Digital Television Project

First Technology and Equipment Group Report, 4 July 2002: Edited Version

This first report from the Technology and Equipment Group (TEG) of the Digital Television Project (DTP) summarises its work since the start of the Project in January 2002. The tasks of the Group were defined in section 5 and parts of section 2 of the December 2001, Digital Television Action Plan (AP).

TEG has met seven times since January and has set up sub-groups on Reception (TEG-R) and Converters (TEG-C) to take forward urgent work in these two crucial areas. TEG-R, chaired by Peter Marshall, DTG and TEG-C, chaired by David Johnston, Philips, have each met three times.

The technical topics covered by this report have been grouped to reflect the practical work plan of TEG and its sub-groups. This edited version of the report is identical to the complete version except that the two Annexes have been deleted (and this covering note amended). Annex 1 listed the tasks of the Group as defined in the December 2001 AP. Annex 2 replicated the recommendations made in each section of this report as a consolidated list.

In the AP, many of the tasks falling to TEG have a Q2 2002 deadline. As well as providing a response to these, this report sets out TEG's recommendations for:

- additional and replacement tasks for TEG, to be included in the next AP update. In particular, the issues listed under Task 5.1 (to "define the full range of equipment and technology issues to be resolved") have been assessed, prioritised and allocated to these proposed new TEG activities;
- actions by other Digital Television Project groups;
- actions by bodies outside the Digital TV Project.
- publication of documents on the website;

It is technological development which enabled the launch of digital TV and is fuelling moves to provide new types of service and to deliver existing services in more efficient ways. It has provided the incentive for switchover (more-efficient use of uhf frequencies) and is fuelling the vehicle to achieve it. Given this technological pervasiveness, there can be no clear separation between TEG's work and that of the other Project groups and there are close formal and informal ties to ensure the different elements of the Project keep in step. Because this paper has been written so that it can be read as a standalone document, it has had to describe and comment on developments in other groups. This has been done solely for the author and readers' convenience. It does not challenge or provide an adequate substitute for reports from the lead groups themselves.

Henry Price, Chairman, DTP-TEG,
4 July 2002

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1. Executive Summary

The conversion of the UK to digital TV will entail effectively converting all the TV devices contained within all consumers' homes to digital reception over the next decade or so. The two main pay platforms of satellite and cable have already made significant inroads into converting the TVs located in main rooms (approaching 40% of UK households). However, 50% of all TVs in the UK are located outside the main room and very few of these have been converted. Also very few VCRs have independent access to digital reception, as where a digital platform is available the VCR tends to share it with the TV.

The Technology and Equipment Group has identified a number of key technical issues that need to be addressed if we are to stand a chance of converting the UK in the suggested timescale:

Set-top Reception

About half of all the TV sets outside the main room get their signal via some form of set-top aerial. It is estimated that about a third of households rely on set-top reception in at least one room. If conversion is to be successful it is absolutely essential that this set-top reception can be duplicated by digital TV at switchover. Furthermore, it is highly desirable for a large proportion of set-top reception to be converted before switchover.

In many cases the set-top aerial could be replaced with a connection to a loft or rooftop aerial, or by using a wired or wireless in-home distribution system to extend reception from a central point. Extending connections from cable or satellite set-top boxes gives the advantage of access to the full range of services to which the consumer has subscribed. This, together with improved reception could provide sufficient incentive to persuade many to switch away from set-top reception.

However, these options are unlikely to be universally adopted. Many people, often living in rented accommodation, etc., use set-top reception because they have no practicable means of accessing a signal from a fixed aerial, dish or cable installation. For them, DTT may well be, not only the most convenient and cost effective way to get digital reception, but the only way. However the DTT transmission mode currently used in UK, combined with the relatively low power of DTT transmissions, is not robust enough to provide good coverage for this service. Given a robust enough signal, the DTT system is capable of providing excellent set-top reception, offering a real benefit over the often poor quality of analogue TV set-top reception.

TEG is currently investigation a number of technical possibilities for improving the robustness of the DTT signal, which are considered in some detail in section 3 of the report. A programme of further work is recommended to take this critical technical issue forward.

Aerial Installations

The resilience of DTT reception through existing rooftop aerials has been investigated by TEG. There are two main reasons why existing rooftop aerial installations in some cases give rise to poor DTT performance:

- In many locations the frequency of the DTT signal lies outside that of the aerial, which was chosen to suit the frequencies of the analogue signals in the area
- Many TV aerials installations in UK households are of poor quality, employing low-grade aerials and cable and/or have deteriorated over time. These shortcomings impair reception of the lower power DTT signals to a greater extent than analogue signals.

If DTT is to be established as the main workhorse of conversion then it will be necessary for perhaps 50% or more of all households to replace their existing aerial system over the next decade. This is significantly faster than the normal replacement cycle and it will be necessary to finds ways in which consumers can be persuaded to accept the extra expense involved and carry out the required upgrades before switchover.

TEG is working with the Confederation of Aerial Industries (CAI) to identify mechanisms by which the quality of new aerial installations can be improved. This includes benchmarking of components, training of installers, adoption of a code of conduct and quality assurance standards. The aim is to develop a strategy for aerial replacement that can be applied across the UK aerial business.

Digital Converters

Many analogue devices will need to be converted to digital reception before switchover can begin. Small, simple-to-use converters (often also called set-top boxes) will be required for this purpose. However, barriers to the introduction of such devices need to be tackled before widespread consumer take up can be assured:

- Costs needs to be driven down to very low levels, especially for free-to-view products
- Products need to be easy to install with simple interconnection arrangements to the analogue device
- Operation needs to be made straightforward, avoiding the need for multiple remote controls where possible and making the converter's controls easy to use and understand

TEG is working on these and other issues concerning converter units. A work plan for future actions has been agreed and is described in section 4 of this report.

Digital Recorders

There are some 28 million VHS recorders in the UK at present, and their number is increasing each year. A large proportion of these devices, or their replacements, will have to be capable of independent digital reception at the time of switchover. As very few of these devices have been converted to date, this represents a huge and critical challenge for the conversion process.

At present there are very few VHS recorders available with digital reception. Such devices might become more widespread in due course, but for many manufacturers the focus of development is now on the next generation of recording device based on the hard disc recorder (the so called Personal Video Recorder, PVR) or the recordable DVD. Trials have shown that such devices are very popular with consumers, making recording and playback of programmes extremely simple and easy to achieve. This change of technology is very exciting, but does not completely replace the functionality of existing VHS recorders.

TEG is planning a special workshop to discuss this issue aimed at recommending what technological developments are needed to encourage the take up of the new PVR devices, and also to identify the special features needed for converting existing VHS recorders.

Interoperability

Interoperability problems have recently caused a number of interactive TV services to fail on some DTT receivers. As DTT is an open, retail platform it is more difficult to ensure that equipment and services work together successfully than for (vertical) platforms with a single controlling body. TEG will be investigating ways of achieving interoperability in horizontal markets and supports the work of the DTG Interoperability Group which is developing an appropriate suite of interoperability requirements and tests, as well as processes for resolving problems.

It is essential that a basic infrastructure be established to support interoperability. This might include the establishment of:

- Codes of Conduct covering the testing of all DTT products and operating software,
- Codes of Conduct covering the testing of broadcast applications,
- bandwidth for updating products via over air software downloads.

Recommendations and Next Steps

This report outlines TEG's recommendations for a number of new work tasks for TEG and other DTP groups. Activities are also proposed for groups outside the Action Plan. Details of the recommendations and proposals for future work are listed in Annex 2 to this report.

TEG recommends that a suitable edited version of this report be published on the website.

2. Logistical Requirements

An ad-hoc meeting in February 2002, chaired by the TEG chairman, reviewed a range of existing information on the deployment of analogue and digital TV receivers in the UK. This material informed an initial assessment by TEG of the extent of the task facing the Project as a whole and TEG in particular.

2.1 Digital rollout

At end 2001 some 9.1 million homes in the UK had digital TV, equivalent to a household penetration of about 36%. This is shared between the three digital platforms:

- Satellite - about 5.9 million homes (23%)
- Cable - about 2 million homes (8%)
- Terrestrial – about 1.2 million homes (5%)

The overwhelming majority of these homes have opted for digital TV as a route to pay television. Prior to the collapse of ITV Digital it was estimated that less than 500,000 homes used digital TV exclusively for free-to-view services and that the majority of these were consumers who had churned away from the pay services.

This penetration of digital TV has been achieved in just three and half years. Whilst growth has been slowing of late, mainly because the conversion of analogue to digital satellite has been completed, nevertheless some 2 million digital TV products (set-top boxes and integrated digital TVs) were sold in 2001.

2.2 Analogue Deployment

In order to evaluate the size of the remaining task of converting the UK to digital TV we need to understand the size and nature of the deployment of analogue TV devices in the UK.

In 2001 approximately 10 million analogue TV products were sold in the UK:

- 1.6 m small screen TV sets (14” or smaller screen size)
- 3.7 m larger screen TVs (1.9 m of them widescreen)
- 1 m combination TV-VCR units (mostly with small 14” screens)
- 3.9 m VCRs

These new purchases were absorbed into a pool of analogue TV devices currently estimated at some 78 million units, which breaks down as follows:

- 50 m TV sets
    - 25 m located in main rooms
    - 25 m deployed elsewhere in the home
- 28 m VCRs
    - 22 m located in main rooms
    - 6 m deployed elsewhere in the home

The ITC carried out a survey in 1996 to obtain a more detailed understanding of whereabouts in the home such TV sets are located, and also to find out how the TVs received their signal. They found that about 40% of main bedrooms and 20% of children's bedrooms were equipped with a TV at that time. Smaller numbers of homes had TVs in the kitchen and other areas.

Recent research by the ITC has indicated that this spread of TVs throughout the house is continuing, especially to children's bedrooms. Their 2001 survey indicated that 75% of eldest children over 10 years of age had a TV in their room. Astonishingly, some 33% of eldest children less than 3 years of age had TV in their bedrooms.

The ITC's 1996 survey found that about half of all sets located in bedrooms were fed from set-top aerials rather than from a roof or loft mounted unit. This means than some 13 million TV sets and perhaps 4 million VCRs get their analogue signal from a set-top aerial. Possibly as many as one third of UK homes use set-top reception at some place in the house.

2.3 Sizing the digital conversion

We have no definitive information yet on how the deployment of digital set-top boxes relates to that of analogue TV devices. However, we know that some 9 million homes have taken digital and we can assume that nearly all these homes have the digital TV kit located in the main room linked to an analogue TV and a VCR.

We have no data as yet on how many other sets and VCRs in these 9 million homes are able to take their signal from the digital set-top box in the main room. However, BSkyB have indicated that over 1 million of their customers are able to view and control the output of their digital set-top box in another room via the "TV Link" system. Also approximately 40,000 Sky subscribers have opted to take out an additional subscription for a second set-top box. Therefore we estimate that:

- about 10 million TV sets have access to digital TV
- about 9 million VCRs share access to digital services with a TV

This leaves:

- 40 million TV sets with access to analogue only
- 19 million VCRs with access to analogue only

When all TV is transmitted digitally a large proportion of consumers are unlikely to be content for the VCR to share digital reception with the TV set. So we should assume that it will in most cases be essential for the VCR (or any future recorder) to be capable of digital reception independent from that of the TV.

2.4 Aerials

Many aerials installations currently used for analogue TV are unsuitable for digital terrestrial TV for the following reasons:

- In some areas the digital transmissions use frequencies that are outside the normal frequency range used for analogue in that area. A new wide-band aerial is then needed to receive the complete set of digital and analogue services.

- Many existing aerials installations are of low quality, with “contract” aerials and low-grade cable. Such installations are poor at keeping out the impulsive interference that arises from electrical devices within the home which can cause the digital service to fail. This problem is discussed in more detail in section 3.

- Recent research suggests that up to 40% of rooftop aerials are at least ten years old and a significant proportion considerably older than that. Such aerials may have deteriorated to the point where digital reception would be impaired although analogue reception might still be acceptable.

Conversion of the UK to digital is therefore likely to involve the renewal of a large number of rooftop and loft aerial installations.

It is important that the Project obtains a clearer picture of the scale of aerial conversion that is likely to be needed. Also we need to understand, at a technical level, how set-top reception is being used at present, i.e. the typical signal level and the quality of the picture. A technical survey of current UK aerial installations and the resulting reception conditions is needed.

2.5 Communal Aerial Systems

It is estimated that between 4 and 4.5 million UK homes receive their TV signal via some form of communal aerial system – either Master Antenna TV (MATV) or

Satellite Master Antenna TV (SMATV) systems. Many of these systems will need to be upgraded or replaced in order to be able to distribute digital TV signals. It is important to know more about such systems and the size and nature of the task of conversion to digital TV. Communal systems should be included in the aerial survey project described in 2.4 above.

2.6 Data collection and Modelling take-up

Reliable data will be required to inform policy decisions on switchover. The ways in which this should be collected, managed and updated needs to be considered by the Project Team.

The proposed ITC and aerial surveys could provide initial data for two "take-up" models:

- A model of the take-up of digital receivers could be used to predict the numbers of:
  - devices required at what times
  - converters required and to which devices they might be attached
  - integrated digital devices likely to be deployed – TVs, recorders, etc
  - homes needing in-home distribution networks

- A model of the take-up of DTT aerials and satellite dishes could be used to predict the time required in each area to convert it completely.

The surveys would need to be the first in a series if they were to provide the primary data source for these take-up models, which would require the creation and regular updating of a database.

2.7 Liaison with Other Countries

Several other countries are deploying DTT and plan national or regional switchovers before UK. Their experiences could provide important guidance for UK. A closer liaison between DTP and switchover organisations in other countries will be needed to gain access to their initiatives.

2.8 Recommendations

The Project Team should consider ways in which to collect, manage and update reliable data required to inform policy decisions on switchover. (2.6)

TEG recommends that the following tasks be added to the Action Plan:

7.- UPDATE ITC SURVEY (2.2, 2.3)

Update survey, conducted by the ITC in 1996 on the deployment on TVs and on the use of aerials, and include collection of additional data on VCRs, set-top boxes and in-home distribution of TV signals.
Commissioned: Q3 2002
Completed: Q1 2003

7.- AERIAL & RECEPTION SURVEY (2.4, 2.5)

Commission a survey to evaluate the quality of current analogue aerial installations and the resulting reception quality, including a more detailed evaluation of the use of set-top aerials and the use of communal aerial systems. The Go Digital project should be able to contribute to this work
Commissioned: Q4 2002
Completed: Q2 2003

7.- AERIAL STRATEGY OPTIONS (2.4, 2.5)

Draft strategy options for completing conversion of all inadequate aerial installations in each area
Report: Q1 2003

7.- MODEL TAKE-UP OF DIGITAL RECEIVERS (2.6)

Monitor the existing population of analogue and digital devices in consumers' homes and develop a timeline model to forecast the changes required to this population to achieve switchover.
Initial forecast: Q2 2003

7.- MODEL DTT AERIAL/SATELLITE DISH TAKE-UP (2.6)

Monitor the geographic deployment of satellite dishes and DTT-capable aerial installations, including multi-household systems and develop a model to forecast the remaining installation work required to achieve switchover in each area.
Initial forecast: Q2 2003.

7.- LIAISON WITH OTHER COUNTRIES (2.7)

Undertake investigations of other important European markets where digital TV is being introduced to see what lessons can be learnt relevant to switchover in the UK.

Commission: Q3 2002
First report: Q1 2003

3. Reception

The remit of the TEG Reception sub-group (TEG-R) includes:

- coverage of transmitted signals,
- aerial installation, and
- receiver rf input capabilities.

The early work of TEG and TEG-R has focussed on investigating possible improvements to the reception of digital terrestrial TV (DTT) as this is seen as being one of the most urgent issues for the group. DTT, with the possibility of simple set-top aerial reception and straightforward in-home distribution, is considered by many to be the natural successor to current analogue TV delivery. However, until DTT coverage can be increased to match that of analogue, all three platforms – DTT, DSAT and Cable – will be needed to achieve the universal coverage required.

3.1 DTT Coverage

The frequencies allocated to DTT are in the uhf frequency range used for analogue TV broadcasting. Apart from Channel 5, the analogue TV services have been on the air in the UK since the early 1960s and today nearly 5000 analogue TV transmitters operate on these frequencies. A similar situation exists in all the UK's neighbouring countries.

In order to find frequencies for the DTT service the spectrum planners had to "scrape the bottom of the uhf frequency barrel". Six frequencies were found for each of the 80 or so of the most important transmitter locations, but there were significant restrictions in what could be deployed at most of these locations:

- The power of the transmitter had to be lower than was ideally needed;

- In many cases there were restrictions to the directions in which the signal could be transmitted;

- The frequencies used were sometimes outside the limited frequency range of the receiving aerials used by most consumers in the area.

These restrictions were mostly necessary to stop the DTT service causing unacceptable degradation to the analogue services in various parts of the UK. Also some transmitters had power and direction restrictions imposed to avoid interference to services in neighbouring countries.

Since services started in 1998, work has been undertaken to examine ways of easing some of these restrictions. In some areas transmitter powers have already been boosted and frequencies changed in order to improve DTT coverage especially for the multiplexes with the poorest coverage. In other areas improvements in coverage have been planned, but are still to be implemented.

Tests have also been conducted to investigate the extent to which transmitter powers can be increased before interference to analogue becomes unacceptable. Initial findings from these tests indicate that it is unlikely that the power of the transmitters can be boosted by much more than currently planned. It seems that we will have to cope with relatively low power levels during the simulcast period.

The predicted coverage at present is:

- Main free-to-view services – 81%
- ITV Digital Pay services (as were) – 74%
- Full package (i.e. "core coverage") – 68%

In contrast, the four analogue services that are transmitted at much higher power levels from the same 80 transmitters provide a coverage of some 94% of the population. It is unlikely that the limited increases in transmitter power levels available to DTT will be able to close this substantial coverage gap until analogue services are shut down.

This means that consumers will need to be provided with reliable coverage information, so that they can decide whether to purchase DTT products. The DTG have made DTT coverage information available by post-code on their web site. This service is primarily aimed at retailers and the aerial trade, but it is also accessible to the consumer. This service is being upgraded to provide a finer grained information database, which should result in consumers getting more accurate result on the coverage available in their area. However, the original data was made available by ITV Digital and, with its demise, updating of the database has stopped. There is now a need to re-establish mechanisms for updating the data from other DTT organisations and to extend the database to include coverage by other platforms.

MPG should consider how best to provide consumers with reliable coverage information from the "postcode" database

3.2 Satellite Coverage

ITC has conducted research into the coverage of digital satellite services in the UK using mathematical modelling to predict the shielding caused by terrain, trees, buildings, etc. This has given a coverage estimate of between 96.6 and 99.5% of the population.

BSkyB has also conducted its own research into satellite coverage based on the practical experience of its own installation teams. Some 150,000 installations were examined to see how many failed due to screening of the satellite by terrain or local obstacles such as trees, etc. It was concluded from research that coverage was a little over 99%, which lies within the estimate obtained from the ITC’s theoretical study.

It can therefore be concluded that, from a technical point of view (excluding planning or landlord issues, etc), satellite coverage of the UK is about 98 to 99% of the UK population.

3.3 Achieving full coverage

The discussion above has made it clear that all three platforms – satellite, cable and terrestrial – will be needed to achieve the near universal coverage required for switch-over. Many viewers are likely to opt for DSAT, to get their free-to-view services. Indeed there will be some areas of the country where cable isn’t available and where there is no coverage from DTT, and in such areas DSAT will be the only way to get digital TV prior to analogue shut-down.

Many of the free-to-view services that are available via DSAT are encrypted for programme rights reasons. Therefore, viewers will need to use smartcards to be able to get the free-to-view channels currently available on analogue. The Government Digital TV Group (GDTG) should consider how the provision of these smartcards for "free-to-view" satellite viewing should be facilitated in the run up to conversion.

3.4 DTT aerials and distribution systems

In practical terms, whether a home can get good DTT reception depends on two factors: Firstly, whether there is an adequate signal free from interference at rooftop level and, secondly, whether the signal is “captured” and conveyed efficiently to the DTT receiver. This second factor, i.e. the rooftop aerial and it’s cabling, has proved to be crucial importance to the reliability of DTT.

Analogue TV reception has proved to be robust and very forgiving of shortcomings in the aerial installation. In contrast, the low power/high-capacity-mode of DTT used in the UK needs a good quality domestic aerial installation to work well. Even within the DTT coverage area and where the frequencies are close to those used for analogue broadcasting, poor aerial installations have resulted in complaints of poor reception. The symptoms - short periods of picture and sound break-up - are mainly caused by impulsive interference such as that produced by electrical switches, electric motors, vehicle ignition systems, etc.

Impulsive interference can arrive at the receiver via two routes. It can be picked up off-air by the aerial alongside the wanted DTT signal, or it can enter the receiving system via the cabling system connecting the aerial to the receiver. The off-air interference can be countered to some extent by careful aerial choice and positioning; the second route can largely be eliminated by using a well designed and installed aerial and cable system. This is especially important, as it is the second route which is particularly vulnerable to interference produced by electrical items within the home itself.

Recent tests by the Digital Television Group and its members have shown that a well designed and installed aerial system can improve the quality of reception by the same degree as raising the transmitter power by 15 dB (a factor of 30) in comparison to a poor installation. A number of elements have been identified in contributing to this improvement:

- The use of a well designed aerial of sufficient gain and directivity and incorporating a balun (i.e. a matching transformer between aerial and cable)
- The use of well screened cable
- Maintaining the integrity of the electrical screening through connectors, wall plates, etc
- Good installation practice

The Confederation of Aerial Industries (CAI) is in the process of introducing a benchmarking scheme for aerials. This scheme would grade the aerial by its gain and quality of construction with an aim of ensuring that the trade moves to a position where only good quality aerials are used. (A similar benchmarking scheme for cables, initiated by BSkyB, has been operating for some time with excellent results.) The scheme is intended to be voluntary, but it is hoped that it will be widely adopted by aerial manufacturers both in the UK and outside. It would also be important for major “do-it-yourself” retail outlets to publicise the scheme as they account for a significant proportion of sales of aerials and related products in the UK. The Project Team needs to consider what steps can be taken to help CAI successfully implement this scheme in the UK.

Good installation practice is also crucial and the CAI and DTG have produced publications and other information to help educate the trade in this area.

TEG plans to develop a strategy for improving the quality of aerials in the UK. This would cover a number of issues:

- Improving the quality of products sold in the UK through trade and retail outlets
- Codes of Conduct for manufacturers and installers
- Instigating a training regime for installers
- Providing simple to understand literature for the consumer explaining about aerials and their rights as consumers

MPG should consider how to ensure that retailers and the public are made aware of the importance of a quality aerial installation.

3.5 Master Antenna TV (MATV) and Satellite Master Antenna TV (SMATV) Systems

As outlined in section 2, many homes get their TV signal via a communal aerial system – MATV or SMATV. Such systems have often been designed and installed for the reception of only a limited number of analogue TV and radio services. In most cases a considerable amount of work is needed to convert such systems to carry DTT and or DSAT services. Integrated Reception Systems (IRS) have been developed that are able to distribute the full range of analogue, DTT and DSAT services.

It is important to understand the extent of MATV & SMATV deployment and how many systems are likely to need be converted. Also at switchover there is likely to be changes to some of the DTT frequencies and substantial increases in transmitter powers. These are likely to cause problems in frequency selective MATV systems and could also cause problems of signal overload, etc. The scale of such problems and possible solutions need to be investigated.

3.6 DTT UK signal parameters

The UK's current DTT transmission network operates using the European DVB-T system in a transmission mode which provides a "payload" capacity of 24 Mb/s per multiplex and with a modulation system that uses somewhat under 2000 radio frequency carriers per 8 MHz frequency channel or multiplex (the 2k system). Countries elsewhere in Europe have chosen a variety of transmission modes; all have adopted a different option of DVB-T which employs four times as many radio frequency carriers (the 8k system).

In theory, it is possible to change both the carrying capacity of the UK's signal (by changing the transmission mode) and to switch to the 8k carriers option. A change of either of these parameters could improve significantly the ability of

DTT receivers to reject impulse noise. TEG is investigating the efficacy of such changes, and other ways of improving impulse noise rejection. In May and June 2002, DTI supported DTG field tests on transmission mode changes and the 8k-modulation option using transmitters at Crystal Palace that previously carried ITV Digital programmes.

3.6.1   Changing the capacity of the signal (changing the transmission mode)

Lowering the capacity of each multiplex to increase the robustness of the service decreases the number of TV services that can be made available on DTT. The system presently operates at a capacity of 24 Mb/s using a mode described as 64 QAM, rate 2/3. It has been proposed that the mode be changed to 16 QAM rate 3/4 , which lowers the capacity to 18 Mb/s. This increases the robustness of the signal by some 4dB, i.e. it is equivalent to more than doubling the transmitter power. Recent tests have indicated that this change would also increase the system's resilience against impulsive interference by a similar amount.

Tests have been carried out on a representative collection of UK DTT receivers which have been deployed in the UK over the past 4 years to see whether they were able to cope with such a change of signal mode. All the receivers tested were able to receive other signal modes. Most receivers were able to change mode automatically, whilst a small number of receivers needed user intervention (switching the receiver off and on, or re-scanning for new channels).

Any decision to lower the capacity of the signal in order to make the service more robust would clearly be a matter for the broadcasters and the broadcasting authorities. It has the potential to increase significantly the number of users able to enjoy reliable reception without requiring any increase in transmission powers.

3.6.2   The 2k *v* 8k option

Most of Europe has adopted the 8k option of the DVB-T specification in order to be able to operate adjacent transmitters on the same frequency (in a Single Frequency Network (SFN)). The UK DTT network uses a multi-frequency network (MFN), with adjacent transmitters on different frequencies, even when carrying identical programming. The relative merits of SFNs and MFNs are complex and a matter for the Spectrum Planning Group. However, the 8k option is better suited to SFNs which can be set up to operate over large areas.

In theory, the 8k option is more resilient than 2k against impulsive interference, irrespective of whether it is used in MFN or SFN networks. Theory suggests that the improvement should be about 6dB or greater (equivalent to a transmitter power boost of a factor of 4 or more). However, initial field tests have indicated that the improvement gained can vary according to the type of interference present. Further investigations are needed to clarify the practical benefit of moving to the 8k option.

In order to make a change from 2k to 8k in the UK without switching off viewers, all their digital receivers will need to be capable of receiving both options of the DVB-T system. Early chip sets used in the UK were 2k-only and are unable to operate at 8k under any conditions. An audit carried out by TEG-R has established that some 43% of receivers deployed in the UK (about 500,000 units) are 2k-only. Most of the remaining receivers (about 600,000) have hardware capable of 8k operation, but the controlling software has only been designed for 2k. Such receivers may be capable of having their software upgraded by over-the-air download, but this is still to be verified. Only some 5% of receivers are currently capable of 8k operation – somewhat less than 100,000 units.

3.7 DTT receiver developments

Under a contract with DTI, DTG's independent Test House has submitted reports on the input sensitivity, selectivity, etc of DTT receivers that have been submitted for testing. Broadly speaking the radio frequency performance of the receivers has been steadily improving, even though the cost of the product has fallen sharply over the last 3 years. The new generation of low cost set-top converters, designed primarily for the reception free-to-view services, are continuing this trend.

Further developments have been made by the DTT chip manufacturers to improve the reliability of reception. A new generation of chips, available from at least one manufacturer, offers improved resistance to impulsive interference. Improvements to chips are also allowing receivers to cope better with delayed signals and with high levels of analogue signals.

Further enhancements to the chips will allow new products to be developed, such as receivers with two aerial inputs to allow diversity reception to be offered. This might in the future allow portable receivers to be developed that would provide more consistent and reliable reception from a pair of simple set-top aerials.

Given the probability of different DVB-T transmission options being deployed in UK, TEG should review the testing of DTT products entering the UK retail market and make recommendations on the appropriate level of technical testing that should be applied to products sold in the UK.

3.8 Set-top aerial reception

As discussed in section 2, some 50% of the TV sets in the UK are located outside the main room, mainly in bedrooms. Techniques for distributing DTT and satellite signals to such TVs round the home using wired distribution systems are well established. Provided the good installation practices discussed in section 3.3 are followed then good reception should be possible throughout the home.

However, many consumers prefer where possible to use set-top aerial reception. This may be to avoid the cost and disruption of installing a wired system or it may be that they live in shared or rented accommodation which has no external aerial socket or in-house distribution system. Replicating analogue set-top aerial reception with digital is going to be a major challenge and one on which the ultimate success of switchover could depend.

Analogue set-top reception generally gives rather poor picture quality which varies with time and with the movement of people round the room, etc. In areas where DTT set-top reception is possible the results are good. However, the low signal level of DTT and its susceptibility to impulsive noise interference means that only a small proportion of the population could potentially benefit at present.

At the close down of the analogue services it should be possible to boost at least some of the digital transmitter powers and thereby significantly improve set-top reception. However, if we are to stand a chance of converting all the TVs and VCRs in the UK before analogue is closed down it is vital that we find mechanisms for improving DTT set-top aerial reception that can be applied in the meantime.

A number of factors have been discussed that hold the possibility of improving the robustness of the DTT signal without increasing transmitter power:

- Using a lower capacity transmission mode
- Moving from 2k to 8k operation.

On the receiver side there is the prospect of:

- improved chip technology to suppress impulsive interference effects
- chips that enable diversity reception from two separate set-top aerials, operating in parallel.

All these factors may well need to be combined if we are to offer the consumer the possibility of low cost reception of digital TV on set-top aerials in areas where they now have analogue set-top aerial reception. TEG-R will be investigating and quantifying the benefits to be gained by employing these techniques.

Portable reception over an integrated or set-top aerial is seen as one of the major strengths of DTT. Even after switchover DTT broadcasters may wish to increase coverage of portable reception. SPG should take this possibility into account when planning the post-switchover DTT network.

3.9 DTT Pilot Zone

It would be a great help in assessing the technical options available on DTT to have access to a small DTT test-bed zone without any analogue transmissions, where the DTT spectrum and reception conditions applicable to switchover and post-switchover could be investigated.

3.10 Recommendations

The Project Team should consider what steps can be taken to help CAI successfully implement its benchmarking schemes. (3.4)

MPG should consider how best to provide consumers with reliable coverage information from the "postcode" database. (3.1)

MPG should consider how to ensure that retailers and the public are made aware of the importance of a quality aerial installation. (3.4)

SPG should consider reaching all existing users of set-top aerials with suitably robust DTT signals. (3.8)

SPG should consider maintaining sufficient flexibility in the spectrum plans to permit major extensions of portable coverage by existing DTT broadcasters. (3.8)

TEG recommends that the following tasks be added to the Action Plan:

7.- RECEPTION DATABASE (3.1)

Consider with DTG how to maintain and develop the "postcode" database.
Q3 2002

2.- SATELLITE RECEPTION (3.3)

Consider how the provision of smartcards for "free-to-view" satellite viewing should be facilitated in the run up to switchover.
Q4 2002

7.- IMPROVING UK AERIAL INSTALLATIONS (3.4)

Develop a strategy for improving the quality of aerial installations in the UK
Q4 2002

5.- EVALUATE THE CONVERSION OF MATV & SMATV SYSTEMS (3.5)

Evaluate the changes to MATV and SMATV systems that will be need to cope with the changes of DTT power and frequency that can be expected at switchover. Q1 2003

7.- USE OF MATV & SMATV SYSTEMS (3.5)

Research the scale of the conversion task for MATV & SMATV systems using information from the Aerial and Reception Survey (proposed in section 2). Q3 2003

5.- TRANSMISSION MODES (3.6.1)

Evaluate the reception benefits of using reduced capacity DTT transmission modes and recommend supportive actions for the UK
Q3 2002

5.- 8K MODULATION (3.6.2)

Evaluate the practical benefits of 8k modulation on reception and, if appropriate, recommend a strategy for migrating UK transmissions to 8k.
Q1 2003

5.- ADVANCED RECEIVING TECHNIQUES (3.7)

Evaluate the reception improvement that might be gained by employing advanced receiver techniques, including pulse suppression systems and diversity reception. Q2 2003

5.- PRODUCT TESTING (3.7)

Review the relevant testing of DTT products entering the UK retail market and make recommendations on the appropriate level of technical testing that should be applied to products sold in the UK.
(This is related to "Interoperability Testing" (7.4))
Q1 2003

6.- DTT ZONE PILOT (3.9)

Consider setting up a small DTT test-bed zone without any analogue transmissions, where the DTT spectrum and reception conditions applicable to switchover and post-switchover can be investigated.
Q4 2002

4. Digital Set-top Boxes and Converters

As outlined in section 2, there are currently some 78 million analogue TV devices deployed in UK homes, and the sales of such devices are now at record levels of some 10 million units per year. The conversion to DTV will require the vast bulk of these devices to be have either been replaced with new digital products or to have been adapted to receive DTV using a set-top converter.

At this stage it is difficult to predict the balance between new digital products and converters, but it would seem reasonable to assume at this time that several tens of millions of converter units will need to be deployed. We assume that such devices will be used to convert the whole range of analogue devices, from simple, low cost small screen TVs to large widescreen sets with high quality sound options, etc.

4.1 Technology Profiles/Features List

From the Project's perspective the primary purpose of converter units will be to enable analogue devices to receive digital TV. However, the market is likely to provide a range of converter products with different features and facilities. Some features may be needed to service specific facilities available on analogue devices, such as timers for VCRs, etc. Other features may take advantage of the converter's digital technology to offer new facilities, such as Internet access, data output, or hard disc video storage.

There is some debate about the facilities that basic converters should offer and whether a minimum specification should be defined. Clearly all converters must be able to receive the picture and sound for the free-to-view services, but the question is whether other features should be required or recommended in a basic minimum specification. Such features could include:

- Interactive TV software
- Subtitling decoder for the deaf and hard of hearing
- Common Interface (CI) to allow conditional access and other facilities to be added
- Audio description decoder
- Uhf loop through and/or Scart connection
- Timer for recording of programmes
- Widescreen options

To date most converter units or set-top boxes have been deployed by the satellite, cable and DTT pay TV operators who have defined the range of facilities available on their platform. However, with the creation of a retail market for DTT products, the decision on whether to include such features is now an issue for the product manufacturers and the retailers. The key question is whether DTP should, acting on behalf of the consumer, identify a list of the features that could be expected in a “baseline” converter? Should this recommendation also include the features which should be included in higher profiles of devices?

4.2 The Remote Control

The use of a digital converter will in many cases double the number of remote controls the consumer needs to use to operate the TV or the VCR – one for the analogue device the other for the converter. Clearly, this is not a very satisfactory situation.

There are several possible solutions that TEG will be investigating:

- The analogue device’s remote control could control both the analogue device and its converter.
- The converter’s remote control could take control of the analogue device as well. The BSkyB remote control can be operated in this fashion at present.
- Third party remote controls could be used to control several devices.

To complicate matters further, the codes used by the remote controls on the infrared link have not been standardised or registered to ensure that different controls do not interact. As a result, sometimes the remote control for one device will cause a spurious response from another device. Clearly the introduction of a large number of new remote controls in homes will exacerbate problems that are encountered today.

The Converter Sub-Group of TEG (TEG-C) is investigating this problem to see how best it can be resolved or at least ameliorated as more analogue and digital devices are deployed. This could lead to proposals to introduce standardisation and registration procedures.

The introduction of new remote controls with different functionality, such as interactive functions, will cause a degree of confusion with some consumers. There might be merit in recommending a preferred layout for some of the more basic functions of the remote control to help avoid such problems. Service providers like BSkyB have already given a lot of thought to these issues. It is suggested that the topic of remote control design could be included in a workshop on inclusive design for digital TV to be held with ITC. This is discussed further in section 8.3.

4.3 Interconnections to Analogue Devices

The digital converter will need to be linked to the analogue TV and VCR by suitable connections. The interconnection of a cluster of several analogue and digital devices can become quite complex and is likely to be beyond the understanding of most consumers. Simplifying these interconnection arrangements will be important in getting digital converters readily accepted by consumers.

Ideally the interconnections should also carry control signals so that the converter can, where appropriate, take control of some functions on the TV or VCR, e.g.:

- Displayed picture
- Recording
- Aspect ratio – widescreen, centre cut out, etc

However it is important that these control signals do not conflict with one another or "lock-out" actions by the consumer, e.g. stop the TV from channel changing.

The DTG have been working in this area for some time and have produced Connectivity Guidelines for Installers and Manufacturers. These give a guide to best practice for connecting digital converters and other devices to TVs and VCRs.

TEG and DTG should work together to develop this technical work. The outcome could be series of Codes of Conduct covering products, interconnections and accompanying literature. MPG should be asked how best to provide appropriate information to consumers and retailers on interconnecting analogue and digital products.

4.4 Widescreen

UK sales of widescreen sets are rising rapidly. In 2001 the sales of widescreen sets overtook that of larger 4:3 sets (1.9m widescreen sets vs. 1.8m 4:3). However, smaller sets, with screens 14" or less, are still exclusively 4:3.

It is likely therefore that by the end of the decade most of the UK's larger screen sets will be widescreen models, whilst many of the smaller sets deployed in bedrooms, kitchens, etc. will still be 4:3. It is expected that virtually all UK TV production will be widescreen at this time, although programmes from overseas may still be produced in 4:3.

As a result, converters will need to continue to offer a range of options for picture format handling, particularly for widescreen programmes displayed on 4:3

screens. Most converters currently offer 16:9 letterbox or 4:3 centre cut-out. On analogue many broadcasters prefer to use 14:9 letterbox as this is considered to give the best compromise between picture area and composition. However, none of the current converters offer this 14:9 format.

Currently the DTG Widescreen Forum is considering the way forward, including the possibility of recommending that all digital converters should offer a 14:9 letterbox option.

4.5 Power Consumption

The introduction of several tens of millions of digital converter units could have significant consequences on power generation requirements in UK. To keep power consumption increases to a minimum converters will need to:

- have low power consumption in the “on” mode
- have very low "standby" mode power consumption
- automatically go to standby if left unattended for a prolonged period of time and/or respond to the on/off/standby mode of the analogue device it "feeds"

Many digital devices might need to be updated during relatively “quiet times” when there is less chance of the user wanting to operate the device, e.g. during the middle of the night. This means that the device has to remain in “listening mode” to detect an update message, even when it is standby. It is important that this facility adds very little to the overall power consumption of the device.

TEG-C is currently working on this issue in conjunction with the Government's Market Transformation Programme.

4.6 Ease of Use Issues

4.6.1 Manual and Auto-scanning or retuning

On occasions digital platforms will add new services or existing services will be renamed or reconfigured. Ideally digital devices should automatically reconfigure themselves to cater for such changes. On the other hand it might sometimes advantageous for the product to offer the ability to be set manually and/or to override automatic settings to prevent the device registering services from the "wrong" transmitter.

With a developing retail market for DTT products it is desirable for receivers to display a consistent behaviour when the service offering changes. This will help retailers and broadcasters manage any channel changes and it may be extremely important in the management of any shut-down of analogue services and consequent changes of DTT frequencies.

4.6.2 Software Upgrades

It is important that the software in converters (and integrated digital devices) is capable of being up upgraded or replaced. This facility enables software bugs to be fixed and products to be upgraded to take new features and services.

Upgrades to satellite and cable units are totally managed by the platform operator. However, retail products using the DTT platform have to be managed in a different manner. The BBC has made bandwidth available in its multiplex for upgrading products via an “engineering channel” and a number of manufacturers are already making use of this facility.

TEG will review the operation of this system to date and make recommendations on any future developments that are needed to enable the system to handle the population of DTT receivers that can be expected to exist in run up to analogue shut-down.

Management of the engineering channel is considered in section 7.2

4.6.3 VCR converters

Many people find the video recorder difficult to operate successfully. Therefore, digital converters for existing VHS recorders, that offered a distinct “ease of use” improvement, might be very attractive to the consumer. Such devices would need to be able to control the VCR to which they were coupled (either through a Scart connection or IR blaster) and to employ a simple-to-operate advanced electronic programme guide (EPG) for selecting programmes to record. Presently the DTT platform does not carry sufficient programme information in a suitable format to allow such a scheme to operate. The provision of such data is dealt with below in section 4.6.4.

The issue of the digital conversion of the recorder is discussed further in section 5.2, leading to a recommendation to hold a Video Recording Technology Workshop.

4.6.4 SI programme data and EPGs

Pressure on DTT bandwidth has militated against the provision of more extensive (SI-based) programme information. There could be merit in such programme and other data being provided to enable EPG functionality in a similar way to the engineering channel (see section 7.2), if the relicensing of Muxes 2-4 does not preclude this. This should be technically feasible, but is essentially a policy issue, to be considered by GDTG.

4.7 Recommendations

MPG should consider how best to provide appropriate information to consumers and retailers on interconnecting analogue and digital products. (4.3)

TEG recommends that the following tasks be added to the Action Plan:

5.- STRAWMAN DTT SPECIFICATION/FEATURES LIST (4.1)

Compile a list of desirable features for DTT receivers and draft a "strawman" proposal for the features a baseline DTT receiver could be expected to offer. If agreed, this work could be extended to include the features which should be included in higher profiles of device.
Q4 2002

5.- REMOTE CONTROLS (4.2, 8.3)

Investigate the range of problems associated with the use of multiple remote controls, and propose mechanisms for simplifying the situation in the home.
(This is related to "Workshop on Inclusive Design/Usability" (8.3))
Q1 2003

5.- INTERCONNECTION GUIDELINES (4.3)

Produce with DTG, and forward to MPG, updated interconnection guidelines for industry, retailers and manufacturers.
Q1 2003

5.- ASPECT RATIO FORMATS (4.4)

With DTG Widescreen Forum, recommend what aspect ratio formats, etc need to available in digital converters in the run-up to switchover.
Q3 2002

5.- POWER CONSUMPTION (4.5)

Make recommendations on digital receivers' power consumption requirements in conjunction with the Market Transformation Programme and investigate ways that such requirements can be incorporated in product testing

Ongoing
First report on converters: Q4 2002

5.- RESCANNING (4.5)

Make recommendations on the most appropriate DTT receiver rescanning schemes
Q4 2002

5.- SOFTWARE DOWNLOAD SYSTEM (4.6.2)

Review and recommend the future development of the DTT receiver software download system (engineering channel).
(This is related to the "DTT Bandwidth for Receiver Updating"(7.4))
Q3 2003

2.- PROGRAMME DATA ON DTT (4.6.3, 4.6.4)

Consider whether it is appropriate to make provision on DTT multiplexes for fuller programme information and other data for a baseline EPG functionality.
Q4 2002

5. Integrated Digital Devices

There are clear benefits to the user in making the analogue-digital conversion by replacing an analogue device with the equivalent digital one:

- The remote control count stays the same;
- The new device is likely to be able to hide complexity easier than a converter unit added to the existing analogue device;
- There are likely to be new features or facilities offered by the new device.

A key factor in achieving conversion to digital TV will be the availability of a wide range of integrated digital TV (iDTV) products. IDTVs have been on the market for some three years and have achieved modest sales of about 250,000 units or so. These iDTVs have by and large been equipped for DTT reception, with a few products being aimed at the digital satellite market.

As was the case with digital converters, we cannot be sure at this stage how many of the 78 million existing analogue products will be replaced by their equivalent digital device. However it would not be unreasonable to assume that that at least half of the existing stock of products would be replaced by digital equipment over the next decade – some 40 million devices. The majority of these products will be replacing TV sets and VCRs and therefore these two main devices are the focus of this section of the report.

5.1 Integrated Digital Televisions

The key challenge with iDTV sets is to introduce the technology into the full range of basic TV products in the shortest possible time. In particular, it is critically important that the small screen TV market, which makes up nearly 40% of all TV sales, starts to go digital well before switchover. Such analogue devices are very low cost, with many models available for less than £100.

There are a number of technical factors that increase the cost of a digital TV relative to its analogue equivalent:

- The cost of the additional electronics needed to receive a digital signal has now fallen to some $40 at factory prices and it is expected to fall further over the next two years as market size increases. This process can be expected to continue as individual chips are combined allowing the price to drop still further. However, it may take some years for costs to fall to the point where digital reception is automatically incorporated in the cheapest consumer products, such as small screen televisions of the type found in children's bedrooms.

- Integrated Digital TV sets are required to have at least one DVB Common Interface (CI). The CI and its supporting silicon cost some $5 at factory prices and there are additional costs associated with integrating the CI into the product.

- IPR licensing charges are a significant element in the costs of integrated digital TVs. As chip prices fall these IPR costs will form an increasingly significant proportion of the total cost of providing digital reception.

TEG is investigating what actions can be taken to reduce bill of material costs in digital receivers as quickly as possible.

5.1.1 Consultation documents on iDTVs

A study on "Digital Switchover in Broadcasting"[1] written for the European Commission by BIPE consulting was published on the web in April 2002. It was accompanied by an Annex including a Cost Benefit Analysis, most of which comprised an analysis of the effects of mandating that all TV receivers with analogue uhf tuners be required to also incorporate a digital (MPEG2) decoder. Such a move would greatly assist the rollout of iDTVs. The Commission's public consultation on the study ended on 1 July 2002.

Task 2.6 of the Action Plan requires the Government to comprehensively investigate with industry and the European Commission issues surrounding the transition to exclusive sales of iDTVs. In pursuit of this, the Government has published a consulation document "The Role of Integrated Digital Television Sets in Achieving Digital Switchover"[2] calling for comments by 27 September 2002. New target dates for Task 2.6 will need to be set for the next phase of this ongoing activity.

[1] http://europa.eu.int/information_society/topics/telecoms/regulatory/studies/index_en.htm
[2] http://www.digitaltelevision.gov.uk/pdfs/role_of_integrated_digitaltv.pdf

5.2 The Integrated Digital Recorder

The VHS recorder has now been on the market for 25 years or so and some would say, as a technology, that it is approaching the end of its lifecycle. This may explain why very few VHS recorders with digital reception have been introduced into the market to date. This contrasts with the introduction of digital sound on analogue TV (NICAM), where the first NICAM product in the UK was in fact a VHS recorder.

Manufacturers are exploring a new generation of recording devices that they believe will ultimately replace VHS. Devices such as hard disc based recorders (often referred to as Personal Video Recorders PVR), and recordable DVD products are already on the market. DVD players already contain MPEG decoders, so need only the addition of a digital tuner to become DTV receivers. Sky+ is the first of this new generation of recorders to integrate together the hard disc recorder with a digital reception platform.

A new set of open technical standards is being developed to allow these advanced recording devices to be operated using programme data, and other information that is carried on the digital broadcast signal. This should allow the recorders to be developed for any broadcast platform and to be sold in retail market. However, the DTT platform at present only carries a very limited amount of programme information (details on the "now and next" programmes) in a machine-readable format. If DTT is to support a retail market of such advanced recording devices then it is essential that the amount of programme data carried on the platform is substantially increased (see 4.6.3 and 4.6.4).

There is a counterpoint to this exciting technical development of advanced recording devices. There are currently 28 million VHS recorders in the UK and VHS sales are currently running at just a little under 5 million per year (including TV-VCR combination devices). It is extremely unlikely that all of these devices will be swapped out for a brand new digital technology in the next decade, especially given that the new systems will be more costly for some years to come. It is likely, therefore, that large numbers of analogue VHS recorders will remain in the market for some considerable time and that many of these devices will need to be converted to digital using converter units (see 4.6.3).

Because of the importance and complexity of digital recording issues, TEG plans to hold a workshop on recorder technology. This will cover:

- The role of the PVR and other hard disc based recorders in the conversion process
- The future role of the VHS recorders with digital reception (maybe as a hybrid device)?
- How existing recorders should be converted
- Use of EPGs to improve the usability of the VCR

5.3 Recommendations

TEG recommends that the following tasks be added to the Action Plan:

5.- LOWER COST CHIP SETS AND COMPONENTS (5.1)

Investigate what actions can be taken to reduce the time to market of lower cost chip-sets and components (eg common interface connectors) to allow low cost TVs.
Q4 2002

5.- RECORDER TECHNOLOGY WORKSHOP (5.2, 4.6.3)

Hold a workshop on "video" recorder technology.
Q4 2002

6. In-home Networks

As discussed in section 2, at present half of all the TVs in the UK are located outside the main room and it appears as if the trend of dispersing TV devices around the home is continuing. TVs are now common in children's bedroom with even very young children often having a TV in their room.

The evidence gathered in 1996 suggests that about half the TVs in bedrooms, etc. are fed from set-top aerials the rest are fed from roof or loft aerials. However, we do not know the proportion of these sets that are connected to the aerial via an RF coaxial cable based distribution system. This data will be gathered during the survey work discussed in section 2.

Clearly a major challenge for the conversion to digital TV is to convert these "out-of-lounge" devices to digital operation. Focusing on free-to-view services we can rank the RF coaxial distribution systems currently available for digital TV in order of installation and operating costs as follows:

- Set-top DTT reception (if in coverage)
- Coaxial distribution of DTT (if in coverage for rooftop reception)
- Coaxial distribution of satellite (The distribution system is somewhat more costly than DTT and multiple smart cards would be required)
- Multiple outlets from a cable network (The additional rental cost per outlet is ~£15 per month at present)

If more advanced in-home network systems are to compete successfully in this area, then they will have to offer cost or user benefits above and beyond the systems listed above.

TEG is working with DTG to investigate the technical issues of such advanced in-home networks and to quantify the benefits that such systems can offer the consumer in the change over to digital TV.

Broadly speaking In-Home Networks can be categorised as wired or wireless based systems. Each has advantages, and accordingly both types of system will be deployed in the home. Therefore consideration has to be given to interoperability between the two types of network.

6.1 Wire based networks

A number of wire based in-home networking systems are being examined:

- IEEE 1394 (Firewire)
- Universal Serial Bus (USB)
- ATM

- Ethernet
- Main wiring based systems
- Coaxial based systems

It is not obvious at present which of these systems, if any, are suitable for in-home networking of TV services. With the exception of the mains wiring systems they would all require the consumer to run wires around the home. They are all based on relatively costly computer-centric technology and it is likely that, for the foreseeable future, they will remain more costly to install and operate than the wireless distribution systems discussed below.

For wired based technology costs to come down, the Consumer Equipment industry will need to agree to support a particular network technology and then build such technology into “home network ready” equipment. The cable chosen for transmission will need to be low cost and suitable for DIY installation.

6.2 Wireless Networks

Wireless network systems are being developed mainly for the computer industry to avoid the cost and difficulties of installing wired networks. The bandwidth of wireless systems has increased to point where they now can be considered for TV applications. In theory a suitable wireless network could provide TV reception throughout the home.

The DTG Wireless In-home Network group is examining a number of possible technologies for this application, such as HIPERLAN 2 and IEEE802.11(a) and is also investigating the availability of frequency spectrum. Two frequency bands (5.15 to 5.35 and 5.47 to 5.725GHz) have been allotted to these wireless networks systems in Europe. However, it is still to be determined how much spectrum would require by each home and how much spectrum in total would be needed.

This type of wireless network is likely to be quite costly, at least initially, and this may limit its suitability as a system for distributing straightforward TV round the home.

6.3 Re-encoding of TV signals for Wireless in-home distribution

It has been suggested that a simpler and more cost effective approach might be to simply re-encode the required video and audio onto the wireless network. This would avoid the additional complexity and cost of implementing a full computer network system whilst still providing the basic facility of distributing the television. A wireless back channel would be required to select the video and audio streams and for any interactive services.

A number of questions remain to be investigated about this type of wireless network in particular:

- The quality of service that can be achieved
- Channel bandwidth required within the home and the total spectrum needed
- The screening effects of walls at the frequencies being proposed
- The effects of interference
- The security of the system

Many of these issues can best be evaluated by the construction and testing of a number of demonstration systems.

6.4 Recommendations

TEG recommends that the following task be added to the Action Plan:

5.- IN-HOME NETWORKS (6)

Work closely with DTG in assessing In-Home networks. In particular support practical tests of such systems to evaluate technical issues and likely consumer costs.
Report: Q2 2003

7. Interoperability

7.1 Interoperability in Vertical markets

In the UK, the satellite and cable platforms are currently largely vertical operations, which closely control the testing and compliance regimes for all hardware and software used on the platforms. This ensures that all applications work across all devices using the platforms to the benefit of the consumer, broadcaster and platform operator. Any software upgrades are subject to the same level of testing.

Applications are authored using approved development toolkits and all applications are tested on the full range of receivers before being transmitted. There are contractual arrangements between the various bodies to enforce this conformance regime.

7.2 Interoperability in Horizontal markets

In horizontal markets (e.g. DTT):

- Products are sold to the public via a retail market without their specifications being controlled by a service provider.
- Several different broadcasters, operating independently from one another, address the same receiver population.
- Applications are not subjected to testing by any central authority.
- There are no all-embracing contractual arrangements between the various parties.

The DTT platform has been horizontal since its inception, and a conformance regime for this platform is still evolving: DTG Test was set up by industry some two years ago to test digital products and devices, mainly for conformance with the DTT platform. It is up to individual manufacturers to decide whether to use this test house for testing their products, software upgrades, etc. DTG Test is also contracted to supply information about product trends and performance to the DTI.

Applications have to date been tested by the three main DTT broadcasters (BBC, D3/4 and ITV Digital) each using its own “zoo” of receivers. However, despite this, interoperability problems have occurred in the recent past that have indicated that the DTT conformance regime needs to be strengthened.

The DTG has taken the initiative of creating a DTT Interoperability group. Its initial recommendations are:

- The creation of a Technical Experts Group on testing and conformance
- Focusing on backward compatibility
- The adoption of codes of conduct for manufacturers, broadcasters and retailers
- The instigation of mechanisms for issue resolution, communications and arbitration

Clearly this matter is of huge importance to the future of DTT and to the switch-over of analogue to digital. If DTT is to take over from analogue as the main platform for delivering services to secondary sets, etc then products and applications must operate reliably and consistently.

Product testing on the RF and demodulation side has already been considered in section 3.7. Another key area where interoperability problems are likely to arise is in the provision and consumption of interactive services (including Internet access). Proposals for a suitable interoperability regime for interactive services should be developed as a matter of urgency by DTP, with TEG contributing to the technical aspects. This should take account of work already carried out by DVB on an authorisation regime for applications sent to DVB-MHP (Multimedia Home Platform) TV receivers.

The technical infrastructure that underpins the interoperability regime will need to be secure and access to data capacity for updating receiver software, etc will need to be guaranteed. Therefore, GDTG should consider how bandwidth should be made available within the DTT multiplexes for the software updating of receivers. A service to broadcast software upgrades to DTT receivers (the "engineering channel") is currently provided by the BBC.

7.3 MHEG5 and MHP

A major advantage of digital TV over analogue TV is the ease at which advanced features (e.g. interactivity, graphics, EPGs) can be added to the basic audiovisual offering. These features (or applications) are delivered to the receivers in a standardised format. The appropriate software API (application programming interface), resident in the receiver, interprets the format and enables the receiver to implement the desired feature.

Most first generation APIs are proprietary, but UK DTT services use a relatively simple first generation API, called MHEG-5, which is an open ISO standard. MHEG-5's limitations (e.g. it does not support full return channel interactivity) have led to moves to standardise an upgraded MHEG specification in ETSI

(European Telecommunications Standards Institute). The DTI should support the work in ETSI to standardise an upgraded MHEG specification.

MHP is the DVB's second-generation open API standard, which offers three profiles that are standardised by ETSI. MHP is a relatively immature technology, with few receivers at present deployed. However, several European countries, including Germany, have committed themselves to adopting MHP as their open API and to migrate to it from existing proprietary APIs. A large multi-national market in MHP-capable receivers is likely to develop and this could result in such devices being offered in the UK market as a cost-effective choice for receiving MHEG broadcasts. The widespread adoption of such devices in the UK could pave the way for MHP services to be deployed in addition to MHEG services, and would provide a route to an eventual full migration to MHP.

A study commissioned by the DTI examined the question of whether the MHEG and MHP APIs could co-exist on the DTT platform. The conclusion of the paper was that the two systems were capable of co-existing together with a couple of different options available for receiver implementations depending on the MHP profile used. This study should be put in the public domain.

This theoretical study needs to be validated by tests to demonstrate that the two APIs can co-exist in practice. The tests would need to:

- Demonstrate the reception of MHEG content on an MHP based device,
- Demonstrate the simultaneous carriage of MHEG and MHP content in a single transmission,
- Quantify the bandwidth implications of providing this facility.

7.4 Recommendations

The study on MHEG/MHP migration should be published on the website. (7.3)

TEG recommends that the following tasks be added to the Action Plan:

2.- CONFORMANCE REGIME (7.2)

Review, in conjunction with ITC, whether it would be appropriate for some aspects of interoperability, particularly for horizontal markets, to be made subject of regulatory requirements, e.g. minimum levels of testing of broadcast applications
Q3 2002

7.- INDUSTRY INTEROPERABILITY SCHEMES (7.2)

Investigate non-regulatory ways of supporting interoperability in horizontal markets.
Q1 2003

5.- INTEROPERABILITY TESTING (7.2)

Determine, in conjunction with the DTG Interoperability Group, an appropriate suite of interoperability requirements and tests for receivers and applications.
(This is related to "Product Testing" (3.10))
Ongoing
Initial report: Q4 2002

2.- DTT BANDWIDTH FOR RECEIVER UPDATING (7.2)

Consider how bandwidth should be made available within the DTT multiplexes for the software updating of receivers.
(This is related to the" Software Download System" (4.7))
Q4 2002

5.- MHEG STANDARDISATION (7.3)

Support work in ETSI to standardise the MHEG specification.
Q4 2002

5.- MHEG/MHP CO-EXISTENCE (7.3)

Hold a practical demonstration of the co-existence of the MHEG and MHP software platforms on the DTT platform
Q4 2002

8. Human Factors

8.1 Scoping Study on Human Factors

Professor Damadoran gave presentations to TEG on her scoping study on Human Factors.[3] It is clear from the study that TEG will need to take into account human factor aspects in all its activities. In particular the need to hide complexity from the consumer and to simplify and standardise the interfaces and interactions between users and equipment are important issues falling particularly to TEG. Some of these concerns are already being addressed by TEG-C.

Professor Damadoran identified the following "key action" which should take place in "Stage 1" - i.e. in 2002

- Initiate actions to engender awareness, understanding and uptake of inclusive design principles.

This is primarily of concern to receiver manufacturers and should be taken up by TEG, which will need to agree a series of specific actions to address the issue.

The scoping study made a number of recommendations in this area, including the following:

- Promote use of 'design for all' and usability standards among DTV equipment manufacturers.

- Promote awareness of good design among consumers and encourage consumer testing and trials of equipment.

- Develop the business case for inclusive design, promulgating awareness of advantages such as:

  - National, European and worldwide market opportunities that derive from leading competitors in inclusive DTV design.

  - Extended market for inclusively designed DTV products and services (as a result of wider diversity of potential users, including the elderly and those with special needs, being able to use the same products as the "average" consumer).

  - Cost savings in the production process arising from HCD and usability engineering.

[3] http://www.digitaltelevision.gov.uk/pdfs/scoping_study.pdf

- Encourage designers and manufacturers to use inclusive design methods specifically for the DTV market through, for example:

  - Promotion of national design competitions (for both students and practitioners) – e.g. for the most “elderly friendly” electronic programming guides, remote controls etc.

  - Provision of government incentives (funding, endorsements) for manufacturers to encourage them to re-evaluate their current products and approaches and move to more inclusive design approaches.

8.2 Results from the Go Digital Pilot Study

The Go Digital pilot study is already producing useful information on equipment usability and consumers' behaviour and attitudes. This needs to be analysed and the lessons learnt need to be disseminated to broadcasters and household equipment manufacturers.

8.3 Workshop on Inclusive Design and Usability

As noted in section 4.2, ITC have initiated the “EasyTV” project which is aimed at making the new interactive facilities offered by digital TV easy to use and accessible by all viewers. TEG is planning to work with the EasyTV project to convene a workshop on inclusive design and usability to which receiver designers and manufacturers amongst others would be invited. This could help promulgate the message and also provide a forum for considering further activities.

8.4 Improving access for people with disabilities

Consumer groups, including those representing disabled groups, have had discussions with the Chairman of the Stakeholders Group about the issues that are concern to consumers. Many of the issues of ease of use are addressed in the scoping study discussed above in section 8.1. However, some of the issues raised were of specific concern of people with disabilities and these are outlines below.

The introduction of digital TV presents a unique opportunity to provide better access to TV and other services for disabled people, especially those with sight or hearing problems.

8.4.1 Subtitles for the Hard of Hearing

Generally the use of DVB subtitling system has been well received. The Tiresias font adopted for DTT was specially designed to make it easy to read and this has benefited the user. There is a desire to see this font more widely adopted for subtitles on the other platforms.

A problem has been identified with existing set-top boxes where it is not possible to select the subtitles when interactive services have been selected. However, with a greater understanding of the way in which interactive services are used and accessed, it should be possible to resolve such difficulties in newer products and services.

8.4.2 Signing services for the Deaf

At present where digital services are signed it is done using an "in vision" signer. This has the disadvantage that the whole audience can see the signer, which many members of the audience find distracting.

Investigations have been conducting into ways that "closed signing" can be carried with the normal broadcast. This would allow the person who wishes to see the signer to add the service to the normal broadcast. Investigations have also been conducted to evaluate systems where the signer is created artificially as a 'virtual human' in the form of an animated avatar. To date such experiments have received mixed responses, but there have been recent significant advances in the quality of signing produced in this way.

Investigations are still proceeding on the best way to provide such a service, and to better understand the technological implications for broadcasters and for the receiver. The European collaborative ViSiCAST project led by the ITC is aiming to develop a special purpose subtitle-like language that could be transmitted in an efficient way and used to animate a lifelike avatar. However, this will require a non-standard STB with extra functionality for what is essentially a small niche market. A new retail/subsidy model is likely to be required to ensure these services are available to deaf viewers.

8.4.3 Audio Description

An audio description system has been developed that can be used to supply a separate sound channel for people who would benefit from a description of what is happening on the screen. On DTT this makes use of a separate low bit-rate sound channel to convey the description. The narration is then mixed with the normal programme sound in the receiver, with the help of fade-control information so that the user can listen to a balanced mix of the two sound sources, while being able to choose the relative loudness of the describer compared to programme sound. On satellite, a separate pre-mixed audio description sound channel is transmitted.

ITV Digital commissioned the design and development of a special audio description module that could be used in conjunction with a set-top box or idTV set, although the commercial development of such a module has been problematic. To keep the extra cost of this technology to a minimum, it is highly desirable that the ability to access audio description should be built into receivers as a standard feature if at all possible.

The issues surrounding the implementation of audio description in receivers need further investigation in order to ensure that the necessary equipment is readily available to those who wish to benefit from it.

8.4.4 Clean Sound Options for the hard of hearing

This would make available a sound channel that is relatively 'clean' of background, effects and music etc. to make it more audible for the hard of hearing viewer.

If this were to be provided via an additional sound channel it would have very significant consequences to the broadcasters, as it would require additional resources to be allocated throughout the whole broadcast chain – production, playout and transmission.

This topic needs further investigation to identify how best such a clean sound could be provided for the user.

8.5 Recommendations

TEG recommends that the following tasks be added to the Action Plan:

5.- WORKSHOP ON INCLUSIVE DESIGN/USABILITY (8.3)

Hold a workshop on inclusive design and usability for TV equipment designers/manufacturers, etc. in conjunction with ITC's EasyTV project. (This is related to "Remote Controls" (4.7))
Q1 2003

5.- FURTHER ACTION ON INCLUSIVE DESIGN/USABILITY (8.1, 8.2, 8.3)

Recommend further activities to promote adoption of inclusive design and usability principles in the light of information from the Scoping Study, Go Digital pilot and the Inclusive Design seminar.
(This is related to "Remote Controls", " Interconnection Guidelines", "Rescanning" etc at (4.7))
Report Q4 2002

5.- ACCESS FOR DEAF AND PARTIALLY SIGHTED PEOPLE (8.4)

Investigate the hardware requirements for reception equipment needed to access services such as Subtitling, Signing, and Audio Description.
(This is related to existing AP task 2.9 "Address ... Access for Disabled People" and supersedes AP task 5.2 "Analyse the Needs of the Disabled" (see Annex 1))
Report Q2 2003

9. Environmental Issues

9.1 Antennae Installation Issues

Planning regulations and landlord restrictions can constrain the availability of digital television and/or reduce the choice of platform available to households. Although satellite coverage of UK households from a technical perspective is about 98% to 99%, planning rules reduce actual coverage by limiting the number of dish installations on blocks of flats. Local authorities can also derogate from general planning permissions granted by statute and exclude areas within their boundaries from the right to install a satellite dish.

9.1.2 Planning Restrictions

Planning regulations should be the minimum necessary to meet defined environmental objectives and should be applied in a consistent manner without discriminating between technologies (terrestrial aerials are currently treated preferentially). The planning rules date from the analogue era when satellite-receiving dishes were larger, (typically 60cm to 1.2m compared with 45cm to 60cm (in Scotland) now).

9.1.3 Landlord-Imposed Restrictions

Landlords (both public and private) can impose restrictive covenants on the installation of antennae, particularly satellite dishes. Even where these merely reflect planning rules, they are subject to a separate enforcement and appeal regime, placing an additional burden on householders wishing to take-up digital satellite TV.

Integrated reception systems (IRS) can extend the reach of DTT and DSAT in multiple occupancy residential developments. Developers of multiple occupancy dwellings could be encouraged or required to install an IRS to provide access to digital TV and/or a choice of platform to the residents.

The enforceability of covenants precluding the installation of TV antennae (whether terrestrial or satellite) could be made subject to the provision of other means of receiving digital TV signals, such as an IRS system.

9.1.4 Further Research

Task 5.7 of the existing Action Plan requires TEG to conduct technical research to enable the satellite DTV industry to cope better with the existing planning restrictions. Given that the size, shape and installation position of a satellite dish are conditioned by the characteristics of satellite distribution technology, they are not amenable to simple adaptation to accommodate planning regulations or other similar requirements. As the laws of physics are less capable of being amended than either the planning regulations or landlord-imposed restrictions themselves, task 5.7 should be superseded by a review on rights of access to digital TV signals.

BSkyB has agreed to undertake research to establish on a postcode basis (comparable to that for DTT) where there are restrictions on the installation of satellite dishes. Such data could be incorporated in a central database on the choices available to households.

9.2 Power Consumption

It is important that all new digital TV equipment should be energy efficient, especially where it is going to remain powered for long periods of time, e.g. in-home networks components and converters. This aspect was dealt with in section 4.5, leading to the recommendation in section 4.7 of a task on "Power Consumption".

9.3 The Waste Electrical and Electronic Equipment (WEEE) Directive

The EU WEEE Directive[4] deals with the environmentally friendly manufacture and disposal of electrical and electronic equipment. As we approach digital switchover it is likely that large numbers of analogue products will be scrapped and will therefore come under the provisions of this Directive. Manufacturers and retailers of digital TV equipment will therefore need to take account of this directive in planning for future equipment and sales.

The AP already has an action on the WEEE Directive (see task 5.8 in Annex 1)

9.4 Unique identification of equipment

It has been suggested that all digital TV equipment should be uniquely identified electronically. This would enable a range of facilities and features to be offered, such as:

- Security tagging so stolen equipment could be disabled
- Manufacturers' update messages, etc

[4] http://europa.eu.int/comm/environment/docum/00347_en.htm

9.5 Alert Messages

The digital TV system could be used to carry a range of alert messages targeted at specific categories of users. For instance flood alert could be targeted at all people with a specific range of postcodes, whilst a regional farming alert might be targeted at all farmers with a specific range of postcodes.

The broadcast signal would need to be able to carry the alert messages and any qualifying information (such as postcode data) in a highly compressed and efficient format. Users would have to input relevant information about themselves (location, profession, etc) and to select the types of alerts that they wished to receive. The receivers would then need to decode the alert messages carried on the broadcast signal and to match the alerts with the data about the user.

9.6 Recommendations

BSkyB should undertake research to establish on a postcode basis (comparable to that for DTT) where there are restrictions on the installation of satellite dishes. (9.1.4)

TEG recommends that the following tasks be added to the Action Plan:

2.- RIGHTS OF ACCESS TO DIGITAL TV SIGNALS (9.1)

Carry out a review of regulatory and contractual restrictions which can prevent households obtaining access to digital television signals. Recommend ways of improving access in the light of the EC Communication on the right to use a satellite dish, switchover requirements and in support of the increased provision of consumer choice. The recommendations could include proposals for legislative change. Q2 2003

2.- USES FOR EQUIPMENT IDENTIFICATION (9.4)

Identify potential uses for unique identification numbers on digital devices and recommend whether identification of individual devices or groups of devices should become a required or recommended feature.
Q4 2002

2.- ALERT MESSAGING SYSTEM (9.5)

Identify potential uses and mechanisms for an alert messaging system and to determine whether such a system should become a required or recommended feature.
Q4 2002