T standard. This would mean that the existing services currently provided by DVB-T standard would be replaced by the same services but using the DVB-T2 standard. However, such a conversion would require a similar, if not greater, effort as the switch from analogue to digital television.

Because the terrestrial television platform is often used for secondary television sets, whether in bedrooms or in vacation homes, it will be difficult to convince viewers that they will need to convert all of their television sets to a new standard. Many viewers will have only recently completed digital switchover and many are quite satisfied with the existing DTT service offering for their secondary television sets. It will also require a significant simulcast period which would be costly for broadcasters.

It is therefore much more likely that the DVB-T2 standard will be used to provide new services on the DTT platform that can complement the existing DVB-T platform. In a first phase, it can be expected that households will purchase DVB-T2 receivers with the aim of upgrading their primary television set. For many service providers, the launch of services using DVB-T2 standard will be used to maintain the competitiveness of the DTT platform and target the primary television set in households.

Pan-European industry recommendations

The DVB-T2 specification allows for a large number of options and combinations. Flexibility has been a key element of the specification to allow for optimization as field experience is gained. However, flexibility can also lead to market fragmentation should national variants of the DVB-T2 specification emerge.

To be able to benefit from economies of scale throughout Europe, manufacturers have undertaken an initiative within Digital Europe (formerly EICTA) to incorporate the DVB-T2 specification into the HD version of the E-Book. The aim is to define the requirements for DVB-T2 receivers that can be used across Europe. These requirements are expected to be a subset of the full DVB-T2 specification that national administrations can adopt on a national level to allow for maximum commonality within Europe It is expected that Digital Europe's E-Book for DVB-T2 will be published in mid 2010.

Digital Europe is greatly benefiting from the work which has taken place in the United Kingdom in preparation for its launch of services using DVB-T2. In March 2009, the DTG published an updated version of its 'D-Book' to ensure that even the earliest DTT receivers can conform to the DVB-T2 features selected for use by broadcasters. DTG members have defined the performance figures for DVB-T2 receivers based on simulated results and verified by the prototype trials that have taken place in the United Kingdom throughout 2009. In addition, a number of DVB-T2 modes have been defined and agreed to enable a test and conformance regime to verify the functional operation of the DVB-T2 specification. DVB-T2 receivers will need to pass the test and conformance regime in order to be awarded the Freeview HD trademark license. In addition, the broadcast industry worked together to agree the minimum receiver specification in conjunction with the plans for service development and transmission launch.

Specification requirements have similarly been established in the Nordic region. In June 2009, NorDig issued its minimum requirements for receivers that can access NorDig compliant signals based on the DVB-T2 specification. The DVB-T2 specification defines a single profile which incorporates time-slicing but not time-frequency-slicing (TFS). Features which would allow a possible future implementation of TFS (for receivers with two tuners/front-ends) can be found in annex E (ETSI EN302755). The NorDig DVB-T2 receiver profile mandates the implementation of Time Frequency Slicing (TFS) after 2012 which has provoked controversy with manufacturers who prefer the adoption of a common specification throughout Europe. According to some manufacturers, the implementation of TFS could lead to market fragmentation, a high level of complexity within receivers, and future delays in the deployment of DVB-T2 since TFS technology has not been fully tested and is not defined in the single profile of the current DVB-T2 specification.

It is expected that most major consumer electronics manufacturers will launch DVB-T2 receivers in early 2010 to meet the United Kingdom's DVB-T2 receiver requirements. The FIFA World Cup in 2010 is expected to serve as a further stimulus in the uptake of HD services and manufacturers will make iDTVs available with DVB-T2 capabilities. The market for DVB-T2 set-top boxes should also be significant given the existing penetration of HD-ready displays in homes.

Section
5

DVB-T2 regulatory issues

The roll-out DVB-T2 will ultimately depend on a decision taken by national regulators when determining the licensing conditions for the DTT platform. Countries that have not yet launched DTT services may choose to do so using the DVB-T2 standard while countries that have already launched DVB-T services may decide to either change existing licensing conditions or grant new DTT licenses using the DVB-T standard.

Given the strong demand for the frequencies in the UHF frequency bands, national administrations may be tempted to launch new television services, or replace existing television services, using the most efficient digital broadcasting standard available. At this time, it is the DVB-T2 standard. However, national regulators will want to ensure that their licensing conditions conform with existing agreements taken at the international and European levels.

International Telecommunications Union (ITU) Agreements

One of the key requirements for the DVB-T2 standard has been its compliance with the Geneva 2006 (GE-06) Agreement. This agreement allocates the frequencies in Bands III and IV/V for DVB-T and T-DAB services. Since the DVB-T2 standard complies with the interference levels and spectrum mask requirements as defined by GE-06 Agreement, the implementation of the DVB-T2 standard avoids the need to renegotiate a major international treaty involving over 110 countries.

The DVB-T2 standard also complies with the requirements of the Radio Regulations, the international framework governing the use of frequency spectrum and satellite orbits. While the Radio Regulations do not set out the specific standards which can be used in the various frequency channels, it does regulate the usage of the channels.

At the last World Radiocommunication Conference 2007 (WRC-07), national administrations modified the Radio Regulations by allowing for the allocation of mobile services in the terrestrial frequency bands between 470-862 MHz traditionally reserved for broadcasting in Europe after June 2015.

While this decision does not have a direct impact on a national administration's decision to launch DVB-T2 services, it does highlight the demand for such frequencies and the likelihood that these frequencies will need to be shared between various service providers. A digital broadcast standard, such as DVB-T2, that makes maximal efficient use of spectrum will have much appeal for national administrations.

The Geneva 2006 Agreement

The Geneva 2006 (GE-06) Agreement regulates frequency usage in the broadcast bands of Europe, Africa and parts of Asia. It establishes two separate plans for an analogue and digital environment in these regions of the world. It is a binding international treaty signed by national administrations and registered with the United Nations.

In an all-digital environment, GE-06 takes into account a total of 72,761 country requirements for 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.

Frequency management prior to GE-06
In Europe and parts of Asia, GE-06 replaces part of the existing Stockholm 1961 (ST-61) Agreement which regulated frequency usage in an analogue broadcast environment. Because it also regulated frequency usage for services in bands I and II, parts of ST-61 and its subsequent agreements remain in force. Similarly, GE-06 replaces the Geneva 1989 Agreement for African countries.

While ST-61 allocated only 5,300 country requirements, it provided the necessary flexibility to allow ultimately for the assignment of 80,000 analogue transmitters. It is hoped that GE-06 will also allow for such flexibility for future requirements.

Reaching this point
The process leading up to the GE-06 began in 2000, when some European countries asked the International Telecommunication Union (ITU) to revise ST-61 for bands III, IV and V.

In 2004, the first session of the Regional Radiocommunication Conference (RRC) met for three weeks in Geneva to establish the planning parameters for an all-digital broadcast environment. The second session met in 2006 to develop the digital plan as well as the analogue plan based on revisions to ST-61 and GE-89. It successfully concluded with the adoption of GE-06.

Analogue switch-off
GE-06 sets the precise date of 17 June 2015 at 00.01 hr UTC as the end of the transition period. This means that after this time, countries will no longer need to protect the analogue services of neighbouring countries and can freely begin using the frequencies assigned to them in GE-06 for their digital services.

It is possible for countries to begin implementing the GE-06's digital plan as of 17 June 2006. However, doing so will require the prior agreement of countries implicated by such an action. Implicated countries are defined as those within a plan entry that need to provide agreement prior to the implementation of an assignment/allotment.

The end of the transition period does not necessarily signify that analogue switch-off will take place throughout a given country. It does, however, mean that analogue services will no longer be protected or available along the borders, and hence could serve as an impetus to switching off analogue services throughout a given country.

The date of 2020 has been set for the end of the transition period in some African and Arab countries for analogue services in Band III.

European Union activities

At this stage, the European Union has not taken any formal decisions that could impact the launch and roll-out of DVB-T2. Rather, the activities of the European Commission have addressed such topics as analogue switch-off, the digital dividend, and mechanisms for allocating frequencies as proposed in the Telecoms Package.

In its communication entitled “on accelerating the transition from analogue to digital broadcasting” issued in May 2005, the European Commission recognized that the full benefits of digital switchover could not be achieved until all countries in a given area had completed the process. As a result, it recommended that its Member-States complete digital switchover by the end of 2012 and nearly all Member-States have announced their intention to comply with this recommendation. However, in order to complete digital switch by 2012, it will be necessary for Member-States to launch their DTT services as soon as possible, if they have not already done so. This could preclude the possibility of launching DTT services using the DVB-T2 standard since sufficient quantities of receivers will not be available in time for the completion of the process. It may therefore be more feasible to launch services using DVB-T2 in countries that have completed digital switchover.

The position of the European Commission regarding the digital dividend and its proposal for the update to the Telecom Package highlight the demand for frequency usage in the UHF bands and the increased competition that broadcasters will face in trying to offer new services in these frequency bands. It can be expected that market-based mechanisms will be tried increasingly in the allocation of frequency licenses while such concepts as service and technology neutrality will be applied following the recent updates made to the Telecom Package.

Conclusion

The availability of the DVB-T2 standard brings new opportunities for the terrestrial television delivery platform. Broadcasters and other service providers can consider offering new services on the DTT platform which would have otherwise been difficult given the limited frequency capacity available in the VHF and UHF frequency bands.

The demand for the development of a second-generation terrestrial television platform has been strong. It has been increasingly necessary to optimize spectrum usage while also providing viewers with access to new television services. In many countries, the DVB-T2 standard offers the opportunity for broadcasters to launch an appealing array of HDTV services on the DTT platform. The DVB-T2 standard also makes possible future service offerings. Next generation services, such as 3D TV, can benefit from the capacity increase available with DVB-T2.

However, in order to benefit from economies of scale throughout Europe, it will be necessary for national operators to adopt common receiver specifications for DVB-T2. This will prevent market fragmentation and ensure that viewers have access to a wide selection of DVB-T2 receivers at the lowest possible price point. It is for this reason that manufacturers have already begun work to define requirements for DVB-T2 receivers throughout Europe.

Following the completion of analogue switch-off, it can be expected that countries will begin to launch services using the DVB-T2 standard. In some countries, this new standard will be used to offer HDTV services, on both free-to-air and pay platforms, but could also be used to enhance the existing standard-definition offer. However, it is unlikely that in the short to medium term it will be possible for the DVB-T2 standard to replace the DVB-T standard. The effort required from viewers and broadcasters is similar to the conversion from analogue to digital and such demands cannot occur too often. Rather, it can be expected that the DVB-T and DVB-T2 standards will co-exist for many years, each offering viewers different types of services. In many countries, the existing service offering on the DVB-T platform will likely suffice for secondary television sets.

DVB-T2 offers many new opportunities. Given its capacity gain that nearly reaches the physical limits possible, it can be expected that the DVB-T2 standard will be relevant for many years into the future.

Annex 1

Status of broadcast services on the terrestrial platform in Europe

Country	DTT launch	ASO status	Compression format	Current HD/DTT status	Future HD/DTT plans
United Kingdom	1998	2012	MPEG-2	Launch 2009	Yes – DVB-T2
Sweden	1999	Completed	MPEG-2 / MPEG-4	Trial services	TBC
Spain	2000/2005	2010	MPEG-2	Trial services	TBC
Finland	2001	Completed	MPEG-2	Launch 2010	Yes – DVB-T2
Switzerland	2001	Completed	MPEG-2	No	No
Germany	2002	Completed	MPEG-2	Trial services	TBC
Belgium (Flemish)	2002	Completed	MPEG-2	No	TBC
Netherlands	2003	Completed	MPEG-2	No	TBC
Andorra	2004	Completed	MPEG-2	No	TBC
Italy	2004	2012	MPEG-2 / MPEG-4	Launch 2009	Yes[1]
France	2005	2011	MPEG-2 / MPEG-4	Launch 2008	Yes – DVB-T
Czech Republic	2005	2011	MPEG-2	Trial services	TBC
Luxembourg	2006	Completed	MPEG-2	No	TBC
Denmark	2006	2009	MPEG-2 / MPEG-4	Launch 2009	Yes – DVB-T
Estonia	2006	2010	MPEG-4	Trial services	TBC
Austria	2006	2010	MPEG-2	No	TBC
Slovenia	2006	2011	MPEG-4	No	TBC
Norway	2007	2009	MPEG-4	Launch 2009	Yes – DVB-T
Malta (pay-DTT)	2007	2012	MPEG-4	No	TBC
Lithuania	2008	2012	MPEG-4	No	TBC
Hungary	2008	2011	MPEG-4	Launch 2008	Yes – DVB-T
Portugal	2009	2012	MPEG-4	Planned	Yes – DVB-T
Croatia	2009	2011	MPEG-2	No	TBC
Latvia	2009	2011	MPEG-4	No	TBC
Poland	2009	2013	MPEG-4	Trial services	Yes – DVB-T
Bulgaria	2009	2012	MPEG-4	No	TBC
Greece	2010	2012	MPEG-4	No	TBC
Ireland	2010	2012	MPEG-4	No	TBC
Slovakia	2010	2012	TBC	No	TBC
Romania	2010	2012	MPEG-4	No	TBC
Cyprus	2010	2012	MPEG-4	No	TBC

Source: DigiTAG

[1] Mediaset launched one HD service on its pay –DTT platform using a combination of DVB-T and MPEG-4 AVC in August 2009. The DVB-T2 standard will be considered once products become available.

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