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Interactive television

Project manager's responsibilities

- To know the potential problems of transferring assets between the mediums of computing and TV
- To recognize that there are many ways to introduce interaction into the viewer's TV experience
- To keep an eye on the emerging iTV market
- To build up an understanding of which interactive formats work with the public and why they appeal more than others

Introduction

Even if their numbers worldwide are increasing, computers still have a long way to go before they achieve the market penetration of television. The convergent model for technology sees media, computing and telecommunications gradually getting closer and closer together and perhaps eventually being indistinguishable from one another. So eventually there will be no real difference between a PC with a TV tuner and a TV with a built-in computer or they may blend into a single device. (This ignores the psychological differences whereby people might want to differentiate the two in order to help keep work and play separate. To follow this train of thought you could consider in what ways a truck is different from a family car.)

Of course, interactivity is heavily dependent on digits and so digital TV is often seen as a path leading to interactive television. This is particularly true in Europe, since at the time of writing the American and Australian routes to digital TV are geared more towards high-definition pictures than interactivity. A heavy early take-up of digital TV in the UK was further fuelled by subsidized hardware from the major players, Sky and ITV Digital. The result was that the curve of user take-up for digital TV was an order of magnitude steeper than for comparable technologies such as compact disk and VCRs.

But there are philosophical differences between how we view a computer and how we view television. Arguably there is a fundamental incompatibility between the lean forward, 'nose touching the screen' philosophy of a computer user and the lean back, 'couch potato' environment of a television viewer. It is still debatable whether the average television viewer wants to interact anyway but it does tend to be older people who raise this point. If you were raised on computer games your take on this would probably be different.

This chapter will explore the technical issues dividing television and computing and explain how those influence the development of interactive applications that use television as their medium. Along the way we'll consider the thorny issue of the return path, web-on-television and the influence of interlace … amongst other things that make up Interactive Television: iTV.

There are two other important areas that relate to iTV: Video-on-demand and DVD. Although they have technical differences in the way they are distributed as compared to each other and to iTV, people usually watch them on a television so I include them in this chapter.

Linguistic note: in British English, there is a computer program and there is a television programme. I unashamedly retain these different spellings partly to help distinguish between the two.

What defines an interactive TV system?

It helps to consider the key elements that define an iTV system; define but also limit. One is the remote control and the other is the characteristics of the display.

A computer user will normally interact by moving a pointer around the screen with a mouse and then clicking on one or more mouse buttons. The iTV or DVD viewer has a remote control handset to control the system. Individual options on screen may be marked to correspond with some of these handset buttons. Some handset buttons allow the viewer to move a 'selection point' around the screen in simple 'up, down, left, right' movements, usually between graphic screen buttons, and some handset buttons control features (such as 'play' and 'stop') without having a specific screen button. Some handset buttons may be used only to control the TV itself and play no part in the interaction. They may not even be accessible to interactive applications.

When a user is interacting with an iTV application, that application may have some control over the TV receiver so that, for example, a TV channel can be previewed in a box on the screen. This is different to actually changing channel on the receiver: the user may press the handset button to select an option that says 'Show me the movie' and the channel may change; but it is the interactive application that changes the channel. The sophistication of interaction will be limited by the remote control. It may be possible to

Idealized Interactive TV Handset
(with thanks to the Digital Television Group).

play games but the kind of smooth cursor movement familiar on a computer is traditionally not a feature of TV interaction.

A television screen is inherently different to a computer screen. We have gone into more detail about this in the chapter on video assets (Chapter 7) but essentially a television screen has a much lower effective resolution than a computer and the viewer is almost certainly sitting much further away so the screen appears smaller to the eye.

VGA computer screens and standard televisions have a similar resolution in pixels (TV is 720 pixels by either 480 or 576) but you cannot just move an image from a computer across to TV without taking some care. A sharp computer image will shimmer and flicker when you view it on a TV. The interlace of the television screen means lines of the picture that are next to each other on screen are not actually displayed next to each other in time because an interlaced display writes half of a screen's worth of lines all the way down the screen and then goes back and writes the rest in between the first half. So interlaced pictures have information arranged along a fragmented time-line because adjacent lines show times a 60th of a second apart in NTSC and a 50th in PAL and SECAM. (Assume SECAM timings are the same as PAL in this discussion.) To compensate for this the TV image is much softer (out-of-focus to some extent) than its computer equivalent since a computer display writes all the lines in order from top to bottom of the screen. This is known as non-interlaced or progressive scan. So any text on the television screen must be larger than you might use on a computer and 24 or 26 point text is considered as 'small' in this context.

Moving video footage between a television display and a computer can leave visible artefacts. (A fuller discussion of the effects can be found in Chapter 7.) A moving object will appear to fragment and vertical edges of horizontally moving objects will show this worst. Moving in the reverse direction from a computer to a television, instead of the vertical edges breaking up, you'll see double images.

You can get around this inherent difference between a computer's progressive display and a television's interlace in four ways:

- shoot on film (in which all parts of the frame show the same moment in time),
- using a progressive scan video camera which shoots like film,
- calculating a frame from the two fields, and
- when moving from TV to computer, reduce the size of the image to a quarter frame or smaller and drop one of the fields. This is a special case of calculating a new frame, of course.

With any of these methods you can produce movie files that will play satisfactorily on both television and a computer.

Television always has a fixed frame rate of 30 (NTSC) or 25 (PAL) frames per second. Since a computer screen can have a wide range of frame rates

the two might not fit together very well. This might occasionally show up as a slight juddering in what should be smooth motion.

The television might have a standard aspect ratio of 4 by 3 but it also might increasingly be wide-screen and so have a ratio of 16 by 9 (for comparison, 4 by 3 is equivalent to 12 by 9). Television is often now treated as if it has an aspect ratio of 14 by 9 which is a reasonable half-way house between standard and wide-screen and so an interactive application might be distorted slightly for both normal and wide screen, but by only a smaller amount and being horizontally squashed for the former and stretched for the latter. If the application is being made to work on both NTSC and PAL sets (rather than being specially produced for each) then a similar distortion will occur since the 480 visible horizontal lines in an NTSC picture would not fill a PAL screen which expects 576 so the picture would be squashed vertically. In all cases the same number of pixels is seen across the screen – 720 – but the shape of those pixels changes. On a computer you can assume that pixels are square.

So the displays are different, and that affects the way the application on iTV looks. But what kind of applications might you find as either enhanced TV or fully interactive TV?

The carousel

The carousel is the most venerable element in iTV. The term refers to a sequence of data that is repeatedly transmitted, ad infinitum. A viewer preselects a portion of this data as it passes 'on the carousel' and the television set displays it or runs it as a program in an interactive system.

Teletext, introduced by the BBC in September 1974 and still going strong, is a carousel digital information system. Hundreds of digital pages are cycled continuously including news, sport, weather, programme information and features. Each page is exactly one kilobyte – 25 rows of 40 characters, each character defined by an 8-bit code. They correspond to ASCII but with additional codes allowing crude graphics, colour and effects such as 'reveal' and 'flash'.

Although teletext is a digital system it is actually transmitted as pulses in part of the analogue TV picture, in the lines 'above' the picture known as blanking or vertical interval. Most countries outside the US have teletext systems. The most common is the so-called World System devised by the BBC but other systems exist, notably in France and Japan (and bearing names like Captain and Antiope).

The viewer chooses what to see by selecting a page number, from 100 to 899 on the remote control. The TV will default to 100, the Index page. There are other 'reserved' page numbers: for example 888 which is used in the UK and elsewhere for closed caption subtitles. These subtitles are displayed in a box cut into the picture and are synchronized to the programme. They are usually intended for people with hearing difficulties but

they can also be used for translations, opera libretti and commentary. Since teletext signals can be recorded on professional videotape, television programmes offered for sale to broadcasters often include subtitles built-in. This became especially common when the Australian government insisted on a certain percentage of programmes, including imports, being subtitled. (World System teletext signals are too complex to be recorded on VHS videocassettes, although they can be stored on analogue LaserDisks, many of which have subtitles. The Closed Caption Line 21 system used for hard-of-hearing subtitles in the USA is more rugged than teletext and can be included on videocassettes.)

The television set needs a kilobyte of memory to store the page of data so that it can be captured as it passes on the carousel and is displayed. The average delay between a viewer pre-selecting a page and it being shown is called the latency and it depends on the number of pages in the carousel and the number of TV lines on which the data is transmitted.

The apparent latency of a teletext system (as with any carousel) can be reduced by caching pages. As the carousel goes round, pages can be cached so that when the user selects a new page it will appear instantly. Unfortunately set manufacturers seem unwilling to put memory in a TV for this and the nearest most teletext sets get is to have a few pre-selected 'next' pages attached to the currently viewed one. This is the Fastext system and the broadcasters implemented it by invisibly tagging each teletext page with the page numbers of four related pages. Sadly, many manufacturers gave their sets four kilobytes of memory to implement Fastext, forgetting the kilobyte required to display the current page which resulted in one of the four Fastext buttons not working instantly.

Teletext suffers from its limited graphics capabilities, although some non-World System systems offered more sophisticated graphics and a level of World System was defined (but not used) that even allowed RGB colour photos. But the available bandwidth in the vertical interval from the top to the bottom of the TV screen would be the limiting factor since it would always coexist with a television frame.

World System was also the basis for other early network interfaces, the best example being the British Prestel system which was a telephone-based digital information system and which even allowed e-commerce (as it is now understood). Prestel is still used extensively in the UK by the travel industry but it offers little more than a VT100 terminal would.

Of itself, a carousel is arguably not really iTV but more a progenitor of it, often referred to as 'enhanced TV': but it certainly gives a lie to the adage that changing channel is the most interactive thing people did with their TV since, in Europe at least, the majority of TV viewers use teletext.

With the advent of digital television, a new and more sophisticated form of teletext magazine with better design and photographic quality has become available, using the high-quality display and interactive capability of the set-top box. This has enabled the humble text and block graphic pages to take on all the sophisticated features available to web pages. It is

also important to remember that many iTV applications will be delivered to the receiver from a carousel since they cannot be requested on demand. One key task of the programmers will be to fine-tune the carousel so that the latency of the system is not apparent to users.

Multi-channel

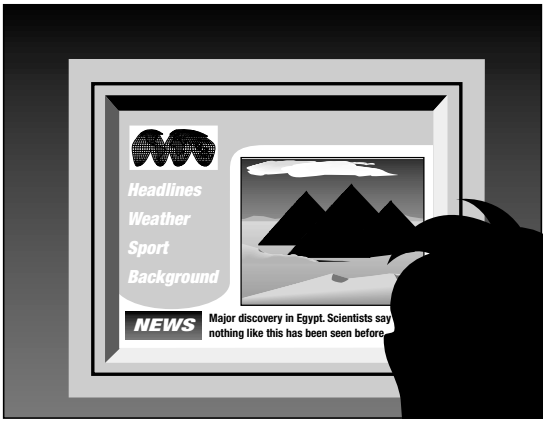
Back in the 1980s, British commercial television ran an advertisement – the product was financial services – which was made in two different versions: one used a sober 'man-in-a-suit' approach and the other featured a song and dance routine. Since the two commercial channels available at the time were synchronizing their commercial breaks, these two versions were run simultaneously. The viewer was even asked, at the start of the commercial, which style of exposition they wanted and was told to switch channels to make the choice. If you watched the commercials carefully you could catch a glimpse of the other version passing in the distance, emphasising the co-incident nature of the different ads.

This was an early example of the simplest form of interactive television, where the viewer chooses a particular channel to watch in order to see a different 'view' of the same event. This is, of course, a very wasteful form of interactivity since each option takes up a whole channel of its own, but choosing a camera angle is a feature of many iTV programmes, especially in sport.

Unintentional iTV had existed before this. As soon as television stations were in competition, there were instances of double coverage of a notable event being done using different resources. The inauguration of a President, key space launches of the 1960s, some sporting events, were covered by two (or sometimes more) stations. The viewer would be making an interactive choice between the options.

Where a broadcaster has sufficient capacity (the digital satellite channels available to BSkyB in the UK provide a good example) it can offer viewers a choice of views of, say, a football match. The match is already being covered using a number of cameras and the programme's director will be selecting which one the viewer sees from moment to moment. At an event like a football match, every camera is likely to see something of the game. Alternatively, at a golf tournament, different cameras would be covering different holes.

As well as these simultaneous views, the broadcaster could provide related material such as a camera showing the trainer's bench, following the game from the point of view of one or more players, or a time-delay feed so the viewer can choose their own 'action replays'. A continuously updated feed of statistics and possibly some highlights from other matches or sports could be added to this mix. The viewer might be able to view two or more images on screen at once by using picture-in-picture.



This combination of features provides a pretty rich set of material for what is probably the simplest true iTV structure. For the broadcaster it also makes use of existing resources.

Multi-channel iTV, like the carousel, illustrates a basic premise of iTV: all the options will be distributed and the viewer catches them as they flash by or stashes them away for later consumption. This is distinct from interactivity on the Web, where the material is only really made available if it is requested.

Near video-on-demand (NVOD) is another multi-channel form of enhanced television. With genuine video-on-demand (VOD) the viewer has a broadband connection to a video server and receives a unique stream of data which allows control over the video providing the same functionality as a VCR. NVOD uses a number of channels to transmit the same movie but with staggered timings. The movie might start every ten minutes which means that someone wanting to watch the movie can do so with a wait of no longer than ten minutes. To do this with a two-hour movie would need 12 channels.

Interactive television needs to be distinguished from interactive video (IV). IV was essentially the result of hooking an analogue videodisk player up to a computer and, after having a brief popularity in the 1980s, has been largely forgotten. (A variation of IV, which used DVD instead of a videodisk player, has been promoted by Pioneer, basically as a way of leveraging existing IV programs in the digital age. The videodisk is transferred, frame by frame, to the DVD so that a simple conversion of the original controlling program can be used. Cheap and very cheerful. At its simplest the system makes use of bar codes. To view a sequence the viewer swipes a bar code which programmes the player and shows the sequence. This method proved very popular in education since it didn't require a separate computer and the controlling 'software' could be copied by photocopying. A splendid example of lateral thinking.)

Associated material

One format for iTV allows a standard linear programme to be enhanced by the transmission of related and possibly synchronized material which can be viewed along with the programme. A website which contains extra information on the subject of the programme is one example; and so you can watch the programme at the same time the video might be windowed into the page. But such things can be much more sophisticated.

One popular format is the quiz show where the audience can take part along with the contestants on-air. If you ever felt that you could answer the questions better than the person on the TV then this gives you the chance. The interactive program running in your television or set-top box provides you with a user interface, possibly shows you the questions in written form and keeps track of your score. This program could be fed from the Internet or a telephone, but it is more likely to use signals transmitted with the TV programme or even from another on-air source, such as the data channel of a local FM radio station.

The extra incentive that iTV can bring is allowing you to compete against not only the contestants but everyone else watching the interactive quiz. Here you need a return path going back to the broadcaster, probably using a telephone line. If the set-top box determines that the viewer has beaten the contestants on-air it might dial up the studio and inform the programme team. The viewer with the best result could then be declared a winner during the programme, if it is live, or announced during the following week's edition.

A similar concept, if simpler, is voting. Quite often TV programmes will ask viewers to telephone certain numbers to choose the winner of, for example, a talent show. All the viewer does is choose whether to dial one number or another, each representing a choice. It's the dialling of the number and connection of the call that registers the choice: this is much more efficient than making a call to a single number and then saying your choice to an operator or pressing a number on your phone key pad. This voting can be so efficient that the feedback takes only a few minutes and there are specialist companies who will provide the facilities for this. (A bonus is that the calls usually cost the viewer a little more than ordinary calls and so the programme can actually earn some income from its voting and help offset the production costs.)

The Golden Shot

Once upon a time there was a very popular television programme in which viewers gave instructions over the telephone to a blindfolded camera operator who pointed the camera, and a crossbow attached to it, at a target in the studio. This was *The Golden Shot* and listening to callers saying 'left a bit, up a bit, shoot!' was a common part of 1960s viewing.

Touch-tone telephones have revolutionized this concept and it is possible to configure an aspect of the television studio so that a viewer can control it this way: perhaps to select a camera view.

Of course, this is interactivity only in a special sense since only one viewer can interact at any time. But it is still counted as interactivity and by a broad definition so might a phone-in radio show. These are not really what we would consider a part of iTV now.

TRANSIT and the backwards news bulletin

Back in the late 1980s, when the BBC first had an Interactive Television Unit – who actually made videodisks rather than real iTV – the Unit's head presented a paper to the Royal Television Society which outlined an interactive approach to broadcasting which still has merit.

Peter Armstrong called his modest proposal TRANSIT, for Transmitted Interactive Television. He envisaged a viewer having a receiver which could receive and store television and which would have sufficient computer capability to run a program which used the recorded material as a resource. The broadcaster would transmit component parts of a TV programme together with the controlling software, and the viewer would then interact with this on their TV using the remote control.

There are now set-top boxes which contain hard disk storage which allows the viewer to time-shift, or even pause, programmes received. This is known as a Personal Video Recorder (PVR). Although at the time of writing there is no sign of additional controlling software, this shouldn't be too difficult to envisage. So what kind of facilities would this provide?

If one side to iTV is giving viewers the opportunity to interact with a TV programme as if they were at their computers, the opposing philosophy looks at the current linear experience and asks how it could be logically enhanced. With this latter model in mind, imagine a viewer tuning in to the evening news programme: *60 minutes*, *TeleJournal*, *News at Ten* or whatever.

The viewer selects the iTV version of the evening news and watches the headlines at the start of the programme. She might have selected to see a headline version of the bulletin or to see a full half-hour programme with all the news reports included. If she sits back and does nothing then the programme proceeds as usual. If, however, the viewer wants to take control of the programme then she can go back over the menu of items and start to pick and choose which to watch and in what order. Or she can watch through the programme and 'click out' of any item she doesn't want to see any more of and skip on to the next item. Another scenario would have the news weighted depending on the viewer's known preferences.

The key to News is topicality. But the items in a news broadcast are not created simultaneously. The most topical breaking stories are created last, but they usually go at the beginning of the programme. The light-hearted 'and finally' story may have been 'in the can' all day. So the programme can

be broadcast to the viewer's set-top box in reverse order. The breaking story may even be viewed live.

So here is another iTV model. The broadcaster transmits the component parts of the programme and the viewer sees a tailor-made compendium of them. You could envisage a continuously re-built news programme which would store stories and update stories and even delete stories, waiting for the viewer to grace it with her presence.

A key to this kind of iTV is indexing. A template program to construct a news programme running in the set-top box needs to know how to treat the news reports that come its way. The program works using templates and the news reports need to fit into templates.

Trimedia production

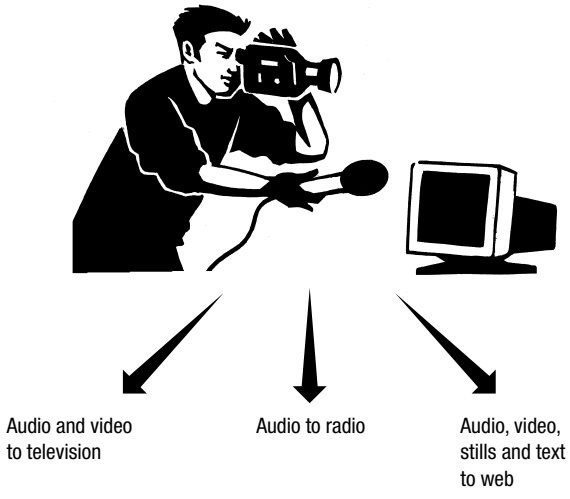
It has become common for broadcasters to work with radio and television simultaneously and bi-media working has become commonplace, especially in news.

The next step is to produce programming which can be used on radio, television and the Internet. The requirements and preferences of each are different. Radio has a relaxed intimacy rather like a companion person who hangs around chatting, while the Internet is responsive and can be directed like a servant. Television, on the other hand, rather takes over and sits you down and force-feeds you short extracts from the world outside.

In trimedia the relationship has another dimension. Radio can provide the community of interest and this community can then interact socially via the Internet. Television can pick up the community and present a distillation to a wider audience still. In 2000, the German broadcaster ORB, based near Berlin, produced an audience participation trimedia 'reality' show called *Waldländer* which means Foresters. This featured a group of three young men and three young women dropped blindfolded in the middle of a forest and having to fend for themselves for 72 hours with only broadcasters for company: described as having 'beds made from leaves, nettle tea and worm soup'.

The local youth radio station, Radio Fritz (yes really!), carried news of their exploits and listeners could also follow it on the Internet and contribute help using SMS, e-mail, telephone or fax and providing advice about edibility of mushrooms and the calorific value of earthworms … amongst other things. Local television broadcast occasional visits to show highlights and significant events. Satellite ISDN was used to provide occasional streamed video coverage from the forest which was then left on the website for further viewing. Unlike *Big Brother* this had to be a collaborative effort and you won by working together.

Material was produced by the ORB team for all three media using specially designed equipment, workflow models and techniques. Web and radio audiences were significant although a late night slot for TV coverage took viewing



In Trimedia Production a reporter (or team) produces material for all media at the same time.

figures down too low to be measured. However, one approach to interactivity in broadcasting is to harness disparate technologies and let them work together. Audiences seem willing to play this game and so will broadcasters, once they achieve trimedia thinking to go along with the programming.

An object-oriented future

There is a way in which issues of differences between computer screens and television screens become irrelevant. If a broadcast programme is made up of a set of distinct objects then artefacts of interlace or resolution (and more) can be avoided by tailoring the format of the object specifically for the display medium. This approach is a key part of the MPEG-4 standard.

A future television receiver will build up the image seen by the viewer based on the objects in a scene and the rules by which they operate: for 'rules' read 'script'. The virtual studios seen in broadcasts work this way, but the image is built in the studio rather than in the viewer's home. The principle is the same.

The objects could be broadcast along with the rest of the programme, or the viewers could define elements of the programme for themselves. The programme presenter will be defined as an object: imagine being able to give a child a gift which allows their own persona to be used as the presenter of a favourite programme. A viewer might feel inclined to use a clown 'object' to present the parliamentary report or the legendary broadcasters like Ed Murrow, Richard Dimbleby or Walter Cronkite might return to present the

news once more. Viewers could in any case choose presenters with whom they could identify.

With this technology, viewers will be able to take a much greater level of interactive control without losing the seemingly essential linear narrative aspects that make television (like all linear entertainment) so compulsive. Let's face it, the best stories take the narrative through twists that the audience could not have imagined. This appears to contradict the approach to interactive narrative adopted in Book 1 Chapter 16, *Multimedia narrative*, but the strengths of linear narrative need not be discarded even after the new strengths of multimedia narrative are established.

The object-oriented nature of MPEG-4 will work alongside wider adoption of XML and MPEG-7. XML allows authors to embed structural and descriptive information in a document (and that document could be an audiovisual programme) while MPEG-7 aims to provide a standardized way of describing audiovisual material for indexing. The combination of these three technologies has the potential to allow programme producers to present audiences with a kit of structured parts from which a programme can be built in a number of ways, depending on a viewer's preferences. (In case you're wondering, the MPEG numbering isn't continuous. It currently goes 1, 2, 4, 7 and 21.)

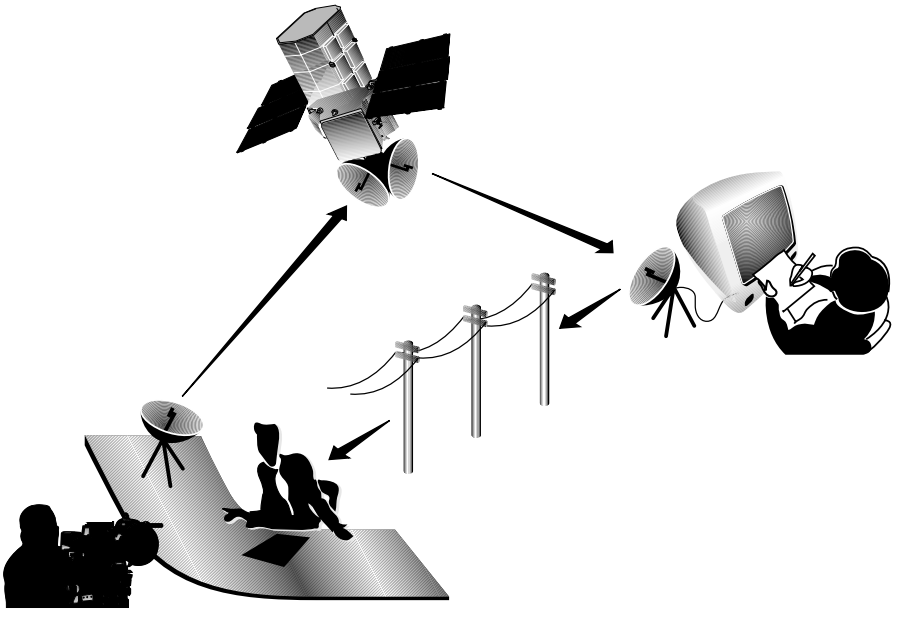
The return path

The connection back from the viewer to the television station is known as the return path or the back channel. As we have seen, it is possible to broadcast interactive television without a return path, but it limits the kinds of interaction that are possible. Significantly, having a return path makes the individual viewer part of a community, just as Internet users are.

The most obvious return path is part of a cable television system. If each individual end-user has a clearly defined connection back to the cable-head-end then this can be used for interactivity. This requires a configuration called a 'Star'. The alternative configuration, called a 'Tree and Branch' only identifies the end-user back to a local node and so is not automatically set up for a return path. Such a configuration is not necessarily physical in a digital system, since digital markers can identify separate packets of information sent along a single path.

Cable operators have long been aware of the importance of the return path. The most sophisticated analogue cable experiments back in the 1970s allocated a return path, but in this case it was for analogue video and audio. The viewer could contribute to the programme back down the cable. This needed a complex distribution mechanism and was never really a commercial proposition: partly because the trial users who had access to the interactivity just didn't want to communicate with the broadcaster.

The return path today is a data path. It could be used for video, but there is usually just not enough bandwidth to allow this.



Interactive TV via satellite currently needs a telephone to provide the return path.

Satellite and terrestrial television seem to be set up so that providing a return path would be impossible. Thousands of receiver antennae point at a single transmitter whether it is at the top of a nearby hill or high in the sky on a satellite. Certainly currently available implementations of iTV using satellites or broadcast use the humble telephone line to provide a return path. Despite this it has been proved possible to provide a return path to both kinds of transmitter without resorting to using a telephone line, even when the viewer is on a communal aerial system. At the time of writing, this is a proof of concept rather than a full-blown service.

DVD

Since this chapter is basically dealing with interactivity using a television it seems sensible to briefly describe DVD. Although DVD Video is primarily a format used for distributing movies and similar audiovisual programmes it has some built-in interactive capability. Strictly speaking DVD is a family of formats but for simplicity we will follow consumer convention here and use the term DVD to refer to the videodisk format used to distribute movies.

Digital video disk (now retro-renamed digital versatile disk) was first designed to be a replacement for compact disk. It had become apparent that

there was not enough data on a CD to hold a full movie at a quality high enough to satisfy the movie companies and the movie fans. The CD-based movie format (Video-CD) used MPEG-1 video and almost always needed two disks for each movie. DVD had data space to spare for the higher-quality MPEG-2 and, with two layers of data on each of two sides of the disk, sometimes room for more than one movie. Although DVD swept the board in Europe and America, Video-CD remains a popular format in the Far East and, surprisingly, DVD-icon movies like *The Matrix* can be found on CDs in places like Singapore. The new format did not have an easy start, since the major movie companies insisted on strong copyright protection and also a system of region codes to restrict where in the world disks could be played. (See also Book 1 Chapter 15, *Rights, copyright and other intellectual property*.) Region coding is not mandatory however, and you can make disks that will play anywhere.

A DVD-ROM disk is just like a high-capacity CD-ROM and DVD videodisks and audio disks are just DVD-ROM disks with a special standardized set of directories and files. DVD players look for certain files in these directories. Since a DVD player has to be a simple device sold at consumer prices the interactive facilities available are tightly specified and limited compared to those available using a computer. The functions, and how to access them, are contained in the DVD video specification and allow you to produce menus, buttons, video segments that can seamlessly jump around and, of course, play sounds and movies.

DVD production will almost certainly use a dedicated authoring software package which will give you a choice of the options available. This used to be a relatively expensive proposition but in mid-2001, with the price of a DVD-R writer coming down, Apple and Dell launched desktop computers that came fully fitted out to produce home DVDs that would play in real DVD players. This distinction is important because the DVD-RAM format, available alongside DVD-R, produces disks that do not generally work in DVD players.

Producing a DVD involves three stages: encoding of the video and audio, authoring of the menus and other interactive features, and pre-mastering to make the (usually) digital tape to send off to be replicated. More information on encoding (which in practice means compression) can be found in the audio and video production chapters of this book: Chapters 6 and 7.

Navigation around a DVD uses menus with up to 36 hot-spots. Since DVD players are operated using hand-held remote controls the user-interaction is deliberately kept simple. Usually a remote's left-right-up-down buttons will move the selected hot-spot around the buttons, highlighting as it goes. When the highlighted button is the wanted one the user presses a 'select' button and initiates the required action.

Besides commands to control the content playback and select from menus there are simple programming functions. These allow a DVD interaction to read timers and registers, do simple maths (including random

numbers and comparisons), and numerical operations such as AND, OR and eXclusiveOR. (If you have never used XOR, it is extremely useful for flipping the value of individual bits without needing to know their original state). In an environment with limited memory and power, such as a consumer player, working with bits at such a level is advantageous.) To continue the similarity with old-fashioned computer programming you also get system and user registers to play with: these are places in memory where you can store and read flags. The system register, for example, will tell you things like language preference or parental control level set.

Seamless branching is built into the DVD specification. It can be used to instantaneously change camera angle on a scene for sports or concerts. It works by laying down interleaved chunks of the various streams in the data. Seamless branching can also be used to allow variation of storyline or to allow different versions of a movie to be played without having to encode each version in its entirety separately. In these cases the branching is done under program control rather than user control.

Subtitles (alternatively known as subpictures) are held as bitmaps so subtitle text is bitmapped text. This neatly avoids any font problems, especially with languages like Chinese, and since the subpictures are the same size as the video the information can be overlaid anywhere on screen. This image-based format is also compatible with the way subtitles are generated for movies. Closed caption subtitles (for the deaf and hard of hearing) are held as data and can be put onto line 21 by the player for decoding and display by the television set.

It has to be said that the plethora of CD and DVD formats available in the last few years are not easy to keep track of.

The replication formats are DVD-ROM, DVD-Video, DVD-Audio and SACD. The last two are discussed in more detail in the chapter on audio (Chapter 6). But, unlike CD formats, all DVD formats are essentially DVD-ROMs. Consumer DVD movie players (and software players for computers) look on a DVD disk to see if they can find information in specified directories. DVD Video disks use a directory called VIDEO_TS while the audio disks look for AUDIO_TS. Open the disks using a computer and you will find one or more of these directories. You might also find directories of accompanying material for use on a computer as well, such as screen savers to help promote the movie.

So a replicated ('pressed' if you prefer) DVD disk is always going to be, at heart, a DVD-ROM. The basic unit of any such DVD is a layer and a layer can contain 4.7 gigabytes of error-corrected data. A particular DVD disk can be single- or double-sided – most disks are single-sided – and a side can have two layers. The DVD player can select a layer by changing the focus of the laser pickup so you can have up to 9.4 gigabytes in two layers. Such a disk is called a DVD9.

These are the main 12 cm (5-inch) formats for DVD. The duration of video assumes an MPEG-2 capacity of two gigabytes (2^{30} bytes in a gigabyte) per hour.

DVD-5	Single-sided, single layer	4.37 gigabytes
DVD-9	Single-sided, double layer	7.95 gigabytes
DVD-10	Double-sided, single layer	8.74 gigabytes
DVD-14	Double-sided, double on one side	12.32 gigabytes
DVD-18	Double-sided, double layer	15.9 gigabytes

A DVD-18 would allow 18 hours of MPEG-2 video. The usual bit rate for DVD encoding averages around 3.5 megabits for video (5 to 6 megabits is regarded as 'transparent', meaning you shouldn't see any difference from the master) with just over a megabit used for audio on top of that. The audio can be up to six-channel (5.1 surround) and in several languages. The audio format on the disks is most likely to be Dolby Digital format but some may be multichannel MPEG or DTS. These sound formats are mutually incompatible but some players can handle more than one and some disks contain more than one.

Although the level of interactivity provided in the DVD Video specification is limited, with some resourcefulness very sophisticated interactive scenarios can be developed: particularly since menus can be made from movies as well as stills. As more and more homes have DVD players you can expect more resourceful use of the medium.

Web on TV

In many homes (and especially in the living room) the only display device is the television. This is an opportunity to marry the Internet with television. At its simplest this means using the television, possibly with a keypad, as if it were the display of a computer. Several manufacturers have produced set-top boxes, and even complete TVs, which can be hooked up to the Internet.

Microsoft's WebTV is the best known of these, but not the only one. It can offer three levels of service: an Internet connection with Web and e-mail (WebTV being the Internet Service Provider); enhancements to regular television viewing; and, at the highest option, a satellite connection which gives the user video-on-demand with individual control over the videos.

The Web and television make strange bedfellows. I mentioned the 'lean forward' and 'lean back' issue at the beginning of this chapter. Until Web content is divorced completely from the display device, there will always be incompatibilities which hinder use of the Web on televisions and mobile hand-held devices. If we assume, as a starting point, a web page as designed for a computer, then displaying this on a TV has some, all or even more of the following problems.

- TV resolution is much lower than a computer screen. This is because of the smaller number of pixels (comparable with a 640 by 480 computer

screen) whereas most websites are designed for 800 by 600 pixels or more.

- Television displays are interlaced (as was mentioned at the beginning of this chapter and as is explained more fully in Chapter 7) while computer displays are not. Television pictures are usually a little softer than computer images. The combination of these two effects results in shimmering and flickering when a sharp computer image is displayed on a television.
- Television programmes don't have scroll bars or windows. What you see is all there is.
- Televisions don't have mice so selecting a link on a web page can be difficult, especially if the link is in a group on the screen and small. The TV user is probably trying to do this using a remote control handset.
- Televisions have different gamma (brightness curve) settings to computers and even the colour phosphors are different.

And this is before we consider the psychological implications of watching TV from the couch on the other side of the room.

Of course the solution to this is specially-designed web pages with larger text and plenty of space to help couch-navigation. This could be achieved by careful use of cascading style sheets and XML. The set-top box can also filter the text and picture information to help readability but currently the provision of special pages is the best option. For this reason many web-on-TV ISPs offer a 'walled garden' of web pages which are designed, selected and vetted for the service.

The link between the web and interactive TV is an important one. There is a mass of information being produced for the web and many iTV features, like electronic programme guides and enhanced teletext, are so similar to web pages that it makes sense to provide XML or even HTML-based systems to program them.

You can see from this chapter that there are many ways of providing interactivity on a television set. Which of them are genuine interactive television, as opposed to being just, say, enhanced TV, is unclear. Certainly, to many long-standing multimedia developers and web designers the features available are not yet sufficient for real interactivity. Whatever the level of interactivity available, the key to iTV will be its role in our lives. Our friendly television set could be a more popular channel for interactivity than the business-like computer after all.

THEORY INTO PRACTICE 3

Either
Choose a DVD and use its 'extra features' section if it has one.
Assess your reaction to the interaction allowed.

1. How easy is it to use the remote control with the menu system	Easy 1	2	3	4	Difficult 5
2. How readable are the menu options	Readable 1	2	3	4	Hard to read 5
3. How easy is it to navigate between options	Easy 1	2	3	4	Difficult 5

4. Write a paragraph about your experience. Are you positive/negative? Why?

Or
If you haven't tried iTV, perhaps you can get a demo of it from a salesman in one of the larger consumer electronics shops. What are the pros and cons? How do you assess the potential?

Summary

- The role of the remote control is vital in iTV.
- If producing video for joint use on both the computer and TV, the production needs to take account of the difference in displays.
- Different models of interactivity are emerging for iTV – carousel, multi-channel, 'return path', and tailored are a few.
- It is possible to combine the strengths of radio, computing and TV into one programme appealing to different audiences.
- Object-oriented approaches to TV component parts may allow far more interactivity for a viewer in the future.
- DVDs allow limited standardized interaction in a consumer environment.
- Web on TV has production problems to take into account but these can be overcome.

Recommended reading

ITV Insider (http://www.itvinsider.com) has news information, news and links to resources for the iTV market and developer community.

The UK Digital Television Group (http://www.dtg.org.uk) provides information on digital television, including iTV.

http://www.opentv.com and
http://www.liberate.com – proprietary iTV software platforms.

http://www.mhp.org – website for the Digital Video Broadcasting consortium's Multimedia Home Platform interactive platform.

TiVo, who produce a PVR (personal video recorder), have a section of their website at www.tivo.com that uses Flash to demonstrate the system.

The Pace Report 2001 ('Consumer attitudes towards digital television in the UK and US') is published by Pace Micro Technology plc, Victoria Road, Saltaire, Shipley, West Yorkshire, BD18 3LF, United Kingdom. www.pace.co.uk. Summary report is available at http://www.pace.co.uk/documents/PR/pacereport01.pdf.

Everything you needed to know about DVD can be found in the DVD FAQ at http://www.dvddemystified.com/dvdfaq.html