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First steps of mobile digital television: state of the art and first user impressions

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Abstract

In the MobTV research and development project VTT Information Technology and its partners are developing a prototype for mobile digital television. This means that a person can watch digital television broadcasts from a small portable device whenever he wants and wherever he is. In the MobTV research project the use of two different sizes of portable devices is explored: PDA (Compaq) and a portable computer (Fujitsu).

The Human Centred Design approach is used in this project. This means that the potential end-users participate in the development and evaluation from the very beginning of the project.

This research report first reviews briefly what is happening in the field of mobile digital television. Then it reviews recent studies on the usability of mobile devices and studies related to digital television. Some evaluation and research methods used in previous studies are also covered. After an overview of related work, the report presents research questions, methods and results of the first consumer interviews concerning mobile digital television in Finland. The purpose of the interviews was to find out peoples' attitudes to and first impressions of mobile digital television.

Altogether 29 interviews were held at the end of summer 2001. The interviewees watched recorded TV programs on devices of two different sizes: a PDA and a portable computer. The interviews were conducted in different places, e.g. schools, stations and trains. Most of the interviewees reacted positively to mobile television. Still, at this point people feel that mobile television should be integrated into some other device or service. That way mobile television would be more easily accepted. TV programs suitable for small screens are different from those suitable for bigger screens. In every interview setting, people said they would most likely watch the news on mobile television. The schools were very exited about the possibilities that mobile digital television would bring, but at the same time they were worried about the costs.

Preface

The purpose of this report is to disseminate the first results of the MobTV research project. This state-of-the-art survey will be updated through out the project, and the consumers' needs and expectations will be taken into account in the development process. We thank all the members of the MobTV management group, the participating companies (Nokia, Sonera, Alma Media, Swelcom, Malibu Telecom, Digita and Elisa Communications), the National Technology Agency (Tekes) and the MobTV project group for supporting this research. Special thanks to Antti Tammela, Eija Kaasinen and Jukka Perälä for their guidance and comments.

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1 Introduction and motivation

In the MobTV project we are developing a prototype for mobile digital television. The topic is still unique and, as far as we know, there are only few existing applications resembling the prototype under development in this project. However, there are projects, e.g. in Singapore and Japan, in which mobile devices are being used to watch digital television programs. These projects started in the year 2000 and there is very little public information available on them. Anyway, the existence of these projects highlights the growing interest in mobile digital television.

Since mobile digital television is a new application, we do not know who the potential users are, how and where they would use the device, and what they would expect from mobile TV. We conducted consumer interviews at the end of summer 2001 to find out peoples' attitudes to and first impressions of mobile digital television. We also asked what kind of mobile device would be most appropriate for mobile television. The interviews were the first part of the Human Centred Design process, which stresses the importance of user feedback from the very beginning of the development process.

2 Related work

2.1 First steps of mobile digital television in the world

A broadcaster from Singapore, MediaCorp TV, announced the launch of TVMobile in 2001. MediaCorp TV is the first in the world to use Digital Video Broadcast (DVB) technology to deliver high-quality mobile TV programmes to public commuters. TVMobile keeps commuters up-to-date with broadcasts of real-time financial data, news updates, weather reports, entertainment and critical information. The selection of programmes is wide: entertainment, fashion, travelogues, documentaries, movie previews, sports and up-to-date news. The criteria for choosing the programmes are based on viewers' travelling time (about 20 minutes). Other requirements for programmes are: they must be entertaining, fast-paced and visually captivating. TVMobile was first launched on 1500 buses. In the future TVMobile will keep people occupied with information and entertainment in queues at supermarkets, clinics, taxis, ferries, private vehicles, etc. At the moment a commuter cannot change the channels so all commuters watch the same program. The TVMobile channel cannot be received at home. (TVMobile 2001.)

NTT DoCoMo in Japan launched a 3G mobile telephone network in 2001. At the moment the Japanese are getting familiar with the new third-generation mobile phones. This means that the can, for example, send music, pictures or video clips to one another. The new phones can also act as videophones. (DoCoMo 2001.)

The Terrestrial Broadcasting Tokyo Pilot Project, which is co-ordinated by the Japanese Broadcasting Corporation and Nippon Hoso Kyokai (NHK), began in 1998 and is now in its second phase[1]. The Tokyo Pilot is carrying out experimental digital broadcasting and studying fixed, mobile and portable reception of digital broadcasting[2]. So, in addition to television at home, digital terrestrial broadcast signals will reach automobile receivers and portable receivers. Portable receivers receive broadcast signals directly and programs can be stored in memory. Data storage allows viewers to watch the broadcast content whenever they like. Mobile receivers will enable users to access the Internet, get detailed information on the broadcasts which they are watching, and use interactive services. Many different sizes of portable receivers will be used: PDAs, cellular phones and ultra-mini receivers attached to eyeglasses.

The project is considering several possibilities: scalable data services for various receivers, read-out services for automobile drivers and location-based data services that supply information specific to a recent position. During the trials, the participating companies will seek next-generation broadcasting and advertising services. The trials will be conducted in Tokyo by the Association of Terrestrial Digital Broadcasting Tokyo Pilot Trials and the Telecommunications Advancement

[1] http://www.dibeg.org/TOKYO.htm 09.04.2002

[2] http://www.strl.nhk.or.jp/open98/1-4/ter-01e.html 09.04.2002

Organization of Japan (TAO) in Hokkaido[3]. One experiment has already been conducted on the bullet trains. The aim was to examine the characteristics of digital terrestrial broadcasting in high-speed mobile reception[4].

We are able to build a testing environment in which we can watch digital television programs in mobile contexts. People are starting to have visions about mobile television, e.g. the news, reported in August 2001, of the release of the first short film which was made with handheld computer and a small camera. The news report stated that more applications are needed. The key feature is that the program needs to be quite short, for example movie trailers could be suitable for mobile devices. (YLE 2001.)

Tampere Film Festival launched a competition to promote the development of short films compatible to portable mobile devices. The competition was held at the Tampere 32nd International Short Film Festival in March 2002[5].

There is also a great deal of interest in the future use of mobile devices and especially the possibilities offered by 3G phones. In the year 2000 Sonera Mspace set up the first consumer trial "PMA-pilot" that simulated next-generation mobile services. Two-hundred trial end-users participated in the pilot. The trial end-users tested mobile multimedia services for two months. They used a device combination simulating a 3G phone: a pocket PC (Compaq iPAQ) and a GSM phone (Nokia 6210). The PMA pilot services consisted of daily news flashes and weather, personalised movie information and trailers, music videos, sports highlights, and directory and map services. End-users were able to modify individual service menu. The end-users' experience of the pilot were very positive: over 60% of the users considered the experience to be enjoyable. Had the transmission speed been higher and had there been only one terminal with a wider range of content, the experience would have been better (60%->80%). Over 90% of the end-users said that they would use the service at least several times a week. According to the received feedback, it can be stated that the most preferred categories were news and music. Games were not among the most desired applications. The most popular service was the Movie Agent service, which provided personalised movie information. (Sonera 2000.)

In October 2001 Sonera launched its "Mstation" pilot, in which the users were ordinary mobile phone customers using a device combination of a PDA and mobile phone connected with Bluetooth. The aim was to study the usability aspects and challenges related to future mobile applications. For example, in the trial the users tested a user interface control based on movements of the mobile device. Mstation applications will cover areas such as wireless games, messaging, on-line betting and lottery services. The results of this pilot will be published in the near future. (Sonera 2001.)

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[3] http://www.strl.nhk.or.jp/open2001/en/tenji/id10/index.html, http://www.nttdata.co.jp/en/media/2001/0216_e.html 09.04.2002

[4] http://www.strl.nhk.or.jp/publica/dayori-new/en/n-0109-2e.html 09.04.2002

[5] http://www.tamperefilmfestival.fi/micromovies/ 09.04.2002

2.2 The usability of mobile devices

Physical, social and cultural contexts affect the way in which a mobile device is used. Also the interconnections to other devices and services affect the usage. One of the major factors is to be able to use the device anywhere and anytime. This is also what makes mobile devices different from stationary office-based devices. (Ruuska-Kalliokulju, Schneider-Hufschmidt, Väänänen-Vainio-Mattila & Von Niman 2001.)

Mobile devices can be used, e.g. in situations where people are moving from one place or situation to another. Mobile devices can have an assisting role, e.g. when a person is in a meeting and wants to check his/her calendar, write a memo or e-mail, etc. The illumination, background noise and the distance of other people may vary from one situation to another. A mobile device should automatically recognise these changes and adapt to the environment. The use of the device needs to be as minimally disruptive as possible and should not demand lots of visual or cognitive attention from its user. (Hinckley, Pierce, Sinclair & Horvitz 2000.)

Wichansky (2000) stresses that there are many usability testing challenges for mobile handheld devices still to overcome. Some of the challenges, according to Wichansky, are:

- Testing involves both the evaluation of hardware and software user interfaces
- Sometimes hardware and software are not available for testing at the same time
- Testing needs to take place in real-life situations
- The user population in often highly diverse and untrained
- Observation is not enough, automatic data logging needs to be developed
- Achieving agreement on design recommendations can be challenging because sometimes different companies develop the hardware and the software. (Wichansky 2000.)

More account needs to be taken of the context of use in the research of mobile devices. This view is stressed especially by Johnson (1998), Kristoffersen and Ljungberg (1999). Johnson points out that HCI researchers have developed a good understanding of human-computer interaction in “fixed” contexts of use, but more attention needs to be paid to mobile interactions. According to Johnson, there are at least four problems to be faced in addressing the HCI of mobile devices:

- the demands of designing for mobile users, to their tasks and contexts
- diversity of devices, network services and applications
- current inadequacy of HCI models to address the varied demands of mobile systems
- the demands of evaluating mobile systems. (Johnson 1998.)

According to Kristoffersen and Ljungberg, different mobile applications and interfaces need to be designed with a particular kind of mobile use context in mind. They also stress that current mobile computers rely too much on direct manipulation, which often demands too much attention from the mobile user to be useful. (Kristoffersen & Ljungberg 1999.) Eisenstein, Vanderdonckt and Puerta (2001), on the other hand, stress that it would be important to develop a single, consistent user-interface for several mobile devices and contexts of use. This way the devices preserve their consistency and usability and it is easier for the users to learn to use them. Einstein et al. also mention that current usability guidelines are not suitable for the design of user-interfaces for mobile computing. More research is needed in this field. (Eisenstein, Vanderdonckt & Puerta 2001.)

So should different mobile devices should be integrated into one "universal communication appliance" or kept separate? Ruuska-Kalliokulju et al. state that they do not believe in one universal appliance. They think there will be variety of communication appliances that operate in connection with one another. According to Ruuska-Kalliokulju et al., devices will get more task specific as the need for inter-device communication increases. (Ruuska-Kalliokulju et al. 2001.)

So far the usability research of mobile computing devices has concentrated mainly on utility applications, e.g. mobile phones and devices needed while working in extreme situations. More research knowledge is needed about the usability of entertainment applications, e.g. mobile digital television.

2.2.1 Users and the context of use

As mobile communication devices have become more common it has been investigated how, why and in what kind of situation people use their devices. It has been assessed that we are acceding to a new communication and working culture where time and place are not so important. In such a culture people find more individual ways to combine or separate their personal and working lives. The way people experience the effect of mobile communication technologies on their lives has been the object of interest. The process in which new technologies become part of society has hardly been studied. There are similarities in the implementation processes of the mobile phone and the fixed telephone. The commencement of use is justified with rational reasons such as security and necessity. However, the telephone soon becomes a mean of social communication. According to research, the communication style has changed with mobile phones. People make calls more often; the duration of the calls is shorter and the call themselves are more informative. Mobile phones make working life more flexible and more effective, while bringing a sense of control over different areas of life. Mobile devices seem to be connected to lifestyle. In some cases they can be seen as status symbols. (Palen, Salzman & Youngs 2000, Väänänen-Vainio-Mattila & Ruuska 1999 & Konkka 1999.)

Examples and results from related research

The article *Going wireless: Behaviour and practise of new mobile phone users* by Palen et al. (2000) describes a study that aims to establish the use and adaptation of mobile phones and the attitudes people have towards use. Nineteen mobile phone users participated in the study. All but one were novice users. The study revealed that the nature of real use regularly differs from the anticipated use. Interviewees whose friends had mobile phones could anticipate their own use of mobile phone better than the rest. Initially the users had a negative attitude to the use of mobile phones in public places or while driving. After a while, however, attitudes changed and such subjects were hardly considered. People usually had several reasons to buy a mobile phone beside the main reason. Telephones were usually bought for business, work or security reasons. Mobile phones were also bought for a certain situation, reason or to be used as a spare phone. Even though social use was not mentioned as a reason for acquiring a phone, social co-ordination soon became a

very important part of the communication practice of all the test users. Mobile phones were used to enable own mobility and to ensure that other people are able to contact the phone owner. They were also used for security reasons. The volume of use was found to fluctuate a lot depending on the current situation. The mode of use depended on life events, which were grouped as follows:

- Mobility of the test user's job or interests
- Availability of other communication devices
- Number of different roles which the test user adapts at work or in personal life
- Degree to which the roles are integrated
- Personal responsibility one has for family members
- Schedules of family members
- Extent of shared resources, e.g. agreeing on the use of a car
- Extra factors like augmentation of physical ability, communication and travel conditions and schedules. (Palen et al. 2000.)

People working with user interfaces at Nokia forecast how mobile communication will develop in the future. According to them there will be new ways to reach the goals of work and leisure time, although the goals themselves will not be changing. We are entering new a communications and working culture where time and place are loosing their significance. People are finding more personal ways to integrate or differentiate personal life from working life. The following areas are mentioned to be strengthening: on-line mobile negotiations, location-based information services and seamless connectivity between different devices. (Väänänen-Vainio-Mattila & Ruuska 1999.)

Katja Konkka (1999) describes in her master's thesis how people experience the impact of current and near future mobile communication technologies on their lives. The research was carried out in Finland and in USA. The research was qualitative and it was carried out by interviewing 20 persons in both countries. Both groups thought that their way of communication has changed because of mobile communication technology. Telephone discussions did not last as long as they used to, and they were more informative but more superficial. People called more often than before. The Finns used a lot of SMSs, which were seen to be a practical way to communicate and organise minor things not worth calling. They were said to give an opportunity to avoid unpleasant face-to-face communication. Sending SMSs was also a way of communicating funny things such as jokes or gossip. (Konkka 1999.)

According to Konkka's research, mobile communication technology was found to make work more effective and easier, but at the same time more demanding. There is a danger that mobile technology chains people to working life even in leisure time. More time spent communicating means less time for other things related to work or personal life. People felt that mobile technology helps to gain the feeling of control in both working and family life. It was noted that mobile technology was used as a status symbol in some cases. (Konkka 1999.)

2.2.2 Two examples of research related to PDAs

Geney: Designing a collaborative activity for the Palm handheld computer

Danesh, Inkpen, Lau, Shu and Booth (2001) are worried that our interactions with technology will become more individual, e.g. Palm devices are designed mainly for personal use. Palm devices are also designed as an aid for professional adults and

very little is known about how children interact with these devices. The most common handheld electronic device used by kids is the Nintendo Gameboy. Children enjoy playing and working together and sometimes are more successful as a result of this collaboration. Using small handheld devices in school is a new thing and most of the earlier research done has concentrated on how the mobile device can be used to collect data. (Danesh et al. 2001.)

Danesh et al. investigated ways to utilise handheld computers for collaborative learning activities. Another interest was to gain insights into the design of children's applications for handheld computers. The development process followed these steps: requirements analysis using mock-ups and scenarios, validating requirements with target users, prototype development, prototype testing with target users and development of an application specification. Nielsen's usability heuristics were applied in this study. (Danesh et al. 2001.)

While testing the prototype the following usability issues came up:

- The menu must be visible on the screen all the time as in traditional desktop interfaces
- Children are able to use both methods of data entry (graffiti and on screen keyboard), but they expressed a strong liking for writing with graffiti
- As much information as possible needs to be at each level and deep structures of embedded screens and dialog boxes must be avoided
- It is important to ensure consistency within the application, but also with other devices
- Ability to cancel, undo is necessary for all operations
- The ability to customise and express their creativity in the mobile device is important to children.

In the usability evaluations one problem related to the data recording came up: how to record screen information from the handheld computer while the person interviewed is moving around. (Danesh et al. 2001.)

Sensing techniques for mobile interaction

Hinckley et al. (2000) have integrated a set of sensors into a handheld device. In their usability evaluations they tested the following four features with test-users:

- recording memos when the device is held like a cell phone
- switching between portrait and landscape display modes by holding the device in the desired orientation
- automatically powering up the device when the user picks it up
- scrolling the display by tilting it.

The test-users said that it was easy to record memos but the feature is not easily discoverable. The users said that they would choose this way to record if possible. All users felt that it was easy to switch display modes by turning the display and that tilting was a good way to scroll the screen. Automatic powering up was also thought of as a good thing because this way the user cannot hit the power button by accident. Sensors have also been used before, but according to Hinckley et al. more usability research is needed on this area. What is especially needed is longitudinal studies to determine how the usage of mobile devices changes over time. (Hinckley et al. 2000.)

2.3 The usability of digital television

If users are to accept digital television, it must be easy to use. When evaluating the user interface of the television, one must take into account the situation in which the television is used, the way the television is used and the purpose of its use. Another very important thing is to give the user feedback about his/her actions and all the possible information about the user interface. For instance, the user must be aware whether (s)he is currently using the Internet or the television. The user interface comprises several components which need to be connected together as well as possible. The movement from passive to active watching of television requires more from the viewers. This means that more attention needs to be paid to the differences between viewers in the development of new television devices. The usability is connected to the users' personal characteristics. In evaluating the digital television one must take into account the following human characteristics: memory, perception, attention, schemas, learning and alertness. (Towards an individualised mediascape 2000.)

In his dissertation Jääskeläinen (2001) tried to identify questions that the developers of interactive television programs could ask themselves. The dissertation gives planning models for six different interactive television (ITV) genres: interactive advertising, video-game-type ITV programs, news on demand, electronic program guides, distance learning applications and background information of other TV programs. The main conclusion was that it pays to ask the same questions that have been found useful in developing film and TV scripts, www applications, multimedia productions, virtual communities or home shopping advertisements. (Jääskeläinen 2001.)

Jääskeläinen reviewed previous studies related to interactive television for his dissertation. He surveyed through field trials in Finland and selected ones abroad, consumer attitude surveys and expert panels. According to Jääskeläinen, not much academic work had been done on the subject. Some research projects are currently under away in the University of Art and Design (Helsinki). So far, user interfaces for interactive television have been studied in Finland, e.g. in the Future TV project. The Future TV project group consists of Tampere University of Technology, the University of Tampere, Helsinki University of Technology and their industry partners (Nokia, YLE, Alma Media, Helsinki Media, Sonera, Helsinki Telephone, Sansibar and Veikkaus). The user interfaces have been investigated more thoroughly by Petri Vuorimaa and Chengyuan Peng. The broadcasters and telecom operators in Finland have been carrying out their own tests and pilots since the mid-1990s. The Finnish Multimedia Programme (KAMU) was a joint research venture of the large Finnish media companies, equipment manufactures and telecom operators. KAMU consisted of 27 projects. The projects were also funded by Tekes. Jääskeläinen concludes that the published results of interactive television field trials do not give many hints as to how one should develop programs and the content for interactive television. The goal of his dissertation is to give more concrete hints for developers and producers. (Jääskeläinen 2001.)

Campbell (2000) has studied the usability of interactive television in the UK. In his dissertation he claims that the reason why interactive television has been studied so little has to do with the fact that there is still very little hardware available. He forecasts that the set-top boxes will develop a lot in the future, but the television and the remote will mainly stay the same. According to Campbell current usability research methods are suitable for designing the interactive

television. Cambell does not release his own results to the public. He stresses the importance of ethnographic methods and long-term field evaluations. (Campbell 2000.)

The development of digital television is different from the development of computers because television differs from the computer in the following areas: applications, technology and the users. One must take into account that people who use computers do multiple tasks, while TV is used mainly for entertainment. Here are some examples of how the users of television and the users of computers differ:

- by their age and ability
- television viewers are not used to error messages
- television viewers are more passive, they are probably not willing to increase their effort. (Ergogero 2001.)

2.3.1 The viewers of digital television and their viewing habits

The Consumer Research Project (Kultu) started in 1996. The research work is being done by the University of Tampere and Tampere University of Technology. Over a period of four years the project surveyed Finnish people's attitudes towards network services. Since the year 2000 the research has focused on television and mobile environments. The objective is to examine attitudes towards the use of digital television and WAP services in everyday contexts. The project has published four reports:

1. Consumers and multimedia services (1997)
2. New media from the consumer’s point of view (1998)
3. The Internet in a Finn’s everyday life (1999)
4. Towards an individualised mediascape (2000)

The first report "Consumers and multimedia services" reports the consumer's perception of media and services, the consumer's needs and motives for using the networked multimedia, studies on the usability of the equipment and services, and the consumer's willingness to pay for the services. Most of the findings are concerned with consumer attitudes and views about the service and they do not offer many ideas on how to develop interactive television programs. The research shows that the interviewees had a positive attitude towards moving pictures and videos in networked multimedia. Video-on-demand was perceived as an interesting service, the biggest advantage was the possibility to watch a film whenever it suits and the fact that one does not have to leave the home to get the film. Television was associated with leisure time and computer more with a working environment.

The second report "New media from the consumer’s point of view" reports on consumer acceptance of Internet browsing, e-mail and their relation to television. The results show that the use of e-mail via the television can be a social experience. The results also show that the Internet connection does not change the viewing habits. The consumers will watch their favourite TV series and news broadcasts as before. The third report "The Internet in a Finn’s everyday life" reports that the television’s Internet connection does not appear to make the experience of watching the television more social. (Jääskeläinen 2001 & Kuluttajatutkimukset hanke 2001.)

The fourth report is called “Towards an individualised mediascape”. The first section of this publication is named “Digital Television from the Consumer’s Point of View”. It approaches digital television from the point of view of the consumer and the user. The issues considered include the purchase of a digital

television set, the usability and use of digital television, the services and choice of channels provided, interactiveness and the social aspects of digital television. The data was collected using group interviews with consumers of varying ages. The results show that consumer views are influenced by public debate, the added value provided by digital television and technological advances. All of these factors form the basis for the consumer's buying motivation and the product's utility value. Consumer attitudes towards digital television are still very cautious. The digital television equipment is considered expensive. People seem to be aware about the increasing possibilities of digital television, but at the same time they are afraid that new services and new channels will bring about extra costs without meeting their needs. There are still many things that people do not know about digital television, so information should be given more extensively. The authors point out that in the interviews conducted, the previously cautious attitudes of users turned into curiosity as the interviewees were given more information about the possibilities of the future television. The interviewees where also asked about the factors related to the price and purchase of digital television equipment. It has been estimated that the price of the set-top box will range from 2,000 to 3,000 Finnish marks (circa 335-505 euro), while the consumers imagined a lower price; they are willing to spend only about 1,200 Finnish marks (circa 200 Euro) on the set-top box. The interviewees mentioned that they intended to wait until the prices fell. (Towards an individualised mediascape 2000.)

According to the authors of "Towards an individualised mediascape", the television has become an established part of life in Western culture and any changes in it will be met with suspicion. People are accustomed to using television in a certain way. Still, in the interviews the attitudes towards new ways of using television were mainly positive. The idea of a personalised television was widely favoured and the most interesting elements of digital television to the interviewees were the TV guide and the super-text-TV. The authors stress that it is important that the users feel they can easily control the information and programme content offered by digital television. (Towards an individualised mediascape 2000.)

The consumers are interested in the idea of extra channels and also the idea of channels that focus on specific topics. All of the interviewees found that "utility services" (e.g. television programme information), distance learning and news services were the most important services of digital television. The least interesting services were shopping for clothes and groceries and gaming on the computer. When asked about payment, the fixed sum option was more favourably received. Pay-per-use was felt appropriate for films and mobile services. The possibilities to store programmes and to seek information were considered the most interesting interactive features of digital television. (Towards an individualised mediascape 2000.)

VTT Information Technology participated in a project entitled ”Applications of Integrated Publishing” (IMU), which studied, amongst other topics, the use of personalised channels and other channels. The system included several different media sources - newspapers (e.g. Helsingin Sanomat, Aamulehti) and TV news. The terminals used were the computer and conventional TV. A set-top box was required to use the system via the TV. Only one fifth (73) of the users personalised their own channels. Users could personalise channels according to entries, media sources and the period of time over which they wanted news. The news that met the parameters set by the user were directed to the personalised channels automatically. Even though the feature was not popular, it was very actively used by those who personalised channels. Also different thematic channels (e.g. sport

news or domestic news) and publisher's (e.g. Helsingin Sanomat, Aamulehti) channels were popular. The most popular channel was the television news. Its advantage was the possibility to watch good-quality TV news irrespective of time. (Södergård 2001.)

According to market research done in Finland (2001), 35 % of Finnish people have a positive attitude towards digital television. Those with the most positive attitude came from the 15-44 years age group. Men had a more positive attitude than women. Digital television is mainly regarded negatively by people from the age group of 65 years and older. (Vahala 2001.)

Hannula-Stenqvist (2001) surveyed in her masters thesis the views of digital television producers. The views were also compared to an earlier study done on the public. According to the interviews the producers feel that the starting time of digital television is too soon. There is not enough equipment yet on the market. The thesis states that the interactiveness is happening only poorly. The main services available include the Electronic Programme Guide (EPG), supertext-TV and games. More sophisticated services will be on the market during the spring of 2002. The producers feel that interactiveness is the most important thing in the success of digital television. Television viewers and the producers think that the most interesting interactive services are the EPG, the recording of TV programs and the supertext-TV. There were differences of opinion on the choice of camera and on the importance of viewing www pages and wide-screen. The viewers think that choosing the camera would be a good idea and the producers think the idea is not so suitable for digital television. (Hannula-Stenqvist 2001.)

The "Media in young peoples' lives" survey did not include questions related to digital television, but it gives some interesting results about how young people today use the conventional television and what programs they watch. 698 young Finns (age 13-19 years) took part in this survey of the University of Jyväskylä. The data was gathered in December 1999. According to the results, television is the most important media for young people. On weekdays half of the young people watched TV at least three hours per day and at weekends two-thirds of them watched TV at least three hours per day. Young people watched foreign and Finnish TV shows and movies. The most popular TV shows were: Salatut elämät (a Finnish soap opera), South Park and X-files. Young people were also interested in news: 85% of them followed the news. Three-quarters of these young people watched Jyrki (a Finnish TV show featuring music videos and interviews). The most interesting content in Jyrki was music videos. Young people took part in making Jyrki by voting music to the countdown chart and taking part in events that were later shown on Jyrki. A fifth of the young viewers had sent feedback to the producers. On the Jyrki web-site, girls voted, chatted and took part in competitions more often than boys. Some young people said they had found new friends through the Jyrki chat line. (Luukka, Hujanen, Lokka, Modinos, Pietikäinen & Suoninen 2001.)

The young people used television for entertainment. Boys were more fascinated by moving picture and special effects, while girls were more interested in texts and stories. This can been seen, for example, in their opinions about commercials and web-sites. According to Minna-Riitta Luukka, young people today are able to use multiple media simultaneously: they watch Jyrki, surf the Internet and write SMS messages. The field of media is very diverse in young peoples' lives and there are many ways to use it. According to the survey one thing that all these young people had in common was their interest in the TV show

Salatut elämät and the magazine 7 päivää. (Luukka et al. 2001, Nuorisotutkimus 2001.)

2.3.2 Consumer surveys in the UK

The Office of Telecommunications (Oftel) in the UK has conducted research on digital television consumers. In August 2000 21% of UK households claimed to have digital television. People use digital television because it brings extra channels, but the games are also popular. People who do not use digital television say that they are not interested in extra channels or they feel that the equipment and services are too expensive. Digital television has spread more equally to the public than computers have. Elderly people and people from the lowest income group use digital television least of all. Usually, people who have digital television also have the Internet. Especially younger age groups are interested in digital television, and the interactive services are mostly used by young people. According to Oftel's survey 13% of homes who do not have digital television are planning to get one in the next 12 months. (Oftel 2000.)

Oftel conducted a new study last year (2001). This study shows that the reasons why people chose digital television included improved picture quality and more information about certain genre. Interactive services were seen as an interesting extra but were never used as a justification for buying digital television. When using the interactive services people need to know clearly what everything costs. People seem to learn to use digital television by trial and error. They start with the most useful services (changing channels) and explore other possibilities later on. People learn new features from their friends and younger family members. In the EPG people tend to browse the "all programmes" menu most often. The interviewees said it only takes a short time and this way they can see the whole range of programs they are paying for. The results of this study suggest that channel identity and branding are very crucial to peoples' decision-making. New channels were easy to miss so they should be highlighted for an initial period. It was an advantage for a TV program to be near the top of the programme list because people tend to make their choice before getting to the end of the list. (Oftel 2001.)

According to Oftel's study, watching TV is a social thing and it may be irritating if one person is using interactive services while others are watching TV. People who did not know how to use computers liked the idea that they could use the Internet or e-mail from their digital television. Most of the interviewees resisted this idea of working with the television. Television and home was experienced as a casual and loose environment, and most users did not want to integrate any "work" type activities into the television (thinking, rationalising, judging, etc.) Games were an exception to this because they were felt to be relaxing and light-hearted. It seems that viewers are sticking to their favoured genres more than to terrestrial scheduled television. (Oftel 2001.)

2.3.3 Examples of usability tests done on digital television

User interfaces for digital television: a navigator case study

Eronen and Vuorimaa (2000) developed two interfaces for digital television. The prototypes were tested with real users. The users' actions were evaluated while they searched for information in EPGs and navigated in the digital television environment. According to Eronen and Vuorimaa, digital television viewers have both entertainment and information search oriented tasks. They stress the importance of usability evaluations because the user's needs vary from passive content watching to more specific information searching, and the users vary in terms of their physical and cognitive skills and abilities. Moreover the user interested in watching the television and not in interacting with the technology. Digital television is mainly used for entertainment. The authors stress that digital television should "maintain the familiar living room TV experience". (Eronen & Vuorimaa 2000.)

The most intuitive type of navigator is the kind where the cursor movement with arrow keys is completed with the "ok". It is intuitive because the cursor can been seen instantly on the screen. 77% of the viewers hold the remote in one hand and press the buttons with their thumb. This is the reason why the remote needs to be the kind that you can operate with your thumb. (Eronen & Vuorimaa 2000.)

For the purpose of this study two navigator prototypes were implemented. The main idea in the first prototype was simplicity. The designers assumed that the users want to complete one task at a time and the number of selections needs to be kept to the minimum. In the other interface the main idea behind it was efficiency. It was assumed that the users want to stay in one application while browsing the television programming information. The interfaces were tested with six test-users. They were given different types of tasks. The evaluations did not show which of the two interfaces was "better". The results show that the users were not so interested in finding specific information on the TV screen. They were more interested in going through all the alternatives and getting a general picture. The users liked the arrow keys and they were found to be easy to use. The coloured keys were experienced as confusing and they were associated with the wrong things. The users liked especially the fact that they were able to see the TV program all the time, e.g., while looking at the program guide. (Eronen & Vuorimaa 2000.)

Eronen and Vuorimaa point out that because new applications come out all the time, the users do not have time to form mental models of the applications they use. This is why the navigation should be made as intuitive as possible and the user interface needs to give the user instant feedback and hints on how to act. (Eronen & Vuorimaa 2000.)

Usability testing of an electronic programme guide and interactive TV applications

Concejero, Gil, Ramos, Collado and Castellanos have evaluated the usability of EPG developed for a Spanish satellite-TV operator. The EPG consisted of the following parts: program grid, thematic search, channels menu, calendar, weather forecast and telebanking application. On top of the usability evaluation they also did a telephone survey on TV viewing habits and people's opinions about advances

in TV technology. In the usability evaluations they were especially interested in how people were able to perform tasks without instructions. The results show that although some of the components were the most difficult to use they were also considered to be very useful by the users. The authors stress that the most important result of this test was the difference between age groups in some of the variables tested. The main reason for these differences is that older people are not used to exploring a new interface. Elderly people preferred guided and hierarchical procedures even though they are slower and less useful. When asked about their attitudes towards technological advances in digital television, people less than 30 years of age were very interested but people older than 30 years thought that in 10 years they will be using the same TV system as now. (Concejero, Gil, Ramos, Collado & Castellanos 1999.)

At home with the technology: an ethnographic study of a set-top-box trial

In the study of O'Brien, Rodden, Rouncefield and Hughes (1999) the test users were able to order movies, music or radio-channels, play games, do shopping, read local adds, check timetables, reserve tickets etc. via the set-top box in their homes. All of the participants reacted favourable to the set-top box. One difficulty was that the users did not know exactly how much everything costs. There was also confusion as to where all the information lay at any given time. The users were confused about whether the information was being downloaded or was in the box all the time. The users also wanted to be better able to control the security facilities, e.g., avoid children from watching certain things. (O'Brien, Rodden, Rouncefield & Hughes 1999.)

2.4 Researching the use of mobile devices

2.4.1 Description of different researches and used methods

In the article *Joking, storytelling, artsharing, expressing affection: A field trial of how children and their social network communicate with digital images in leisure time,* Mäkelä, Giller, Tscheligi and Sefelin (2000) describe a project that aimed at the development of a communication device for children and their social network. The use of digital pictures for leisure-time communication was studied in two field trials. The benefit of a field trial made with real users is emphasised as a part of the user-centred design process. The two groups of test users were first interviewed in a familiar environment. The test users kept photo diaries and field trials were conducted to understand the daily communication of children and their social network. Then different product concepts were developed and evaluated in the laboratory by the users. The concepts were introduced to the users with blank models, screen demos and in some cases with storyboards. According to the findings, one of the generated concepts was chosen for prototyping, which enabled users to send, receive and edit digital messages. (Mäkelä et al. 2000.)

The prototypes offered mainly three different functions. They could be used to take and save digital pictures. The users could edit the pictures taken and received. The digital pictures could be sent and received wirelessly. The functions

of the prototype were limited to pictures to keep the focus on communication with digital images. Every picture sent was saved in a log-file on a server, enabling observation of users' communication in real time. Technical problems were detected immediately. This also enabled the researcher to ask more concrete and contextual questions. Since the field trial lasted only four weeks, the selected users were already familiar and also motivated. The test users were interviewed once a week. The interviews were very concrete and contextual, providing the users with an opportunity to tell freely about experiences and to make improvement proposals. They were motivated to tell about usage situations and changes that occurred in their communication behaviour. Images saved on the server were browsed through. The research also revealed that the motivation of the users varied between different users and the meaning of the photographs changed during the test. The use of the prototype increased during the first two weeks, being stable for the rest of the time. (Mäkelä et al. 2000.)

An article by Iacucci, Kuutti and Ranta (2000) entitled *On the Move With a Magic Thing: Role Playing in Concept Design of Mobile Services and Devices* discusses how two techniques of participative design, role-playing game with toys and situated and participative enactment of scenarios (SPES) can help to face new design challenges with new mobile devices and services. There is a need to consider mobility from a new ethnographic view. The applicability of the techniques was considered in relation to situations in which new services and devices are developed. Different things were considered: mobility and parallel need to communicate with others, leisure-time use when socio-cultural aspects of life are still more effective and when the exact target of use is unknown. The scenarios consisted of different services and devices. The basic idea in role-playing games was that the participants played some role in a certain situation. They imagined what kind of devices or services could support their mobility and communication. They discussed and played out these ideas in the situation. When the SPES technique was used, people were given mock-up versions of future devices. The situations in which the new device or service would be useful were explored by following the users in everyday actions. The users formed different product concepts. The role-playing game technique seemed to suit the design of services which include group action and dynamic actions. The SPES technique helped to concentrate on less dynamic action like listening to music and checking news from the Internet. Scenarios made with SPES were more detailed since it was possible to record realistic contextual information. (Iacucci et al. 2000.)

3 Research questions

In finding out consumer attitudes to mobile digital television the research questions were:

1. The device

    - What kind of device would be most suitable for mobile television?

2. The content of mobile digital television

    - What type of programs are suitable for small screens?

3. Operation situations

    - Where would the mobile television be used?

4. Needs and expectations of the users

    - What do people expect from mobile digital television?

4 Methodology

4.1 Prototype based interviews

The interview method was chosen because the interviewees were not previously familiar with the mobile digital television. During the interviews the interviewees were able to ask questions and get familiar with the equipment. The interview themes were:
1. device
2. content of mobile digital television
3. operating situation and needs and expectations of the users (Appendix 1).

The interviews were held during August - September 2001 in several different places: a railway station, train, bus station, schools (elementary school, secondary school and vocational adult education centre), home, workplace and cafeteria. From schools both teachers and pupils were interviewed. These places were selected because they might be the sites where mobile digital television will be used in the future. Interviewing in the field was important also because in the real situations it was easier for the interviewees to think how they would use mobile television.

First, all of the interviewees filled in a background information form (Appendix 2). After that the interviewees got familiar with the devices (computer and PDA) and then they were interviewed. The interviews were recorded and some pictures were taken of the situation. One interview took about 15 minutes.

Picture 1. Interview situation at school.

4.2 The equipment and the software

The interviewees used two devices to watch television programs during the interviews:
- PDA: Compaq iPAQ pocket PC
and
- Portable computer: Fujitsu Siemens Lifebook B-2175/128 MB.

Clips of TV programs were stored in the memory of the portable computer and the PDA. Windows Media Player was used to watch the programs. Live TV broadcasts were not used.

Picture 2. An interviewee using the computer to watch a television program.

The stored TV program clips included the news, Salatut Elämät (a Finnish soap opera), Kymppitonni (a Finnish game show), Formula 1 racing and Pokemon. The selected TV programs did not affect the answers.

5 Interviewees

Together 29 interviews were held. Of the interviewed people 16 were female and 13 were male. Most of the interviewed people reported having several different hobbies. The most popular hobby was sports (23/29). Music and reading were the second most popular hobbies. Five interviewees mentioned that studying is their hobby and three mentioned a special interest in technology (Appendices 3 and 4). The age distribution was 10 – 72 years (Figures 1 and 2). The interviewed people were selected in the places were the interviews were held. The interviewers went up and asked people to participate in the study.

Figure 1. The age distribution of the interviewed females.

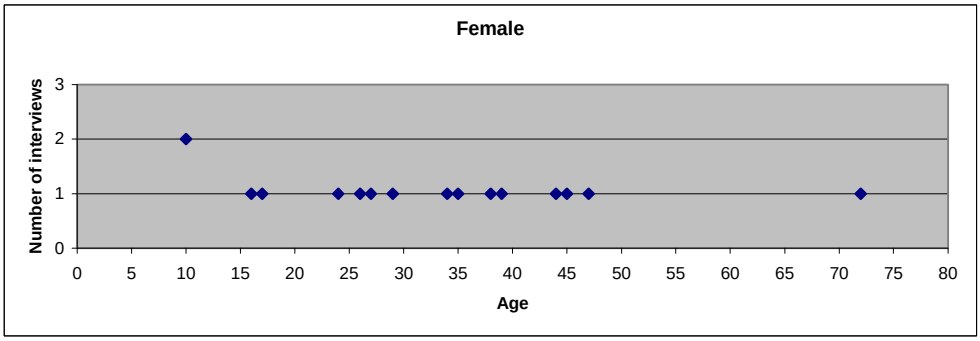
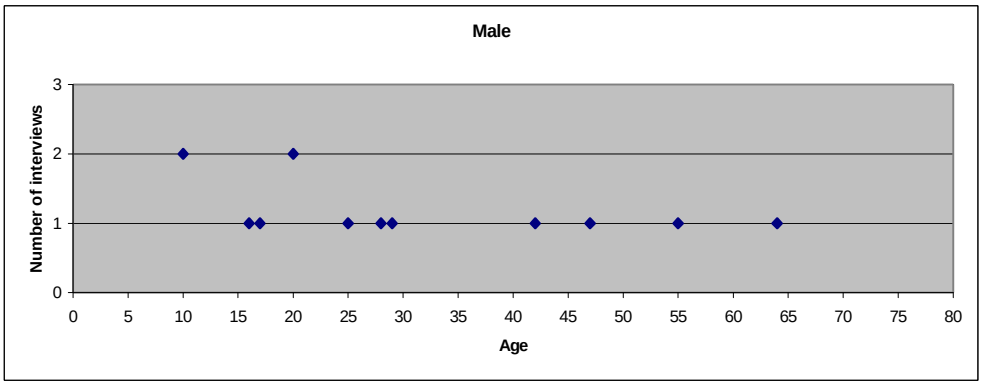


Figure 2. The age distribution of the interviewed males.



6 Results

6.1 First impressions and opinions about the devices

6.1.1 First impressions

After getting familiar with the equipment, 20 of the interviewees said their first impression of mobile digital television was positive, two interviewees had a mixed opinion and seven interviewees reacted negatively. The seven who reacted negatively included people from the whole age range (10-72 years). Two of them said that the equipment was unnecessary, two said that they could not see anything from the screen (these people were interviewed on a train were there were lots of reflections from the windows), two said they seemed too difficult to use and one

young interviewee from an elementary school commented that the mobile television needs to be more like a normal television. By this he meant that changing channels and the adjustment of sound and colour should be as easy as it is on a conventional television.

Woman aged 38:
"I would take this (PDA) immediately if it could be connected to the computer. I follow international football and this would be a very useful device for me. Whenever I have some spare time I could check the results and so on."[6]

Boy aged 10:
"I don't really know. Maybe a portable TV would be better. This needs to be more like a normal TV."[7]

6.1.2 Weight of the device

Most of the interviewees thought that the equipment introduced was lightweight. A woman aged 72 was the only interviewee who said that the portable computer was too heavy to carry around. Some interviewees even recommended that the equipment should not be more lightweight because then it might be easily lost. One of the interviewees suggested putting non-slip material on the bottom of the device.

Girl aged 10:
"The bigger one isn't too heavy. This must be somehow different from the normal ones... The smaller one is very lightweight."[8]

Woman aged 26:
"If I were to use this (PC), I would like to be sitting down, e.g., on a train. I would also like to have headphones. The smaller one (PDA) I could use anywhere."[9]

6.1.3 Size of portable device

Of the interviewed people, 18 said they would carry around a mobile television the size of the portable computer. The main reason for this was that they felt they could use the portable computer also for other purposes. Only three of them said they would choose the bigger device because of the bigger picture. Nine interviewees would only carry a small device with them. Two interviewees said they would not

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6 "Mä haluaisin tämmösen (PDA) varustettuna tolla tietokoneen siis sanotaan liitännällä välittömästi, koska mä tykkään, mä seuraan kansainvälistä jalkapalloa, niin tota tällainen niin kuin olis hirmu kätevä mukana niin kuin, vois aina joutohetkenä katsoa, että ahaa nyt tuli tällaiset ja tällaiset tulokset."

7 "En mä nyt ehkä tiiä semmonen, että TV ehkä olis pikkusen parempi, semmosen kannettavan TV:n tapanen. Jos tähän pistäis enemmän kaikkia samanlaisia kuin tv:ssä. Miten pistetään väriä ja kanavien vaihto."

8 "Toi iso ei paina kovin paljoo, vaikka se onkin ton kokonen. Se on kai sitten erilainen kun tavalliset. Toi pienempi taas on tosi kevyt."

9 "Jos tätä (PC) käyttäis niin mää ainakin haluaisin olla istumassa. Että siis jotain junaa voisin hyvinkin kuvitella. Ja semmosessa paikassa ehkä vielä niin, että se olis kuulokkeilla."

carry around either of the two devices; these interviewees were the two oldest ones, a man and a woman.

Woman aged 38:
"I could carry around this size (PC) of mobile television easily because I always carry a bag with me. This is, of course, a feminine view because women are used to having a bag."[10]

Man aged 28:
"The weight is not bad but I would only carry this for work purposes. I wouldn't carry this around for watching a music video or a TV show."[11]

6.1.4 The selection: PC or PDA sized device?

In the end the interviewees were asked to choose between the two devices. The bigger device was chosen by 15 people and the smaller one was chosen by 14 people. On the train six people (6/7) chose the smaller device. In the secondary school five people (5/6) chose the bigger device, and in the adult education centre all the interviewees (3) chose the bigger device (Table 1).

Table 1. Selection of the device in different places.

Interview place	Gender	Age	PC or PDA?
adult education centre	f	38	PC
adult education centre	m	25	PC
adult education centre	f	39	PC
Secondary school	f	16	PDA
Secondary school	m	16	PC
Secondary school	f	47	PC
Secondary school	f	17	PC
Secondary school	m	17	PC
Secondary school	m	47	PC
Elementary school	m	10	PC
Elementary school	m	10	PDA
Elementary school	f	10	PC
Elementary school	f	10	PDA
Elementary school	f	29	PDA
railway station	m	20	PDA
railway station	f	24	PC
railway station	f	72	PDA
buss station	f	34	PC
Train	m	64	PDA
Train	m	55	PDA
Train	m	42	PDA
Train	f	35	PDA
Train	f	45	PC
Train	f	44	PDA
Train	f	27	PDA
Cafeteria	m	20	PDA
Home	m	29	PC
Home	m	28	PC
Workplace	f	26	PDA

10 "Kyllä mulla kulkee läppärin kokoinenkin mukana. Mulla on aina kassi mukana. Siis mulla henkilökohtaisesti, mutta se on tietysti naisnäkökulma asiaan, koska naisilla on yleensä aina joku kassi mukana, niin ei se koko sillä tavalla haittaa."

11 "Ei tää musta enää paha oo (PC). Jos niin kuin töitä varten, en mää tätä musiikkivideoiden tai kymppitonnin takia rupeis kanniskeleen."

6.1.5 Should the mobile phone and television be integrated into the same device?

We asked the interviewees if the mobile phone should be integrated into the television device. Of the interviewed people, 14 said it should be integrated and 13 said it should not; two interviewees had no opinion on this matter.

Woman aged 26:
"The size of this PDA is too big to have it with me all the time so I would choose a small mobile phone instead."[12]

Woman aged 16:
"They could be kept separate. I wouldn't take the mobile television with me to every place I go, but the phone is with me all the time."[13]

A few comments on the behalf of the integration:

Woman aged 45:
"I would choose to have the mobile phone integrated into a bigger device, I wouldn't loose it so easily."[14]

Woman aged 27:
"I don't want to carry around many small devices."[15]

6.2 Content of mobile digital television

The interviewees were asked to compare the watching of mobile television to normal television. The quality of the picture was experienced as poor and this was the main reason besides the size of the screen why mobile television was experienced as different from normal television. Especially the youngest four interviewees (10 years old) commented on the difference in picture quality.

The interviewed people said that the programs most suitable for the **small screen** (PDA) are news and weather. They are both programs that you mainly listen to and you do not necessary need to see in detail. The interviewees described the programs suitable for a small mobile device as following:

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12 "Se taas on kakspiippunen juttu, että koska se olis kuitenkin tän kokonen (PDA), niin se olis ehkä turhan iso raahattavaksi aina aina mukana, sen vuoksi ottaisin ehkä kuitenkin erillisen tällasen ja pienen kännykän."

13 "Kyllä se mun mielestä voi olla eri laite. Ei telkkaa tarvi kuitenkaan ottaa mukaan joka paikkaan. Puhelimen yleensä ottaa joka paikkaan."

14 "Kun mulla on noin iso tuo (kassi), niin ehkä mä saattasin ottaa sen kännykän tohon, koska sitten mä löytäsin sen tuolta. Mutta mä varmaan oon hyvin harvinainen, että mä mieluummin pidän isompaa, koska se ei huku."

15 "Yes, ei liikaa eri vehkeitä."

Woman aged 29:
"Small device functions almost as a radio."[16]

Woman aged 27:
"In the programs things other than the visual feedback are important."[17]

Woman aged 47:
"The programs need to be the kind that you just quickly check some facts".[18]

On the **bigger screen** (PC), people would watch more entertainment-based programs like TV series and movies. The interviewees said that sports, for example, include so many details that people interested in them would want to watch them on the bigger screen. On the other hand, it can be expected that people almost always want to see in more detail the programs that are important to them. As one interviewee put it:

Woman aged 38:
"My hobby is football and I want to be able to see it well. People differ in what they want to see well: Somebody might want to see the "wheel of fortune" well."[19]

Watching a movie can also be a social thing, as one interviewee put it:

Man aged 16:
"It would be boring to watch movies alone from a screen the size of a playing card."[20]

6.3 Operating situation and needs and expectations of the users

Brief duration and plenitude of information was typical of programs which people would watch on mobile television. The most common choice of program in every interview setting was the news. Also other programs related to current affairs were mentioned. Especially people interviewed on trains mentioned the news.

Some interviewees also gave examples of possible operating situations:

Woman aged 38:
"I usually wait for my children a lot. They study in a conservatory and I spent hours and hours waiting for them in the cafeteria. I could really use some kind of portable computer during that spare time."[21]

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16 "Uutiset olis helppo, kun se toimii jopa niin kuin radiona."

17 "Sellaset, joissa painottuu muut tekijät kuin visuaalisuus."

18 "Tilapäisiä, esimerkiksi säätila. Semmonen minkä sä vaan katsot ja toteat."

19 "Joku jalkapallo esimerkiksi se on ehdottomasti toi iso näyttö kyllä siihen kätevä. Kun se on harrastus niin se on harrastus. Jokaisellahan joku sellainen juttu on, mikä on niin kuin "se", joku kattelee Onnenpyörää taas vastaavasti ja sillai."

20 "Elokuvat ainakin isommalle. Niitä on tylsä katsoa yksikseen jostain tollatteesta korttipakan kokosesta laitteesta."

Man aged 25:
"I work in a sports store. With this device I could show what some merchandise really looks like and how it acts in real situations."[22]

Peoples' expectations of mobile digital television varied a lot. Some of the expectations that where mentioned by more than five interviewees were: lots of choice in channels, better quality of picture and sound, long-lasting battery and other services integrated into the same device, e.g. e-mail, Internet, phone and computer programs like "Word". Especially the pupils and teachers in the secondary school stressed the importance of other services besides the television.

6.4 Mobile digital television in school

The pupils in the elementary school did not mention any particular learning situation for which mobile television would be suitable. For them, mobile television would give a possibility to stay in their own classroom when watching programs. Nowadays they have to change classroom. The students in the secondary school and in the adult education centre thought that mobile television could be used during breaks, field trips, teamwork and in tasks that require information searching, writing and printing. They wished that mobile television would have other features in addition to television. If schools were to have mobile digital television on portable computers, pupils would not need to use the computer class so often and maybe in the future the schools would not need computer classes at all.

Man aged 17:
"It would be practical if everybody were to have this equipment. Then we wouldn't need computer classes any more." [23]

Two of the interviewed teachers saw mobile television as useful in language teaching. There was a suggestion that during an educational program some transparencies could be shown or something could be written on the program.

Woman aged 27:
"If the portable computer had enough memory, you could store an educational television program there. Then you could make some transparencies of it or write something on the program. The program could also be projected on to a screen. If the pupils had those

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21 "Yleensä joudun odotteleen hirveesti, mulla on kaksi lasta, jotka opiskelee Tampereen konservatoriolla, mä istun lukemattomia tunteja esimerkiksi konservatorion siinä kahvilassa, joten mulla ois todellista joutoaikaa joku kannettava pitää mukana niin kuin täysin."

22 "Mitä nyt ite on urheilukaupassa aika paljon näitten edustajien kanssa ja tekee kaiken maailman ostoja sun muuta, niin siinä on niin samanhenkisiä ihmisiä, että toi ois siinä mielessä sellasessakin yhteydessä ihan hyvä alotus. Mää näkisin, että sillä olis helppo ainakin esitellä sit jotain, niin kuin oikeesti olevaa tavaraa, ett se olis niin kuin käytössä ja sen pystyis tuosta kattomaan, nähdä niin kuin oikeesti, miten se toimii liikkeessä."

23 "Olishan se aika käytännöllistä jos kaikilla olis koulussa tommonen, ei tarvittais mitään tietokoneluokkia."

smaller devices, the program could be sent to them and they could watch it later when they have the time."[24]

6.5 Mobile digital television on the train

On the train the most interesting program content was the news. When people interviewed on the train were asked to select between the two devices, six of them (6/7) chose the smaller device. It was very hard to see the picture from the screen of the PDA because of the strong reflections from the windows. On the train, headphones are needed so that watching television does not disturb others. One thing that came up while observing people on the train and at stations is that people seem to become easily immersed in the television programs, so you might not hear what a person next to you says if you are concentrating on watching a movie. This means that while you are watching mobile television on a train, you might miss your station if you do not get some kind of message on the screen saying "We will shortly be arriving in Tampere".

7 Discussion

Most of the interviewees reacted positively to mobile television. This does not mean that they would be willing to spent a lot of money to buy one, but the idea itself was acceptable. The results are similar to those of the earlier study “Towards an individualised mediascape”. Even though people are suspicious of any changes in conventional television, they mainly have positive attitudes towards new ways of using television. At the time they were cautious about the price. They are afraid that new services and new channels will cause extra costs without meeting their needs (Towards an individualised mediascape, 2000).

The equipment used in the interviews was experienced as lightweight and easy to carry around. The main reason why a portable computer sized mobile television would be carried around would be that people could use the computer also for work or school assignments. It has also been noticed in the previous research (Palen, Salzman & Youngs 2000) that the start of the use of telephones is justified with rational reasons such as security and necessity. People may search for such reasons to rationalise their use of mobile digital television. Especially interviewees in the secondary school and in the adult education centre were very interested in the portable computer and its possibilities. This probably has to do with the fact that students are required to write essays and they need to find information constantly.

On the basis of these interviews it is not clear if the interviewees would carry around a portable computer sized device that would only be used as a mobile

24 "Jos ajattelee opettajan kannalta niin kuin opetusvälineenä, niin toihan ois tosi hyvä jos siinä on muistia tarpeeksi niin sä voit jonkun hyvän koulu-tv:n ohjelman tallentaa. Sit se on sulla siinä kannettavassa ja sä voit ehkä näyttää sieltä jonkun kalvon tai kirjoittaa jotakin ohjelman päälle tai jotakin vastaavaa ja sitten heijastaa vaan sen ohjelman pyörimään. No sit sen vois vielä siirtää, jos vaikka oppilailla olis tommoset pienemmät, ne vois katsoo sen sitten omaan aikaan, kun se aika löytyy ja kiinnostusta, vaikka koulumatkalla jossain bussissa sä voit kattoo jonkun koulu-tv:n ohjelman."

television. In the part where the interviewees had to select from two devices, half of the interviewees selected the smaller device. Maybe the mobile television needs to be still a bit smaller portable computer?

Almost half of the interviewees said that the mobile phone and television should be integrated into the same device and the other half disagreed. One of the reasons for not wanting to integrate the mobile phone and the television might be the fact that people are starting to carry around mobile phones all the time, which usually means that the devices need to be small in size. People might feel that if the mobile television is integrated, the size of the phone will increase. Another reason might be that people do not see the need to carry the mobile television with them because it is a new thing for them, and that is the reason for wanting two separate devices. One thing to consider is that mobile television might more easily become a part of our everyday life if it were to be integrated into some other device, e.g. the mobile phone or portable computer, which is already used regularly by many people. People's need to rationalise the use of new equipment also supports the idea of the integrated devices.

Another thing to consider is that the mobile television might be more easily accepted if in the beginning it were integrated with some other service, e.g. travelling on a train or in an aeroplane. In such a case the device should automatically recognise changes and adapt to the environment, as suggested by Hinckley, Pierce, Sinclair & Horvitz (2000).

The experience of watching mobile television was compared to watching normal television. The mobile television differed in the quality of the picture and the size of the screen. The programs suitable for small screens are different from those suitable for bigger screens. It seems that small screens would be most suitable for utility programs like the news and weather. People would use small screen mobile televisions mainly to keep up with what is happening around them. On the bigger screen people would watch more entertainment-based programs. These they would want to see in more detail. These programs could be, for example, related to their hobbies.

In every interview setting, the people said they would most likely watch the news if they had a mobile television. The news was also among most preferred category in the Sonera Mspace's consumer trial "PMA-pilot". The trial end-users tested mobile multimedia services on a device that simulated a 3G phone. In our study especially the people on the train wanted to watch the news. This is possibly connected to the fact that while you are on the train there is usually only little or no connection to the outside world because the mobile phones and radios go out of coverage area or there is only a poor connection.

It was not an easy task to think how mobile television could be used in schools. It was especially hard for the children in the elementary school since they were so young. One thing worth noticing is that schools do not have very much money to invest in new things. The people interviewed in the schools were very interested in the possibilities that mobile digital television could offer them, but at the same time they were worried about the costs.

In these interviews we did not ask about what kind of program format would be most suitable for mobile digital television. We did get some answers related to this but this topic needs to be addressed more in the future evaluations. One of the interviewees (a woman aged 26) said that if you are watching TV on a small screen, all the "extra stuff", e.g. commercials and screen credit/theme music, should be edited out of the programs.

In most cases the places (train, station, home, etc.) where people were during the interview did not affect their answers. Also, none of the background information (gender, age, hobbies, etc.) had any significant effect. The reason for this might be that mobile digital television was a new thing for all interviewees. The few times when the place or the background information had some effect have been mentioned in the text.

According to our review of related work, there are only few research results about mobile digital television. Our round of interviews showed that consumer attitudes to mobile television are mainly positive, but it was difficult for the users to say why they would use it. Most often the possible use of mobile television was justified on the grounds of rational use such as watching news.

The way in which mobile television is introduced to the public should be carefully considered. It might be hard for the users to accept it solely as an entertainment application. In our opinion this subject must be studied further. We also need more information about the content and context of use. Longitudinal studies would reveal the use in everyday circumstances and changes in use.

Changes in conventional television caused by digital television might cause anxiety among users because people are used to the idea of a certain kind of television. This idea does not support the more personal, mobile and active use of television. We must try to find ways to bring about these changes so that they do not become too overwhelming.

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Appendices

Appendix 1. The interview themes and questions (translated from Finnish)

The device

What is your first impression of these two portable devices?

What do you think about their weight?

How about their size?

What size of mobile digital television would you be willing to carry around
- in your pocket
- in your bag
- in your car?

Must the mobile phone be integrated into the same device?

(How about the Internet?)

The content

What is it like to watch TV programs on these devices?

What kind of programs are suitable for the small device (PDA)?

What kind of programs are suitable for the bigger device?

(How would the text-TV fit into the mobile digital television?)

Operational situations, needs and expectations

What kind of programs would you like to watch in this situation where you are at the moment?

(In schools: In what kind of situations could the schools use this kind of devices?)

What do you expect from mobile digital television?

Would you use it yourself?

Which of these devices would you choose for yourself?

Appendix 2. The background information form (translated from Finnish)

Age: _____

Gender: 1) Female 2) Male

Living conditions: 1) Live alone 2) Live with family 3) Other?_____

Number of children living at home: _____

What are your hobbies/what kinds of things are you interested in?

_____

_____

Can the photos taken during the interview be used when publishing the research results?

1) Yes 2) No

Would you be interested in participating in a mobile digital television project as a test user later on?

1) Yes 2) No

Appendix 3. Background information on the people interviewed in schools

Interview place	Age	Gender	Family relations*	Hobbies, interests	Participation in the future*
elementary school	10	male	only child	Aikido	yes
elementary school	10	male	1 sibling	drawing, swimming	yes
elementary school	10	female	only child	piano, singing	yes
elementary school	10	female	only child	piano, scouts	yes
elementary school	29	female	no children	sports, reading, technology	yes
secondary school	16	female	only child	horse riding, music	yes
secondary school	16	male	2 siblings	singing, golf, sports	yes
secondary school	17	female	1 sibling	sports, reading, movies	yes
secondary school	17	male	sister moved away	ice-hockey, sports	yes
secondary school	47	female	3 children	studying, painting, sports	yes
secondary school	47	male	1 child	sports, music	yes
vocational adult education centre	38	female	2 children	football, computers, studying, travelling, children	yes
vocational adult education centre	25	male	no children	sports, travelling	yes
vocational adult education centre	39	female	1 child	sports, studying	no

* = Number of children living at home or number of siblings
* = If the answer is "yes", the person is willing to take part in field evaluations of mobile digital television in the future

Appendix 4. Background information on the people interviewed in other places

Interview place	Age	Gender	Family relations*	Hobbies, interests	Participation in the future*
workplace	26	female	2 children	sports, home	yes
cafeteria	20	male	no children	politics, sports, music	yes
home	29	male	no children	sports, work, family	yes
home	28	male	no children	sports, movies, travelling, arts	yes
bus station	34	female	1 child	reading	yes
railway station	20	male	no children	gliding, reading, sports	no
railway station	24	female	no children	sports, reading, outdoors, culture, technology	yes
railway station	72	female	no children	travelling, television	no
train	64	male	no children	reading, music, outdoors, training	no
train	55	male	1 child	sports, spectator sport	yes
train	42	male	2 children	golf, reading, genealogy	no
train	35	female	2 children	childcare, knitting	yes
train	45	female	5 children	studying, outdoors	yes
train	44	female	2 children	sports, current affairs	yes
train	27	female	no children	sports, knitting, home, e-learning	yes