

The All-Digital Home

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Abstract

The UK government is determined to move forward rapidly to a situation where analogue uhf can be switched off. Working with the government's Digital Action Plan, the DTG has identified a range of technical issues that need to be solved in order to convert homes and apartments to an all-digital environment. Topics include:

- *Improving reception through new receiver techniques and new standards for domestic aerial installations*
- *Seeking solutions for home distribution*
- *The weakest link – home recording*
- *Set-top box development and product differentiation*

The author will survey the issues involved and show ways in which a pro-active approach to solving them can hasten the transition.

Introduction

Confidence is increasing that the government's objectives for analogue switchover can be achieved before 2010. The government's Digital Action Plan aims to focus government ministers, departments, regulators and Industry on what has to be done to achieve an early switchover and specialist groups are making rapid progress in resolving spectrum, marketing and technical problems.

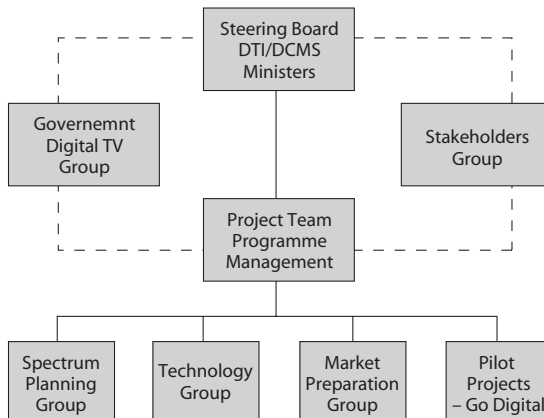


Figure 1: Action plan structure

The Digital Action Plan (Figure 1) sensibly envisages trials to ensure that householders are able to replace entirely all analogue TVs and equipment in the home with digital. The first of these trials, the ‘Go Digital’ project, has already taken place and has drawn attention to the importance of converting the whole household, and not just the living room TV.

Earlier this year, the DTG was awarded a contract to manage a number of investigations into outstanding technical problems. This paper reports on progress in issues affecting the home installation.

Digital reception

In today’s multi-channel world, terrestrial transmission using the uhf spectrum is seen by some to be an obsolete delivery mechanism. Yet, in the UK at least, satellite has not shown the growth potential to become the universal delivery medium and the success of Freeview on Digital Terrestrial has revealed a very considerable market segment which seems certain to play an important part in the progress towards analogue switchover.

However, DTT is by no means the universal delivery medium that analogue was – coverage to fixed rooftop antenna is currently approx. 75% of households. The change to 16 QAM on four multiplexes has made a significant improvement in coverage and in the reliability of reception but there are always viewers on the periphery of the coverage area for whom reception is marginal. Also, the ability to receive DTT on portable TVs and set-top aerials is much more limited than analogue.

The problem may be seen most graphically in Figure 2. Over 70% of sets with multichannel access are in the main living room. Delivery of multi-channel to second and third TVs in the home is a ‘bridge too far’ for many people.

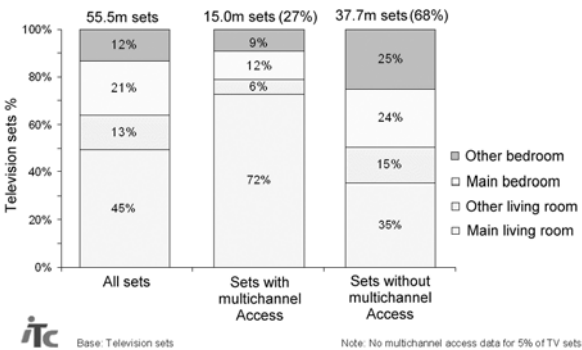


Figure 2: Multichannel access in the home

Clearly, improvements to the transmitter network both before and after analogue switchover will help but an increase in field strength so as to equate portable DTT reception with portable analogue reception is seen as expensive and wasteful of scarce spectrum.

Alternative possibilities include:

- Improved reception techniques such as active antenna and diversity.
- On-channel loft repeaters.
- In-home distribution at 5.8 GHz.
- Digital home-networks.
- Wired distribution systems.

These are not mutually exclusive. If successful, each will have its place.

Receiver improvements

Readers will know at first hand the difficulties of positioning a set-top antenna to receive analogue TV in marginal situations. Standing waves caused by the walls of the room and the effect of people moving about all conspire to make reception difficult. Multi-path effects dominate reception. DTT has some immunity but the evidence is that all distortions add to the 'noise bucket'. When the bucket is full, reception fails.

Recent development shows that diversity reception can make a very big difference to static portable reception as well as reduction of the effect of Doppler in mobile applications. The problem for manufacturers is to justify the additional cost in the situation where the extra cost of digital is already out of proportion to the cost of the analogue equivalent.

Other less costly improvements concern immunity to impulse interference, such as thermostats, switches and dimmers in the home and car ignition interference. These noise sources can be a source of failure in marginal reception conditions.

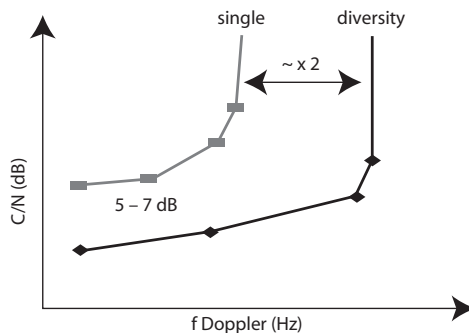


Figure 3: Diversity reception

For fixed rooftop aerials, the Confederation of Aerial Industries (CAI), in conjunction with the DTG has developed benchmarking schemes for aerials and download to ensure that installations use quality components. Better matching between aerial and download, together with screened components all the way to the back of the TV, can give rise to 10 dB or more of reduction in the effects of impulse noise.

But, for portable (set-top) reception, impulse noise remains a potential problem except in areas of high signal strength.

Several silicon manufacturers have introduced proprietary techniques to detect and cancel noise impulses. They are effective against certain types of noise spike and in general reduce the incidence of disturbances but not eliminate them.

A change to 8 K carriers has not been ruled out in the future and the DTG hopes to carry out trials in the next year to inform this debate.

Home gateway and distribution

Increasingly, the TV in the living room will become the home of a cluster of entertainment equipment that accesses services from a range of external and internal sources. Set-top boxes will provide sources of broadcast satellite or cable (pay) and free to air channels, broadband internet, and local recording devices provide personal libraries of music, still pictures and video programming.

Consumers will expect to be able to view these sources in other rooms; it is quite likely that different family members will require several different services at the same time. Nor will PAL uhf distribution be adequate – the trend to flat screen LCD screens in secondary viewing locations, either a PC screen or separate, will require digital distribution of component (RGB) signals to preserve quality.

On-channel loft repeaters

One prospect is to raise the signal strength in the room by the use of a ‘leaky amplifier’ in the loft. Early experiments showed promise. The problem with them was that it was difficult to produce them with enough rejection of adjacent channel analogue in a low-cost domestic product.

But when analogue is switched off, could they come into their own? Fears were also expressed about the potential for positive feedback from output to input causing oscillation. Such a device would need to detect and limit any howlround.

In-home distribution at 5.8 GHz

Analogue video senders working in the unlicensed band at 2.4 GHz have proved to be popular with consumers and the digital equivalent could have an important place in our armoury of tools for switchover. However, 2.4 GHz is fast becoming a disaster area with too many conflicting uses all competing for the same space.

Consequently, the DTG is working with partners University of Manchester, Zetacast, CRL and ATDI to explore home distribution at 5.8 GHz.

A range of profiles is envisaged, starting with a simple up-converter/down-converter pair to get a selected multiplex from the living room receiver to a remote TV in another room. More sophisticated products would provide modulation of a baseband source.

Digital home-networks

In this survey of possibilities, it should be recognised that wireless computer networks using IEEE 802.11 standards are becoming cheap and popular. Unfortunately, the 802.11 standard does not contain the necessary extensions to ensure QoS when carrying video signals.

A number of proprietary extensions are being promoted. Other drawbacks include the lack of agreed copy protection/copy management systems and, as before, congestion in the unlicensed 2.4 GHz band. Nevertheless, it seems likely that 802.11 standards will be pressed into service for carriage of TV signals and potential problems tested in the market place.

Wired distribution systems

In this investigation, we should not forget wired distribution. Running new wiring may be a disincentive to consumers but the fact is that maybe half of installers business is putting in coax for distribution of analogue signals at uhf.

We need to replace PAL encoded signals with quality MPEG-2. Low cost encoders are already commonplace – COFDM modulators could become consumer items, just as easily.

IEEE1394 is the Industry's officially adopted interconnection standard. However, there is evidence that manufacturers have abandoned its development in favour of IP based solutions. Progress has been held back by the need to agree Industry standards for copy protection and management but progress is being made by the DVB in this area, albeit more slowly than many would like.

Also to be kept under review, is the possibility that distribution systems using the power wiring may become viable. Early proposals for power-line were for home-access, a much more demanding requirement than distribution within the home. Concerns have also been expressed about radiation in radio bands. A number of companies have proposed solutions – developments have been set back by the 'dot-com crash' and the subsequent drying up of venture capital. But the set-backs are being overcome and if, as expected, the 2.4 GHz band becomes saturated and ceases to offer the necessary quality of service, wired alternatives could well come to the rescue.

VCR replacement

During 2002, the ITC and some 15 industry partners converted 30 homes to Digital in the West Midlands area of the UK and in-depth studies undertaken into the consumers' attitudes to the change. One of the most important findings of the 'Go Digital' trials concerned the perceived need by the participants to find a direct replacement for the analogue VCR. Some participating households were supplied with a PDR (Sky Plus) device and these were quickly adopted and valued but in most households the lack of convenient ways to use existing VCRs with digital receiver boxes proved to be a considerable problem.

This has been followed up in a DTG study into Recorder Technologies for the UK government Digital Action Plan. The findings are as follows:

- 1 Most large manufacturers are unwilling to consider production of VCRs with a digital tuner and VHS mechanism. They regard the VCR as obsolescent technology (mainly because the profit margins are low) and want to move to recorders based on hard disc (or in some cases DVD-R) technology.
- 2 Very large investments will be made into making the PVR a mass-market item and prices will be driven down from a current £350 to a target of £199 within a few

years. However, in order to achieve the necessary volumes, initial products will be pan-European analogue devices.

- 3 Smaller manufacturers are likely to take a lead in providing a range of digital set-top box and recording devices based on hard disc and DVD-R technologies. These will including single and twin-tuner set-top boxes with software to allow programmed recording using an external VCR or analogue PVR device and combinations of integral recording mechanisms.

Home recording will undoubtedly benefit from competition in the horizontal market and a wide range of solutions seems likely. Nevertheless, there are some 30 million analogue VCRs in the UK and their replacement or accommodation within digital home systems remains a critical path element in the planned switchover to digital by 2010.

New recording devices

As has been said above, manufacturers want to move to recorders based on hard disc (or in some cases recordable DVD) technology. So far, proprietary products such as TiVo and Sky+, have only been a modest success in terms of take-up, although owners enthuse that they could not be without their PVRs. The perceived wisdom is that purchasers will want to see a range of product for sale in the shop without subscription before they commit in large numbers.

At the end of 2002, the TVAnytime Industry-group agreed the first phase of a generalised public standard for advanced hard disc recorders and these are in the process of ratification through ETSI. The DVB Project has adopted TVAnytime and is working on their implementation in a DVB environment.

TVAnytime is advanced – although it can do simple programmed recording functions, it will come into its own when consumers have access to a range of delivery mechanisms and will use intelligent search tools to locate programmes that interest them.

In the meantime, most manufacturers have designs ready for simple devices working on programme metadata supplied over DVB service information (SI) or, in at least one case, analogue teletext! The DTG has concerns that these ‘interim’ products could undermine the market for TVAnytime products and ‘lock’ broadcasters into transmitting schedule data in inefficient ways.

Consequently, the DTG is spearheading a PVR Testbed – trial – of prototype products from a number of manufacturers, which it is hoped will lead to broadcast TVAnytime metadata on DTT multiplexes. UK DTT is uniquely placed in Europe to carry out such a trial with a large open market in consumer goods.

Schedule

The transmission of schedule information has been an emotive subject for as long as DTT has been transmitted in the UK. With the advent of new recording devices and the need to provide them with programmed recording capability, solving the ‘EPG problem’ has taken on a new urgency. The argument is very simple. Manufacturers want an open-standard mechanism and favour the use of EIT (Event Information

Tables) in DVB SI. But this standard does not allow for the use of compression; such inefficiency is a matter of great concern to broadcasters on DTT, the alternatives are:

- 1 To use compression in a proprietary solution.
- 2 To seek a new, more efficient standard.

After a number of false starts, UK broadcasters have recognised that a solution requires the participation and agreement of manufacturers as well as broadcasters and an industry working group is now actively seeking solutions under the auspices of the DTG. The hope is to adopt elements of the TVAnytime standard for a long-term solution. At the same time, a subgroup is looking at the possibility of transmitting a small amount of schedule in Event Information Tables so as to satisfy immediate demands for an improvement in the current limited 'now and next' situation.

Clearly, terrestrial broadcasters will not want to duplicate information in EIT and TVA streams so the aim is to provide a limited EPG in EIT for existing and future low-cost equipment and further-ahead/fuller schedule information in a TVAnytime stream. Future TVA capable receivers will be capable of assembling the full schedule database from more than one source (the TVA term is 'fragments').

Set-top box development and product differentiation

Consumer confusion

I have described a number of the main areas of development that is seen by government and industry in the progress towards analogue switch-over. It is important to recognise that Digital (Terrestrial) is an open market, with many manufacturers competing in a quite unregulated way. Product differentiation is a good thing, of course, but at the same time there is a significant risk of consumer confusion, which is wholly counterproductive.

The DTG believes that this can best be avoided by the adoption of a voluntary industry standards and labelling scheme and has been working with broadcasters and manufacturers to agree a baseline facilities standards for set-top boxes and receivers¹ to ensure that consumers can have confidence in purchased products.

But manufacturers will also want to market products both above and below the baseline. Above the baseline will exist products with added features such as PVR recorders and internet browsers and below baseline really low-priced 'digital adaptor' boxes, to convert existing PAL analogue receivers to receive DTT signals. Clearly these will have more limited facilities.

Consequently, the concept is developing of a star rating system; one star for a converter box, two stars for a baseline receiver and three stars for products satisfying both baseline requirements and with additional features. At each level, the DTG's test laboratory will provide product assurance.²

¹ Baseline Facilities Standard for Receivers v 1.0 available from the DTG

² www.testing.dtg.org.uk for details

API development and interactive applications

In the competitive marketplace that DTT products face, it is important that the API works consistently and well. The Digital Network has recently approved MHEG 1.06 as the mature version of the API, based on the several years of experience with enhanced programming and other applications. The heady days of the dotcom boom are past and budgets for enhanced programming and interactive applications are limited. Nevertheless, steady progress has been made in finding what works and does not work and firm foundations are being established on which to build.

The first lesson is that 'stand-alone' e-commerce does not work – at least not yet. Virtually all applications that have been judged a success have been part of 'enhanced' programming such as *Big Brother*, *Who Wants to be a Millionaire*, the BBC's *Walking with ...* series and sports events offering multiple feeds and highlights.

Much can be achieved without using a return path at all. The addition of a simple return path without the complexity of transaction security, greatly extends the scope by enabling voting applications. No transaction does not mean that there is no money to be made – increasing viewer interest increases loyalty and viewing numbers, which has indirect if not direct value to the channel. Where transactions are required, they can as an alternative use fixed line telephone, or the added convenience of mobile phone or SMS, where charging mechanisms are well developed. So users of baseline DTT boxes, without return path, can still participate.

Nevertheless, UK DTT is deficient by comparison with satellite and cable and work is in progress in ETSI to add return path to the MHEG standard. Work is also under way in DVB to provide the necessary compatibility between MHP and MHEG5 so that both can co-exist on the same platform and share the same data. In this way, low-cost converter boxes and up-market advanced products can both be supported.

A good and reliable user experience requires that both set-top box software and the applications themselves are conformant to system standards. DTG Testing is spearheading a Code of Conduct under which application writers, broadcasters and manufacturers will operate such that applications are thoroughly tested before transmission and problems, if they slip through undetected, are reported and resolved in a professional manner.

TV internet browser

The subject of TV browsers attracts hot debate. There is no doubt that early browsers were not a commercial success, being technically a poor substitute for a PC and with little dedicated content. Nevertheless, there is a growing understanding that there is a segment of the population that may never aspire to own a PC at home, for whom the TV screen offers the best opportunity to participate in the internet revolution.

Government services could be an important driver. Of course, it would stretch the imagination to suggest that a consumer would buy a digital set-top box in order to receive government services but, having bought a set-top box, the ability to renew a library book or make a doctor's appointment using it would be a useful additional feature.

The DTG believes that the cost of adding internet services using a browser or via edge translation can be quite small and the facility may be an increasingly attractive

option in a market which is fiercely competitive. However, standards for IP services on TV are notably absent. This is an impediment to the development of content that is the essential market driver – a typical chicken and egg problem. The DTG is attempting to break this vicious circle with the DTG I-Book – a compendium of recommendations for software developers and set-top box manufacturers (available from the DTG).

Broadband

In its first edition, the I-Book concentrates on standards for conventional slow speed modems. But it is clear that broadband services are the objective and a number of major manufacturers are known to be developing TV products and services that are based on high speed connection. So, the DTG plans a second phase of work to establish standards and rules of operation to establish interoperability between content sources and the expected range of CE products.

The future

I want to end this presentation with a personal view and to put in a plea for fresh thinking on the subject of high definition.

In the 1980's European manufacturers invested heavily in the development of (analogue) high definition equipment. It was not cost effective – there was no business case at the time. Fingers were burnt – they lost a lot of money. The bitter experience has been well remembered by people who have now risen to senior positions.

When ITV Digital first launched in 1998, experience showed that a general entertainment channel required some 5 Mb/s; Four channels could fit in a 24 Mb/s multiplex. Since then, improvements in encoder design has improved the data rate efficiency by 1.5–2 times. A further factor of 2 could be obtained by changing to an improved coding algorithm.

In the meantime the cost of high definition products is tumbling and HD production is becoming affordable and much more common. At the consumer end, CRT products are easy and could be affordable in mass production; flat screen plasma and LCD are still beyond general reach but projection systems are well within range for a high-end product.

Is it now not time to start planning for a high definition service. This would not be a wholesale change, as is being attempted in the USA and Australia – I am suggesting a new dedicated premium service carrying first run, drama, movies, sporting events and concerts. Using the 720P standard, the cost of transmission bandwidth could be affordable even on DTT.

Many a good idea has bombed not because it was bad but because the timing was wrong. In the case of HD, we need to be mindful that the last failure was a long time ago and the factors that caused that failure are now different.

We also need to be (a little) ahead of the game – you cannot expect a mass market product to spring up from a standing start. Widescreen is a good example. The early pioneers of widescreen in Europe were never going to achieve instant commercial success. But that pioneering work set the foundations on which the huge success of widescreen digital was built.

We now need to be building on the success of widescreen at standard definition. Capacity needs to be allocated for trial services ahead of analogue switchover; standards need to be set; experience amassed and the prospects and understanding raised. It will take time and we should be starting the planning process soon.

Conclusions

It was always said that the first clunky set-top boxes were just the start of the digital revolution. We are now beginning to see the scope of new products and services that will drive that revolution forward. The relaunch of DTT in the UK as a free-to-air platform has proved to be a great success and manufacturers are coming forward with new innovative products.

There is now increasing confidence that the UK can achieve a total switchover to digital by the end of the decade, with the combination of free-to-air on DTT augmented by pay TV services on satellite and cable. Public standards and competition in horizontal markets are the key to driving the revolution forward.