

Multiplexes and multiplexing

Background

1. DTT uses multiplexing and compression technology to combine multiple television channels on to a single broadcast frequency, which is known as a DTT multiplex. The DTT platform consists of six DTT multiplexes, each of which is licensed by Ofcom (with the exception of Multiplex 1 which was granted to the BBC by the UK Government). Each multiplex is currently able to carry between six and ten television channels as well as data and radio. The current low-power DTT network is broadcast from around 80 sites and reaches about 73 per cent of the population (as explained in paragraph 4).
2. The UK is currently committed to complete a switchover of terrestrial television broadcasting from analogue to DTT. This process is referred to as Digital Switchover and is due to be completed by 2012. To ease the transition, DSO will occur on a region-by-region basis between 2008 and 2012, with Whitehaven/Copeland in Cumbria acting as a pilot scheme in October 2007.
3. Until DSO is complete in each region, both analogue and DTT will be available. Once DSO is complete in a region, the broadcast of analogue television will cease and DTT will be switched from its current low-power broadcast to high-power broadcast.
4. Pre-DSO there are 86 NGW and Arqiva sites broadcasting DTT, of which:
 - 78 sites broadcast all six multiplexes;
 - two sites broadcast five multiplexes;
 - three sites broadcast four multiplexes; and
 - three sites broadcast two multiplexes.

5. This information can also be put the following way:
 - one multiplex broadcasts from 84 sites (Digital 3&4's multiplex 2);
 - one multiplex broadcasts from 83 sites (the BBC's multiplex 1);
 - two multiplexes broadcast from 82 sites (SDN's¹ multiplex A and the BBC's multiplex B); and
 - two multiplexes broadcast from 81 sites (NGW's multiplexes C and D).

6. From these 80 or so sites, digital broadcasts from the six multiplexes currently reach around 73 per cent of UK households (ie 18.4 million households).²

Broadcasting supply chain

7. The key elements of the broadcasting supply chain for analogue and digital terrestrial television are:
 - Content (broadcast channels)—the provision of programmes and other content for each channel;
 - Multiplexing (for DTT only)—blending the channels into a digital signal;
 - Distribution—sending the analogue channel or DTT multiplex to each of the main transmission sites;
 - Managed Transmission Services—preparation of the signal for transmission and monitoring quality of service; and
 - Network Access—combining the channels or DTT multiplexes and transmitting them from the antenna.

8. The supply chain for DTT adds additional complexity due to the number of channels that are included in each multiplex and the combination of these channels through multiplexing (which occurs prior to distribution).

¹SDN is owned by ITV plc.

²See www.ofcom.org.uk/tv/ifi/tech/dttcoverage/.

Multiplexes

9. The UK has licensed six multiplexes for DTT which use the DVB-T³ standard and MPEG-2⁴ compression⁵ and currently broadcast a total of around 45 television channels in addition to data and radio channels. The three multiplexes designated as PSBs⁶ will use 1,160 transmission sites, post-DSO, and are required to reach 98.5 per cent of the population. Post-DSO the commercial multiplexes C and D (operated by NGW) will be broadcast from 80 sites and commercial multiplex A (operated by SDN) will be broadcast from 81 sites, achieving an expected coverage in excess of 90 per cent of UK households.⁷ The six multiplexes and the channels carried by each one are outlined in Table 1 at the end of this appendix.

Multiplexing

10. Multiplexing refers to a process whereby multiple digital data streams are combined into one 8 MHz frequency channel. Two different modes of modulation (how data is carried within the signal) are used by the various multiplexes. These are referred to as 16-QAM and 64-QAM.⁸
11. 64-QAM—used by multiplexes 2 and A—provides more capacity than 16-QAM and hence a greater number of television channels can currently be carried on the multiplexes. However, 64-QAM is less resilient than 16-QAM and so is more prone to interference and therefore distortion of the television reception.

³DVB-T is the technical standard used in the UK that specifies the framing structure, channel coding and modulation for DTT broadcasting. Other DVB standards that are used in the UK include DVB-S2 for satellite television and DVB-H that has been used in some trials for mobile television.

⁴The digital technology used to compress the video component of the majority of digital television services in the UK.

⁵Ofcom is currently consulting on a proposal by BSkyB to broadcast three channels in MPEG-4.

⁶The PSB multiplexes are BBC (1), D3/4 (2) and BBC (B).

⁷Ofcom has stipulated that the coverage achieved by the commercial multiplexes post-DSO should not fall below current levels (73 per cent): Ofcom, *Switchover related changes to DTT licences*, 7 December 2006. See:

www.ofcom.org.uk/consult/condocs/dtt_changes/statement/statement.pdf.

⁸Quadrature amplitude modulation (QAM) is a modulation scheme that conveys data by changing (modulating) the amplitude of two carrier waves.

12. Multiplexing is a discrete process that requires specialist digital processing hardware. There are two DTT multiplexing service providers operating in the UK, Arqiva and Siemens IT Solutions and Services (which was purchased by Siemens following sale by the BBC). Two multiplex operators (BBC and NGW) currently outsource their multiplexing to Siemens IT Solutions and Services, while the other two multiplex operators (D3&4 and SDN) outsource their multiplexing to Arqiva.

Distribution

13. The distribution of the content to the transmission sites can occur through fixed line (eg BT circuit), satellite communication or through microwave link. For analogue television the distribution occurs to the 51 main transmission sites and is then relayed to the remaining sites. However, following DSO, a larger number of sites will require distribution feeds, although the actual number is still to be determined.

Managed Transmission Services

14. MTS is sometimes used to refer to all broadcast transmission services except NA as defined by Ofcom, with the MTS supplier providing an 'end-to-end' contract. However, some elements of the broadcast transmission services, such as provision of multiplexing services and distribution of signals to broadcasting sites, are sometimes contracted separately to third-party suppliers. The core elements of MTS (which would normally be included in any MTS contract and which any MTS provider must, therefore, be in a position to supply) include network design, procurement and installation of transmitters, network monitoring and field maintenance of the transmission equipment. As previously noted, the MTS provider also takes responsibility for procuring NA (see below).

Network Access

15. NA involves the signal for each of the multiplexes (or channels for analogue television) being fed into a combiner which creates a signal for broadcast from the antenna. NA in this context is defined by Ofcom to be:
- (a) access to allow for the installation and maintenance of broadcast transmission equipment and related equipment (or provision of access to permit installation by third parties);
 - (b) access to allow for the connection of such equipment to power, standby generators and other essential services;
 - (c) access to sites for the use or establishment of common or exclusive building accommodation; and
 - (d) access to and use of shared or shareable broadcast equipment comprising combiners, feeders, circuit way-leaves, antennae, transmitters, self-contained equipment housings and remote telemetry of the shareable equipment.
16. The transmission site will typically consist of a mast or tower which will support a number of antennae, together with a building or cabin which will house a range of technical equipment, including the transmission equipment owned by the MTS providers and the NA equipment such as feeders and combiners. Where the site is owned by a third party, the MTS provider will gain access to that site through a site sharing agreement.

End-users' aerials

17. Because of the integrated network of television transmission, each end-user (viewer) only requires one aerial pointing towards the relevant broadcast site. This is not the case in some other countries where multiple aerials are required. In order to receive DTT, viewers require either a digital set-top box or integrated digital television in order to decode the signals into its component channels.

High-definition television

18. DTT is capable of broadcasting HDTV. However, to date, this has only occurred on a trial basis. In February 2007, a coalition made up of television manufacturers, retailers and PSBs launched a campaign called HDforAll lobbying for spectrum for a seventh multiplex to be gifted on either a long-term or permanent basis.
19. Ofcom has recently confirmed that spectrum for a seventh multiplex will not be gifted for the purpose of launching HDTV on the DTT platform. Ofcom has proposed that there is sufficient space on the existing six multiplexes to carry four⁹ HDTV channels without losing existing SDTV services, and has published a consultation paper on this proposal.¹⁰
20. There is currently the potential for additional capacity on the existing multiplexes, as four of the multiplexes currently broadcast at 16QAM, and it is planned to change this to 64QAM. This will release sufficient space for around eight additional channels, or could be used to reorganize the channels allocated to each multiplex—to free one multiplex entirely. This multiplex could then be used to broadcast four HDTV channels. Ofcom told us that, while there are various options for the standard and compression used to broadcast HDTV, its consultation paper proposes that HDTV should be broadcast in MPEG 4 and DVB-T2.¹¹

⁹Three HDTV channels by 2009 or 2010 and a fourth HDTV channel by 2012.

¹⁰*The Future of Digital Terrestrial Television—Enabling new services for viewers*. Published 21 November 2007.

¹¹DVB-T2 is a second generation system currently under development that could take advantage of advances in modulation and coding technology.

TABLE 1 Current multiplex structure (England only)

<i>November 2007</i>					
<i>Mux—1 (16-QAM)</i>	<i>Mux—2 (64-QAM)</i>	<i>Mux—A (64-QAM)</i>	<i>Mux—B (16-QAM)</i>	<i>Mux—C (16-QAM)</i>	<i>Mux—D (16-QAM)</i>
BBC	D3&4	SDN	BBC	NGW	NGW
Operated under main BBC Trust	Joint venture between ITV plc and Ch 4	Wholly owned by ITV plc	Owned and operated by BBC Free to view Ltd		
PSB	PSB	Commercial	PSB	Commercial	Commercial
BBC 1 BBC 2 BBC3/CBBC BBC News 24 BBCi	ITV1 ITV2 ITV3 ITV4 C4 E4 More 4 C4+1 CITV Teletext Teletext Cars Teletext on 4	S4C (in Wales) Five QVC bid tv Price-drop.tv UKTV Style Eurosport Setanta sports Five US Five Life TopUp Anytime1 TopUp Anytime2 TopUp Anytime3 Nuts TV S4/C2 (in Wales) Teachers' TV TVX/RED HOT Teletext Holidays Teletext Games	BBC4/Cbeebies BBC Parliament BBCi 301 BBCi 302/ Community BBCi 303 BBCi 305 x4 news	Sky 3 Dave Sky News Sky Sports News E4 +1 SmileTV Sky Text tvvDigital (EPG Data)	UKTV History The Hits Virgin1 TMF ITV2+1 Ideal World Gems TV Film 4 4TV interactive
Radio x 2	Radio x 2	Radio x 2	Radio x 10	Radio x 4	Radio x 9

Source: www.dtg.org.uk/retailer/dtt_channels.html.