

Chapter 2

Interactive TV Applications and Their Context of Use

2.1 Interactive TV Applications

The aim of this section is to define and classify interactive TV applications. Classification is relevant in supplying a frame of reference within which such applications may be described and specified. Hence the following steps have been taken:

- An analysis and evaluation of existing definitions of interactive TV applications and a choice of the most suitable definition for this book (Section 2.1.1)
- An analysis and evaluation of existing classifications of interactive TV applications (Section 2.1.2)

2.1.1 Definition

In this section existing definitions for interactive TV applications are analysed and evaluated regarding their relevance to interaction design.

Before interactive TV applications can be defined, traditional television should be clearly understood. In view of current changes in television technology and use, a definition of television should not depend on the device used for reception and display. Nor should it depend on the physical environment in which television is used. Nowadays television can be watched not only on a set at home but also on a personal computer equipped with a television card, in a car or on a handheld mobile device, e.g. a mobile phone or personal digital assistant (PDA). In effect television can now be viewed in offices, cars and trains, on a street or elsewhere. Hence a definition of television should rather be related to its function in communication: Television consists of watching television (Hasebrink 2001, p. 10). Traditional or “classic” use of television is defined by Hasebrink as personal contact with audio-visual communications having all the following attributes (Hasebrink 2001, p. 11):

- Standardised (the same for all recipients)
- Time dependent (simultaneous for all recipients)

- One way (with no reversal of sender and receiver)
- Public (offered to all members of the public)

This definition applies to the use of either analogue or digital television without interaction, whatever the equipments used for reception or display or whatever the physical environment of use, and it meets the stated requirements for a definition of television in the context of this book.

The term “interactive TV application” means different things to different people. No definition is presently accepted by all researchers and practitioners, since “the nature of ITV services is evolving rapidly, with constant and continuous technological changes and evolving business models making it difficult to specify a definition” (Federal Communications Commission 2001, p. 3). Since the aim here is to develop design guidance for interactive TV applications in general, not just for any particular kind, a suitable definition is called for. Within this context it ought to

- Be content independent
- Be independent of the kind of application
- Refer to digital television

Basically there are two different approaches to defining interactive TV applications:

- Definitions based on content or function
- Definitions based on technology

An example of a content-based definition, used by the British Broadcasting Corporation, is presented in Table 2.1 (British Broadcasting Corporation 2004, p. 51). Content- or function-based definitions usually refer to interactive TV or interactive TV programmes instead of interactive TV applications. An example of a more function-based definition, offered by the former British broadcasting regulator, the Independent Television Commission (ITC), is also presented in Table 2.1 (Independent Television Commission 2001, p. 1). Most definitions of interactive TV applications are from standardisation organisations, broadcasters or scientific authors (Table 2.1).

Only two of the cited definitions for interactive TV applications meet the stated needs of this book. Since the European Broadcasting Union definition is precise and pithy, it will be adopted here: Interactive TV applications are “...enhanced or interactive services with digital television (iTV)” (European Broadcasting Union 2004a). Based on this definition, interactive TV applications may be classified as follows.

2.1.2 Classification of Interactive TV Applications

According to how iTV applications are defined, the classification varies. ITV applications are usually classified according to their degree of interaction or

Table 2.1 Evaluation of definitions for interactive TV application

Definition	Requirements for iTV definition		
	Content independence	Application-type independence	Reference to digital TV
“...enhanced or interactive services with digital television (iTV)” (European Broadcasting Union 2004a)	Yes	Yes	Yes
“Interactivity is a functionality rather than a specific type of service, and it can be applied in a wide variety of contexts. Its distinguishing characteristic is the ability of viewers to interact with TV programmes by one of two methods: by changing the content which appears on the screen – for example to access background information, to change camera angles, to view more than one picture at a time, or to view associated text at the same time as a main picture, by providing information to the broadcaster through a return path, usually a telephone line – for example to order a product, to exercise ‘votes’ on options provided by a programme or to participate in an on-screen quiz show. These services are available only to members of the public with digital equipment, whether satellite, cable or digital terrestrial” (Independent Television Commission 2001, p. 1)	Yes	Yes	Yes
“...a service that supports subscriber-initiated choices and actions that are related to one or more video programming streams” (American Federal Communications Commission 2001, p. 3)	Yes	Yes	No
“Interactive TV is an umbrella term. Interactive TV is the content and services (in addition to linear TV and radio channels) which are available for digital viewers to navigate through on their TV screen. In practice, at the moment, this means giving the viewer control over some video, audio, graphical and text elements or allowing them to use simple games and quizzes or send simple communications back to the broadcaster” (British Broadcasting Corporation 2004, p. 51)	Yes	Yes	No

Table 2.1 (continued)

Definition	Requirements for iTV definition		
	Content independence	Application-type independence	Reference to digital TV
“...anything that lets the viewer or viewers and the people making the television channel, programme or service engage in a dialogue. More specifically, it can be defined as a dialogue that takes the viewers beyond the passive experience of watching and lets them make choices and take actions...” (Gawlinski 2003, p. 5)	Yes	Yes	No
“Interactive Television (ITV) is a generic term used for all television systems that offer consumer interactivity beyond channel switching and Teletext” (Chorianopoulos 2004, p. 9)	Yes	Yes	No
“An interactive television programme is a programme or a service in which the content itself, or the presentation manner of the content or even the presentation order of the content can be affected by the viewer” (Jääskeläinen 2001, p. 19)	Yes	Yes	No

their relationship to the current TV programme. The degrees of interaction, from low to high, are often termed local, simple and full (Pagani 2003). Local interaction refers to applications needing no return channel, e.g. teletext or near-video-on-demand. Already a range of locally interactive functions is offered by most TV sets, e.g. choice of screen ratio (4:3 or 16:9), choice of stereo or two channel sound and subtitles. Others offer further functions like digital teletext. Applications with simple interaction integrate a return channel, e.g. home shopping, games and pay per view. Fully interactive applications include video telephony/conferencing. Similar degrees of interaction also form the basis for technical middleware standards for digital iTV applications and set-top boxes, e.g. the three profiles of the Multimedia Home Platform (MHP), the Enhanced Broadcast Profile, the Interactive Broadcast Profile and the Internet Access Profile.

From the point of view of production and application development, iTV applications are usually classified according to how they relate to current TV programmes. This approach is favoured by television broadcasters producing iTV applications, e.g. the British Broadcasting Corporation (BBC), UK, and ARD Digital, Germany. They discern between permanently available stand-alone services (24/7 services) and TV applications or services (eTV) enhancing specific programmes. At the BBC this approach is even reflected in the organisation of the New Media and Technology department responsible for iTV application development. As regards interaction design guidance, this approach is more suitable since design guidance is integrated into the broadcasters' iTV development process.

2.1.2.1 Permanent “24/7” Stand-Alone Services

The British Independent Television Commission (ITC) refers to 24/7 stand-alone allocations as “dedicated interactive services” and describes them from the user perspective: “These are services accessed in their own right, usually through an electronic programme guide. Typically they consist of electronic ‘shopping malls’ and entertainment services such as betting and gaming. Their content is not usually linked to specific programmes. Some of these services operate entirely within a ‘walled garden’ controlled by the broadcaster, others may be linked to a form of full Internet access” (Independent Television Commission 2001, p. 4)

The BBC shows the range of possible applications by stating that “... permanent or ‘24/7’ ‘stand alone’ services [are services] which are not directly related to TV programming. These include permanently available information services like weather, news headlines, sports news, entertainment news etc. They may be text or video-based...” (British Broadcasting Corporation BBC 2004, p. 51). Coming from the production side, Gawlinski classifies iTV applications in terms of the user experience they provoke (2003). He suggests the following classes based on terms current among producers in the iTV industry:

- Electronic programme guides (EPGs)
- Teletext-style services
- Walled gardens
- Internet on television
- video-on-demand and near-video-on-demand
- Personal video recorders
- Enhanced television

The first six classes represent “permanently available ‘24/7’ stand-alone applications”. Only “enhanced television” refers to enhanced TV applications. Pagani (2003, p. 115) considers various kinds of iTV application offered in Europe in 2002 and shows that 60% of them were 24/7 services and 40% were enhanced TV applications. This classification differs slightly from Gawlinski’s in dividing 24/7 services into eight classes.

2.1.2.2 Enhanced TV Applications

The European Broadcasting Union (EBU) refers to enhanced TV as “enhanced broadcast” focusing on the user perspective and production issues: “...EBU members call normal television and radio programmes ‘linear programmes’ (because one event follows another without intervention by the viewer). The use of interactive multimedia to augment a linear programme produces what is called ‘enhanced broadcasting’. [...] The multimedia can be overlaid on top of the television programme by the viewer (with a digital receiver!). The viewer can thus experience the two together, and this can be used for providing supplementary information about the programme, in an interactive way” (European Broadcasting Union 2004b). A similar definition is given by Gawlinski:

“Enhanced television can be defined as any interactive television service that makes an existing television programme better, while that programme is running and shortly afterwards. Enhanced television service providers typically add overlays, text and graphics to programmes, so viewers can interact while they watch” (Gawlinski 2003, p. 17).

Showing the range of enhanced TV applications the BBC defines an enhanced TV (eTV) application as “...a service which directly enhances a particular TV programme or event. eTV covers an enormous range of options from multistream video services to a simple graphics banner allowing a viewer to vote on a topic within a programme. At its very simplest it can be a page of additional text information...” (British Broadcasting Corporation 2004, p. 51). From a production perspective the BBC defines enhanced TV (eTV) applications or formats in terms of their basic production and distribution:

“An eTV format offers an enhanced TV service with pre-defined elements: in particular in terms of look and feel (graphic design), user-journey (navigation) and user-experience (functionality). Technically, in order for an eTV service to work, a complete end-to-end chain has to be established. So, an eTV format is supported by an infrastructure comprising:

- an iTV software application
- the means to introduce content to the application
- the means to play out the service to appropriate receivers (set top boxes)” (British Broadcasting Corporation 2004, p. 51)

This book focuses on enhanced TV applications for the following reasons:

- Evidence for high audience interest.
- Research results suggest that a TV audience is more interested in enhanced TV applications than in 24/7 services (Bjoerner 2005), and van den Broeck et al. report that enhanced TV applications (2004) appeal to about 40% of Flemish viewers. Such applications are likely to appeal to a comparable percentage of viewers elsewhere in the west. These findings tally with others that, in buying digital set-top boxes, most viewers want more of what they already know and like, e.g. in the form of enhancements of their favourite TV programmes (van der Broeck et al. 2004). Applications related to personal computers seldom seem to be the main reason for buying digital set-top boxes, but once viewers have boxes, they may try these applications.
- Great design challenges.
- Enhanced TV applications offer great challenges for interaction design, since they relate directly to linear TV programmes. These applications are meant to support the dramaturgy and flow of the enhanced TV programmes without being distracting. Research into iTV users has shown that interaction with an iTV application often distracts them from the video content (Sperring and Strandvall 2006), so designers of applications should try to avoid this (Lamont 2003b). This problem is specific to iTV and shows a need here for design guidance.

Some alternative classifications of enhanced TV applications are given below.

2.1.3 Classification of Enhanced TV Applications

There are various ways to classify enhanced TV applications. They differ in terms of criteria:

- A classification based on the kinds of application, e.g. used by the British Broadcasting Corporation (BBC) (Somerville 2004)
- A classification based on advertising and consumer-protection issues, e.g. Independent Television Commission (2001, pp. 5)
- A classification based on the content of the enhanced TV programme as used for traditional programmes, e.g. Gehrau (2001), Weiß (1998) and Hohlfeld and Gehrke (1995)

If a classification of enhanced TV applications is based on the kinds of application, it has the advantage of being in line with the developmental approach favoured by broadcasters. Thus if iTV design guidance is developed in line with such a classification, it may be integrated more easily into the process of iTV development. Such classifications are also based on many years of experience. The BBC, for instance, not only favours this kind of classification but is also one of the world's most experienced and successful producers of interactive and enhanced TV applications, so this kind of classification has been chosen for this book.

According to this classification the BBC distinguishes between “schedule-busting services” and “engaging services”. Each class is split up into two subclasses (Somerville 2004). While the subclasses of “schedule-busting services” are based on production specifics, the subclasses of “engaging services” are based on the degree to which users are involved in programmes.

2.1.3.1 Schedule-Busting Services

“Schedule busters for us is when creating interactivity or creating content or making content available around an event makes it bigger than the schedule. Interactivity allows us to explode the linear schedule” (Somerville 2004).

- Live schedule-busting service
 - Parallel expansion of schedule:

Applications for events with a lot of things happening at the same time may use interaction to make all happenings available at the same time too. Viewers are then free to choose between offers, which in being simultaneous do not extend the schedule (Somerville 2004). Examples: Sky News Active (UK), BBC Olympics 2004 application (UK) and ARD/ZDF Olympics 2004 application (Germany).
 - Stretch expansion of schedule:

Applications for events not covered from start to finish in the normal schedule. Viewers can watch such events all the way through, even when the events are no longer in the main programme. Example: BBC snooker application (UK).

- Pre-recorded schedule-busting services

Applications for events for which content is available before, during and after the programme. The applications provide extra material on the subject. Example: BBC programme on Dunkirk (UK).

2.1.3.2 Engaging Services

“Applications that focus closely on the programme itself and allow the audience to get deeper into the program moment” (Somerville 2004).

- *Participation services*: “Services that allow the viewer to be involved in the fabric of the programme” (Somerville 2004), e.g. by playing along with the programme and getting a personalised response at the end. The viewer perceives these programmes as truly interactive. Examples: BBC Test the Nation, BBC Come and Have a Go and BBC Crisis Command (UK).
- *Enhancements*: Applications that “layer information on top of a programme to add value” (Somerville 2004). Examples: BBC’s The Sound of Music (with karaoke lyrics on top of the broadcast) and BBC The Proms (UK).

2.2 Context of Use

The aim of this section is to define usability and to analyse the context of use of iTV applications. The definition of usability serves the aim of this book since usability is the criterion used in evaluating the quality of design. Specifying the iTV context of use serves the aim of this book in two ways. It serves as

- A basis for identifying interaction design problems specific to iTV
- A reference for usability tests of iTV applications

To achieve this aim the following steps have been taken:

- An analysis and evaluation of various definitions of usability (Section 2.2.1)
- An analysis of various definitions of “context of use” and of existing context-of-use analyses for iTV applications (Section 2.2.2)
- An analysis and specification of iTV users (Section 2.2.3)
- An analysis and specification of iTV user goals and tasks (Section 2.2.4)
- An analysis and specification of the iTV equipment (Section 2.2.5)
- An analysis and specification of the iTV environment (Section 2.2.6)

2.2.1 Usability

In the human–computer interaction research and practice community usability is the most widely used quality criterion for interaction design. Well-established methods and metrics are available for evaluating usability. For these reasons in this

book usability has been chosen as the criterion to be used in evaluating the quality of iTV interaction designs.

The concept of usability is of key importance to this book since the aim of this book is to support the design and development of easy-to-use iTV applications. Various definitions of usability have been published (Hix and Hartson 1993, Preece et al. 1994, Wixon and Wilson 1997, Dumas and Redish 1999, Mayhew 1999, Nielsen 1993, Rubin 1994, Shackel 1991, Shneiderman and Plaisent 2005). The various definitions correspond only partly and differ mainly concerning the following issues:

- Usability criteria and their metrics
- Priority and weighting of the criteria and their metrics
- Combination of criteria and their metrics

For this book usability is defined as “the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use” (ISO 9241-11 1998, p. 2). This definition of usability is chosen because the understanding of usability presented in ISO 9241 is widely accepted within the international community devoted to usability research and practice. As an ISO standard it is the result of several years of discussion and voting among international usability experts (Stewart and Travis 2003). Although ISO 9241 was originally developed for office work with visual display terminals, the new version of the standard has been renamed to “ergonomics of human–system interaction” (ISO 9241-110 2006) indicating its wide field of applicability beyond software for office work. Regardless of how relevant the various parts of ISO 9241 may be to iTV applications, its part 11 is a suitable basis for a usability framework for iTV applications.

In iTV research some authors argue that usability should be enhanced by other quality criteria, e.g. accessibility (Royal National Institute of the Blind 2005, Carmichael 1999) or emotional appeal (Chorianopoulos 2004). Certainly these factors play a role regarding user acceptance, but usability is commonly accepted within the iTV community as the main criterion in evaluating the quality of a design. Other criteria, like sociability and playability, are sometimes used in evaluating iTV applications, but these are not relevant to all such applications, so are unsuitable for this book.

2.2.2 Context of Use

The context of use is part of the usability framework described in ISO 9241-11 because the context of use fundamentally influences the user’s experience. Context of use means “the users, goals, tasks, equipment (hardware, software and

materials), and the physical and social environment, for the purpose of achieving particular goals” (ISO 9241-11 1998, p. 2). Summarising, the context of use includes:

- Users
- User goals and tasks
- Equipment
- Environment

The user is “the person who interacts with the product” (ISO 9241-11 1998, p. 2). Whoever interacts with an iTV application can be called a user, a viewer or a consumer depending on the perspective taken (Chorianopoulos 2004). In the field of computer science and human–computer interaction this person is called the user; in the field of media science the viewer; and in the field of marketing the consumer. Since this book is about human–computer interaction, the term “user” is chosen and used throughout. This term is also suitable in suggesting that iTV applications lead viewers to do more than doze off in an easy chair.

A user analysis consists of three aspects (ISO 9241-11 1998, Thomas and Bevan 1996):

- User types (primary and secondary or indirect users)
- Skills and knowledge (product skill/knowledge, system skill/knowledge, task experience, organisational experience, level of training, input device skills, qualifications, language skills and general knowledge)
- Personal characteristics (age, gender, physical capabilities, physical limitations and disabilities, intellectual ability, attitude and motivation)

A user goal is “an intended outcome” while a user task is “the activities undertaken to achieve a goal” (ISO 9241-11 1998, p. 2). A task analysis “means understanding users’ work or play” (Redish and Wixon 2003, p. 923). Tasks can be physical or cognitive and can be divided into sub-tasks. General characteristics of user tasks are a task name, task frequency of use, task duration, frequency of events, task flexibility, physical and mental demands, task dependencies, task outcomes, risks resulting from errors and safety critical demands (ISO 9241-11 1998, Thomas and Bevan 1996).

In a context-of-use analysis several equipment issues need to be considered (ISO 9241-11 1998, Thomas and Bevan 1996). For iTV applications three pieces of equipment are relevant:

- Set-top box
- TV screen
- Remote control

There are also three kinds of environments (ISO 9241-11 1998, Thomas and Bevan 1996):

- The organisational environment (since iTV applications are used mostly during leisure at home, not during work in an office; this kind of environment will rather be called social)

- The technical environment
- The physical environment

Usability can be assessed only after the context of use has been specified. Therefore a context-of-use analysis is sometimes referred to as usability context analysis. The context-of-use analysis is an important phase in the user-centred design process of interactive applications (ISO 13407 1999). In a context-of-use analysis the requirements and constraints of using the application are identified.

For iTV applications, only very few publications analysing the context of use are available. This is hardly surprising since the technology involved is new. Three context-of-use analyses have been documented (Eronen 2004, Gawlinski 2003, Chorianopoulos 2004). Table 2.2 compares them in terms of the ISO 9241-11 definition.

Table 2.2 Comparison of existing analyses of the context of use of iTV applications

Context-of-use component		Eronen (2004)	Gawlinski (2003)	Chorianopoulos (2004)
Users	User types	–	–	–
	Skills and knowledge	–	–	–
	Personal characteristics	–	Viewer demographics	–
	Goals	TV viewing is entertainment oriented with no productive purposes	Viewers expectations	Entertainment vs. information
User goals and tasks	Tasks	–	–	Low vs. high attention to TV, planned vs. impulse programme selection, interactive vs. passive
Equipment	Set-top box	–	–	Computer generated content vs. fixed content, real time vs. time shift
	TV screen	–	–	Computer vs. television visual design
	Remote control	The remote control is not a mouse	Remote control (navigation, text input, feedback)	–
Environment	Social	Most TV viewing in living rooms is done in groups	The social context, time of day	Group vs. individual watching
	Technical	–	–	–
	Physical	The TV screen stands far away from viewers	Lean forward vs. lean back, distance from screen	–

All in all there is not much difference between the specifics described by Eronen, Gawlinski and Chorianopoulos as regards the context of use. In this respect they describe many relevant details specific to iTV but do not offer complete analyses, especially as regards users' goals and tasks. Hence context of use will here be comprehensively analysed for iTV applications by analysing present studies on iTV users, their goals and tasks, equipment and environment. Since this book is about design guidance for iTV applications in general, rather than about any specific application, the context of use will be analysed for iTV applications in general too. The general context of use can then serve as basis for specifying the context of use of specific iTV applications due to be developed.

Media research into TV and related services, like analogue teletext, has yielded a lot of data on the context of use of TV, but there seemed to be no need to record the data in a form which experts on human-computer interaction could easily work with. Since this data may provide relevant insights into the context of use of iTV applications they are here taken into account. By organising the data according to ISO 9241-11, this book may make them more accessible to iTV designers and developers.

2.2.3 *iTV Users*

2.2.3.1 User Types

There are various ways to classify users of iTV. Mayer (2003) splits iTV users up into seven classes based on user acceptance phases of new technologies: Early clickers, generation i, armchair athletes, gadget guy, daytime dabblers, i-potato and silver sofas. Eronen (2001, 2004) classifies iTV users according to user profiles derived from both quantitative and qualitative data. The classification of digital and iTV users has also been viewed in terms of user-group modelling and personalisation (Ardissono et al. 2004).

TV audience research has shown that watching TV is mostly a group activity, e.g. of families, partners or friends (Barwise and Ehrenberg 1988). Though 30.4% of Germans have more than one TV set at home (Hasebrink 2001), the first iTV supporting set-top box in a home is likely to be in the living room, so iTV applications, too, may be used mostly by groups. Hence two user groups can be defined:

- Users with remote control (primary users)
- Users without remote control or by-sitters (secondary or indirect users)

Group viewing, when members of the group are either together in one room or apart, is increasingly the subject of iTV research meant to support social functions (Rasmussen 2005, Agamanolis 2006), but there have also been reports of problems in using iTV applications in couples and groups, and some evidence suggests that iTV applications are mainly used by single viewers (Bjoerner 2005).

2.2.3.2 Skills and Knowledge

Little is known about the skills and knowledge of iTV users, but user studies suggest that most of them are experienced in using new technology and interactive applications. They are early adopters and heavy users of new consumer technologies, e.g. DVD players, Internet, mobile phones, game consoles and digital cameras, as well as early adopters of digital transaction services, e.g. Internet banking (British Market Research Bureau 2004).

Freeman and Lessiter (2003) classify potential and actual digital and interactive TV users according to their attitude towards technology in general and towards digital and interactive TV in particular. Users in the UK are clustered into seven classes, and the percentage of digital iTV viewers in each class was then determined: “technology enthusiasts” 65%, “TV families” 46%, “swung by the offer” 34%, “telly traditionalists” 30%, “busy professionals” 23%, “discerning viewers” 11% and “strong resisters” 6%.

Each class was described in terms of its skills and knowledge, e.g. its use of other home entertainment products and services, as well as user characteristics. The study aimed at finding and understanding users most likely to have problems with digital and interactive TV, so the seven classes were joined into three groups, then the distribution of users with potential problems was found for the UK; 33% belonged to the group labelled “It’s too complicated for me” (which included “swung by the offer”, “telly traditionalists” and “strong resisters”), 42% to “I can deal with it if there’s content I want” (which included “TV families” and “discerning viewers”) and 25% to “it’s too slow and chunky for me” (which included “technology enthusiasts” and “busy professionals”).

2.2.3.3 Personal Characteristics

Very little has been done to specify actual users of iTV applications, since at present these applications are broadcast and received by wider audiences in only a few countries. The most sophisticated tracking of iTV audiences is being done in the UK, most notably the interactive measurement of the Broadcasters’ Audience Research Board (BARB), but the results are not publicly available and are based, due to technical constraints, on only digital satellite households. There are still no tracking solutions for terrestrial and cable reception.

Also in Britain, two surveys a year are carried out by the Audience Interaction Monitor (AIM) of the British Market Research Bureau (BMRB) and focus on the interactive elements of digital TV. Viewers are questioned on topics such as the acceptance of digital TV, games, attitudes to interactivity, personal video recorders (PVRs), interactive programming, interactive services and interactive advertising. The number of digital TV viewers questioned in April 2004 was 1,137, of whom 648 viewed digital satellite (Sky Digital), 268 digital cable and 281 digital terrestrial (Freeview). According to the answers, 42% of all digital TV viewers and 52% of Sky Digital viewers in the UK had interacted with a digital TV application (British Market Research Bureau 2004). The typical user

of iTV applications was male, 16–34 years old and middle to upper class. Interactive sports and games were the most popular applications, and 32% of viewers had used a remote control to play along with a TV game show.

These findings were confirmed and enriched by the results of Broadsystem's UK survey "Switching on to interaction: consumer insights into participation TV" from August 2004. This survey identified young adults (16–34 year old) and small families (those with one child at home) as the viewers most likely to be responding to iTV applications.

Characteristics distinguishing users of digital TV from users of iTV in the UK are described by Freeman and Lessiter (2003) and include gender, age and income.

2.2.4 iTV User Goals and Tasks

2.2.4.1 User Goals

Unfortunately there has been little direct research into user goals in turning to iTV applications, so here the results of research into their motivations will be analysed for the sake of gaining insight into their goals.

People watch TV mostly during periods of leisure so TV is associated much more closely with leisure than is reading a newspaper or listening to the radio (Media Perspektiven 2003). Most Germans spend more than a quarter of their leisure time in watching TV. From 1980 to 1995 the average period of leisure grew from 5 h and 10 min to 5 h and 46 min, but the percentage of this period spent in watching TV remained at 35–37% (Berg and Kiefer 1996, p. 117). This may show how strongly TV has been integrated into Germans' daily routine. Since TV is a leisure time activity, iTV too is likely to be or become one.

In Germany the main reason for watching TV is a wish to relax (89%). Other reasons given are "so as not to feel alone" and "so as to forget everyday life" (both 87%), "so as to have fun" (86%), "because I'm used to it" (78%), "so as to be able to join in conversations" (77%), "so as to get food for thought" (74%), "so as to be informed" (73%) and "so as to find my way around in daily life better" (70%) (Media Perspektiven 2003).

Because not much is known about the actual iTV user goals it is helpful to consider the TV viewers' expectations. The former British Independent Television Commission (ITC) emphasised the importance to build upon existing audience experiences and expectations regarding television when developing iTV applications (Independent Television Commission 2001). According to the ITC, user expectations regarding iTV substantially differ from the Internet because they are offered by familiar and trusted TV broadcasters in the context of TV content. However, user expectations regarding pulled content can be quite different to pushed content due to the exercised control over the content by the viewer. Television viewers were found to have specific expectations and concerns regarding future television technologies in general (Gauntlett and Hill 1999). Their major concerns are about cost, aesthetics and available time

“...and the related feeling that perhaps the existing services were quite expensive, unattractive and plentiful enough already” (Gauntlett and Hill 1999, p. 171).

It can be expected that the motivations to use iTV are not solely entertainment-oriented but also information-oriented as a study of the German regional public broadcaster SWR in 2002 on the motivations to use television, teletext and Internet suggests (Blödorn and Gerhards 2004); 94% of the respondents stated to use TV “because I want to inform myself”. For the same reason 93% stated to use teletext and Internet. “To be able to join in conversation” stated 67% as motivation to use TV, 44% for teletext and 48% for Internet usage. “Because I get cause for thought” stated 58% for TV, 34% for teletext and 61% for Internet usage. “Because it helps me in everyday life” stated 31% for TV, 27% for teletext and 40% for Internet usage. Another indicator that the demand for interactive information on television programmes is high is provided by the usage of websites to television programmes shows. Information on TV programmes that is offered on Internet websites is likely to raise users’ interest in these programmes (Krüger 1999), e.g. Internet users stated to have watched television programmes 40% more often when associated online information was available. It is quite likely that this might be true also for TV programmes enhanced by interactive applications.

Especially in the case of enhanced TV applications, users are able to interact with programs, and their choices are bound to reflect their interests, so in designing iTV applications “...we should build on existing audience expectations” (Independent Television Commission 2001, p. 2).

2.2.4.2 User Tasks

Some research related to tasks of iTV users has already been carried out (Eronen 2004, Lamont 2003b, van der Broeck et al. 2004, Hsu et al. 2008, Bjoerner 2005, Christensen 2004, Quico 2003). However, most of this research has not been directly into the tasks but rather into user requirements or concepts for iTV programmes and services (Eronen 2004). For the sake of consistency in this analysis, their findings have been reformulated here as being about user tasks and have been classified according to the kinds of iTV application referred to, especially 24/7 services and enhanced TV (Section 2.1.2).

In carrying out a study of home-users, Eronen (2004) identified several functional needs of users of 24/7 iTV services as well as of enhanced TV. Bjoerner (2005) identified user tasks for 24/7 services and for enhanced TV by means of theoretical analysis, then he confirmed the results empirically by interviewing families in an iTV field test. Hsu et al. (2008) identified iTV services and classified them into five groups of user activities representing 24/7 iTV services: Transactions, daily living, entertainment, information and education. But for their usability tests Hsu et al. refer to three generic iTV user activities. Each of these is made up of several user actions: Watching TV programmes, browsing information and performing business transactions.

For some specific 24/7 iTV systems and applications, standard user tasks have been identified, e.g. for Electronic Programme Guides (EPGs) (Lamont 2003a) and Personal Video Recorders (PVRs) (Looms 2005, Darnell 2006).

According to Quico (2003), a chat application of an iTV multi-user game was used most often in Portugal. This application helped viewers to make friends and chat with them, to flirt, to debate issues, to comment on a TV programme or to quarrel with other users. These user tasks could also be taken into account in devising chat applications meant to enhance specific TV programmes.

User tasks for enhanced TV can be classified according to the content of the TV programme they are meant to enhance, but some tasks of users are unrelated to the contents of the programme and could also enhance other programmes. Existing research studies have identified several such tasks for enhanced TV applications. Table 2.3 shows them together with the method of identification and the names of the respective authors. Eronen (2005) for instance reports on four content-independent classes of concepts for iTV applications, including concepts for enhanced TV. These concepts, which were identified in design sessions with broadcasters, are opinion-polls and voting, quizzes and competitions, personal contributions to TV programmes by TV viewers and information.

Table 2.3 Content-independent user tasks for enhanced TV which have been identified by existing research studies

Content-independent user tasks for enhanced TV	Method	Source
Information about people of ongoing TV show	User study in home environment (interviews)	Eronen (2004)
Participating in quiz on ongoing TV show		
Finding favourite TV shows by personalised EPG		
Online betting		
Playing lottery		
Participating in problem solving related to ongoing TV show	User study in home environment (interviews)	Eronen (2005)
Background information on subject of ongoing TV show		
Participating in opinion-polls and voting		
Participating in quizzes and competitions (TV games, quizzes on ongoing TV programme)		
Personally contributing to TV programme		
Informing oneself about something	Theoretical analysis empirically validated by participants of iTV field test (family interviews)	Bjoerner (2005)
Viewing further information about person in TV programme		
Choosing between different endings in a movie		

As regards enhanced TV, most of the user tasks identified by existing research studies depend on the content of the TV programmes. Tables 2.4 and 2.5 show the content-specific user tasks for the following kinds of TV content: Sports, game shows, news, music, talk shows, cooking shows and travel magazines. They also show the methods used to identify the respective tasks together with the corresponding author.

Table 2.4 Content-specific user tasks for enhanced TV applications for sports programmes identified by existing research studies

Content category	User tasks	Method	Source
Sports	Participating in sports quiz	User study in home environment (interviews)	Eronen (2004)
	Looking up further statistics about the sporting league and/or each team playing	Theoretical analysis based on reasons why people watch TV	Lamont (2003b)
	Informing about extra score updates for other teams playing in the league or current standings		
	Switching camera angles		
	Expressing emotions to fellow fans and rival fans, e.g. before the game		
	Informing about biography of specific athletes		
	Informing about scoring statistics of top scorers on each team		
	Informing about players	Focus groups	Van der Broeck et al. (2004)
	Switching camera angles		
	Following a certain player (player camera)	Theoretical analysis empirically validated by participants of iTV field test (family interviews)	Bjoerner (2005)
	Changing camera angle	Data analysis of real use	Quico (2003)
	Using video-on-demand		
	Taking part in forum (cheering on own team, provoking other users who are supporters of the rival team, commenting on incidents which occur during the game, complaining about service, provoking female users by male users)		
	Participating in polls on the current game and national league		
	Participating in trivia which allows users to win prizes		
	Informing about teams and results		
	Buying products		

Table 2.5 Content-specific user tasks for enhanced TV applications for game shows, news, music programmes, talk shows, cooking shows and travel magazines identified by existing research studies

Content category	User tasks	Method	Source
Game shows	Playing along with game show	Focus groups	Van der Broeck et al. (2004)
		Theoretical analysis empirically validated by participants of iTV field test (family interviews)	Bjoerner (2005)
	Playing along with game show (as a group without internal competition)	Focus groups	Christensen (2004)
News	Viewing further information about news story, e.g. an accident	Theoretical analysis empirically validated by participants of iTV field test (family interviews)	Bjoerner (2005)
Music	Informing about musicians and scriptwriters	User study in home environment (interviews)	Eronen (2004)
	Singing along/karaoke supported by displayed lyrics	Design session with broadcasters	Eronen (2004)
Talk shows	Viewing background information about talk show	User study in home environment (interviews)	Eronen (2004)
	Sharing one's own opinion by voting or chatting	Focus groups	Van der Broeck et al. (2004)
	Choosing video stream	Data analysis of real use	Quico (2003)
	Sharing one's own opinion/discussing an issue (in a forum)		
Cooking shows	Looking at the recipe during the show	Theoretical analysis empirically validated by participants of iTV field test (family interviews)	Bjoerner (2005)
Travel magazine	Information and video on travel destinations	User study in home environment (interviews)	Eronen (2004)

It needs to be pointed out that user tasks identified by using focus groups can differ a lot from those identified in field trials. Focus group results reflect only potential use whereas field trials reveal actual use. Van der Broeck et al. (2004) report on very contradictory findings from focus groups and iTV field tests. For instance communication functions, like email, were expected not to be used much by non-Internet users, but in the field test they were.

Part of the iTV user tasks stand in direct competition to other media supporting the same user tasks, especially newspapers, print magazines, tele-text, Internet, telephone and short message service (SMS). Gawlinski (2003) names some of these user tasks and the corresponding media. Due to the competition, iTV applications need to have outstanding usability in order to be used at all.

2.2.5 iTV Equipment

2.2.5.1 Set-Top Box

Set-top boxes demultiplex and decode the digital TV signal including the interactive applications to be executed and displayed on-screen. An important component of the set-top box is its middleware. The middleware is part of the set-top box software and defines the technical interface between the set-top box software and the iTV applications. The middleware defines set-top box functions that enable data reception and sending. This data can be radio or TV programmes, multimedia applications, interactive applications or Internet content. The purpose of the middleware is to provide a standard technical interface to execute iTV applications on various set-top boxes that support this middleware in the same way. Also, the middleware determines the programming language for developing iTV applications. There are different open and proprietary middleware standards used by different iTV providers, platforms and set-top boxes (Morris and Smith-Chaigneau 2005). The most popular open iTV middleware standards are the Multimedia Home Platform (MHP) and MHEG-5. The most widespread proprietary iTV middlewares are OpenTV, Liberate and MediaHighway. Middleware software updates can usually be downloaded to the set-top box and do not require an exchange of the set-top box. Digital iTV can be received not only on set-top boxes but also on personal computers equipped with a TV card and the middleware software, e.g. MHP4free.

The Multimedia Home Platform (MHP) (European Broadcasting Union 2000) was approved as open standard for interactive applications for Digital Video Broadcasting (DVB) by the European Telecommunications Standards Institute (ETSI) in September 2000. The MHP specification is firstly intended for implementers of the MHP on hardware and software platforms and secondly for developers of applications using the MHP functionality and APIs (application protocol interfaces). It mainly covers the applicable technologies and technical definitions. However, middleware standards also influence the presentation of graphics and texts on-screen, as they determine the minimum graphics capabilities of the corresponding set-top boxes. For instance MHP set-top boxes are required to support transparencies of 0%, 30% and 100% and the Tiresias text font in the font sizes 24, 26, 31 and 36 points (European Broadcasting Union 2000). The set-top box can also limit the available presentation

sizes of the video stream. MHP set-top boxes are required only to support full-screen and quarter-screen sized video.

For truly interactive TV a return path is needed. The return path is implemented differently according to the TV signal distribution platform. On satellite and terrestrial digital TV the return path is via a telephone line connected to the set-top box. On digital cable, the return path uses the cable also conveying the TV signal to the set-top box.

Some set-top boxes are equipped with a chip-card reader that can identify the user, to enable conditional access services, e.g. Pay TV. Conditional access technology makes further applications like iTV banking and services needing money transaction possible. Other set-top boxes include hard-disc memory to store TV programmes or application data locally.

2.2.5.2 TV Screen

When designing graphics for the TV screen, one has to keep in mind the differences to computer monitors. The many specifics of TV screens refer to screen resolution, the aspect ratio, safe areas, the amount of available colours, colour luminance, colour saturation, pixel shape, transparency, detailed graphics and the distance of screens from viewers. Comprehensive descriptions of the TV screen specifics are provided by Rinnetmäki (2004) and Gawlinski (2003). Design guidance for TV text and graphics is also analysed in Section 3.1.

Due to digitalisation TV usage is becoming increasingly independent of technical distribution channels and of specific devices for reception and display. For instance TV content can be displayed by computer monitors and mobile devices whose screen ratios, resolutions and safe areas differ from those of TV sets.

2.2.5.3 Remote Control

User interaction with iTV applications presently happens via the remote control of the set-top or the TV set, if the set incorporates the set-top box. Since the remote control sends infrared (IR) signals to the set-top box, a line of sight between the two devices is needed. Unfortunately, remote control designs vary widely and usability is often poor (Daly-Jones 2003, Eronen 2004). There has been usability research by Lessiter et al. (2004) on the labelling of remote control buttons for digital TV.

Standard remote controls include four colour keys (red, green, yellow and blue), four arrow keys (up, down, right and left), a confirmation or “OK” key and ten number keys (0–9). According to the MHP specification, there also has to be a dedicated teletext key on each MHP set-top box remote control (European Broadcasting Union 2000) (Fig. 2.1). All other keys that producers of set-top boxes might include in the remote control are optional and may not be supported by broadcasted MHP applications.

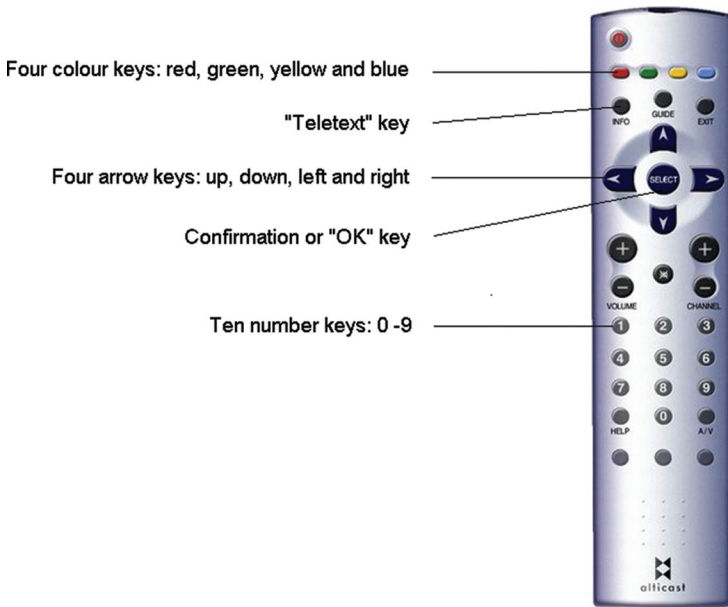


Fig. 2.1 Standard remote control keys for MHP set-top boxes

Present remote controls strongly limit interaction possibilities. For instance they support neither the interaction style of direct manipulation nor text input. Direct manipulation is an interaction style that lets users complete tasks by pointing at and manipulating graphical depictions of objects and actions of interest, as known with the mouse of personal computers (Shneiderman and Plaisant 2005, pp. 213). Hence there is increasing research into other kinds of interactive methods and hardware for interactive TV like pointing devices (Hsu et al. 2008), mobile phones (Roibàs et al. 2005), speech recognition for command and text input (Roibàs et al. 2005), ambient-audio sonification (Fink et al. 2006) and presence-indicated implicit interaction (Farré 2006).

2.2.6 *iTV Environment*

2.2.6.1 Social Environment

ITV usage happens in a private context (Berg and Kiefer 1996), as with other members of the family, a partner or friends (Barwise and Ehrenberg 1988). But there has so far been no analysis of who watches which programmes with whom. When iTV is used by a group, the distinction between the primary user and the secondary or indirect user is based on who has the remote control. This in turn is a social issue, but so far no research results have been published on this issue.

Interruptions while using iTV applications can be expected to be of the same kind as in watching TV. Usage interruptions while watching TV is a well-described phenomena in TV audience research. Interruptions can be caused by other things done at the same time, like eating, reading, phoning, ironing or chatting. In a German study from 1991, only 44% of the interviewees claimed to have watched TV without doing anything else at the same time (Opaschowski 1992, Hasebrink 2001). There was then a downward trend, for in 1996 only 38% and in 1999 only 36% claimed to have done so (Opaschowski 1999). The multi-tasking of viewers while watching or listening to TV is confirmed by Carey (2002). No longer is TV given undivided attention for lengthy periods, so it seems to be turning into a background media, as radio did when TV became increasingly popular.

For iTV applications, there are generally no physical reference materials or user manuals, but help in using iTV applications can be given by other users, like relatives, partners or friends. Help may take the form of a demonstration during an iTV programme or of an explanation at another time. Help from other users is a common way to learn how to use new consumer technologies. Research results show that the amount of help asked for by other people depends on the users' culture. Such help is much more common in China and India for instance than in Germany (Honold 2000).

2.2.6.2 Technical Environment

The technical environment consists of the transmission system for digital TV distribution and the return channel. There are alternative means of transmission in both cases. The most important digital TV distribution channels are satellite, cable or terrestrial (broadcast channels). In Europe the Digital Video Broadcasting (DVB) standard is used for digital TV transmission (DVB-S, DVB-C and DVB-T). Alternatively the digital TV signal can be distributed using the Internet protocol (IPTV), e.g. via VDSL-based telephone networks.

For using the return channel, various technologies are available, e.g. telephone networks (e.g. DVB-RCT for DVB Return Channel Telephone), digital wireless telephony (DECT), the DVB cable network, Power Line Communications (PLC) technologies and the GSM or UMTS network. The GSM and UMTS return channel technology could also be relevant for mobile iTV applications broadcasted to mobile devices using DVB-H or Digital Multimedia Broadcasting (DMB).

2.2.6.3 Physical Environment

The physical environment of iTV is mostly the same as that of traditional TV some years ago. At present each household usually has only one set-top box, which is usually connected to its main TV set, normally in the living-room. This set is usually the one with the largest screen, the highest screen resolution and the best quality sound system in the household.

The viewing distance for iTV applications is the same as for watching TV, since both have the same physical environment. The average distance between viewers and screens is about 3 m. On watching iTV and especially enhanced TV applications, users are likely to be lean back and relax as in watching TV. If in their living-rooms, they are likely to be lolling in armchairs or on sofas. If in their bedrooms, they may be in bed, and if in the children's room, they may lie on the floor or sit on the bed. Hence iTV is more suited for lean-back than for lean-forward information and entertainment.

The physical environment can vary greatly, e.g. depending on the time of day. Sometimes it may be dim, especially in the evening when the TV is at the central focus of attention, and some viewers dim the lights to enhance their TV viewing experience. This may lessen their ability to identify the keys on the remote control for iTV applications, especially the colour keys. In a family household the physical environment is inconstant, since one or another person may just walk in and change it, for instance by switching the light on, making a phone call or being noisily active. This certainly affects users' iTV experience. If and what changes in the physical environment affect response to an iTV application depends mainly on the application. If the application is giving spoken advice which is drowned by noise in the room, the advice will hardly be understood and heeded.

Due to digitalisation, TV usage is becoming less dependent on technical distribution channels. From a user perspective, the usage of TV content is potentially becoming more flexible and less dependent on specific devices, places and times. In the case of iTV applications on mobile devices, e.g. on mobile phones and organisers, the usage environment is still less constant, with all kinds of possible distractions. Furthermore, digital TV reception in cars is now offered by all main car manufacturers. As with mobile devices, iTV applications are bound to be used in cars in the course of time. In cars the surroundings are stabler and easier to specify, as for mobile handheld devices. Such specification, though, lies outside the scope of this book.

2.2.7 Conclusions

In the first part of this section various definitions of interactive digital TV applications have been analysed and evaluated. For the sake of this book, interactive TV applications are defined as "...enhanced or interactive services with digital television (iTV)" (European Broadcasting Union 2004a).

Various ways to classify interactive TV applications have been analysed and evaluated. For the sake of this book, they are classified into "enhanced TV applications" and "permanent 24/7 stand-alone applications", according to their relationship to the TV programmes. This book will focus on enhanced applications, since evidence suggests that they interest many viewers and great interaction design challenges.

Various ways to classify enhanced TV applications have likewise been analysed and evaluated. For the sake of this book, they are classified, according to their kind of application, into “schedule-busting services” and “engaging services”. The classification of interactive TV applications may help in describing and specifying applications.

In the second part of this section usability has been defined and the iTV context of use has been analysed and specified. Usability will serve as the criterion of design quality to be supported by the iTV design guidance to be developed.

The definition of the context of use has been analysed, and existing analyses of the context of use of iTV applications have themselves been analysed and evaluated. The iTV context of use has been analysed and specified in regard to users, user goals and tasks, equipment and environment, thus providing a usability framework for iTV applications.

The results of analysing the context of use serve the aim of this book in two ways. They provide

- A basis for identifying iTV-specific design problems (Section 6.2)
- A reference for usability tests of iTV applications (Section 6.4)

The results of these analyses suggest that the iTV context of use is very different from that of personal computer applications, so design guidance developed for personal computers cannot be applied directly to iTV applications. How much of it can be applied indirectly remains to be assessed (Section 3.1).

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