

Benefits of digital broadcasting

A report for the
GSMA

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Executive Summary

There has been considerable discussion of the benefits of changing use of UHF spectrum for mobile (i.e. the Digital Dividend) but discussion of the benefits for broadcasters from the transition to digital technology is often neglected in political and regulatory debates, which tend to focus on the mobile industry. This report addresses the benefits for the broadcasting industry of this transition which include:

- An increase in the capacity of broadcast transmission networks by improving spectrum efficiency (i.e. more data can be transmitted per unit bandwidth)
- Provision of better signal quality which increases robustness to interference and picture degradation
- The support of HD services and interactivity
- A potential reduction in transmission network energy usage
- The implementation of single frequency networks (SFNs) instead of the independent parallel networks which are common in analogue broadcasting.

In addition:

- The take-up of digital TV is likely to boost sales of TV sets and digital video recorders
- Digital TV could lead to positive upstream benefits in terms of increased time spent watching TV and greater demand for digital content
- In a competitive multi-channel, multi-platform environment, DTT provides opportunities for terrestrial broadcasters to address the challenges posed by pay TV operators and the Internet.

The consumer benefits arising from digital switchover are widely recognised, happen relatively quickly and are primarily driven by increases in programming and quality. There are also broader benefits to society of introducing digital TV including the potential to use digital broadcasting to narrow the digital divide, reach unserved areas, and to provide e-government and other digital services.

The costs for the transition to digital broadcasting are substantial and most of these occur at the early phases of digital switchover, particularly during DTT rollout and while transmissions are simulcast. So while consumers will see immediate benefits, those for the broadcasting industry will take longer to accrue.

Consumers can also face significant costs to make the transition to digital, especially those in lower income groups or similar circumstances. Subsidy is usually required to ensure adoption within these groups and a key role of government is to ensure that the finances and organisation of the transition to digital broadcasting are well thought out and implemented with suitable governance.

In addition to covering the activities required for the transition to digital broadcasting and its benefits and costs, we have also captured the following learning from our research interviews:

- Government intervention and management is required to drive the digital switchover process. A market-led approach alone is unlikely to meet universal coverage and timeframe objectives for switch-off
- Sufficient, safeguarded funding provides the foundation for long term planning and facilitates a smooth transition

- An adequate simulcast period is necessary to facilitate DTT take-up and minimise consumer disruption at analogue switch-off. This also provides time for regulators and industry to address coverage and content-related issues
- Consumer awareness, affordability of set-top boxes, broadcasters' costs and the future of local TV could all cause delays and resolving them early requires engagement of all stakeholders.

Access to skilled resources and creating the environment for knowledge transfer were also cited in our research as key enablers, especially for developing markets and again government plays a key role in enabling these aspects.

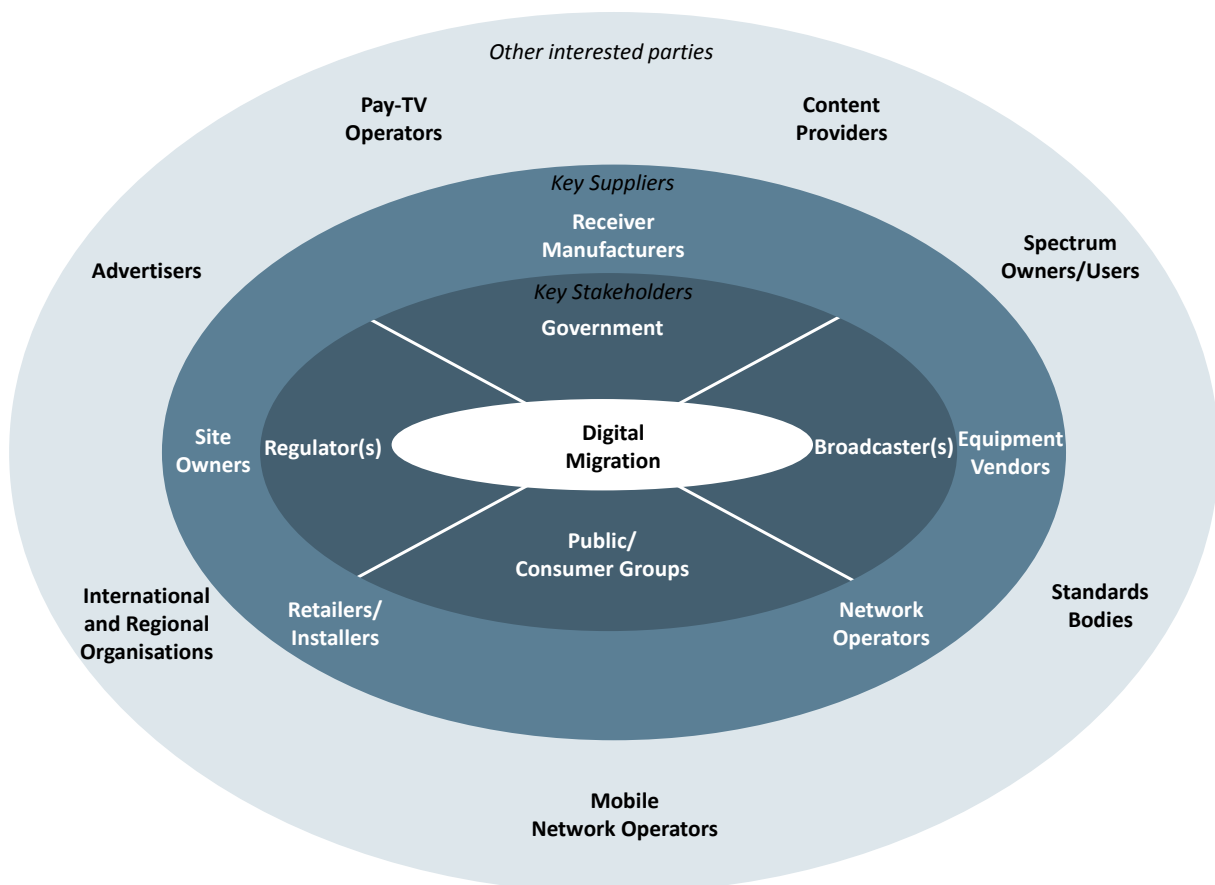
1 Introduction

There has been considerable discussion of the benefits of changing use of UHF spectrum for mobile (i.e. the digital dividend) but discussion of the benefits for broadcasters from the transition to digital technology are often neglected in political and regulatory debates, which focus on the mobile industry. This report addresses the benefits for the broadcasting industry of this transition.

The value of digital terrestrial broadcasting to the broadcasting industry should not be underestimated. It enables the use of better transmission standards and the delivery of a greater range of services, which consumers are likely to value and which will generate medium to long term benefit for the broadcasting industry.

The move to digital broadcasting is a complex and potentially long process, which directly involves many stakeholders. These include government, policy makers, regulators, broadcasters and consumers. It also impinges on many other industry players, such as content providers, service providers, network operators, receiver manufacturers and equipment vendors. These players can be segmented into three groups as shown in Figure 1-1.

Figure 1-1: Digital migration Key Stakeholders, Suppliers and Other interested parties



1.1 Timing of benefits

The incidence of benefits and costs is widely dispersed across the players, meaning that no single party gains the full benefits whilst incurring the costs of DSO. For this reason it is important to ensure that the right incentives are established early on in the transition process to achieve an effective outcome. This requires the establishment of conditions and objectives for the key stakeholders and other players. Governments frequently play a key role in setting such objectives and steering the switchover process and usually set the timeframe for completion of digital switchover. Figure 1-2 illustrates the four phases of the digital migration process and it assumes a phased switch-off, as opposed to a simultaneous switch-off. The time taken to complete the migration can differ between countries and depends on the successful accomplishment of activities during each phase.

Figure 1-2: The typical digital switchover process

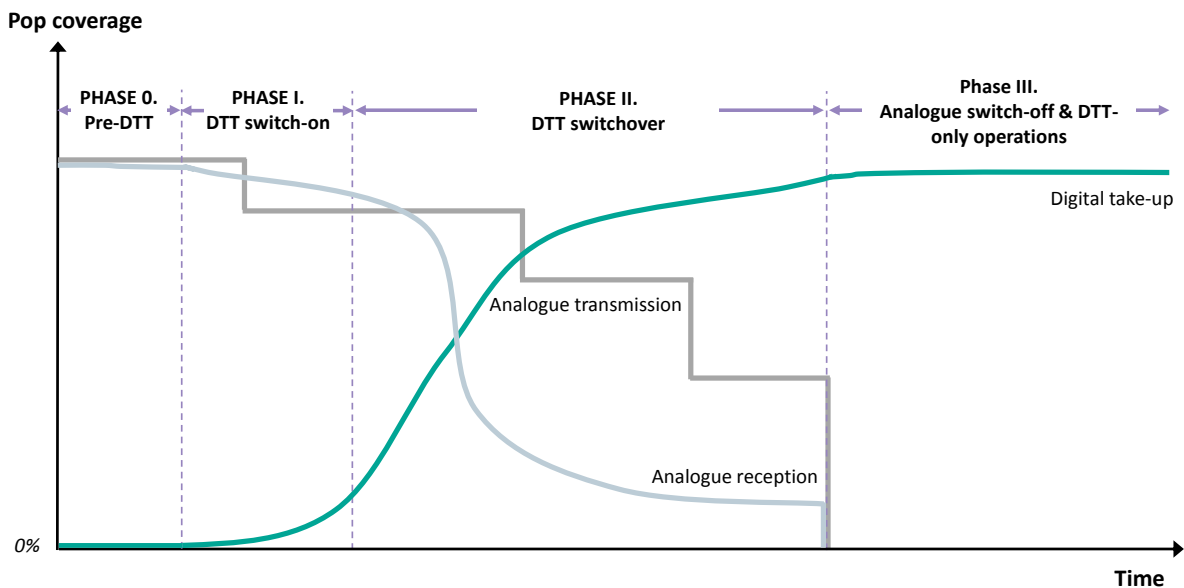


Table 1-1 sets out in more detail some of the activities for the different phases for the transition to digital broadcasting.

Table 1-1: Phases for the transition to digital broadcasting

Phase	Key activities	Stakeholders involved
Phase 0: Pre-switchover planning	Decisions on overall policy and digital strategy for television broadcasting. Establishing the licensing and regulatory framework. Policy and process for allocation of subsidy. Frequency planning. Planning and implementation of transmission and receiver standards.	Government, regulators
	Network planning, build and test Manufacturing of receivers	Industry
Phase I: Switch-on	Network deployment and introduction of DTT services	Network operators, broadcasters

Phase	Key activities	Stakeholders involved
	Marketing and communications campaign Provision of subsidies and consumer support services	Government, industry
	Adoption of DTT services	Consumers
Phase II: Switchover	Marketing and communications campaign Provision of subsidies and consumer support services	Government, industry
	Adoption of DTT services	Consumers
	Complete network deployment and achieve coverage objectives Network monitoring	Network operators, broadcasters, regulators
Phase III: Analogue switch-off	Switch-off analogue TV	Broadcasters
	Restacking of frequencies to free up digital dividend	Government, industry
	Retuning of TVs or STBs	Consumers

1.2 Benefits considered in this report

In this report we have considered benefits arising for two groups:

- Consumers. TV viewers at home or in other locations on TV sets or through set top boxes or potentially other devices (e.g. mobile TV)
- The broadcasting industry (including organisations from content creators through to signal transmitters).

Some benefits are expected to be realised during the early stages of the transition (especially those for consumers) while others are likely to develop over the longer term following the completion of switchover.

In section 2 of this report we describe the benefits of digital terrestrial television. Section 3 reviews the costs associated with DTT implementation.

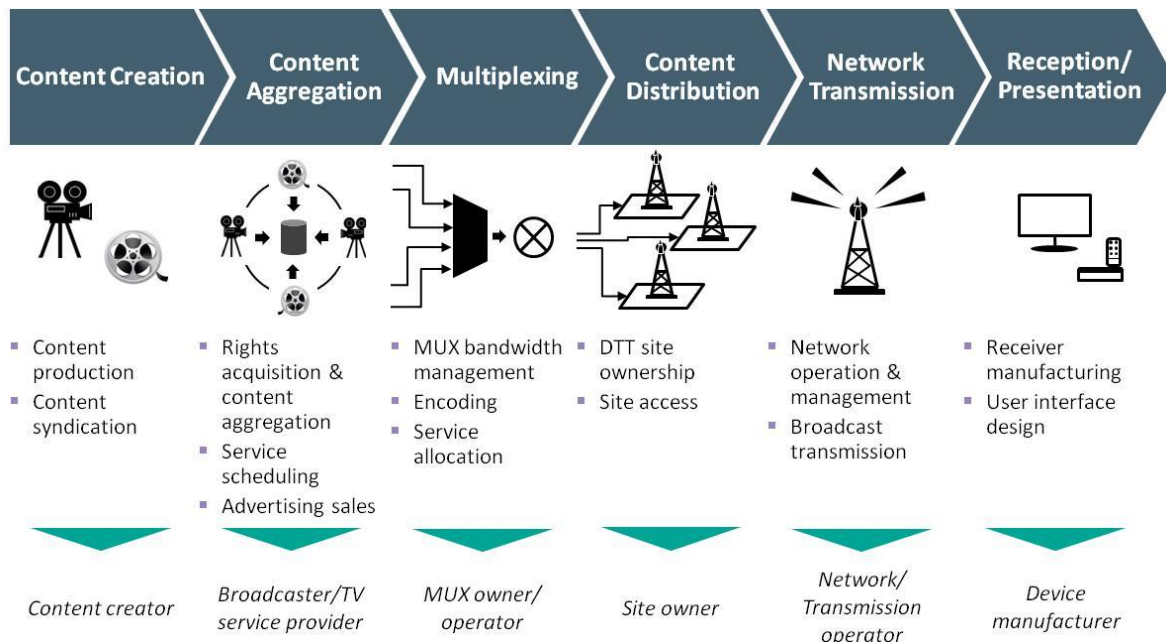
It is important to note that this report describes benefits from a qualitative rather than a quantitative perspective.

2 The benefits of DTT

The transition from analogue to digital terrestrial TV can be considered a natural evolution for the broadcasting industry. While the adoption of digital broadcasting has been led by cable, satellite and to some extent IPTV, it is the transition of the terrestrial broadcast platform that arguably brings most benefits to society. This is especially true for countries where the size of the terrestrial platform is large and terrestrial TV is the primary mode of TV reception for most households.

Migrating to DTT involves considerable costs especially for broadcasters. However, these are outweighed by the significant advantages digital broadcasting delivers for all players across the entire value chain. The broadcasting value chain is shown in Figure 2-1.

Figure 2-1: Digital broadcasting value chain



2.1 Digital strategy for broadcasters

In a competitive multi-channel, multi-platform environment, DTT provides opportunities for terrestrial broadcasters to address the challenges posed by pay TV operators and over-the-top offerings through the Internet. Globally, TV viewing is under pressure due to the development of other delivery platforms and internet-connected devices which deliver media content (e.g. smartphones, tablets).

“In a market where Pay-TV is growing, the DTT platform can differentiate itself by strengthening a multi-channel, free-to-air proposition, whilst improving competitiveness among digital platforms.”

Lara Kantor - Group Executive, Regulatory Strategy at eTV (South Africa)

DTT can contribute to the digital strategy of broadcasters and help secure the long term future of terrestrial TV in the following ways:

- DTT delivers an attractive, low cost multi-channel service offering to a wide audience. In many countries it is or will be the primary means of distributing broadcast video content and it can be developed as part of a multi-platform digital broadcasting strategy
- Through use of interactive standards¹ digital broadcasting enhances broadcasting functionality and enables interactive features for viewers. Interactivity provides access to data and other services that utilise the digital transmission capability of the DTT multiplex. In this one way mode it can be used for a variety of data distribution services. Where a return path is available via a fixed or mobile broadband connection a richer set of interactive services can potentially be provided
- DTT allows introduction of HD and full-HD services. In future, if there is adequate bandwidth available it may also support the introduction of ultra-HD services
- Conditional access² facilitates new business models (e.g. hybrid free-pay TV business models). Although much use of DTT is for free to air services, most technology solutions for DTT are capable of supporting a conditional access module that can provide a mixed free-pay environment. This potentially enhances the service mix that providers can offer and support segmentation of the digital broadcasting market. The use of encryption more generally (for free to air as well as pay services) supports better content protection, which helps prevent piracy and protects investment in content creation
- DTT reduces barriers to entry for service providers (the delivery cost of provision of a TV service within a multiplex will be lower on a per unit basis than that of providing a single analogue TV channel). The lower barrier to entry enables DTT the ability to provide more opportunities to deliver niche, regional and community content.

All of the above can contribute to a vibrant and competitive broadcasting landscape post switchover which improves plurality and choice. The extent of transformation depends on national/local market conditions, licensing and regulatory frameworks and the TV market structure following the analogue switch-off.

“The policy framework and regulatory environment for the digital migration must be clear, transparent and consistent to facilitate a successful transition to digital broadcasting services. Uncertainty from policy makers and lack of direction and leadership from Government can hinder investment and commitment from broadcasters and other stakeholders.”

“In a period when broadcasters continue to face challenges from reaching collective audiences, it is critical for Governments to adequately create incentives to promote the transition to digital TV.”

Lara Kantor - Group Executive, Regulatory Strategy at eTV (South Africa)

¹ e.g. MHEG, MHP, HbbTV: MHEG – Multimedia and Hypermedia Experts Group – licence free TV middleware for interactive TV services <http://www.mheg.org/users/mheg/index.php>; MHP – Multimedia Home Platform – (DVB-MHP) is an open middleware system with version supporting both Java and HTML <http://www.mhp.org/>; HbbTV – Hybrid Broadcast Broadband TV – European initiative aimed at harmonising delivery of broadcast and broadband entertainment <http://www.hbbtv.org/> ;

² Conditional access provides protection of content by defining access criteria and encryption standards. See DVB <http://www.dvb.org/standards#conditional>

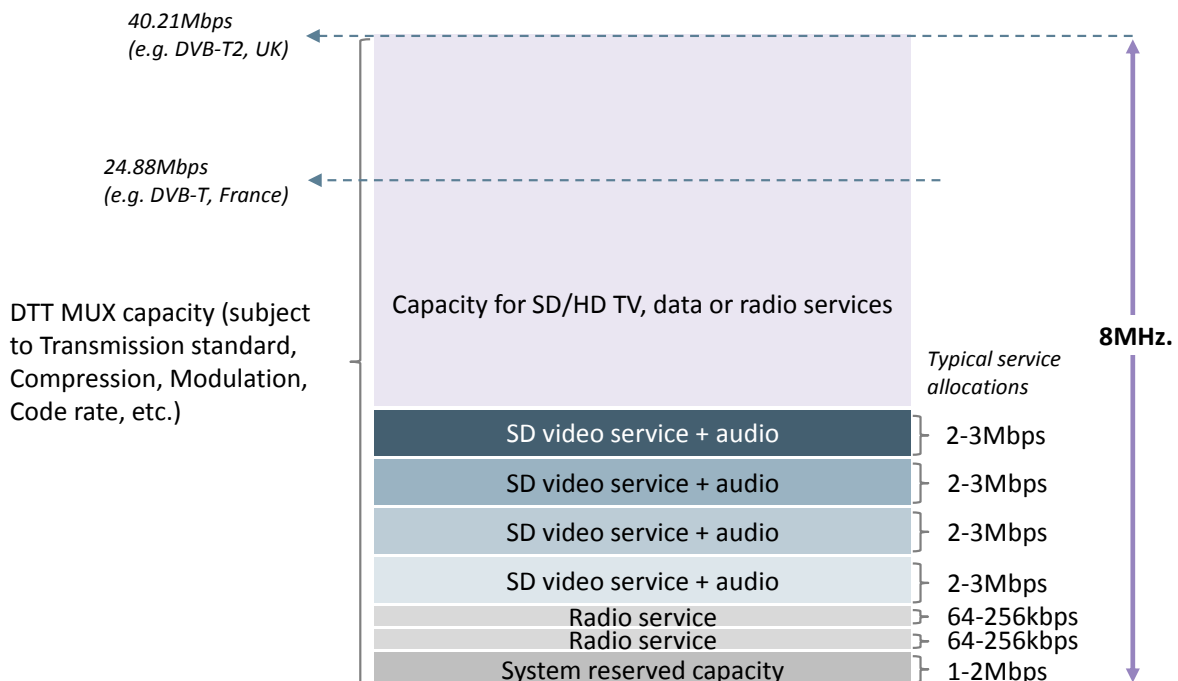
2.2 Benefits for the broadcasting industry

DTT can deliver a range of potential benefits across the broadcast value chain – many of which are inter-related. The following sections discuss the key benefits for broadcasters, content providers, transmission operators and device manufacturers.

2.2.1 Spectrum efficiency gains and increased transmission capacity

Digital broadcasting standards increase the capacity of transmission networks by improving spectrum efficiency (i.e. more data can be transmitted per unit bandwidth). In an equivalent frequency channel used for one analogue TV service, DTT typically allows between 4 and 18 services to be accommodated. Figure 2-2 provides an example of how an 8 MHz DTT channel could be utilised.

Figure 2-2: Analogue vs digital transmission



Typical spectrum efficiency gains are expected in the range of 5x - 15x, depending on the digital transmission standard, modulation scheme, network configuration (e.g. compression, code rate, guard interval, etc.), service bitrate allocation and frequency planning. Compared to the equivalent average analogue bitrate of 2-3 Mbps per channel, DTT offers considerable improvement as shown in Table 2-1.

Table 2-1: Examples of currently deployed bitrates on DTT platform

Country	Standard	Modulation	Bandwidth (MHz)	MUX Bitrate (Mbps)
Germany	DVB-T	16-QAM	8	13.27

Country	Standard	Modulation	Bandwidth (MHz)	MUX Bitrate (Mbps)
France	DVB-T	64-QAM	8	24.88
UK	DVB-T2	256-QAM	8	40.21
Brazil	ISDB-T	64-QAM	6	18.28
Japan	ISDB-T	64-QAM	6	17.27
US	ATSC	8-VSB	6	19.29
China (Beijing)	CTTB	16-QAM	8	21.66
China (Shanghai)	CTTB	16-QAM	8	20.79

Source: DVB.org

The increase in transmission capacity can be utilised to deliver additional TV channels (SD/HD), multi-sound features, radio or data services. Broadcasters can also opt to increase the bitrate allocated for a particular service during a specific event to enhance the viewing quality of the programme.

2.2.2 Improved signal quality and robustness

Another technical benefit of DTT is the better signal quality which increases rejection of noise and interference. Interference with digital transmissions does not create the same type of visual distortion often experienced by analogue transmission (e.g. ghosting). However, once DTT signals drop below a defined power level the receiver will not decode the signal. This can lead to a reduction of the service area.

2.2.3 Lower energy consumption and maintenance costs

Replacing the analogue terrestrial transmission network with a DTT network often results in a reduction in energy usage. Overall power savings will depend on network configuration and possible requirement to build new transmission or re-broadcast sites to fill-in coverage gaps.

The increasing obsolescence of analogue broadcast equipment will lead to rising maintenance and support costs for analogue broadcasting. By migrating to DTT broadcasters also benefit from lower maintenance costs of digital systems and better support from vendors, further contributing to reduction of operational costs.

2.2.4 Flexibility and more efficient use of infrastructure

Digital broadcasting will allow the implementation of single frequency networks (SFNs)³ instead of independent parallel analogue networks which are commonly used for broadcasting today. The use of

³ A Single Frequency Networks (SFN) is a broadcast network where several transmitters simultaneously send the same signal over the same frequency channel

SFNs is, in principle, more spectrally efficient than multi-frequency networks (MFNs) if service areas are large, of similar shape and size, and do not overlap.⁴

Under an MFN configuration, different transmitters use different frequency channels to carry the same TV services and many frequency channels are required to cover the service area. In SFNs, different transmitters use the same frequency channel to transmit the same TV service and only one frequency channel is required to cover the service area.

The deployment of a SFN means elements of the transmission network (e.g. masts, antennas) can be shared thus reducing capital expenditure on deploying and maintaining separate infrastructure and increasing speed of DTT rollout.⁵

The use of SFNs also means there is also no need to retune receivers when travelling through different areas. This is useful for mobile/portable reception and facilitates use of mobile devices with integrated receivers (e.g. DVB-H, DVB-T2 lite).

“The transition to digital broadcasting creates the potential for a more efficient use of infrastructure, reducing signal distribution costs for broadcasters and allowing new players to enter the market. A diverse ecosystem of digital broadcasting transmission equipment vendors can also contribute towards lower maintenance costs.”

Aldred Dreyer - CTO, Namibian Broadcasting Corporation (NBC)

2.2.5 Stimulates demand in the consumer electronic market (e.g. STBs, iDTVs, aerials, HDTVs, etc.)

Digital switchover creates demand for the equipment necessary to receive and decode digital TV signals. DTT receivers include external set-top-boxes (STBs) or TV sets with integrated digital tuners (iDTVs). Viewers may need to purchase more than one receiver depending on the number of TV sets in the household. In some cases, new aerials are required to receive the signals.

The take-up of digital TV is also likely to generally boost sales of TV sets and digital video recorders. Consumer expenditure on digital equipment could lead to positive upstream benefits in terms of increased time spent watching TV and greater demand for digital content.

2.3 Consumer benefits

The consumer benefits from digital switchover are widely recognised. Compared to analogue broadcasting, DTT delivers a variety of benefits including:

- Wider choice of programming and services (including additional channels, HD offerings, radio, data services, pay programmes)
- Better quality – less likely to experience signal interference and picture quality issues

⁴ Conversely, where there are many small service areas, differing significantly in shape and size and that are either adjacent or overlapping, there will be marginal difference in the spectrum efficiency, if any, between SFNs and MFNs.

⁵ A common infrastructure approach may require a non-discriminatory regulatory framework to ensure fair access to multiplex capacity for all broadcasters or programme providers.

- Interactivity – offers a range of interactive applications (games, enhanced teletext), more user-friendly interfaces and better personalisation (e.g. mosaic/multiscreen capability, multi-lingual subtitling, audio-description)
- Convenience – video-on-demand/catch-up services allow viewers to watch programmes at a time of their choosing
- Parental lock setting – gives parents and/or guardians greater control of what their children watch on television via classification of programmes or full channels.

All of these factors contribute to a richer experience where consumers have greater choice and control over their TV viewing. More advanced services (e.g. voting, email and web access) and true on-demand services can be enabled in cases where a return channel is available. Figure 2-3 shows an example of interactive functions on BBC's DTT service.

Figure 2-3: BBC's Red Button sports multiscreen



Source: BBC

2.4 Wider benefits

Besides benefiting the broadcasting industry players and consumers, DTT also has a role in delivering wider public benefits.

2.4.1 Narrowing digital divide and reaching unserved areas

The transition to digital broadcasting can help bridge the digital divide by increasing access to information to those without access to the Internet. DTT, sometimes supplemented by satellite, could potentially deliver universal digital TV coverage. Although predominantly a broadcast platform, DTT

has the potential to provide viewers with a range of alternative services, including e-mail, Internet access and access to government portals and other interactive services (the transmission sites provide facilities which mobile operators can access for deployment of mobile broadband to rural populations). Site sharing potentially reduces the cost of deployment by mobile network operators and makes it possible to deliver broadband services to unserved rural areas.

2.4.2 E-government and other public services

Interactive applications can evolve sufficiently to provide an effective low cost way for delivering e-government and other public services to people who do not have broadband access. Although the development of such services on digital television has not been a priority for Governments so far, the extensive coverage of over-the-air digital broadcasting can open the way for greater use of these services as increased numbers of households move to digital television and users become more familiar with digital interactive services.

Another important advantage of DTT is the capability to integrate into receivers early warning systems for natural disasters. Japan, the Philippines and Indonesia are among the countries which have adopted such systems.

2.4.3 Resilience of communications infrastructure

DTT, by providing an alternative communications platform, improves the resilience of a country's communications infrastructure. This is particularly important in times of national crises, e.g. natural disasters or cyber attacks. National administrations have a greater level of control over DTT systems which are inherently national or local, compared to IP networks and satellite platforms which may fall outside national jurisdiction.

2.4.4 Release of Digital Dividend spectrum for other services

As discussed above, DTT allows more efficient use of spectrum for broadcasting, thus freeing up valuable spectrum in the UHF band for other uses. The allocation of sub-1 GHz spectrum used by analogue TV to other uses (e.g. mobile, PPDR) could deliver significant economic and social benefits.

2.5 Learning from practical experience

In our interview with the BBC and Arqiva, the following key lessons were noted:

- Digital switchover only works if Government led (there has to be clear legislation, regulation and an overall coordination body in place)
- A functioning supply chain is crucial for a smooth DSO process (without this it is not possible to ensure that consumers have access to new receiver equipment at the right time)
- Digital broadcasting enables more services to be offered but this is only of benefit if the content is there (the right content to attract viewers and enough of it) to use the capacity/capability DTT

offers. In the UK this was especially true for commercial broadcasters who need advertising revenue on their platforms

- Adequate funding across the supply chain is very important to ensure success; in the UK, having a large market size helped and BBC licence fees were the main source of funding; in smaller countries and lower income countries, large government subsidies may be required.

3 Costs of digital switchover

The migration to digital broadcasting delivers many benefits. However, there are also substantial costs and most of these occur at the early phases of the digital switchover, particularly during the DTT rollout and simulcast phases. The costs of digital switchover do not just fall on a single party; rather each stakeholder (broadcast industry, consumers, government and regulators) will face a different set of costs.

3.1 Broadcast industry costs

While DTT adoption enables potentially substantial long term cost savings, there are large upfront costs for broadcasters and network operators at the initial phases of implementation. The main costs to the broadcasting industry are shown in Table 3-1.

Table 3-1: Broadcast industry costs

Rollout of DTT network (capex)	The costs for the provision of equipment (transmission equipment, processing hardware and aerials), configuration and deployment of DTT. These are typically borne by broadcasters and/or multiplex operators This category may also include additional investment for enhancing coverage (gap fillers/relay stations)
Content production and acquisition	Production and acquisition of programming – the increased variety of digital content is a key driver of DTT take-up; however this requires broadcasters to invest in content origination or digital content acquisition
Simulcasting	The period when industry costs are increased resulting from the simultaneous transmission of analogue and digital services (see Figure 1-2, phases 0-2)
Conformance and certification	Compliance to conformance regimes, certification processes – receiver performance testing, auditing procedures to ensure interoperability and feature upgrades; labelling and certification of receivers
Communications and marketing	Provision of clear and comprehensive information to all viewers about the process and scheduled switchover dates, with more prominent regional awareness campaigns in the period leading up to switchover
Customer support	Helplines and other contact media to deal with consumer enquiries and complaints (e.g. equipment, installation, interference issues)

Rollout costs will also include various planning and operational costs for network planning, service migration and minimising disruption to existing services which require a high level of network and service availability. Other possible costs in this category include coordination for the approval of new sites with neighbouring countries and accessing remote sites during inclement weather. There will also be costs associated with the decommissioning of redundant analogue equipment.

"One of the major challenges the NBC faces for the digital switchover, is the lack of specialised technical skill-set and knowledge of the digital standards and technology together with system-level and overall project management capabilities. Acquiring and developing these skills is required from the initial phases of network rollout, throughout the migration process and into operational phases."

"Capacity building programmes across Governments, Regulators, Broadcasters, Network Operators and the Public are critical not only to raise awareness on the challenges of the digital migration, but also to enable knowledge transfer across the Southern Africa region and allow for more effective coordination and planning."

Aldred Dreyer - CTO, Namibian Broadcasting Corporation (NBC)

In some cases, government subsidies may be provided to help the broadcast industry offset the large upfront costs of switchover, e.g. for extension of DTT coverage and communications campaigns.

3.2 Consumers costs

Consumer costs for DTT are shown in Table 3-2. Consumers will directly bear these costs unless they (or the retail distribution chain) are in receipt of government subsidy.

Table 3-2: Consumer costs

Purchasing new equipment (digital receivers, TV sets)	Unless consumers already own a DTT capable TV they will need to buy either a set top box to interface with their existing TV equipment or an integrated digital TV Households with additional TV sets will need to obtain equipment to adapt all the television sets they wish to use after migration
Upgrading aerials	Consumers may need to improve their aerial installations for good digital TV reception
Purchasing of additional SCART/HDMI leads for households with video-recorders	If required to interconnect with existing recording and other accessory equipment

To minimise consumer costs and ensure a smooth switchover, adequate and clear information should be provided to consumers with sufficient lead time to enable them to buy and install the right equipment.

3.3 Government costs

Governments are heavily involved in digital switchover from the planning phase through to the switch-off phase and they play a crucial role in steering the whole process. Government costs for DTT are shown in Table 3-3. Government costs may be borne by tax payers or levies on one or more groups of industry players.

Table 3-3: Government costs

Government/regulator	
Policy, planning and regulatory activities	<ul style="list-style-type: none"> Setting objectives and timescales Assessment, consultation and adoption of appropriate licensing and regulatory framework for digital TV Selection of appropriate technical standards
Frequency management	<ul style="list-style-type: none"> Allocation of frequency bands for TV services (during simulcast and post-switchover) Migration of other incumbent spectrum users in relevant frequencies Planning bands to be released for other purposes
Clearance of the digital dividend spectrum	<ul style="list-style-type: none"> Clearance of TV services from digital dividend spectrum after analogue switch-off, allocation of spectrum to other services
Subsidies to migrate viewers	<ul style="list-style-type: none"> Assessing the level and criteria for public expenditure required – these will be aimed primarily (but not necessarily exclusively) at low income or other disadvantaged groups)
Communications and marketing campaigns	<ul style="list-style-type: none"> Information campaigns, initiatives to accelerate take-up, subsidies for low-income groups

Appendix A: Glossary of Terms

ASO	Analogue Switch-Off
DD	Digital Dividend
DSO	Digital Switch-Over
DTH	Direct-to-Home
DTT	Digital Terrestrial Television
DVB	Digital Video Broadcasting
EPG	Electronic Program Guide
FTA	Free-To-Air
HbbTV	Hybrid Broadcast Broadband TV
HD	High Definition
HDMI	High-Definition Multimedia Interface
IDTV	Integrated Digital TV
IPTV	Internet Protocol TV
ITU	International Telecommunication Union
MFN	Multi Frequency Network
MHEG	Multimedia and Hypermedia Experts Group
MHP	Multimedia Home Platform
MPEG	Moving Picture Experts Group
MUX	Multiplex
OTT	Over-the-top (platform/service)
PSB	Public Service Broadcaster
PVR	Personal Video Recorder
RF	Radio Frequency
RFI	Request for Information
RFP	Request for Proposal
SCART	Syndicat des Constructeurs d'Appareils Radiorécepteurs et Téléviseurs
SD	Standard Definition
SFN	Single Frequency Network
STB	Set-Top-Box